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

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion for Lease Sale 258, Cook Inlet, Alaska 2017-2022

NMFS Consultation Number: AKRO-2022-02861

Action Agencies: Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE)

Affected Species and Determinations:

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

Consultation Conducted By: National Marine Fisheries Service, Alaska Region

Issued By:

Jonathan M. Kurland
Administrator, Alaska Region

Date: August 25, 2023

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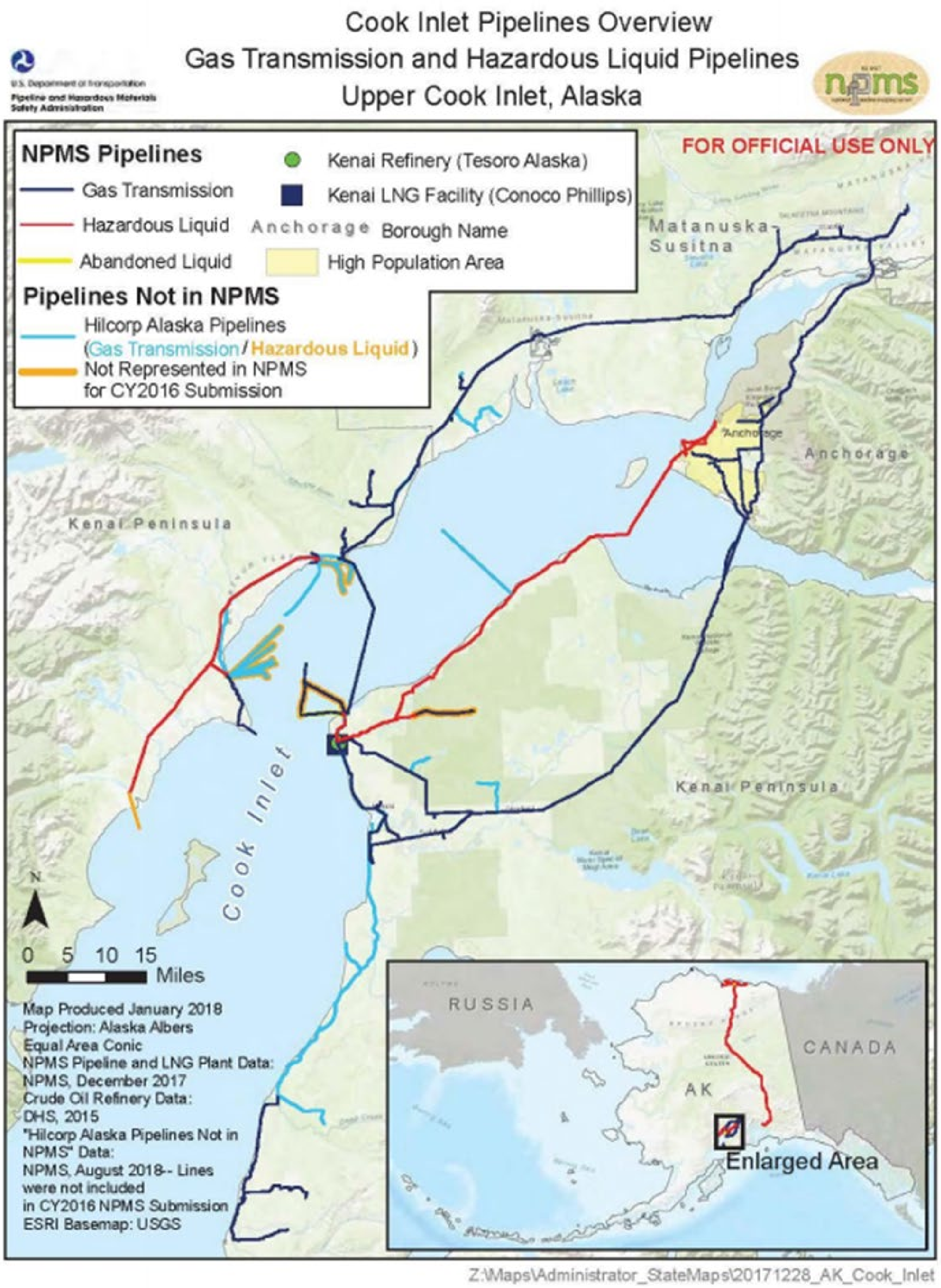
Cook Inlet Pipelines Overview
Gas Transmission and Hazardous Liquid Pipelines
Upper Cook Inlet, Alaska
U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration
npms
FOR OFFICIAL USE ONLY
NPMS Pipelines
Gas Transmission
Hazardous Liquid
Abandoned Liquid
Kenai Refinery (Tesoro Alaska)
Kenai LNG Facility (Conoco Phillips)
Anchorage Borough Name
High Population Area
Pipelines Not in NPMS
Hilcorp Alaska Pipelines
(Gas Transmission/Hazardous Liquid)
Not Represented in NPMS
for CY2016 Submission
Matanuska-Susitna
Anchorage
Kenai Peninsula
Cook Inlet
N
0 5 10 15
Miles
Map Produced January 2018
Projection: Alaska Albers
Equal Area Conic
NPMS Pipeline and LNG Plant Data:
NPMS, December 2017
Crude Oil Refinery Data:
DHS, 2015
"Hilcorp Alaska Pipelines Not in NPMS" Data:
NPMS, August 2018-- Lines
were not included
in CY2016 NPMS Submission
ESRI Basemap: USGS
RUSSIA
CANADA
AK
Enlarged Area
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TERMS AND ABBREVIATIONS

μPa	Micro Pascal
2D	Two-Dimensional
3D	Three-Dimensional
ACIA	Arctic Climate Impact Assessment
AEWC	Alaska Eskimo Whaling Commission
AGL	Above Ground Level
APD	Application for Permit to Drill
API	American Petroleum Institute
ARBO	Arctic Regional Biological Opinion
ASAMM	Aerial Surveys of Arctic Marine Mammals
ASL	Above Sea Level
ATOC	Acoustic Thermometry of the Ocean Climate
BA	Biological Assessment
Bbl	Barrels
Bbbl	Billion Barrels
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOSS	Bering Sea and Okhotsk Seas
BSAI	Bering Sea/Aleutian Island
BSEE	Bureau of Safety and Environmental Enforcement
BWASP	Bowhead Whale Feeding Ecology Study
CAA	Conflict Avoidance Agreement
CHIRP	Compressed High Intensity Radar Pulse
CI	Confidence Interval

CNP	Central North Pacific
CPUE	Catch Per Unit Effort
CSEL	Cumulative Sound Exposure Level
CSEM	Controlled Source Electromagnetic
CSESP	Chukchi Sea Environmental Studies Program
cui	Cubic Inches
CV	Coefficient of Variance
CWA	Clean Water Act
dB re 1μPa	Decibel referenced 1 microPascal
DDT	Dichloro-Diphenyltrichloroethane
District Court	U.S. District Court for the District of Alaska
DP	Dynamic Positioning
DPP	Development and Production Plan
DPS	Distinct Population Segment
DWH	Deepwater Horizon
E&D	Exploration and Development
EEZ	Exclusive Economic Zone
EP	Exploration Plan
EPA	Environmental Protection Agency
ERA	Environmental Resource Area
ERL	Effects Range Low
ERM	Effects Range Medium
ESA	Endangered Species Act
EZ	Exclusion Zone
ft	Feet
FWS	U.S. Fish and Wildlife Service

G&G	Geohazard & Geophysical
gal	Gallons
GLG	Growth Layer Group
Hz	Hertz
IHA	Incidental Harassment Authorization
IPCC	Intergovernmental Panel on Climate Change
ITL	Information to Lessee
ITS	Incidental Take Statement
IWC	International Whaling Commission
km	Kilometers
kn	Knot
km2	Square Kilometers
L	Liters
LOWC	Loss of Well Control
LS 258	Lease Sale 258
m	Meter
mi	Mile
ms	Milliseconds
MLC	Mudline Cellar
MLC-ROV	Mudline Cellar Remotely Operated Vehicle
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MODU	Mobile Offshore Drilling Unit
MONM	Marine Operations Noise Model
MWCS	Marine Well Containment System
NEPA	National Environmental Policy Act

Ninth Circuit	U.S. Court of Appeals for the Ninth Circuit
NMFS	National Marine Fisheries Service
NPDES	National Pollution Discharge Elimination System
NTL	Notice to Lessee
OBC	Ocean Bottom Cable
OBN	Ocean Bottom Node
OC	Organochlorine
OCSLA	Outer Continental Shelf Lands Act
Opinion	Biological Opinion
OSR	Oil Spill Response
OSRA	Oil Spill Risk Analysis
OSRV	Oil Spill Response Vessel
OST	Oil Supply Tanker
OSV	Offshore Supply Vessels
PAH	Polycyclic Aromatic Hydrocarbons
PBDE	Polybrominated Diphenyl
PBR	Potential Biological Removal
PBU	Prudhoe Bay Unit
PCB	Polychlorinated Biphenyls
PCE	Primary Constituent Element
PR1	Office of Protected Resources- Permits and Conservation Division
psi	Pound Per Square Inch
PSO	Protected Species Observers
PTS	Permanent Threshold Shift

R95%	Radius of a Circle Encompassing 95% of the Area of the Contour
Rea	Radius of a Circle with Area Equivalent to the Total Area of the Contour
Rmax	Maximum Distance from Sound Source to the Contour
rms	Root Mean Square
RPA	Reasonable Prudent Alternative
SAE	SAExploration, Inc.
SDR	Satellite Data Recorder
SEIS	Supplemental Environmental Impact Statement
SONAR	Sound Navigation and Ranging
SPLASH	Structure of Populations, Levels of Abundance and Status of Humpback Whales
TAPS	Trans-Alaska Pipeline System
TGS	TGS-Nopec Geophysical Company ASA
TTS	Temporary Threshold Shift
USDOI	United States Department of Interior
USFWS	United States Fish and Wildlife Service
VGP	Vessel General Permit
VLOS	Very Large Oil Spill
VMS	Vessel Monitoring System
VSP	Vertical Seismic Profiling
WNP	Western North Pacific

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)).

For the actions described in this document, the action agencies are the U.S. Department of the Interior's Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE), which propose to lease areas for oil and gas exploration and authorize subsequent oil and gas exploration activities, and ensure environmental compliance of these activities associated with Lease Sale 258 (LS 258) blocks in Cook Inlet under the Outer Continental Shelf Lands Act (OCSLA) beginning in 2023 and lasting approximately five years. The consulting agency is NMFS's Alaska Regional Office.

BOEM/BSEE determined that the proposed action may affect, and is likely to adversely affect, Cook Inlet beluga whale, fin whale, Western North Pacific distinct population segment (DPS) humpback whale, Mexico DPS humpback whale, and Western DPS Steller sea lion; and may affect, and is likely to adversely affect, designated critical habitat for Cook Inlet beluga whales and Steller sea lions.

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. However, per NMFS's regulations, 50 CFR §402.14(i)(6) and §402.02, an ITS is not required at the programmatic level for framework programmatic actions where precise information on the specific number, location, timing, frequency, and intensity of actions is unknown; and any incidental take resulting from any actions subsequently authorized, funded, or carried out under the program will be addressed in separate ESA section 7 consultations. A framework programmatic consultation evaluates the effects of an agency policy or program as a framework for the development of future actions that are authorized, funded, or carried out at a later time; any take of ESA-listed species would not occur unless and until those future action(s) are authorized, funded, or carried out and subject to further ESA section 7 consultation (50 CFR § 402.02).

The program addressed in this opinion is LS 258. A lease sale in and of itself will not affect marine mammals or result in the incidental take of listed species or modify their critical habitat. However, if blocks are leased in the sale, the subsequent exploration, development, production, and decommissioning activities may affect listed species and designated critical habitat and may require subsequent consultation. First, the subsequent authorization of geological and geophysical exploration permits, ancillary activities, exploration plans, permits to drill, and development and production plans may affect listed species and may require project-specific consultation associated with the issuance of Marine Mammal Protection Act Letters of Authorization or Incidental Harassment Authorization (16 USC §1371(a)(5)(A) & (D)). In addition, subsequent authorizations at the exploration stage, including geophysical and geotechnical (G&G) permits, exploration plans, and a permit to drill, may affect listed species and may require BOEM and BSEE to initiate project-specific consultations for specific actions under this first incremental step. Finally, if commercially recoverable reserves are found and are proposed for development, BOEM and BSEE also may initiate consultation on future incremental steps associated with development, production, and decommissioning activities that affect listed species.

Accordingly, consultation will be required for all activities related to LS 258 that may affect listed species or their critical habitat. For each subsequent consultation NMFS will determine whether a future activity under this program is likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of the critical habitat of such species. Moreover, at each step, project-specific information will aid in the assessment of effects on listed species and the amount and extent of incidental take resulting from that project; project-specific information also will aid in the development of sufficiently specific and meaningful terms and conditions for each project and will ensure an accurate and reliable trigger for reinitiation of consultation (80 FR 26832, 26835-36; May 11, 2015). For these reasons, NMFS will not be including an ITS with this opinion.

This is an incremental step programmatic consultation per 50 CFR §402.14(k),[1] with the first step consisting of leasing and exploration activities (years 1-5), and future steps consisting of development, production, and decommissioning activities (years 6-40). LS 258 offered 193 Outer Continental Shelf (OCS) blocks for lease covering approximately 399,518 ha (987,230 acres). However, only one block was bid on (Block 6255) and leased. While the proposed action focuses on the first incremental step, we also consider potential impacts through the endpoint of the action (i.e., decommissioning activities). This consultation determines whether the first

[1] Incremental step consultations are a type of programmatic consultation, addressing a framework programmatic action as described under 50 CFR §402.14(i)(6).

incremental step violates section 7(a)(2) of the ESA, and also considers the reasonable likelihood the entire action violates section 7(a)(2), in accordance with 50 CFR §402.14(k).

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the letter of concurrence would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different. New proposed rules were published in the Federal Register on June 22, 2023 (88 FR 40753).

This document represents NMFS's biological opinion (opinion) on the effects of this proposal on endangered and threatened species and designated critical habitats. The opinion was prepared by NMFS in accordance with section 7(b) of the ESA of 1973, as amended (16 U.S.C. §1536(b)), and implementing regulations at 50 CFR Part 402.

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

1.1 Background

BOEM held LS 258 on December 30, 2022, pursuant to the Inflation Reduction Act of 2022 (Pub. L. No. 117-169, 136 Stat. 1818). BOEM prepared a Final Environmental Impact Statement (FEIS) for LS 258 BOEM (2022b), which describes BOEM's "Preferred Alternative." The proposed action analyzed in this consultation is the Preferred Alternative in the FEIS, which includes the lease sale and post-lease activities, associated assumptions, and mitigation measures.

The first incremental step for this consultation includes all on-lease activities associated with the exploration and delineation of a hypothetical field with commercially viable oil and gas resources. BOEM considers all on-lease activities that would occur after the initial exploration, and delineation to be components of future incremental steps. Future incremental steps, beginning with the submission of a Development and Production Plan (DPP), would be the subject of separate ESA Section 7 consultations on the specific project(s) at that time. Decommissioning would follow development and production and would also require additional consultation.

BOEM developed a hypothetical Exploration and Development (E&D) Scenario to provide a basis for analysis of potential effects. While it is hypothetical, the E&D Scenario estimates a reasonable range of petroleum-related activities, their timing, frequency, and duration, based on the best available information. The proposed action includes the actions resulting from Cook Inlet LS 258 as modified by exclusions and mitigation measures, focusing on first incremental step activities, as described by the hypothetical E&D Scenario. The first incremental step includes all reasonably foreseeable activities associated with the exploration and delineation of oil and gas resources on LS 258.

This opinion considers the effects of the authorization of oil and gas exploration activities for LS 258 under the OCSLA from May 2023 to May 2028. These actions have the potential to affect the endangered Cook Inlet beluga whale (*Delphinapterus leucas*), endangered fin whale (*Balaenoptera physalus*), endangered Western North Pacific DPS humpback whale (*Megaptera novaeangliae*), threatened Mexico DPS humpback whale, and endangered Western DPS Steller sea lion (*Eumatopias jubatus*), as well as the designated critical habitat for Cook Inlet beluga whale, and Steller sea lion.

This biological opinion is based on information provided in the November 10, 2022 Biological Assessment (BOEM 2022a); October 2022 Final Environmental Impact Statement on the Effects of Oil and Gas Activities in the Lease Sale 258 in Cook Inlet, Alaska (BOEM 2022b); clarifying email and telephone conversations between NMFS and BOEM staff; and other sources of information. A complete record of this consultation is on file at NMFS's Alaska Regional Office.

1.2 Consultation History

- **October 20, 2022.** Final EIS for LS 258 published.
- **November, 3, 2022.** First coordination meeting between BOEM and NMFS
- **November 10, 2022**. BA and initiation package received from BOEM.
- **November 14, 2022**. NMFS receives 7(d) determination from BOEM that indicates no irreversible or irretrievable commitment of resources will occur during the first incremental step of the lease sale.
- **November 18. 2022.** Questions regarding the BA are emailed to BOEM.
- **December 21, 2022.** BOEM forwards a letter they received from the Center for Biological Diversity regarding a 60-Day Notice of Intent to Sue for Violations of the Endangered Species Act.
- **December 30, 2022**. Cook Inlet Lease Sale 258 is held. Hilcorp Alaska LLC bids on one block.
- **February 3, 2023**. Additional questions sent to BOEM.

- **February 6, 2023**. Partial response to first set of questions received by NMFS.
- **March 2, 2023**. NMFS participates in a conference call with BOEM to discuss their responses to our questions and how the sale of a single block versus the high development scenario analyzed in the BA could potentially affect their analysis and the information presented to us.
- **March 13, 2023.** Responses to all questions received.
- **March 16, 2023.** Proposed rule for listing the sunflower sea star as a threatened species under the ESA was published.
- **March 17, 2023.** BOEM contacted regarding inclusion of the sunflower sea star in the consultation.
- **March 27, 2023.** BOEM responds that they will not be including the sunflower sea star in the consultation.
- **March 27, 2023.** Consultation was initiated.

2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

"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 CFR §402.02). A framework programmatic action means, for purposes of an incidental take statement, a Federal action that approves a framework for the development of future action(s) that are authorized, funded, or carried out at a later time, precise information on the specific number, location, timing, frequency, and intensity of actions is unknown, and any take of a listed species would not occur unless and until those future action(s) are authorized, funded, or carried out and subject to further section 7 consultation (50 CFR §402.02).

This opinion considers the effects of BOEM and BSEE's leasing OCS blocks for oil and gas exploration activities (marine seismic, geohazard surveys, geotechnical surveys, and exploratory drilling). The BA considered effects resulting from offering 193 OCS blocks contained within the northern portion of the Cook Inlet Planning area (Figure 1). Three levels of development (high, medium, and low) were considered as a consequence of the lease sale. BOEM chose to analyze the high level of development to ensure all possible effects of the action would be considered. The hypothetical high scenario assumed that 28 blocks would be developed. Although only one block was sold, BOEM decided not to revise the analysis of effects to listed species in their BA to reflect a much smaller development scenario. Because the effects of exploration and development cannot be reduced on a linear or directly proportional scale (i.e., $1/28^{th}$ of what was presented), we consider the effects of the proposed actions as BOEM presented them in their BA. However, where possible and appropriate, we take into account that the scale of project effects will be less than what was expected in the BA. The activities comprising the proposed action are further described below.

The purpose of the broader proposed action (of which this first incremental step is a part) is for BOEM and BSEE to manage the exploration, development, production, and decommissioning of oil and gas resources on leases issued through LS 258 in the U.S. OCS of Cook Inlet, Alaska, pursuant to the OCSLA. The OCSLA sets out a four-stage process for planning, leasing, exploration, and development and production of oil and gas resources in the OCS.

Incremental Step Consultation

Regulations at 50 CFR §402.14(k) allow incremental consultation on part of the entire action as long as the incremental step does not violate ESA section 7(a)(2) or section 7(d) concerning irreversible or irretrievable commitment of resources; there is a reasonable likelihood that the entire action will not violate section 7(a)(2); and the agency continues consultation with respect to the entire action, obtains biological opinions, as required, for each incremental step, and obtains sufficient data upon which to base the final biological opinion on the entire action.

BOEM and BSEE requested incremental section 7 consultation with the proposed action covering the first step – leasing and exploration activities consisting of: (1) deep penetrating seismic surveys; (2) geohazard surveys; (3) geotechnical surveys; (4) exploratory drilling; and (5) delineation wells. The first incremental step consists of all activities associated with leasing and exploration and delineation of oil and gas resources in the proposed LS 258 area up to the submission of a Development and Production Plan (years 1-5).

Future incremental steps include all subsequent actions including: development, production, and decommissioning. As required, this consultation considers potential impacts through the endpoint of the action: the first step laid out above (years 1-5), and the hypothetical E&D Scenario (which includes exploration, development, and production activities), followed by the decommissioning of all of these activities (years 6-40).

BOEM and BSEE's Process for Permitting

Specific permits and authorizations required by BOEM and BSEE affect the progression of oil and gas exploration activities. The following summarizes BOEM and BSEE's permitting process:

- G&G Exploration Permits – In accordance with 30 CFR Part 551, a permit must be obtained from BOEM prior to conducting geological or geophysical exploration on unleased lands or on lands under lease by a third party (off-lease activities). On-lease G&G exploration on lands under lease by the leasing party can be conducted under a G&G permit or an Ancillary Notice in accordance with 30 CFR Part 550 (on-lease activities). G&G exploration is defined in 30 CFR §551.1 (off-lease) and 30 CFR §550.105 (on-lease).

- Ancillary Activities – These on-lease activities include geohazard surveys, two-dimensional (2D) and three-dimensional (3D) deep penetration marine seismic, and geotechnical surveys. More specifically, ancillary activities include:

  (a) G&G explorations and development activities;

  (b) Geological and high-resolution geophysical, geotechnical, archaeological, biological, physical oceanographic, meteorological, socioeconomic, or other surveys; or

  (c) Studies that model potential oil and hazardous substance spills, drilling muds and cuttings discharges, projected air emissions, or potential hydrogen sulfide (H_2S) releases.

  Ancillary activities are conducted in accordance with 30 CFR Part 550 (30 CFR §§550.207-550.210).

- Exploration Plan (EP) – An exploration plan is submitted to BOEM by the lessee to conduct exploration activities in accordance with 30 CFR Part 550 (30 CFR §§550.211-550.228). An EP is not required to conduct G&G or ancillary activities.

- Application for Permit to Drill (APD) – A permit must be obtained from BSEE prior to conducting drilling operations and requires detailed information on the seafloor and shallow seafloor conditions for the drill site from shallow geophysical surveys in accordance with 30 CFR Part 250 (30 CFR §§250.410-250.418).

The proposed action consists of ancillary activities (marine seismic surveys, geohazard surveys, and geotechnical surveys) that would be conducted by lease holders on their leased area(s) following the notice process under BOEM's regulations, and drilling activities that would be authorized under an exploration plan and a permit to drill. While BOEM's regulations concerning ancillary activities do not require a permit or other formal approval, the lessee must provide BOEM with advanced notice of the proposed ancillary activity. The notice gives BOEM the opportunity to review and ensure that the ancillary activity complies with performance standards referenced in 30 CFR §550.209 and listed in 30 CFR §550.202. This process allows BOEM to determine whether proposed ancillary activities may affect listed species or critical habitat.

If a lessee were to propose ancillary activities that may affect listed species or critical habitat, BOEM will notify the lessee that they cannot begin the proposed ancillary activities until: 1) the action is modified to eliminate the concern so there is no effect to listed resources or consultation has been completed with NMFS and/or FWS; and 2) an EP or DPP has been submitted and approved.

2.1 BOEM and BSEE's Proposed Activities

BOEM and BSEE propose to authorize a limited number of activities associated with exploration including marine seismic, geohazard surveys, geotechnical surveys, and exploratory drilling on the block leased in LS 258 in Cook Inlet. The maximum anticipated level of exploration activity expected during the first incremental step can be seen in Table 1 and represents the exploratory activities possible from this first incremental step and analyzed in this biological opinion. Table 1 was created under the assumption that 28 blocks would be leased. Because only one block was sold, the lowest number presented in a range of values most likely represents a realistic estimate of what will occur for each activity.

Table 1. Anticipated level of exploration activities that may occur during the first incremental step as modified by the mitigation measures (BOEM 2022a).

Activity	Year(s)	Restrictions	Estimated Operations	Associated Transportation
Geophysical and Geotechnical Surveys				
Deep penetrating 3D seismic surveys	1	Not allowed on any OCS block between Nov 1 and Apr 1. Not allowed on beluga whale nearshore feeding area OCS blocks between July 1 and Sept. 30. Not allowed on any OCS block north of Anchor Point during drift gillnetting season which is designated by ADF&G (usually mid-June to mid-Aug) and occurs in state waters. Could occur on any available lease block from April 2-June 30 (or start of gillnet season) and Oct 1-Oct 31.	1 survey total Survey methods could include towed streamer, OBN, and OBC	For towed streamer: 1+ vessel. For OBN: 2 node layout/pick up vessels, 1–2 source vessels, possibly 1–3 smaller utility boats. For OBC: Same as OBN plus 1 vessel for recording. For all survey types, an additional vessel for marine mammal monitoring may be needed. No aircraft.
Geohazard surveys	2-5	Not allowed on any OCS blocks between Nov 1 and Apr 1. Not allowed on beluga whale nearshore feeding area OCS blocks between July 1 and Sept. 30. Not allowed on any OCS block above Anchor Point during drift gillnetting season, which is opened by ADF&G (usually mid-June to mid-Aug) and occurs in State waters.	1–4 surveys total. Equipment/methods could include: echosounders, side scan sonar, subbottom profilers, bubble pulsers or boomers, controlled source electromagnetic sounding.	1 survey vessel. An additional vessel for marine mammal monitoring may be needed. No aircraft.

		Could occur on any block from April 2-June 30 (or stat or gillnet season) and Oct 1-Oct 31.		
Airborne Geophysical Survey	1-5		1 airborne survey	1 survey aircraft
Exploratory Drilling Operations				
Exploration and delineation drilling	3-5	No discharge of drilling fluids and cuttings or seafloor-disturbing activities (including anchoring and placement of bottom-founded structures on the 7 available OCS lease blocks located within 1,000 m of northern sea otter critical habitat.	A maximum of 3 wells per drilling rig could be drilled, tested, and plugged per drilling season. Drilling would take 30-60 days per well. A total of up to 8 exploration and delineation wells would be drilled (including dry holes and additional unsuccessful wells from other Cook Inlet OCS prospects).	1 drilling rig with a maximum of 1 per prospect. 1-2 resupply vessel trips per week per drilling rig during exploration drilling. 1-2 trips total per week (likely from Nikiski or Homer). 1-2 helicopter flights per day per drilling rig while on location. 7-14 trips total per week (helicopters likely traveling from Nikiski or Homer).
Government-initiated oil spill response exercises	3-4	Year-Round	1-2 exercises per year, each lasting no more than 1 day. Exercises could involve offshore and shoreline-based equipment deployment. Equipment could include containment boom, temporary storage devices (bladders towed in water or placed on the beach, fast tanks placed on the beach).	The number and types of transportation would vary dependent on the exercise. A likely scenario could include: Vessels (including OSRVs, M/Vs, Class 2, 3, 5, 6, and 8 vessels, containment barges, skiffs). Helicopters for personnel transport, area overflights. Fixed-wing aircraft for area overflights. Landing craft, all-terrain vehicles, and motor vehicles.

Notes: OBC = ocean bottom cable, OBN = ocean bottom node, OSRV = oil spill response vessel M/V = motor vessel.

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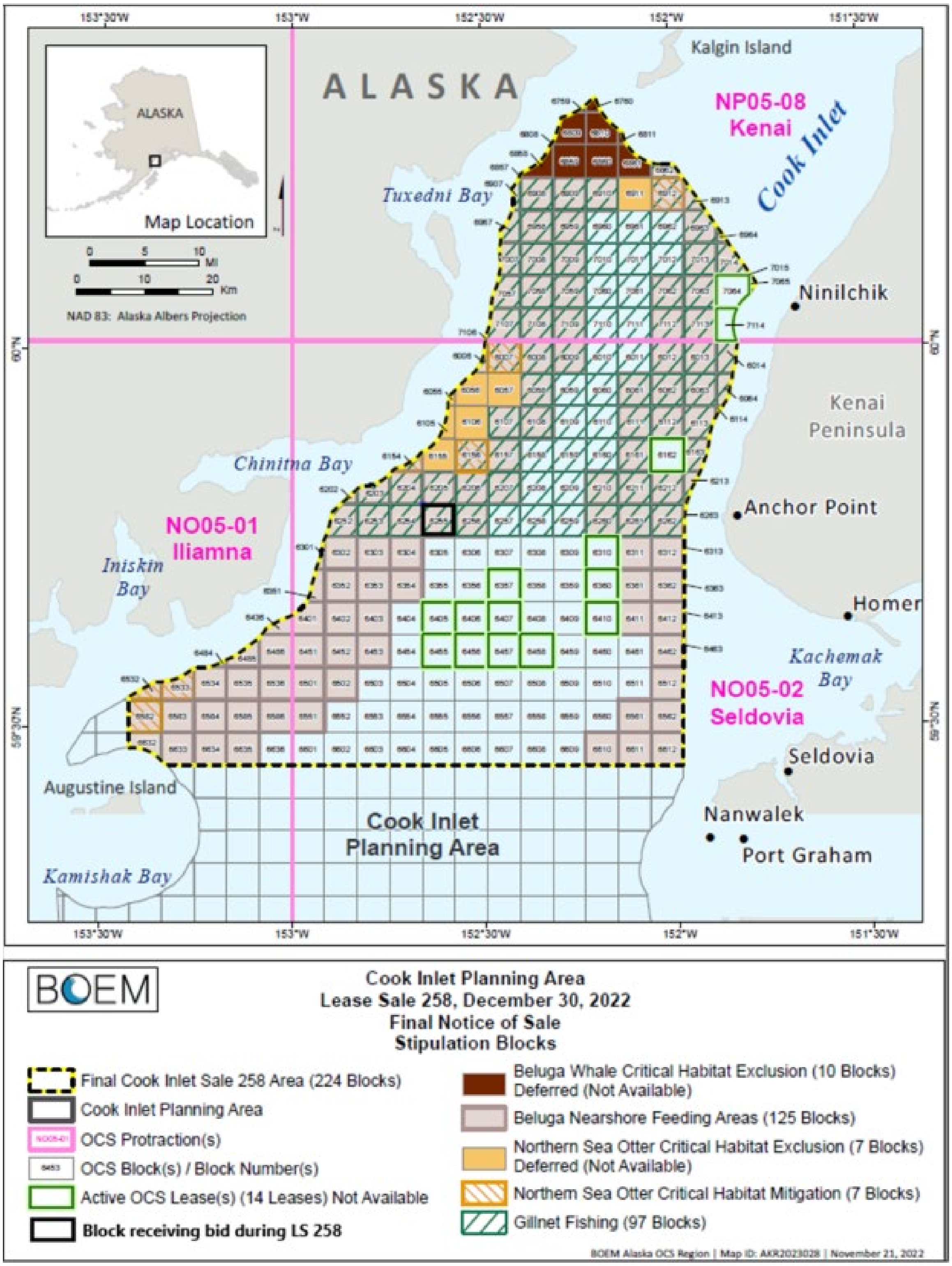

Figure 1. Cook Inlet Program Area, Lease Blocks Included in LS 258, and areas excluded under the Preferred Alternative (BOEM 2022a). Leased block outlined in black.

2.1.1 Acoustic Equipment

Marine seismic and geohazard surveys, as well as exploratory drilling, may involve a variety of active and passive acoustic sources. Active systems are those that emit acoustic energy or sound into the water. Passive acoustic systems do not generate acoustic energy in the water, but are used to listen for sound in the water.

The active acoustic systems under the proposed action include devices for seismic reflection profiling, such as airgun arrays and subbottom profilers; sonar devices, such as echosounders, and sidescan sonar; and other sources of noise, such as vessels and aircraft.

The E&D Scenario considers two types of active acoustics: 1) marine seismic surveys, which generally cover a larger area of leased acreage, and 2) geohazard surveys, which use both high-resolution seismic and sonar equipment and which are conducted on a more specific site to detect archeological resources or seafloor features that might be hazardous to operations, such as drilling a well or installing a platform or pipeline. Geohazard surveys may be accompanied by geotechnical surveys, which involve sampling or measuring mechanical properties or stability of seafloor sediments.

Detailed descriptions of marine seismic surveys, geohazard surveys, geotechnical surveys, and exploratory drilling are provided in Sections 2.2.3.1 to 2.2.3.3 of the BA (BOEM 2022a), and are incorporated here by reference and discussed below.

2.1.2 Marine Seismic Surveys

Marine seismic surveys (also known as deep penetration seismic surveys) are a type of ancillary survey conducted to identify prospective oil and gas deposits and to optimize drilling sites on leases acquired in lease sales. Different types of marine seismic surveys include: towed streamer 2D or 3D surveys, ocean bottom cable (OBC), and ocean bottom node (OBN). Marine seismic surveys could occur on any available lease block from April 2 to June 30 (unless gillnetting season opens mid-June) and Octorber 1 to October 31 (Table 1). These timeframes were set in place to minimize potential overlap with Cook Inlet beluga whales.

Lessees will use deep penetrating 3D seismic survey data to determine the optimal location for drilling the first well on their lease acreage. Deep penetration seismic surveys are the primary tool used to identify prospective locations to drill for subsurface deposits of crude oil and natural gas. Recording, processing, and interpreting reflected seismic waves created by introducing controlled source energy (such as seismic airgun impulses or vibratory waves) into the earth provide a means to identify rock structures that may form traps for petroleum migrating upwards from thermal generation centers. Operators would generally want to conduct a deep penetrating 3D seismic survey on their leased acreage prior to drilling additional exploratory wells to identify the optimal location(s) to drill.

BOEM assumes that one deep penetrating 3D seismic survey could be conducted during the first year of the E&D Scenario. The most likely support base for seismic exploration would be Kenai/Nikiski, or Homer. The deep penetrating 3D seismic survey will be focused on the one lease block sold to Hilcorp but they can apply to survey a larger area around their block. Three-dimensional 3D survey lines are spaced in a grid pattern concentrated in a specific area of interest. These surveys provide the resolution needed for detailed geological evaluation for well site placement. For 3D surveys, the sound source array typically consists of two to three subarrays of six to nine airguns each. An energy source (e.g., airgun, water gun, or marine vibrator) is used to transmit energy into the subsurface and generate seismic waves. Seismic waves reflect and refract off subsurface strata and travel back to acoustic receivers (hydrophones). The characteristics of the reflected seismic waves, such as travel time and intensity, are used to evaluate geologic structures, subsurface deposits, and natural resources to help facilitate the location of prospective drilling targets. The acoustic receivers consisting of streamers with multiple hydrophone elements can be towed behind the vessel, or ocean bottom nodes (OBN) can be placed on the seafloor. The OBN contains the geophone and data storage which is downloaded when OBNs are retrieved.

Airguns are the typical acoustic sound source for deep penetration seismic surveys. An outgoing sound signal is created by releasing a high-pressure air pulse from the airguns into the water to produce an air-filled cavity (a bubble) that expands and contracts. The size of individual airguns can range from tens to several hundred cubic inches (in^3). A group of airguns is usually deployed in an array to produce a more downward-focused sound signal. Airgun array volumes for deep penetrating 3D seismic surveys are expected to range from 1,800 to 5,000 in^3 but may range up to 6,000 in^3. In 2019, Hilcorp Alaska, LLC (Hilcorp) used a 1,945-in^3 gun array to conduct a 3D seismic survey in Cook Inlet (Fairweather Science 2020). No arrays larger than 2,400 in^3 have recently been used in Cook Inlet, and there is no information to indicate that a larger array would be needed or likely in the future. Airguns are fired at short, regular intervals, so the arrays emit pulsed rather than continuous sounds. While most of the energy is focused downward, and the short duration of each pulse limits the total energy into the water column, the sound can propagate horizontally for several kilometers (Greene and Richardson 1988).

The sound-source level (zero-to-peak) associated with typical deep penetrating 3D seismic surveys ranges between 233 and 255 decibels (dB) referenced to 1 microPascal at 1 meter (dB re 1 μPa @ 1 m), with most of the energy emitted between 10 and 120 hertz (Hz). Marine 3D surveys are acquired at typical vessel speeds of 4.5 knots (kn) (8.3 km/hour). A source array is activated approximately every 10 to 15 seconds, depending on vessel speed. The timing between outgoing sound signals can vary for different surveys to achieve the desired “shot point” spacing to meet the geological objectives of the survey; typical spacing is either 25 or 37.5 m (82 or 123 feet (ft)) but may vary depending on the objective of the survey. Airguns can be fired between 20 and 70 times per km.

Survey parameters for the deep penetrating 3D seismic survey will vary depending on client specifications, subsurface geology, water depth, and target reservoir(s) and may vary from the descriptions presented here. Vessels tow one to three source arrays of six to nine airguns each. Arrays are towed below the water surface but above the seafloor. Most operations use a single source vessel, depending on the survey design specifications required for the geologic target. However, more than one source vessel will be used when working in shallow waters that cannot provide a large enough platform for the total seismic airgun array necessary to obtain target depth. The overall energy output for the permitted activity will be the same but firing of source arrays on individual vessels will be alternated. Receiver streamer arrays for a 3D survey would include multiple (possible range 4 to 6) streamer-receiver cables suspended in the water column and towed behind the source array.

The data from deep penetrating 3D surveys are acquired along pre-plotted track lines within a specific survey area. Parallel track lines are generally spaced several hundred meters apart. The areal extent of the equipment limits both the turning speed and the area a vessel and equipment covers. It is, therefore, common practice to acquire data using an offset racetrack pattern, whereby the next acquisition line is several km away from, and traversed in the opposite direction of, the track line just completed. Seismic vessels operate day and night, and a survey may continue for days, weeks, or months, depending on the size of the survey, data-acquisition capabilities of the vessel, and weather conditions.

OBN and OBC (ocean bottom cable) deep penetrating 3D seismic surveys are used in Cook Inlet primarily to acquire seismic data in transitional zones where water is too shallow for a seismic survey vessel or where the tides make acquisition with streamers very difficult due to problems keeping the streamers straight in the tidal currents. OBN seismic surveys require the use of multiple vessels. A typical survey includes: (a) two vessels for cable or node layout/pickup; (b) one vessel for recording OBC data only; (c) one or two source vessels; and (d) possibly one to three smaller (10 to 15 m (33 to 49 ft)) utility boats. It is unlikely that helicopters would be used for vessel support and crew changes unless there are safety concerns. An additional support vessel may be used to monitor for marine mammals ahead of the survey vessel. The OBN seismic source arrays are smaller in size than the towed marine streamer arrays, and the surveys occur in shallower water depths.

An OBN or OBC operation begins by deploying nodes or cables off the back of the layout boat. Cable or node length typically is 4 to 8 km (2.5 to 5 mi) but can be up to 12 km (7.5 mi). Lines of nodal receivers are attached to the line in intervals typically of 40 to 60 m (131 to 197 ft). Multiple lines of nodes or cables are laid on the seafloor parallel to each other, with a cable spacing of between hundreds of meters to several kilometers, depending on the geophysical objective of the deep penetrating 3D seismic survey. When the cable is in place, a vessel towing the source array passes over the sound receiver cables or nodes with the source being activated in intervals (often every 25 or 37.5 m (82 or 123 ft)). The source may be a single array, or an array of multiple airguns.

OBN surveys may use an acoustical positioning system (or "pinger" system) to position and locate nodes placed on the seafloor. The pinger system consists of a vessel-mounted transceiver and transponders that attach to nodes. The transceiver uses sonar to communicate with the transponders, which in turn emit a response pulse. A pinger system used by SAE in Cook Inlet consisted of a transceiver that generated sonar at transmission source levels of 197 dB at frequencies between 35 and 55 kilohertz (kHz) and a transponder that produced short pulses of 184–187 dB at frequencies also between 35 and 35 kHz (NMFS 2015).

2.1.3 Geohazard and Geotechnical Surveys

Prior to submitting an EP or DPP, oil and gas industry operators are required to evaluate any potential geological hazards and document any potential cultural resources or benthic communities pursuant to 30 CFR Part 550. Geohazard surveys are conducted as ancillary activities on an oil and gas lease. The survey data are used to identify shallow hazards such as old pipelines or wrecks; obtain engineering data for placement of structures (e.g., proposed platform locations and pipeline routes); and detect subsurface geologic hazards (e.g., faults and gas pockets), archaeological resources, and certain types of benthic communities. BOEM assumes that up to four geohazard and geotechnical surveys could be conducted to assess up to 36 individual well sites throughout the duration of the project. Surveys could occur in a leased block during the periods April 2 to June 30, or the start of the drift gillnet season, and October 1 to October 31 as described in Table 1 (see timing restrictions for beluga whale habitat and drift gillnetting season).

The suite of equipment used during a typical survey may include single beam and multibeam echosounders, which provide water depths and seafloor morphology; a side scan sonar that provides acoustic images of the seafloor; a subbottom profiler which provides 20 to 200 m (66 to 656 ft) sub-seafloor penetration with a 6- to 20-centimeter (cm) (2.4- to 7.9-in) resolution; a bubble pulser or boomer with 40- to 600-m (131 to 1,969 ft) sub-seafloor penetration; and a multichannel seismic system with 1,000 to 2,000 m (3,280 to 6,562 ft) sub-seafloor penetration. Table 2 provides a list of representative equipment specifications used in high resolution geophysical surveys and their sound intensity (Crocker and Fratantonio 2016). (Crocker and Fratantonio 2016) tested equipment for the available power settings and frequency settings available for the equipment. For purposes of this analysis, the representative equipment in Table 2 is conservatively listed using the highest power settings and source levels. Actual use could have source levels below those indicated.

Table 2. Acoustic Characteristics of representative geophysical survey equipment. (Crocker and Fratantonio 2016).

	Highest Measured Source Level (Highest Power Setting)						
HRG Source	Source Setting	PK	RMS	SEL	Pulse Width(s)	Main Pulse Frequency (kHz)	Inter-Pulse interval (1/pps)
AA200 Boomer Plate	250 J (low)	209	200	169	0.0008	4.3	1.0 (1 pps)
AA251 Boomer Plate	300 J (high)	216	207	176	0.0007	4.3	1.0 (1 pps)
Applied Acoustics S-Boom (3 AA252 boomer plates)	700 J	211	205	172	0.0006	6.2	1.0 (1 pps)
Applied Acoustics S-Boom (CSP-N Source)	1000 J	209	203	172	0.0009	3.8	0.33333 (3 pps)
FSI HMS-620D Bubble Gun	Dual Channel 86 cm	204	198	173	0.0033	1.1	8.0 (1 per 8 sec.)
ELC820 Sparker	750 J (high) 1 m depth	214	206	182	0.0039	1.2	1.0 (1 pps)
Applied Acoustic Dura- Spark	2400 J (high), 400 tips	225	214	188	0.0022	2.7	0.33333 (1–3 pps)
Applied Acoustic Delta Sparker	2400 J at 1 m depth, 0.5 kHz	221	205	185	0.0095	0.5	0.33333 (1–3 pps)
EdgeTech 424 with 3200- XS topside processor	100% power, 4-20 kHz	187	180	156	0.0046	7.2-11	0.12500 (8 pps)
EdgeTech 512i Sub-bottom Profiler, 8.9 kHz	100% power, 2–12 kHz	186	180	159	0.0087	6.3-8.9	0.12500 (8 pps)
Knudsen 3202 Sub-bottom Profiler (2 transducers), 5.7 kHz	Power 4	214	209	193	0.0217	3.3-5.7	0.25000 (4 pps)
Reson Seabat 7111 Multibeam Echosounder	230 dB, 100 kHz	228	224	185	0.00015	100 kHz	0.0500 (20 pps)
Reson Seabat T20P Multibeam Echosounder	220 dB, 200, 300, or 400 kHz	221	218	182	0.00025	≥200 kHz	0.0200 (50 pps)
Bathyswath SWATHplus-M	100%, 234 kHz	223	218	180	0.00032	≥200 kHz	0.2000 (5 pps) 0.002–0.004
Echotrac CV100 Single- Beam Echosounder	Power 12,	196	193	159	0.00036	≥200 kHz	0.0500

	80 cycles, 200 kHz						(20 pps)
Klein 3000 Side-Scan	132 kHz (also capable of 445 kHz)	224	219	184	0.000343	132 kHz	0.03333 (30 pps)
Klein 3900 Side-Scan	445 kHz	226	220	179	0.000084	≥200 kHz	unreported
EdgeTech 4200 Side-Scan	100%, 100 kHz (also a 400 kHz setting)	206	201	179	0.0072	100 kHz	0.03333 (30 pps)
Sonardyne Scout USBL and Tz/OBC Type 7805-000-06 Pinger* and transponder	Not specified	202	197	172	0.002-0.004	33–55 kHz	0.4 (2.5 pps)

*Pinger information from (79 FR 51584, August 29, 2014).

The echosounders and subbottom profilers are generally hull-mounted. All other equipment is usually towed behind the vessel. The towed multichannel seismic system consists of an acoustic source which may be a single small airgun of 10 to 65 in^3 (164 to 1,065 cm^3), or an array of small airguns usually 2 or 4 guns of 10 in^3 (164 cm^3). The source array is towed about 3 m (9.8 ft) behind the vessel with a firing interval of approximately 12.5 m (41 ft) or every 7 to 8 seconds. A single 300 to 600 m (984 to 1,969 ft), 12 to 48 channel streamer with a 12.5 m (41 ft) hydrophone spacing and tail buoy is the passive receiver for the reflected seismic waves.

The ship travels at 3 to 4.5 kn (5.6 to 8.3 km/hour). These survey ships are designed to reduce vessel noise, as the higher frequencies used in high-resolution work are easily masked by the vessel noise if the ships are not quiet. Surveys are site specific and can cover less than one lease block, but the survey extent is determined by the number of potential drill sites in an area.

A single vertical well-site geophysical survey will collect about 46 line-miles (74 line-km) of data per site and take approximately 24 hours. If there is a high probability of archeological resources, the typical 150-m by 300-m (492-ft by 984-ft) grid must extend to 1,200 m (3,937 ft) from the drill site.

Geotechnical surveys are conducted to collect bottom samples to obtain physical and chemical data on surface and near sub-surface sediments. Sediment samples typically are collected using a gravity/piston corer, grab sampler, or dredge sampler. Shallow coring (0.3 to 152 m depth (1 to 500 ft)), using conventional rotary drilling from a boat or drilling barge, is another method used to collect physical and chemical data on sub-surface geology.

The E&D Scenario estimates 11 to 36 well-site clearances in total will be conducted, including both geophysical and geotechnical surveys. Multiple well-sites will be combined for a total of up to 4 geotechnical and 4 geophysical survey efforts. However, as explained previously the E&D scenario was based on a high development scenario on 28 lease blocks. Because only a single block was leased, it is highly likely that these numbers overestimate the number of geophysical and geotechnical surveys that may occur.

2.1.4 Exploration and Delineation Drilling Operations

Operators will drill exploratory wells based on mapping of subsurface structures using 3D deep penetrating seismic data and historical well information. Based on the geologic analysis, exploration and delineation wells will average approximately 1,829 m (6,000 ft) in true vertical depth. Prior to drilling exploration wells, operators will examine the proposed exploration drilling locations for geologic hazards, archeological features, and biological populations using geohazard seismic surveys and geotechnical studies. Site clearance and other studies required for exploration will be conducted normally the season before the drill rig is mobilized to the site.

Exploration drilling operations are likely to employ Mobile Offshore Drilling Units (MODUs). Examples of MODUs include drillships, semisubmersibles, and jack-up rigs. Drilling operations in Cook Inlet are expected to range between 30 and 60 days at different well sites, depending on the depth of the well, delays during drilling, and time needed for well logging and testing operations. BOEM estimates three wells per drilling rig could be drilled, tested, and abandoned/plugged during a single drilling season using one MODU. It is assumed that only one MODU would be used in the Lease Sale Area as a result of LS 258. This is based upon the number of exploration wells anticipated, the number of years that exploratory drilling might be conducted and the number of wells which can be drilled by a single rig during a drilling season. Based on the size and reservoir characteristics, as many as 8 wells could be drilled during exploration activities. Exploration drilling could occur during any period. However, while the Cook Inlet OCS LS 258 area remains relatively ice-free during the winter, the unpredictable winter weather conditions may limit drilling operations either by logistics or the additional expense required to conduct winter operations.

If there is a discovery during exploratory drilling, an operator will use drilling rigs to drill delineation wells to establish the areal extent of economic production. Operators need to verify that sufficient volumes of oil or gas are present to justify the expense of installing a production platform and pipelines. As many as 8 wells might be associated with exploring and delineating prospects.

Jack-up Rig

A jack-up rig is an offshore structure composed of a hull, support legs, and a lifting system that allows it to be towed to a site, lower its legs into the seabed and elevate its hull to provide a stable work deck. When a jack-up rig comes on site, the legs are lowered to the seafloor and preloaded to simulate the maximum expected load. This ensures the supporting soil will provide a reliable foundation after the rig is jacked up to the maximum height above the water (air gap). The actual dimensions of a jack-up rig would depend on the environment in which the unit would be operating and the maximum operating water depth. A typical jack up rig for use in up to 50 m (164 ft) of water is approximately 50 m (164 ft) in length, 44 m (144 ft) beam, and 7 m (23 ft) deep (BOEM 2017b).

Marine Acoustics (2011) performed underwater sound source verification (SSV) in Cook Inlet for the *Spartan 151* jack-up drilling rig. The rig was located in 24.4 to 27.4 m (80 to 90 ft) water depth within the Kitchen Lights Unit, 12 miles northeast of Nikiski Bay. The major sources of sound were the diesel engines, mud pump, ventilation fans, and electrical generators, with the loudest source being the diesel generators. None of the measured sound exceeded the 180 dB re 1 µPa or 160 dB re 1 µPa thresholds. Non-continuous sound levels in the frequency band between 8.9 Hz to 44.7 Hz that exceeded 120 dB re 1 µPa were measured to a range of 1.17 km to 1.4 km (3839 – 4593 ft). The source level of the diesel engines was estimated to be 137 dB re 1 µPa @ 1 m (rms) in the 141-178 Hz ⅓ octave band. From this, the 120 dB re 1 µPa acoustic received level isopleth would be 50 m (154 ft).

Jasco Applied Sciences performed SSV on the *Randolph Yost* jack-up drilling rig in water approximately 23 m (75 ft) deep at a well site in the Kitchen Lights Unit near Nikiski, Alaska (Denes and Austin 2016). Noise sources included vessels approaching, departing, and holding station near the drill rig, deep well pumps, mud pumps, and drilling. The loudest identifiable sources were vessel thrusters, which had best fit and 90 percent fit 120 dB threshold ranges of 3.4 and 4.6 km (2.1 and 2.9 mi) respectively. The source level for drilling on the *Yost* was determined to be 158 dB using 90 percent fit to the data. The distance to the 120 dB isopleth was estimated to be ~330 meters for the 90 percent fit to the data (Denes and Austin 2016).

Towing of the jack-up rig to a drill site can also create in-water noise. JASCO Applied Sciences conducted a sound source verification (SSV) to measure tugs pulling a jack-up-rig at various power outputs in Cook Inlet during October 2021. The SSV returned a source level of 167.3 dB re 1 µPa for the 20 percent power scenario and a source level of 205.9 dB re 1 µPa for the 85 percent power scenario (NMFS 2022). Assuming a linear scaling of tug power, a source level of 185 dB re 1 µPa was calculated as a single point source level for three tugs operating at 50 percent power output. This is an important estimate as a small fraction of the total time spent by tugs under load will be at greater than 50 percent power.

Pile Installation

Pile driving may be required during the first incremental step for two reasons; to install a drive pipe (conductor casing) or to set platform footings when there is an need for additional support beyond what is normally provided for a caisson or gravity-founded platform structure. Recent exploration drilling operations in Cook Inlet[2] have required the installation of a drive pipe in order to support the initial sedimentary part of the well, preventing the surface layers from collapsing and obstructing the wellbore. The pipe also facilitates the return of cuttings from the

[2] See Cosmopolitan 90-day report (Owl Ridge 2014a), Furie Biological Evaluation (Jacobs Engineering 2017b).

drill head. Drive pipes may be installed using drilling, impact pile driving, or a combination of these techniques. The drive pipe is also used as a foundation for the wellhead (Jacobs Engineering Group 2017). For a 2017 Kitchen Lights installation in Cook Inlet by Furie, a drive pipe was to be installed using an impact hammer, and was expected to be driven downwards to about 150 feet below the seafloor. Pile driving is expected to take 8-10 hours per pile, spread over two to three days (Jacobs Engineering Group 2017).

SSV measurements were made when a jack-up rig drive pile was set using a Delmag D62-22 for a 30-inch installation at Buccaneer's Southern Cross lease in 2013, Cook Inlet. This previous study reported a sound source of 190 dB re 1 at 55 m ((Illingworth & Rodkin 2014). Using the practical spreading loss model, in water sound is expected to attenuate to 160 dB at 5,500 m.

2.1.5 Seafloor Disturbance

Exploration and delineation drilling will disturb an area of the seafloor from the displacement of sediments from the mud cellar, jack up legs, and drill hole discharge. The total area of disturbed seafloor will depend on the number of wells drilled, oceanographic parameters, and environmental factors.

It is estimated that each site at a jack-up rig disturbs a seafloor area of approximately 1 ha (2.5 ac) (BOEM 2012a). Because a single block sold we estimate that a single jack-up rig will be required for the proposed action. Consequently approximately 1 ha (2.5 ac) would be disturbed.

2.1.6 Vertical Seismic Profiling

Vertical seismic profiling (VSP) is a geotechnical survey technique carried out by using geophone receivers (sensor string) located on a cable and placed in a borehole at different depths to record acoustic signals from an external acoustic source near the wellbore (zero-offset VSP) or from a vessel at different distances from the wellbore (walk-away VSP).

In all VSP surveys, sensors are lowered down a borehole before production tubing is placed in the wellbore or the well is abandoned. The sensors lowered down the borehole can be connected together in strings of 16-36 receivers spaced from 15-150 m (49-492 ft) apart, depending on the survey objective and other variables. After lowering the sensor string to the lowest portion of the borehole to be surveyed, the sensors are temporarily attached via a mechanical caliper that clamps to the side of the wellbore and seismic signals are recorded. Subsequently, the sensor string is repositioned and the next set of seismic signals are recorded. Seismic sources used in VSP surveys are the same as those used in conventional 2D and 3D seismic airgun surveys.

Zero offset VSP surveys are typically conducted using a single airgun suspended approximately 10 m below the sea surface by a crane located on the deck of the drilling rig. Walk-away VSP surveys utilize a workboat with four to eight airguns towed 7-10 m (23-33 ft) below the surface. These surveys involve a source vessel firing at varying distances from the receivers within the borehole. The airgun arrays used for these surveys can vary in volume, depending upon the survey objective. One version of walk-away surveys requires the source vessel to travel in a spiral track. The source vessel begins the spiral track at a distance of 200 m (656 ft) from the borehole and keeps the distance between spirals equal to the number of arrays times the array separation. Airgun arrays are fired in an alternating fashion with the first array firing followed by the second array 11-14 s later. At a typical vessel speed of 8.3-9.3 km/hr (4.5-5 knots), the distance between firings is between 28 and 36 m (92 and 118 ft). The source vessel continues firing on the spiral path out to a distance of up to 9 km (4.9 nmi). If the borehole sensor string needs to be raised to another level, the whole procedure is repeated.

Survey duration depends on the type of survey, objectives, cost of the drilling rig, and equipment used. A zero-offset survey can take less than a day to complete. A walk-away survey can be completed in less than one day or may require up to 10 days to complete, however, 30 percent of that time may be with the airguns in standby mode.

VSP operations are not considered to be a marine seismic survey for analysis purposes in this opinion, but rather as part of an exploratory drilling program, even though airguns are used for a short time. Borehole surveys are not required for well construction and are not needed in all cases. However, in Cook Inlet, Furie Operating Alaska, LLC drilled one well in the Kitchen Lights Unit of Cook Inlet in 2011 and conducted VSP as part of the planned activities (NMFS 2017a). Although borehole surveys are not required for all wells, in cases where they are necessary, they should not exceed one per well.

It is unlikely that VSPs would be conducted at every exploratory and delineation well. However, for the purposes of this opinion, NMFS assumes that VSP would be conducted in association with each wellbore, resulting in a maximum of 8 VSP occurring during the first incremental step. VSP operations are anticipated to use a 500 in^3 array with a source level of 228 dB re 1 μPa rms (BOEM 2017b).

2.1.7 Vessel and Aircraft Operations

Under the proposed action, marine vessels would be the primary form of transportation during the first incremental step (Table 1). The number of vessels deployed for seismic surveys would be dependent on the type of survey. During exploration surveys, these vessels would be largely self-contained; therefore, helicopters would not be used for routine support of operations. Under the proposed action, smaller support vessels would make occasional trips (one to two roundtrips per week, depending upon the duration of the survey) to refuel and resupply, probably operating out of Homer or Nikiski. Additionally, if directed by NMFS or the U.S. Fish and Wildlife Service (USFWS) during consultation, a mitigation vessel might accompany the seismic survey vessel(s).

The vessels conducting surveys generally are 70 to 120 m (230 to 394 ft) long. Vessels tow one to three source arrays of six to nine airguns each, depending on the survey design specifications required for the geologic target. Most operations use a single source vessel. Marine 3D surveys are acquired at vessel speeds of 4.5 knots (kn) (8.3 km/hour). Vessel transit speeds are highly variable, ranging from 8 to 20 kn (14.8 to 37.0 km/hour) depending on a number of factors including, but not limited to, the vessel itself, sea state, and urgency (the need to run at top speed versus normal cruising speed) (BOEM 2017b).

Seismic vessels operate day and night, and a survey may continue for days, weeks, or months, depending on the size of the survey, data-acquisition capabilities of the vessel, and weather conditions. Vessel operation time includes not only data collection, but also deployment and retrieval of gear, line turns between survey lines, equipment repair, and other planned or unplanned operations.

The 2D seismic survey vessels generally are smaller than 3D survey vessels; larger 3D survey vessels also are able to conduct 2D surveys. For 2D seismic surveys, the source array typically consists of three or more sub-arrays of six to nine airgun sources each, but may vary as newer technology is developed. Only one streamer is towed during 2D operations. Seismic vessels acquiring 2D data are able to acquire data at 4 to 5 kn (7.4 to 9.3 km/hour) and collect data from multiple transect lines, totaling between 137 and 177 line km (85 and 110 line miles) per day, depending on the distance between line changes, weather conditions, and downtime for equipment problems (BOEM 2017b).

The OBN seismic survey requires the use of multiple vessels (Table 1). A typical survey includes: (a) two vessels for cable or node layout/pickup; (b) one vessel for recording (ocean bottom cable (OBC) only); (c) one or two source vessels; and (d) possibly one to three smaller [10 to 15 m (33 to 49 ft)] utility boats. It is unlikely that helicopters will be used for vessel support and crew changes if there are no safety concerns.

The post-lease activities may include one aerial gravitational and/or magnetic survey conducted using aircraft in the lease area. Airborne gravity and magnetic surveys are flown for collection of data used to identify potential geologic structures which may contain oil and/or gas. Data will be collected by sensitive equipment mounted aboard the aircraft. All data collection is passive; no signals will be emitted from the equipment.

Data are collected while aircraft fly over the area(s) of interest in a prescribed grid. The specific methods will depend on the survey area, objectives, and available equipment, but are assumed to be similar to those used during recent airborne geophysical surveys conducted in Cook Inlet by Hilcorp Alaska, LLC (Hilcorp) in 2018. Based on this assumption, transects will be flown using both helicopters and fixed wing aircraft. Transects flown by fixed-wing aircraft will be 100 km (62 mi) long and 500 m (0.3 mi) apart, with tie lines at 5,000 m (3.1 mi) intervals. Transects conducted by helicopter will be 25 km (15.5 mi) long and 500 m (0.3 mi) apart and will also have tie lines at 5,000 m (3.1 mi) intervals. Total survey area could cover up to 1 million acres or 4,047 km2 (1,563 mi2). The aircraft will fly at minimum altitudes of 1,500 ft above sea level (ASL) except when weather conditions do not allow for safe operations, and operators will take all reasonable precautions to avoid flying directly over or within 457 m (1,500 ft) of marine mammals.

Aerial geophysical surveys are expected to occur during either year 1, 2, or 3 and will take approximately 14 days total within a 2-month period, although workdays may not be consecutive due to weather or equipment delays. There are no seasonal restrictions applied to airborne geophysical surveys, but suitable flight conditions are most likely to occur in June and July.

Both helicopters and supply vessels would support operations during exploration drilling (Table 1). Each drilling rig could expect one to three helicopter flights per day and one to two support vessel trips per week. Nikiski or Homer would be the most likely operational base for these support activities. The numbers and types of transportation used during government-initiated oil spill response exercises would vary dependent on the exercise but would likely include vessels (e.g., oil spill response vessels, containment barges, skiffs), helicopters, fixed-wing aircraft, and terrestrial transportation. During normal production operations, the frequency of helicopter flights offshore would remain the same as during development (1 to 3 per day), but marine traffic would drop to about 2 trips per week to each platform. Marine traffic would occur year-round since this area remains ice free during the winter. If barges are used to transport the drill cuttings and spent mud from production wells during drilling operations, a dedicated barge could make 1 to 2 trips per platform per week to an onshore disposal facility.

For decommissioning activities the number and types of vessels, aircraft, and onshore transportation would vary dependent upon the location of the platform. Use of vessels, including barges with cranes and tugs for platform removal, is anticipated. Terrestrial transportation and equipment for onshore decommissioning would be similar to that used during installation. Aircraft and terrestrial transportation to support decommissioning efforts and possible post-decommissioning surveys likely would occur.

2.1.8 Summary of Acoustic Noise

Marine seismic and geohazard surveys, as well as exploratory drilling, may involve a variety of active sources. Active systems are those that emit acoustic energy or sound into the water.

The active acoustic systems under the proposed action include devices for seismic reflection profiling, such as airgun arrays and subbottom profilers; sonar devices, such as echosounders, and sidescan sonar; and other acoustic sources, such as vessels and aircraft (Table 3). More information on the sound source verification measurements, source levels, and modeling assumptions are provided in the description of the proposed action (Section 2.1), and exposure analysis (Section 6.2).

Table 3. Summary of acoustic noise sources that may be associated with the propose action.

Active Acoustic Source	Frequency (kHz)	Approximate Broadband Source Level (dB re 1 µPa at 1m)
2400 in^3 marine seismic airgun array	<1	~238[1]
500 VSP in^3 airgun array (broadside)	<1	~228[2]
440 in^3 geohazard airgun array	<1	~225[1]
10 in^3 airgun survey (broadside)	<1	~206[1]
Bubble Pulser / Boomer	<1	~200[2]
Subbottom profiler	0.40-30	~230[2]
Side Scan Sonar	50-900	~230[2]
Single beam Echosounder	2-60	~200[2]
Multi beam Echosounder	180-240	~220[2]
Pinger	35-55	~197[2]
Impact Pile Driving	0.1-2	~190 @ 55m[3]
Tugs under Tow	<1	<200[4,5]
Vessel Noise Transit	<1	<200[2]
Drilling Operations	0.02-10	158[4]
Rotary Aircraft	<1	~162[2]

1 Sound source verification measurements for Apache 2012 seismic program in Cook Inlet (Austin and Warner 2012).

2 Lease Sale 244 Biological Assessment (BOEM 2017b).

3 Sound source verification measurements for impact hammer pile installation Southern Cross lease in Cook Inlet (Illingworth and Rodkin 2014)

4 Sound source verification measurements for *Randolph Yost* jack-up rig in Cook Inlet (Denes and Austin 2016a)

5 Furie exploration drilling program Biological Evaluation (Jacobs Engineering Group 2017).

2.1.9 Authorized Discharges

Authorized discharges from OCS facilities during the first incremental step include drilling fluids and cuttings, deck drainage, sanitary and domestic waste, desalination unit brine, cooling water, bilge and ballast water, and other miscellaneous discharges. The type of drilling fluids used depends on availability, the geologic conditions, and experiences of the drilling contractor. Often, several different types of drilling fluids are used in a single well and most (80 percent) of the drilling fluids are recycled. BOEM assumes that the discharged drilling fluids used for drilling the shallowest part of the well will be a common water-base mud of the generic composition (based on USEPA, Type 2, Lignosulfonate Mud) shown in Table 4. The average exploration or delineation well will produce up to 9,000 bbls of drilling fluids and up to 588 cubic yards of dry rock cuttings. BOEM assumes that drilling wastes (muds and cuttings) will be disposed of at the 3 to 8 exploration and delineation well sites that are scattered throughout the Lease Sale Area.

Well operations use a variety of drilling fluids, each with a different composition. While components vary, they may include a number of compounds in varying proportions (Table 4). Fluid discharges are regulated by federal and state agencies.

Table 4. Composition of typical drilling fluids (based on U.S. Environmental Protection Agency (EPA), Type 2, Lignosulfonate Mud) (BOEM 2022a)

Drilling Fluid Components	
Bentonite	Barite
Lignosulfonate	Drilled solids
Lignite	Soda ash/Sodium bicarbonate
Caustic	Cellulose Polymer
Lime	Seawater/Freshwater

Not including drilling discharges, the major waste discharges produced during the first incremental step include bilge water, ballast water, fire control system test water, cooling water, sanitary and domestic wastes, and deck drainage (BOEM 2022a). Bilge water collects in the lowest part of a ship; it may be contaminated by oil that leaks from the machinery within the vessel and is required to be processed through an oil-water separator prior to discharge. The discharge of any oil or oily mixtures having oil >15 parts per million (ppm) is prohibited under 33 CFR 151.10. Ballast water is used to maintain the stability of the vessel. Generally, ballast water is pumped into and out of separate compartments from bilge water and is not contaminated with oil. All vessels with toilet facilities must have marine sanitation devices that comply with 40

CFR Part 140 and 33 CFR Part 159 for sanitary wastes. Waste solids must either be macerated so that the discharge contains <150 milligrams per liter (mg/L) of suspended solids and a bacteria count <200 per 100 milliliters (mL) or retained until it can be disposed of at proper onshore facilities. In State waters, state and local governments regulate domestic and gray water discharges that consist of materials discharged from sinks, showers, laundries, safety showers, eyewash stations, hand-wash stations, and galleys (BOEM 2022a).

The U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) program regulates discharges of sanitary and domestic waters in federal waters. Rainwater and other water falling on contaminated areas of drilling rigs or platforms will pass through an oil-water separator prior to discharge. NPDES permits generally require deck drainage to contain no free oil. Other discharges that could occur during exploration drilling include desalination unit discharges, well treatment, workover, or completion fluids, boiler blowdown discharges, excess cement slurry, and uncontaminated freshwater and saltwater (BOEM 2022a).

Discharges from exploration operations in Cook Inlet are regulated under NPDES General Permits issued by the US EPA, with a term of five years. No existing authorization is currently in place under the US EPA NPDES program for new oil and gas drilling discharges. Operators will be expected to comply with standards set by individual permits or by a new General Permit, when one is developed. Further, BOEM and BSEE's regulations under the Outer Continental Shelf Lands Act require operators to plan operations that do not cause undue or serious harm or damage to the human, marine, or coastal environment (30 CFR § 550.202 (e)) and use the Best Available and Safest Technology (30 CFR §250.107(c)). Lease Sale 258 also prohibits discharges in selected lease blocks within 1,000 m of sea otter critical habitat.

2.1.10 Accidental Oil Spills or Gas Release

Spills are illegal and are not authorized by BOEM, but they may occur during activities associated with LS 258 (See also Section 6.3.4 for oil spill analysis for Future Incremental Steps). Petroleum exploration activities have been conducted in State of Alaska onshore lands and waters adjacent to the Cook Inlet OCS since the 1960s. Small oil spills have also occurred from State of Alaska or Pacific and Gulf of Mexico OCS oil and gas operations during exploration and are considered likely to occur during the first incremental step as well as subsequent stages. Spills during exploration activities are estimated to be small (50 barrels (bbl) or less) and consist of refined oils because crude and/or condensate oil would not be produced during exploration. Based on a review of potential discharges and on the historical oil spill occurrence data for the Alaska OCS, most spills were small. Large or very large spills of diesel or crude oil are not estimated to occur during the First Incremental Step activities of exploration (BOEM 2022b).

From 1975 to 2015 industry drilled 85 exploration wells in the entire Alaska OCS (BOEM, 2016). During this time the drilling industry has had approximately 53 small spills totaling about 32 bbl or 1,344 gallons. Of the 32 bbl spilled, approximately 24 bbl were recovered or cleaned up. The total and annual number and volume of small, refined oil spills during exploration activities was estimated by applying spill data (BOEM 2012b, 2016a) to the E&D Scenario for LS 258 and is displayed in Table 5. Up to 6 spills are projected to occur during the First Incremental Step, ranging in size from <1 bbl up to 50 bbl per spill (BOEM 2022a).

Refined oil is used in exploratory drilling activities for equipment and refueling. Any small refined oil spills during seismic and geophysical and geotechnical surveys and exploratory drilling activities are likely occur during April through early November when those activities are allowed. Refined spills of the maximum assumed sizes (<13 bbl for G&G and <50 bbl for drilling, Table 5) are anticipated to evaporate and disperse within 24 and 48 hours, respectively (BOEM 2016b, 2022b).

Table 5. Cook Inlet Lease Sale 258 action area oil spill estimates: First Incremental Step (BOEM 2022a).

Activity	Type of Small oil Spills	Total Number of Small Spills	Total Volume of Small Spills (bbl)	Annual Number of Small Spills	Annual Volume of Small Spills (bbl)
Exploration Geological and Geophysical Activities	Refined	0–3	0–13	0–1	0–<1 or <13
Exploration and Delineation Drilling	Refined	0–3	0–60	0–1	0–<5 or <50

2.1.11 Oil Spill Response Exercises

Government initiated oil spill response exercises (GIUEs) or spill response practice activities may occur and could include oil spill response equipment deployment, vessels and/or aircraft traffic, unmanned aerial surveillance, and personnel or vehicle movement. The operator is required to carry out the training, equipment testing, and periodic oil spill response drills described in their Oil Spill Response Plan (OSRP). Since 1989, BSEE has conducted GIUEs that provide an economically feasible mechanism for agencies to comply with the requirements defined in 30 CFR Part 254. In addition to table-top exercises, BSEE will also conduct field deployment GIUEs which will most often take place in waterways and shorelines adjacent to where the equipment is stored, but they may be moved if the exercise requires a more remote deployment. GIUEs can be required for an operator or a facility. A facility includes any structure, group of structures, equipment, pipeline, or device (other than a vessel) which is used for exploring for, drilling for, producing, storing, handling, transferring, processing, or transporting, oil.

A Mobile Offshore Drilling Unit is classified as a facility when engaged in drilling or downhole operations (30 CFR Part 254). Spill drills may therefore be required during exploratory drilling prior to development. Operators may also conduct spill drills separate from those required by BSEE. Typical deployment exercises last only a few hours and are rarely longer than a day. Deployment exercises are generally limited to a single skimming system involving from one to six vessels Sorbent boom would likely be deployed and could include up to 3,000 ft of ocean/conventional boom for offshore response tactics and up to 2,000 ft of coastal boom for near shore and shoreline protection tactics. This would represent a very large-scale exercise that simultaneously tested the operator's competence in carrying out response operations in both types of environments. The most likely scenario would be much smaller testing of only a single tactic. An open water tactic would most likely require between 90 ft and 500 ft of conventional boom. A shoreline protection response would require between 250 ft and 500 ft of coastal boom. BSEE endeavors to coordinate with and include other Federal, State, and local agencies where appropriate to reduce impacts on government and industry.

2.2 Future Incremental Steps (Development, Production, and Decommissioning)

As described previously, future incremental steps include all activities that would occur after exploration and delineation and the approval of a Development and Production Plan (DPP). A lessee must submit a detailed DPP per 30 CFR Part 550 (30 CFR §§550.241-550.262) that BOEM must review under NEPA. Development, production, and decommissioning activities will also require ESA section 7 consultations. Table 6 details the activities anticipated during future incremental steps, including associated transportation.

While the proposed action is focused on exploration activities, this consultation also considers potential impacts through the endpoint of the action as described below in the hypothetical E&D Scenario, followed by the decommissioning of all of these activities (years 6-40).

Unlike other Alaska OCS planning areas, the Cook Inlet Planning Area has a nearby market for both oil and gas. Cook Inlet gas has become a valuable commodity to be used locally or potentially transported as liquefied natural gas (LNG). As a result, the current E&D Scenario does not defer gas sales until oil production is depleted. The existing natural gas distribution system in south-central Alaska could be extended to transport gas from the Cook Inlet OCS to the greater Anchorage and Kenai Peninsula areas (BOEM 2016b).

Under the proposed action, development of the field would begin in approximately Year 7, where BOEM assumes that majority of development activities would occur through Year 21. BOEM anticipates that production activities would begin in approximately Year 7 and that the production of oil and gas would continue through Year 38. Decommissioning would commence after oil and gas reserves at a given platform are depleted, and income from production no longer pays operating expenses which will occur between Years 24–38. To comply with BSEE regulations (30 CFR 250.1710-.1716—wellheads/casings and 30 CFR 250.1725-.1729—

platforms and other facilities), lessees are required to remove all seafloor obstructions from their leases within one year of lease termination or relinquishment.

The schedule of activities presented here is a compressed and ambitious one resulting in a robust level of activities upon which to base the impacts analyses in this consultation. The proposed action assumes there would be no construction delays for platforms, regulatory delays, or other delays of any kind. The proposed action also assumes immediate commitment from the operator(s) after a successful exploration program, with no funding delays, and that all operators coordinate and cooperate successfully. These assumptions help ensure the potential impacts of the proposed action will not be underestimated, while the actual timeline for development of a prospect in the Leased Area would be determined by the lessee and could be affected by any of the variables mentioned above.

As discussed before, because a single block was leased, and all the numbers presented in Table 6 represent BOEM's estimate of a high level of development on 28 blocks, the lowest number in the ranges presented are probably more closely represent what may occur. For example, 8 production wells, 4 service wells, and one steel jacketed platform are likely a better estimate of development that may occur.

Table 6. Production and Development Activities associated with Lease Sale 258

Element	Number	Footprint Area (ac)	Season	Comment
Production wells	8–81	n/a – area within platform footprint	Year Round	Production wells area disturbance is included in the platform seafloor disturbance.
Service wells	4–27	n/a – area within platform footprint	Year Round	Production wells area disturbance is included in the platform seafloor disturbance.
Rock cuttings from production and service wells (cy)	7,056–63,504	0	Year Round	Production and service wells would average 588 cy of dry rock cutting, which would be disposed of in service wells or barged to shore for disposal and established treatment facilities.
Drilling fluids from service and production wells (bbl)	9,360–84,240	0	Year Round	On average, 2,369 bbls of drilling fluid would be used to drill each production well. 80% of the drilling fluid is expected to be recycled; 20% would be injected into disposal wells or discharged[1].
Steel jacketed platforms installed	1–6	<1	Open Water	0.14-acre footprint/platform (85 ft by 70 ft)
New shore bases	0			
New onshore drilling and production waste handling facilities	0			
Total oil production (MMbbl)	192.3	n/a	Year Round	
Total gas production (Bcf)	301.9	n/a	Year Round	
Peak oil rate (Mbbl/day)	36.7	n/a	Year Round	
Peak gas rate (MMcf/day)	85.64	n/a	Year Round	

Notes: ac = acres cy = cubic yard bbl = barrels Bcf = Billion cubic feet MM bbl = Thousand million barrels
Bcf = billion cubic feet Mbbl = thousand barrels MMcf = million cubic feet n/a = not applicable
All values are for entire lifespan of the E&D Scenario.
1 Water-based drilling fluids and cuttings would be discharged under the NPDES in accordance with the Clean Water Act.

2.2.1 Development Activities

Development activities include installing production platforms, installing and connecting pipelines to existing onshore pipelines, drilling production and service wells, disposing of drilling wastes, and constructing facilities. Production activities include the processing of produced oil, gas, and water; treatment and reinjection of produced water and gas for reservoir pressure maintenance; facility, well, and process equipment maintenance; and transportation of materials, process waste, and personnel to support these ongoing production activities. Table 6 and Table 7 describe development and production activities and infrastructure for this E&D Scenario based on the following assumptions:

- A reservoir could be discovered and developed at any location leased in the leased block.
- Offshore developments resulting from LS 258 would make use of existing facilities in the Cook Inlet region such as airfields, docks, storage, and processing facilities.

- Production platforms would have a single drilling rig capable of year-round drilling.
- Each platform could have up to 24 well slots, processing equipment, fuel and production storage capacity, and quarters for personnel.
- All processing would be done on platforms; there would be no new onshore processing facilities.
- Produced water would be separated and reinjected into the reservoir using service wells.
- Domestic wastewater from the crew quarters and mess facilities on the platforms would be disposed in service wells.
- Up to 80 mi of offshore and 80 mi of onshore oil pipelines would be installed to connect the offshore oil field to the oil refinery at Nikiski (Table 7).
- Up to 120 mi of new offshore gas pipelines would be installed with 1 mi of new onshore gas pipeline installed that would connect to the existing gas pipeline that runs from Homer to Nikiski (Table 7).

It is difficult to estimate to what extent pipeline number or length might be reduced by a smaller proposed project. But similar to production estimates (Table 7), the amount of pipeline required for a single lease block is likely a fraction of the estimated pipeline needed for the development on 28 blocks.

Table 7. Pipelines associated with Lease Sale 258

Element	Number	Footprint Area (ac)	Season	Comment
Onshore Oil Pipeline (mi)	0–80	0–290	Year Round	Footprint based on an estimated 30-ft. wide disturbance for pipeline installation. Onshore pipeline would be buried where practical.
Onshore Gas Pipeline (mi)	1	4	Year Round	Footprint based on an estimated 30-ft. wide disturbance for pipeline installation. Onshore pipeline would be buried where practical.
Offshore Oil Pipeline (mi)	0-80	0–291	Open water	Footprint based on an estimated 30-ft. wide disturbance for pipeline installation. Offshore pipeline would be buried where practical.
Offshore Gas Pipeline (mi)	40–120	145–437	Open water	Footprint based on an estimated 30-ft. wide disturbance for pipeline installation. Offshore pipeline would be buried where practical.
New Pipelines to shore	1-2	n/a	n/a	Number of new pipelines crossing the shoreline.

Notes: All values are for entire lifespan of the E&D Scenario. n/a = not applicable

2.2.1.1 Pipelines

Construction of the pipelines is anticipated to occur between the beginning of May and the end of September. Unlike other Alaska OCS Planning Areas, the Cook Inlet region has existing onshore oil and gas infrastructure. We assume that existing onshore facilities (e.g., Nikiski) and nearby ports (e.g., Homer, Port Graham) will be used as shore bases.

The preferred method to transport oil and gas from the initial platform would be via subsea pipelines from the initial platform to the nearest landfall location, probably on the Kenai Peninsula between Homer and Nikiski. Where subsea soil conditions allow, the pipelines will be trenched using a subsea trenching jet similar to the method employed for the proposed Trans-Foreland pipeline to be installed between the Kustatan Production Facility on the west side of Cook Inlet and the Kenai Pipeline Company Tank Farm near Nikiski. If soils are not conducive to pipeline burial, anchors may be used to provide support and stability for the pipeline necessary to resist tidal movements.

Seafloor disturbance as a result of pipeline construction, trenching, or associated anchors would depend on the final length of the pipelines and whether trenching occurs. It is estimated that placement disturbs between 0.5 and 1 ha (1.25 and 2.5 ac) of seafloor per kilometer of pipeline (for both oil and gas), with the uncertainty depending on whether trenching is required (Cranswick 2001). It is difficult to estimate the amount of disturbance that will occur but we assume one pipeline will be built that extends from the leased block to landfall between Homer and Nikiski, approximately 85 km (53 mi).

2.2.1.2 Production Platforms

In the E&D Scenario platform installation would commence year 7. We expect one platform would be installed over the course of four years. Water depth, sea conditions, and ice conditions are important factors in selecting a platform type. The existing platforms in Cook Inlet located in state waters were constructed onshore, floated to the targeted location, and installed. In the E&D Scenario it is assumed that each production platform will be a steel-caisson platform constructed and designed to be tide and ice resistant. It is assumed that installation activities could occur year-round. The platform would house production and service (injection) wells, processing equipment, fuel, and quarters for personnel. Total area of sediment disturbed by use of a steel-caisson platform will depend on platform design. The 2012 Leasing Programmatic EIS estimates each production platform will disturb approximately 1.5 ha (3.7 ac) of seafloor (BOEM 2012a).

2.2.1.3 Transportation

Helicopters and supply vessels from existing facilities located in either Homer or Nikiski would support OCS construction (i.e., platform and pipeline installation) and development drilling operations. Helicopters would probably fly at a frequency of one to three flights per platform per day during development operations. Support-vessel traffic is estimated to consist of one to three trips per platform per week.

Pipeline installation would occur between May and September during years six through nine. Both oil and gas pipelines would be installed simultaneously. Two vessels, a laying vessel and a trenching vessel, would likely be used for installation.

Platform installation would occur year-round during years seven through 10. Transport and placement of platforms likely would require the short-term use of vessels for transport and placement. The types of vessels needed would be dependent on the type of platform chosen. Installations typically require two barges with cranes and one or more tugs to help tow, position, and stabilize platforms and to hoist modules topside.

During the drilling of production and service wells, drilling fluid and cuttings may be disposed of in service wells and/or barged to shore for disposal. Transportation of cuttings for onshore disposal is estimated to require 1 to 2 barge trips per platform per week during drilling operations.

During future incremental steps, government-initiated oil spill response exercises would occur every 1-3 years. The numbers and types of transportation used during government-initiated oil spill response exercises would vary dependent on the exercise but would likely include vessels (e.g., OSRVs, M/Vs, containment barges, skiffs), helicopters, fixed-wing aircraft, and terrestrial transportation (Table 1) (BOEM 2017b).

2.2.2 Production Activities

Oil production would commence with the drilling of the first platform production well and ramp up as more wells are drilled. In the E&D Scenario, oil and gas production would probably begin in the 7th year and production would continue year round. In Cook Inlet the associated gas produced with the oil can be sold to the local natural gas distribution system. Oil production would continue through the 34th year and gas production would continue through the 39th year. Production operations would largely involve resupply of materials and personnel, inspection of various systems, and maintenance and repair.

2.2.2.1 Maintenance

After the OCS infrastructure construction is complete, operations largely will involve resupply of supplies and personnel, inspection of various systems, maintenance, and repair. Maintenance and repair work will be required on the platforms, and processing equipment will be upgraded to remove bottlenecks in production systems. Well repair work will be required to keep both production and service wells operational (BOEM 2017b). Pipelines will be inspected and cleaned regularly by internal devices (e.g., pipeline inspection gauges or "pigs"). Crews will be rotated at regular intervals.

2.2.2.2 Authorized Discharges

Discharges from production and development operations in Cook Inlet are regulated under NPDES General Permits issued by US EPA, with a term of five years. Discharges authorized under the General Permit include sanitary waste, domestic waste, deck drainage, desalination unit waste, cooling water, ballast and bilge water, and other miscellaneous effluents.

Production fluids (oil, gas, and water) would be gathered on the platforms where gas and produced water would be separated, and gas and water reinjected into the reservoir using service wells. During the later gas sales phase, only water would continue to be reinjected. Disposal wells would handle wastewater from the crew quarters on the platforms (BOEM 2017b).

2.2.2.3 Transportation

During normal production operations, the frequency of helicopter flights offshore would remain the same as during development (1 to 3 per platform per day), but marine traffic would drop to about one to two trips per week to the platform (Table 8). Marine traffic would occur year round since this area remains ice free during the winter. If barges are used to transport the drill cuttings and spent mud from production wells during drilling operations, a dedicated barge could make 1 to 2 trips per platform per week to an onshore disposal facility (BOEM 2022a).

2.2.3 Decommissioning Activities

Decommissioning activities may begin in the 35th year. After oil and gas resources are depleted and income from production no longer pays operating expenses, the operator will begin to shut down facilities. In a typical situation, wells will be permanently plugged with cement and wellhead equipment removed. Processing modules will be moved off the platforms. It is not expected that pipelines will be removed at the end of their serviceable life; rather, they will be decommissioned, cleaned, and left buried in sediment. This practice prevents the additional disturbance to sediments and benthic communities which would occur if pipelines were removed. Subsea pipelines will be decommissioned by cleaning the pipelines, plugging both ends of individual pipelines, abandoning them in place. Lastly, the platform will be disassembled and removed from the area, and the seafloor site will be restored to some practicable predevelopment condition. Cutters are typically used to remove platform legs. Post decommissioning surveys would be required to confirm that no debris remains and pipelines were decommissioned properly (BOEM 2017b).

2.2.3.1 Authorized Discharges

As with discharges from other future incremental steps, discharges from decommissioning activities would be regulated under NPDES permits. Discharges authorized under the General Permit include sanitary waste, domestic waste, deck drainage, desalination unit waste, cooling water, ballast and bilge water, and other miscellaneous effluents (BOEM 2017b).

2.2.3.2 Transportation

The number and types of vessels, aircraft, and onshore transportation would vary dependent upon the decommissioning activities. Use of vessels, including barges with cranes and tugs for platform removal, is anticipated. Terrestrial transportation and equipment for onshore decommissioning would be similar to that used during installation. Aircraft and terrestrial transportation to support decommissioning efforts and possible post-decommissioning surveys likely would occur (Table 8). The amount of transportation is likely two or three times the amount that will be needed to service one lease block.

Table 8. Transportation activities for exploration, development, and production, and decommissioning for Lease Sale 258

Element	Number of Activities	One Way Distance (Miles)	Season	Comment
Maximum flights per week during peak exploration activity	14	700[1]	Year-Round	Approximately 2 flights per day. Flights would depart from Homer or Nikiski.
Maximum boat trips per week during peak exploration activity	5	250[1]	Open Water	Vessels would depart from Homer.
Flights per week during peak development, production, and decommissioning phases	7–42	350–2,100	Year Round	One flight could service multiple platforms. Number of platforms range from 1–6. Flights would depart from Homer or Nikiski.
Boat trips per week during peak development, production, and decommissioning phases	7–42	350–2,100	Open Water	Number of platforms range from 1–6. Vessels would depart from Homer.

Notes: All values are for entire lifespan of the E&D Scenario.
[1] Distance assumes maximum number of trips to likely development locations within the sale area (50 miles from Homer or Nikiski).

2.2.4 Accidental Oil Spills or Gas Release

Oil spills could potentially occur as illegal, unauthorized events resulting from activities in the first and future incremental steps. BOEM developed hypothetical oil spill scenarios using technical data about Cook Inlet’s oil and gas resources and data from spill events during activities similar to those of the proposed action. Scenario models predicted the probable spill volumes and geographical trajectories. The models were then used to evaluate the likely effects of spill events given seasonal timing (BOEM 2022b). Small spills are reasonably certain to occur, but large spills are unlikely. BOEM considered effects of a large spill to ensure effects to listed species and critical habitat are not underestimated. A very large oil spill is a highly unlikely event, therefore not reasonably foreseeable or reasonably certain to occur.

2.2.4.1 Small Spills (< 1,000 bbl)

Small spills of both refined oils and crude and/or condensate oils could occur both onshore and offshore during future incremental steps. The estimated total numbers and volumes of small oil spills resulting from future incremental step activities are presented in Table 9. BOEM and BSEE estimate that approximately 405 small spills of crude, condensate, or refined oil spills could occur during the 32-years of development, production, and decommissioning and one large spill could occur during Future Incremental Steps (Table 9).

Table 9. Total and annual potential small oil spills for oil and gas activities for Lease Sale 258.

Activity	Type of Small Oil Spills	Total Number of Small Spills	Total Volume of Small Spills (bbl)	Annual Number of Small Spills	Annual Volume of Small Spills (bbl)
Development and Production, Decommissioning	Refined, Crude, or Condensate	0 – 405	0 –310	0 – 13	0 – 10

2.2.4.2 Large Spills (≥1,000 bbl) or Gas Releases

A large spill is not an expected outcome of the proposed action. However, to ensure effects are not underestimated, BOEM assumes one large spill (3,800 bbl) of crude, condensate, or refined (diesel) oil would occur during development and production activities. BOEM also assumes one loss of well control or one pipeline rupture (offshore or onshore) over the 32 years of gas production. The gas release would result in loss of up to 30 million cubic feet of natural gas over one day. Consequently, for purposes of conducting a large spill analysis, BOEM assumes the occurrence of one large spill, and conducts a large oil spill analysis for the future development and production activities accordingly. Overestimating the projected number of large spills or gas releases helps to ensure that potential environmental effects are not underestimated. Because BOEM used an E&D Scenario that greatly overestimated the potential development of oil and gas resources (high level of development on 28 blocks), the estimates presented in this section are extremely conservative.

The chance of a 3,800-bbl spill occurring is estimated to be 19 percent, and the chance of no large spills occurring is 81 percent over the E&D Scenario lifecycle (BOEM 2022a). The estimated chance of a 30-MMcf gas release is 4 percent, and the likelihood of no gas release is 96 percent over the life of the proposed action. These estimates are based on historical data on spills ≥1,000 bbl, statistical estimates of the mean number of large spills from platforms and pipelines, the number and size of large spills on the OCS, and project-specific information from the E&D Scenario (BOEM 2022b).

BOEM used an oil-spill trajectory model, known as the Oil Spill Risk Analysis (OSRA) model, which calculates the probability of oil-spill contact (conditional probabilities) and occurrence and contact (combined probabilities) with specific geographic areas within and outside of Cook Inlet (Ji and Smith 2021). In this approach, BOEM ran simulations of a large spill (≥1,000 bbl) originating from one of six Launch Areas (LAs) and four Pipeline Segments (PLs)–hypothetical locations in the Lease Sale Area shown in the FEIS ((BOEM 2022b), Appendix A). The locations are not meant to represent or suggest any particular development scenario or outcome. BOEM uses the results of more than 800,000 trajectory simulations to calculate the likelihood that a large spill from one of the LAs or PLs would contact certain geographic areas in Cook Inlet and the surrounding region. The specific geographic areas are categorized as Environmental Resource Areas (ERAs), Land Segments (LSs), or Grouped Land Segments (GLSs).

The OSRA presents conditional and combined probabilities (expressed as a percent chance) of a large oil spill contacting or occurring and contacting areas an ERA, LS, or GLS. Conditional probabilities are based on the assumption that a large oil spill has occurred ((BOEM 2022b), Appendix A). Combined probabilities factor in the chance of a large oil spill occurring and then contacting a specific resource area. The conditional probabilities are discussed first, followed by the combined probabilities.

A large spill is not a likely outcome from the proposed action, but for the purpose of the analysis, BOEM assumes that a large spill originating from an offshore LA or PL would occur at 40 m (131 ft) water depth or less and that the released oil would reach the sea surface within a short period of time. The OSRA trajectory model is based on the movement of unweathered oil with no effective mitigation from oil spill response activities. BOEM also performs weathering calculations to estimate the fate of spilled oil. Potential mitigating factors, such as spill response strategies, are not incorporated into the model and are only considered when assessing potential impacts from spills.

Evaluating the potential effects of the proposed action, which entails oil and gas exploration, development, production, and decommissioning activities projected to take place over 40 years, is complicated by uncertainty in several respects. First, there is some uncertainty inherent in the E&D scenario provided by BOEM. The proposed action includes a detailed hypothetical scenario based upon the best available information that BOEM had at the time. It projects reasonably foreseeable activities and locations, and thereby provides a reasonable and suitable basis for impact evaluation. There is uncertainty in the number, volume, timing, and location of possible oil spills. The OSRA model estimated the number and volume of spills that may take place, based on historic spill rates sizes derived from OCS data and the volume of oil estimated to be produced. A trajectory model calculates the chances of a large spill contacting important resource areas and then tabulates the chance of a large spill occurring and contacting these same resources. As with any projection or forecast, forward-looking statements are inherently susceptible to uncertainty and changes in circumstances. Actual events would be unlikely to exactly match the projections provided.

2.2.4.3 Very Large Oil Spills (≥120,000 bbl)

Very large oil spills and gas releases are very low probability, high impact events. Although very unlikely (>0.00001 – <0.0001) and not considered part of the proposed action, BOEM considered a hypothetical long duration loss of well control resulting in 120,000 bbl of oil and released gas. BOEM analyzed a very large oil spill (≥120,000 bbl) and gas release, which is not reasonably certain as a result of Cook Inlet OCS oil and gas activities, for Lease Sale 258 (BOEM 2022b). The FEIS includes a discharge analysis methodology, general effects of oil and gas on physical, biological, social, and economic resources, and impacts to resources from the initial loss of well control event to long-term recovery.

2.2.4.4 Oil Spill Response Drills

Government-initiated unannounced exercises (GIUEs) or spill drills conducted by the lessee were discussed in the first incremental step (Section 2.1.11) and would continue throughout the future incremental steps. BSEE anticipates up to one spill drill per year through production (Year 33). Spill drills for each individual operator or facility generally occur every 3 years unless additional drills are warranted based on inadequate performance on previous exercises. Multiple operators or facilities may occur in the Lease Sale Area, and although rare, two spill drill exercises could occur in one year. Field activities would occur during a single day. The spill drill location would be adjacent to the facility or in the local area (within 25 kilometers of the staging area). Spill response practice activities could include oil spill response equipment deployment, vessels and or aircraft traffic, unmanned aerial surveillance, and personnel or vehicle movement. There is some potential for a small refined spill to result from spill response or an oil spill response exercise. Oil spill response equipment and vessels or aircraft may be staged in or near the drilling or production area or onshore in the Cook Inlet Region.

2.3 Mitigation Measures

Mitigation measures are applied at several stages. At the lease sale stage, BOEM applies mitigation measures in the form of lease stipulations. These stipulations are fully enforceable as required conditions for the sale on all leases. Proposed lease stipulations are summarized below and provided in full in Appendix B of the BA (BOEM 2022a). Final lease stipulations were published in the Final Notice of Sale document before LS 258 was held. Post-lease activities may have mitigation imposed through conditions of approval of plans, permit conditions, or other mechanisms. Oil and gas activities on the OCS must comply with all applicable Federal, state, and local laws and regulations, some of which also impose mitigation measures. Compliance with all applicable laws and regulations is assumed for the activities considered in this biological opinion.

Leaseholders and other permittees also routinely request and are expected to obtain authorizations for activities that could result in the "take" of marine mammals under the Marine Mammal Protection Act (MMPA). These Incidental Harassment Authorizations (IHAs) or Letters of Authorization (LOAs) contain mitigation measures to ensure the authorized activities will result in the take of no more than small numbers of marine mammals and have no more than a negligible impact on marine mammal stocks. This represents a different threshold for impacts than the jeopardy standard under the ESA, but mitigation measures to prevent and minimize take under the MMPA also serve to reduce take under ESA. The mitigation measures typically required for activities in Cook Inlet are described below and included in the effects analysis in Section 6. Each LOA or IHA will specify final design features and operational procedures to mitigate impacts to marine mammals and may differ from those described here. BOEM will review any proposed differences and will reinitiate consultation or request project-specific consultation if the activities or effects differ from those considered in the BA and this biological opinion.

2.3.1 Lease Stipulations

Lease Stipulations are binding contractual provisions that apply to all Ancillary Activities, EPs, DPPs, and Development Operations Coordination Documents (30 CFR §550.202). Lease Sale Stipulations often consist of protective measures designed to decrease the likelihood of impacts to environmental resources such as marine mammals. The Lease Stipulations are part of the Proposed Notice of Sale package for LS 258. Lease Stipulations that are intended to reduce impacts to listed marine mammals that NMFS protects are provided below. A complete description of all the lease stipulations for LS 258 are provided in Appendix B of the BA (BOEM 2022a) and on the BOEM website as part of the Final Notice of Sale package (https://www.boem.gov/AK258).

- Stipulation B-1.2 – Protection of Biological Resources
- Stipulation B-1.3 – Orientation Program
- Stipulation B-1.5 – Protection of Beluga Whale Nearshore Feeding Areas
- Stipulation B-1. 6 – Protection of Beluga Whales

The lease stipulations that have the most impact on NMFS' trust resources, including endangered or threatened species and their critical habitat, are stipulations 2, 3, 5, and 6. Lease stipulation 2 is intended to protect biological resources that are discovered during the course of operations. If previously unidentified biological populations or habitats that may require additional protection – for example, marine mammal haul out areas – are identified in the lease area, the lessee may be required to conduct biological surveys to determine the extent and composition of such biological populations or habitats. The lessee may also be required to do one or more of the following: relocate the site of operations; establish that its operations will not have a significant adverse effect upon the resource identified, or that a special biological community does not exist; operate during those periods of time that do not adversely affect the biological resources; and/or modify operations to ensure that significant biological populations or habitats deserving protection are not adversely affected. Stipulation 3 ensures that all personnel are aware of the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals, and provides guidance on how to avoid or minimize disturbance. Stipulations 5 and 6 are intended to protect endangered Cook Inlet beluga whales and their habitat, by prohibiting activity during feeding and when it is likely that beluga whales are in specific areas. The date ranges of these exclusions are between July 1 and September 30, and November 1 through April 1.

The Lessee(s) may request a waiver from, or variance to, these stipulations at the time of filing an ancillary activities notice, EP, or a DPP with the Regional Supervisor of Leasing and Plans (RSLP). Lessee(s) requesting a waiver or variance must provide a description of the proposed method(s), and an analysis evaluating the effectiveness of such method(s), for protecting the beluga whales from the specified activities in their plan or notice. Such requests must demonstrate that the alternative method(s) will provide commensurate protection for beluga whales. The decision to approve, approve with conditions, or disapprove a request for waiver of or variance from the provisions of this stipulation is in the sole discretion of the RSLP.

2.3.2 Information to Lessees and Operators

BOEM's Information to Lessee (ITLs) provides information about issues and concerns related to particular environmental or sociocultural resources, provide guidance on how lessees might plan their activities to meet BOEM requirements, or reduce potential impacts. Other ITLs provide information about the requirements or mitigation measures imposed by other federal and state agencies. ITLs are effective in lowering potential impacts by alerting and informing lessees and their contractors about possible mitigation measures that could be required. The ITLs listed below are the ones most pertinent marine mammal protection for all OCS activities in Cook Inlet conducted pursuant to LS 258 leases and are considered part of the proposed action.

The BA (BOEM 2022a)identifies eleven ITLs; four of which (No. 1, 3, 4, and 8) may help to reduce impacts on endangered or threatened species and critical habitat by providing information and situational awareness to lessees and operators. The additional seven ITLs are not likely to measurably reduce direct impacts on the listed species within this consultation. A complete list of ITLs can be found in Appendix B of the BA (BOEM 2022a).

- ITL No. 1 – Seismic Surveys: Environmental and Regulatory Review and Coordination Requirements. This ITL advises lessees and operators that seismic surveys could affect northern sea otters, beluga whales, other marine mammals, and coastal birds. It also advises lessees and operators that all seismic surveys conducted in the Cook Inlet Planning Area as an ancillary activity in support of an EP or DPP is subject to environmental and regulatory review by BOEM and that protective measures may be developed based on consultations with NMFS and USFWS.
- ITL No. 3 – Discharge Restrictions and Prohibitions. Lessees are advised that certain discharges into Cook Inlet proposed in an EP or DPP must be authorized by, and comply with, a NPDES permit. By agreement between the U.S. EPA, BSEE may conduct NPDES permit compliance inspections of post-lease operations authorized under the Outer Continental Shelf Lands Act (OCSLA). Also, in accordance with 30 CFR 250.300(b)(1), BSEE may further restrict the rate of drilling fluid discharge or prescribe alternative discharge methods. BSEE may also restrict the use of certain components in discharges which could cause unreasonable degradation to the marine environment.

  The NPDES General Permit for Oil and Gas Exploration Facilities in Federal Waters of Cook Inlet (Cook Inlet GP; AKG-28-5100) became effective on September 1, 2016, and expired on August 31, 2021 (USEPA, 2015a). Although lessees who are not existing permittees can no longer apply for coverage under AKG-28-5100, the permit is described in this ITL to provide prospective bidders with awareness of the types of requirements and restrictions that may be included in future Cook Inlet NPDES general or individual permits.

- ITL No. 4 – Trash and debris pose a threat to marine mammals, birds, fish, and other wildlife; cause costly delays and repairs for commercial and recreational boating interests; detract from the aesthetic quality of recreational shore fronts; and increase maintenance costs for parks and refuges. Because oil and gas operations can contribute to this chronic problem, BSEE regulations at 30 CFR 250.300(a) and (b)(6) prohibit lessees from deliberately discharging containers and other similar materials (i.e., trash and debris) into the marine environment. BSEE regulations at 30 CFR 250.300(c) and (d) require lessees to make durable identification markings on equipment, tools and containers (especially drums), and other material, and to record and report items lost overboard to the BSEE Regional Supervisor/Field Operations through facility daily operations reports.

  The intentional jettisoning of trash has been prohibited by the International Convention of the Prevention of Pollution from Ships (MARPOL) Annex V, the Marine Plastic Pollution Research and Control Act, and regulations imposed by agencies including the USCG and the US EPA. Certain USCG and US EPA regulations further require that lessees become more proactive in avoiding accidental loss of solid waste items by developing waste management plans, posting informational placards, manifesting trash sent to shore, and using special precautions such as covering outside trash bins.
- ITL No. 8 – Lessees are advised they must be prepared to respond to oil spills which could occur as a result of offshore natural gas and oil exploration and development activities. The lessee will submit for approval an Oil Spill Response Plan (OSRP) in accordance with BSEE regulations at 30 CFR Part 254. Of particular concern are sections of the OSRP that address the following:
  - potential spill size and trajectory;
  - specific actions to be taken in the event of a spill;
  - the location and appropriateness of oil-spill equipment; and
  - the ability of the lessee to protect communities and important resources from adverse effects of a spill.

In addition, lessees will be required, pursuant to BSEE regulations at 30 CFR Part 254, to conduct spill response drills that include deployment of equipment to demonstrate response preparedness for spills under realistic conditions.

2.3.3 Other Mitigation Measures

This section provides a general description of mitigation measures, that in addition to the lease stipulations and ITLs, will be required for the first incremental step activities. When take of a marine mammal is expected from project activities, the mitigation measures will be updated and specific to the proposed project. BOEM will review each plan submitted by a lessee to make sure that the activities are within the scope of activities covered in this consultation. BOEM's project-specific review will include an evaluation of the mitigation measures to ensure they will be implemented in accordance with the intended purpose and effectiveness of the mitigation measures presented here.

2.3.3.1 General Requirements

In the event of an anticipated spill, the operator will comply with NOAA's most current Marine Mammal Oil Spill Response Guidelines (NMFS 2023).

For all activities that may cause harassment of marine mammals, NMFS must be notified prior to the start of the activity, when activities are complete, and when any unplanned delays occur.

The following mitigation measures cover the activities we anticipate occurring in the first incremental step. Additional mitigation measures may be required once project-specific details are developed and addressed in subsequent project-specific consultations.

2.3.3.2 Protected Species Monitoring

Protected Species Observers (PSOs) will watch for ESA-listed species during activities that generate high levels of noise. PSOs are biologists or local experts who have previous marine mammal observation experience. Qualifications for these individuals are provided to NMFS for review and acceptance. All observers complete a training session on marine mammal monitoring shortly before the start of their season. Duties of the observers will include watching for and identifying marine mammals, recording their numbers, distances from, and reactions to the survey operations, initiating mitigation measures, and reporting the results.

The observers are usually stationed aboard the source vessel. At least one observer must be on watch during all daylight periods when the specified activities are being conducted. A shift will not exceed 4 consecutive hours, and no observer works more than 3 shifts in a 24-hour period (12 hours total per day) in order to avoid fatigue. PSOs have no other duties during their watch. An example of specific protected species monitoring protocols can be found in the 2019 Hilcorp Cook Inlet Seismic Biological Opinion (NMFS 2019a).

The following are the standard monitoring methods utilized to ensure that appropriate mitigation measures are initiated at the appropriate times.

- **Vantage point:** The observer(s) will watch for marine mammals from the best available vantage point on the operating source vessel, which is usually the bridge or flying bridge. Personnel on the bridge will assist the PSOs in watching for marine mammals.

- **Observer equipment:** Operators will provide or arrange for the following equipment for use by the observers: reticule binoculars, 20 x 50 image stabilized binoculars, Big Eye binoculars, laser rangefinders, inclinometers, and laptop computers. NMFS approved night vision equipment will be used when needed.

- **Shutdown zones:** Deep penetrating 3D seismic surveys, vertical seismic profiling, and certain types of geophysical equipment may generate levels of sound that exceed NMFS's established thresholds for injurious noise (NMFS 2019a). For these sources, PSOs will monitor a shutdown zone. If an ESA-listed species is seen in or approaching the applicable shutdown zone shown in noise-producing equipment will be shut down immediately.

• **Monitoring zones:** The observer(s) will monitor a zone around the source vessel. In this zone, received sound levels may exceed NMFS's thresholds for broadband underwater sound pressure levels that cause behavioral disturbance, referred to as Level B harassment under Section 3(18)(A)(ii) of the MMPA. When a marine mammal is seen approaching or within the monitoring zone, the vessel crew will be notified immediately so that operations can be shutdown. The observer then will maintain a watch to determine when the mammal is outside the monitoring zone such that regular operations can resume. Examples of prior monitoring zone sizes are provided in this consultation (Table 10) but actual sizes are determined when the applicant submits a plan indicating the equipment they intend to use.

• **Sighting information:** When a marine mammal sighting is made, the following information about the sighting is recorded: (1) species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from the source vessel, apparent reaction to the source vessel (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace; (2) time, location, heading, speed, activity of the vessel, and operational state (e.g., operating airguns, ramp-up, etc.), sea state, ice cover, visibility, and sun glare; and (3) the positions of other vessel(s) in the vicinity of the source vessel.

• **General information:** The ship's position, heading, and speed; the operational state (e.g., number and size of operating energy sources); and the water temperature (if available), water depth, sea state, ice cover, visibility, and sun glare will also be recorded at the start and end of each observation watch, every 30 minutes during a watch, and whenever there is a substantial change in one or more of those variables.

• **Estimated distances:** Distances to nearby marine mammals will be estimated with binoculars containing a reticle to measure the vertical angle of the line of sight to the animal relative to the horizon. Observers will use a laser rangefinder to test and improve their abilities for visually estimating distances to objects in the water.

2.3.3.3 Field Data Recording and Verification

The following procedures for data recording and verification will allow initial summaries of data to be prepared during and shortly after the field season and will facilitate transfer of the data to statistical, graphical, or other programs for further processing. Quality control of the data will be facilitated by the start-of-season training session, subsequent supervision by the onboard field crew leader, and ongoing data checks during the field season.

• Recording: The observers will record their observations onto datasheets or directly into handheld computers.

• Database: During periods between watches and periods when operations are suspended, data will be entered into a laptop computer in an electronic database format that can be transmitted to and read by BOEM's and NMFS's computer systems.

• Verification: The accuracy of the data entry will be verified in the field by computerized validity checks as the data are entered and by subsequent manual checking of the database printouts.

2.3.3.4 Reporting

Observation reports are submitted to NMFS on a weekly basis and include the general information, sighting information, and estimated distances described previously. Reports must be filed with NMFS within 24 hours when any lethal take or injury to a marine mammal occurs due to project activities or when marine mammals are observed within the exclusion zone. A report that summarizes the monitoring results and operations must be received no later than 90 days after completion of the project. The reports include:

• Summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through study period versus operational state, sea state, and other factors affecting visibility and detectability of marine mammals);

• Summaries of the occurrence of shutdowns, ramp-ups, and ramp-up delays;

• Analyses of the effects of various factors, influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare);

• Species composition, occurrence, and distribution of marine mammals, including date, water depth, mammal numbers, age/size/gender categories (if determinable), group sizes, and ice cover;

• Sighting rates of marine mammals versus operational state (and other variables that could affect detectability);

• Initial sighting distances versus operational state;

• Closest point of approach versus operational state;

• Observed behaviors and types of movements versus operational state;

• Numbers of sightings/individuals seen versus operational state;

• Distribution around the acoustic source vessel versus operational state; and

• Estimates of take by harassment.

The take estimates are calculated using two different methods to provide both minimal and maximal estimates. The minimum estimate is based on the numbers of marine mammals directly seen within the Level B zone by observers on the source vessel during activities. The maximal estimate is calculated using densities of marine mammals from data collected during (a) vessel-based surveys in non-operational areas, or (b) observations from the source vessel or supply boats during non-operational periods. The estimated densities in the observable monitoring zone in areas without data acquisition activity are applied to the amount of area exposed to the relevant levels of sound to calculate the maximal number of animals potentially exposed. These reports are due 90 days after termination of the survey season.

2.3.3.5 Geological and Geophysical Surveys

Mitigation measures vary with the specific category of survey being conducted. BOEM's mitigations for vessel-based geophysical (high-resolution) surveys include:

• Timing and location restrictions: Timing and locating survey activities to reduce the potential for disturbing marine mammals protected species and fisheries.

• Minimized energy: Selecting and configuring the energy source array in such a way that it minimizes the amount of energy introduced into the marine environment by using the lowest sound levels feasible to accomplish data collection needs.

• Shutdown and Level B monitoring zones: PSOs will monitor the appropriate zones to minimize harassment and for the prevention of exposure to injurious levels of underwater noise. Zones will be established based on sound source levels and distances to the sound exposure thresholds as determined by a sound source verification test using the equipment that will be used for the actual seismic survey.

The operator or leaseholder will be required to conduct acoustic measurements of their equipment (including source arrays) at the source for 3D seismic and sub-bottom profiler activity prior to or at the start of the survey. These underwater sound source verification tests will be used to confirm appropriate sizing of the ensonified radii. A report on the preliminary results will be submitted within 5 days after collection and analysis of those measurements. Based on these results, the shutdown and monitoring zones may be increased or decreased.

2.3.3.6 Deep Penetrating 3D Seismic Surveys

The potential disturbance of marine mammals during deep penetration 3D seismic survey operations is minimized through implementation of several ship-based mitigation measures, speed and course alterations, ramp-up (or soft start) procedures, shutdown procedures, and provisions for poor visibility conditions. Furthermore, LS 258 blocks excluded any critical habitat areas and the Lease Stipulations and ITLs contain timing restrictions to minimize adverse effects to beluga whales and their food sources.

• Shutdown and monitoring zones: Operators will use NMFS-approved observers onboard the survey vessel to watch the shutdown and monitoring zones for presence of listed species and to implement appropriate mitigation measures. The observers monitor the visible area of the 160-

dB radius for Level B harassment takes. Examples of Level B harassment zones are shown in Table 10.

• Ramp-up: A ramp-up (or "soft start") of a sound source array provides a gradual increase in sound levels for sound sources that generate sound energy within the frequency spectrum of marine mammal hearing. A ramp-up involves a step-wise increase in the number and total volume of airguns until the desired operating level of the full array is attained. During a survey program, the operator is required to ramp up sound sources slowly at a rate of no more than 6 dB per 5-minute period over no less than a 20-minute period. Full ramp-ups (i.e., from a cold start after a shutdown, when no airguns have been firing) will begin by firing one small airgun. Ramp-ups are required at the start of operations and any time power to the airgun array has been discontinued for a period of 10 minutes or more and the observer watch has been suspended.

• Shutdowns: A shutdown is the immediate cessation of firing of all energy sources. The arrays will be immediately shut down if a marine mammal is sighted approaching or within the applicable exclusion zone.

• Site clearances: The Level B monitoring zone or all waters within 2,000 m (whichever is smaller) must be clear of marine mammals for 15 minutes prior to beginning the ramp-up from a cold start to ensure that no marine mammals enter the monitoring zone. Following a shutdown, operation of the airgun array will not resume until the marine mammal has cleared the applicable zone. If a marine mammal(s) is sighted within the Level B monitoring zone during the 30-minute watch prior to ramp-up, ramp-up will be delayed until the marine mammal(s) is sighted outside of the monitoring zone or the animal(s) is not sighted for at least 15 minutes for pinnipeds and 30 minutes for cetaceans. The vessel operator and observers will maintain records of the times when ramp-ups start and when the airgun arrays reach full power.

• Operations at night and in poor visibility: Most operators conduct seismic operations 24 hrs/day. When operating under conditions of reduced visibility attributable to darkness or to adverse weather conditions, infrared or night-vision binoculars will be available for use. It is recognized, however, that their effectiveness is limited. For that reason, observers will not routinely be on watch at night, except in periods before and during ramp-ups. Survey operations may continue under conditions of darkness or reduced visibility if ramp up procedures, including complete site clearances, are conducted at the beginning of each new line and airguns are shutdown between shooting of lines.

• Speed and course alterations: If a marine mammal (in water) is detected in or near the Level B mitigation zone and, based on its position and the relative motion, is likely to enter the shutdown zone, the vessel's speed and/or direct course will be changed in a manner that does not compromise safety requirements. The animal's activities and movements relative to the source vessel will be closely monitored to ensure that the individual does not continue its approach. If the mammal continues, further mitigation actions must be taken; either further course alterations, or shutdown the airgun(s) to prevent the animal from entering the shutdown zone.

• Dead or Injured Animal: In the event that an injured or dead marine mammal is sighted within an area where the operator deployed and utilized airguns within the past 24 hours, the airguns must be shut down immediately and NMFS notified (Table 11). If an assessment, certified by the lead PSO onboard, indicates the marine mammal was not a casualty of project-related vessel/seismic operations, the ramp-up may be initiated, and the survey continued.

2.3.3.7 Exploration and Delineation Drilling

• PSOs will monitor the Level B harassment zone during drilling operations and when rig operations will produce under water sound pressure levels exceeding 160 dB.

• Operators will also be subject to vessel and aircraft mitigation, such as that described in the sections that follow.

2.3.3.8 Vessel Operations

There are a wide variety of vessels of different types and sizes that operate in support of exploration activities. Vessels typically conform to the following operational procedures with respect to marine mammals:

• Maximum distance. Operators of vessels will, at all times, conduct their activities at the maximum distance possible from pods of whales. At a minimum, vessels will avoid approaching within 100 yards (91 m) of cetaceans or pinnipeds

• Changes in direction. Vessel operators will avoid multiple changes in direction when within 300 yards (274 m) of whales; however, those vessels capable of steering around such groups should do so.

• Changes in speed. Vessels in transit shall be operated at speeds necessary to ensure no physical contact with whales occurs. Vessels will avoid multiple speed changes and reduce speed to ≤10 kn when within 300 yards (274 m) of whales, especially during poor visibility, to reduce the potential for collisions.

• Groups of marine mammals. Vessels will not be operated in such a way as to separate members of a group of marine mammals.

Table 10. Example Level B harassment zones associated with oil and gas related activity

Activity	Level B harassment zone radius (disturbance zone)	Basis for disturbance zone radius
440 in^3 array	2,500 m	Austin and Warner (2012) (from NMFS (2016)
1,945 in^3 array	7,100 m	Austin (2019)

2,400 in^3 array	9,500 m	Austin and Warner (2011) and (Warner et al. 2011) (from NMFS (2016)
Jack-up rig transport by three tugs	1,500 m	(NMFS 2022)
Pile driving Delmag D-62	5,500 m	190 @ 55m dB (Illingworth and Rodkin 2014, but with practical spreading loss applied)
Drilling and pumping	330 m	SPL (Denes and Austin 2016)

2.3.3.9 Aircraft Operations

Aircraft are typically required to operate within specific height and distance parameters with respect to marine mammals and birds. These include the following:

• All aircraft: Aircraft are required to operate at least 1,500 ft (457 m) above sea level when within 500 lateral yards (457 m) of marine mammals, except for an emergency or navigational safety.

• Helicopters: Helicopters may not hover or circle above marine mammals.

• Inclement weather: When weather conditions do not allow a 1,500 ft (457 m) flying altitude, such as during storms or when cloud cover is low, aircraft may be operated below 1,000 ft (305 m), but the operator should avoid known marine mammal concentration areas and take precautions to avoid flying directly over or within 500 yards (457 m) of marine mammals.

• Support aircraft: Support aircraft must avoid extended flights over the coastline to minimize effects on marine mammals in nearshore waters or the coastline.

2.3.3.10 Mitigation Measures for Future Incremental Step Activities

BOEM will request consultation with NMFS on future incremental step activities. Future activities, including all development and production work, will be described in a DPP. The DPP will be developed by the lessee if exploration and delineation work reveal oil and gas reserves of sufficient size, and companies choose to move into production. The DPP would describe the timing of these activities, information concerning drilling vessels, the location of each proposed production platform or other structure, and an analysis of both offshore and onshore impacts that may result from the plan's implementation. The DPP would identify the precise location of the production well and associated facilities, such as pipelines to shore and onshore processing facilities, providing BOEM, BSEE, and NMFS with project-specific details that would enable the agencies to evaluate impacts on listed species at a more detailed level and allow identification of potential mitigation needs. All activities during future incremental steps would also be subject to permits, authorizations, stipulations, required operating procedures, and best management practices of applicable resource and management agencies.

Table 11. NMFS Contact Information

Reason for Contact	Contact Information
Consultation Questions & Unauthorized Take	AKR.PRD.section7@noaa.gov
Reports & Data Submittal	AKR.section7@noaa.gov (please include NMFS AKRO tracking number in subject line)
Stranded, Injured, or Dead Marine Mammal *(not related to project activities)*	Stranding Hotline (24/7 coverage) 877-925-7773
Oil Spill & Hazardous Materials Response	U.S. Coast Guard National Response Center: 1-800-424-8802 & AKRNMFSSpillResponse@noaa.gov
Illegal Activities *(not related to project activities; e.g., feeding, unauthorized harassment, or disturbance to marine mammals)*	NMFS Office of Law Enforcement (AK Hotline): 1-800-853-1964
In the event that this contact information becomes obsolete	NMFS Anchorage Main Office: 907-271-5006 Or NMFS Juneau Main Office: 907-586-7236

2.3.3.11 Onshore Operations

First Incremental Step

Onshore activities during the first incremental step are limited to support operations, which are expected to use existing facilities at Homer or Nikiski. All onshore activities during the first incremental step would be subject to permits, authorizations, stipulations, required operating procedures (ROPs), and best management practices (BMPs) as recommended or required by the appropriate land-based resource and management agencies.

Future Incremental Steps

Future incremental steps may include two pipeline landfalls (one oil and one gas), probably on the southern Kenai Peninsula near Homer or Nikiski. The BA projects that onshore oil and gas pipelines 80 km (50 mi) long will be constructed (BOEM 2022a). Locations of pipeline routes and landfalls will depend on where a commercial discovery is made, but are expected to be within the Action Area.

All onshore activities during Future incremental steps would be subject to permits, authorizations, stipulations, ROPs, and BMPs as recommended or required by the appropriate land-based resource and management agencies.

2.3.3.12 Opportunities for Intervention and Spill Response

In the event of an oil spill, response operations could occur that may cause small amounts of acoustic harassment, but which will seek to reduce the volume of spilled material and spatial extent of the spill, thereby potentially decreasing the environmental effects of the spill. Several oil spill response methods and activities may occur simultaneously. The availability and effectiveness of each technique may vary with environmental conditions and oil characteristics. For example, offshore intervention activities may be hampered during winter months by low temperatures, the presence of ice, unfavorable seas and weather, darkness, and other factors.

- **Mechanical Recovery**: Physical removal of oil from the sea surface, typically accomplished using containment booms and skimmers. Boom would be deployed on the sea surface and positioned within or around an oil slick to contain and concentrate the oil into a pool thick enough to permit collection by a skimmer. The recovered oil would be transferred to a storage vessel (e.g., barge or tanker) and subsequently transferred to shore for appropriate recycling or disposal.
- **Dispersants**: Chemical dispersants are a combination of solvents and surfactants that are applied to oil to promote the dispersion process and form smaller droplets. Smaller droplets may then remain submerged rather than rising to the sea surface, spreading, and potentially contacting land. Dispersion into smaller droplets results in greater surface areas available for microbial degradation, and eventual dissolution. Dispersant use is generally limited to waters > 10 m in depth. To receive authorization to use dispersants, a Dispersant Use Request must be submitted by the Responsible Party to the Federal On-Scene Coordinator (FOSC), as described in the Alaska Unified Plan. The FOSC, in consultation with representatives from the Department of Commerce (DOC), Department of Interior (DOI), and EPA's Alaska Regional Response Team (ARRT), and the State On-Scene Coordinator, will review the Dispersant Use Request and grant authorization, if warranted. Dispersants may be aerially applied using low-flying aircraft (i.e., aircraft flying < 46 m [150 ft] above the sea surface), or from offshore vessels. Dispersants also may be applied directly at the subsea source of the release using a remotely operated vehicle. The use of dispersants in the presence of cold water and ice is discussed in the Final Second Supplemental EIS for Lease Sale 193, Section 4.4.2.2.8 (BOEM 2015b).
- **In Situ Burning**: Intentional ignition of floating oil at the sea surface is conducted to enhance volatilization of the lighter compounds in oil. Burning causes temperatures to increase at the sea surface, and temporary air quality issues, and generates residues that may float or sink.

2.3.3.13 Additional Mitigation Measures

Additional mitigation measures related to exploration, development, production, and decommissioning may be required by NMFS for site-specific activities as specified in an Incidental Take Statement or by BOEM in a specific exploration plan or development and production plan or by BSEE in a drilling permit. However, since those measures would be addressed in future ESA section 7 consultations and may, or may not, be incorporated in future permits and authorizations, they are not considered as part of this proposed action.

2.4 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.

The action area for this biological opinion includes the waters and shorelines of lower Cook Inlet and the Shelikof Strait (Figure 2). The analysis considered the extent of onshore activities as well as the Oil Spill Risk Analysis (OSRA) in determining the Action Area. Onshore activities during the first incremental step are limited to support operations; it is expected these will use existing facilities at Homer or Nikiski. Future incremental steps are expected to include up to two offshore pipelines from the initial platform to shore, with a landfall probably on the Kenai Peninsula between Homer and Nikiski (BOEM 2022a). Onshore sections of the oil pipeline estimated to be up to 80 mi long may be constructed. Locations of pipeline routes and landfalls will depend on where a commercial discovery is made but would be within the Action Area.

The Lease Sale Area is within the Action Area and contains all OCS lease blocks offered in the Lease Sale (Figure 1). Seventeen OCS blocks in the Lease Sale Area contain beluga whale and northern sea otter critical habitat but no leases were offered on those blocks. LS 258 offered 193 OCS blocks for lease (approximately 399,518 ha or 987,230 acres) and one was sold (Figure 1).

The OSRA looked at probabilities of various sized spills contacting waters and shorelines of Cook Inlet and Shelikof Strait. Based on these possible spills, the boundary of the action area extends from the LS 258 area southeast to the Kennedy Entrance of Cook Inlet and south into Shelikof Strait past Karluk, Alaska. Additional information on hypothetical oil spill trajectories can be found in Appendix A of the FEIS (BOEM 2022b), and below in Section 6.3.4.

Mobilization, demobilization, and resupply vessels are expected to traverse from Kenai/Nikiski or Homer to well locations or seismic vessel locations (BOEM 2022a). These transit routes will also have a sound propagation buffer associated with vessel noise that may range from 100 m to 2.2 km depending on the vessel type whereby typical supply vessels will likely have a disturbance zone of about 100 m in radius, while tugs engaged in towing may have a larger disturbance zone. Based on these transit routes, the boundary of the action area extends from the LS 258 area north to Nikiski, Alaska (Figure 2).

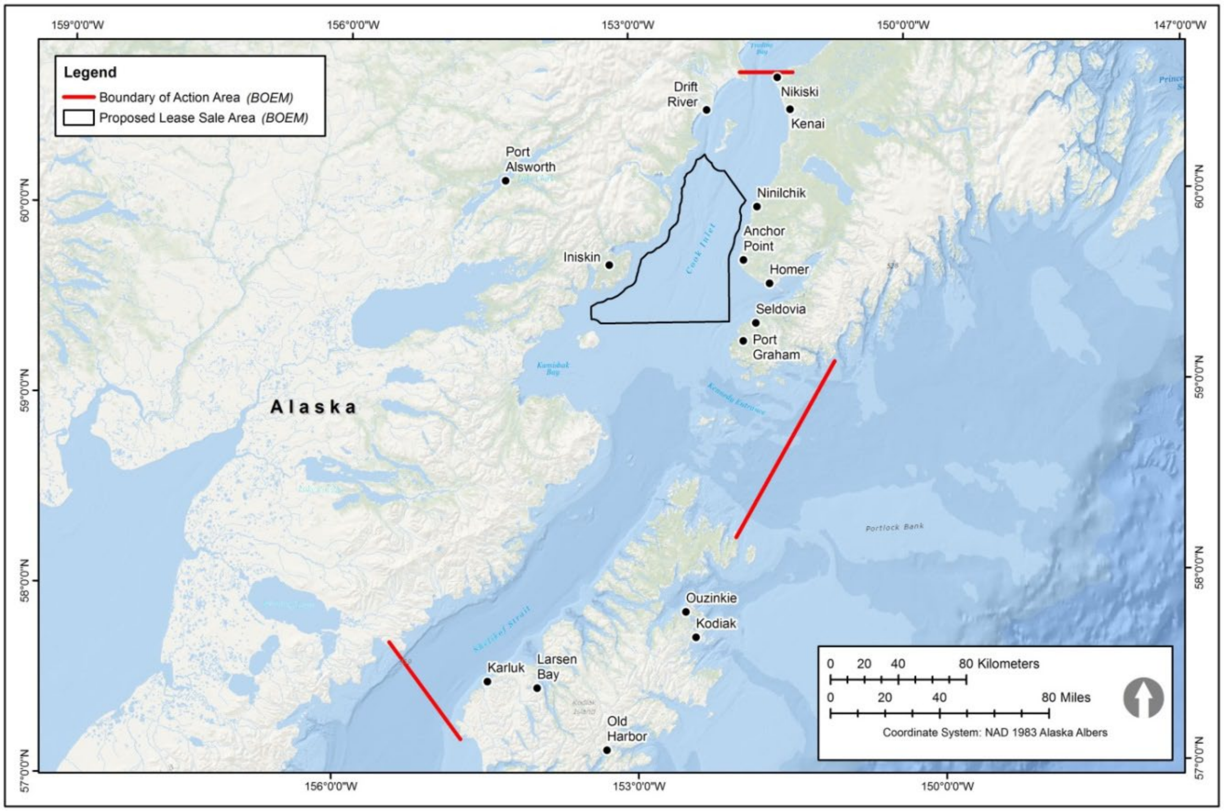

Figure 2. Action Area Map for Lease Sale 258 (BOEM 2022a)

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 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, our use of the term PBF also applies to Primary Constituent Elements and essential features.

We use the following approach to determine whether the proposed action described in Section 2.0 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 direct or indirect 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*; expected 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 action. 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 PBFs. 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 6.3 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 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 to the action.

4 RANGEWIDE STATUS OF THE SPECIES AND CRITICAL HABITAT

This opinion considers the effects of the proposed action on the species and designated critical habitats specified in Table 12. Five species/DPSs of marine mammals listed as threatened or endangered under the ESA under NMFS's jurisdiction may occur in the action area. Critical habitat has been designated for some of these species as well (Table 12). This opinion considers the effects of the proposed action on these species and on designated critical habitat for Cook Inlet beluga whale and Steller sea lions. BOEM made no effects determinations regarding project effects on Western North Pacific and Mexico DPSs humpback whale critical habitat, therefore we did not include that critical habitat in our effects analysis.

Table 12. Listing status and critical habitat designation for marine mammals considered in this opinion.

Species	Status	Listing	Critical Habitat
Cook Inlet Beluga Whale (*Delphinapterus leucas)*	Endangered	NMFS 2008 73 FR 62919	NMFS 2011 76 FR 20180
Fin Whale (*Balaneoptera physalus*)	Endangered	NMFS 1970 35 FR 18319	Not designated
Humpback Whale, Western North Pacific DPS (*Megaptera novaeangliae*)	Threatened	NMFS 2016 81 FR 62260	NMFS 2021 86 FR 21082
Humpback Whale, Mexico DPS (*Megaptera novaeangliae*)	Threatened	NMFS 2016 81 FR 62260	NMFS 2021 86 FR 21082
Steller Sea Lion, Western DPS (*Eumatopias jubatus)*	Endangered	NMFS 1997 62 FR 24345	NMFS 1993 58 FR 45269

4.1 Climate Change

One threat common to all the species we discuss in this opinion is global climate change. Because of this commonality, we present an overview here rather than in each of the species-specific narratives that follow. A vast amount of literature is available on climate change and for more detailed information we refer the reader to these websites which provide the latest data and links to the current state of knowledge on the topic in general, and in the Arctic specifically:

https://www.ipcc.ch/reports/

https://climate.nasa.gov/evidence/

http://nsidc.org/arcticseaicenews/

https://arctic.noaa.gov/Report-Card

4.1.1 Air temperature

The decadal global land and ocean surface average temperature anomaly for 2011–2020 indicates that it was the warmest decade on record for the globe, with a surface global temperature of +0.82°C (+1.48°F) above the 20th century average[3]. This surpassed the previous decadal record (2001–2010) value of +0.62°C (+1.12°F)[4]. The 2020 Northern Hemisphere land and ocean surface temperature was the highest in the 141-year record at +1.28°C (+2.30°F) above average. This was 0.06°C (0.11°F) higher than the previous record set in 2016[2].

Since 2000, the Arctic (latitudes between 60ºN and 90ºN) has been warming at more than two times the rate of lower latitudes because of "Arctic amplification," a characteristic of the global climate system influenced by changes in sea ice extent, atmospheric and oceanic heat transports, cloud cover, black carbon, and many other factors[5] (Serreze and Barry 2011, Overland et al. 2017) and the average annual temperature is now 3-4° F warmer than during the early and mid-century (Figure 3; Thoman and Walsh 2019). The statewide average annual temperature in 2020 was 27.5°F, 1.5°F above the long-term average even though it was the coldest year since 2012[6]. 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).

4.1.2 Marine water temperature

Higher air temperatures have led to higher ocean temperatures. More than 90 percent of the excess heat created by global climate change is stored in the world's oceans, causing increases in ocean temperature (IPCC 2019, Cheng et al. 2020). The upper ocean heat content, which measures the amount of heat stored in the upper 2000 m (6,561 ft) of the ocean, was the highest on record in 2019 by a wide margin and is the warmest in recorded human history (Cheng et al. 2020).

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[3] https://www.ncdc.noaa.gov/sotc/global/202013 viewed on 5/31/2021

[4] https://www.ncdc.noaa.gov/sotc/global/202013 viewed on 5/31/2021

[5] NASA wepbage. State of the Climate: How the World Warmed in 2019. Available at https://www.carbonbrief.org/state-of-the-climate-how-the-world-warmed-in-2019, accessed January 20, 2020.

[6] https://www.ncdc.noaa.gov/sotc/national/202013 viewed on 5/31/2021

The seas surrounding Alaska have been unusually warm in recent years, with unprecedented warmth in some cases (Thoman and Walsh 2019). This effect can be seen throughout the Alaska region, including the Bering, Chukchi, and Beaufort seas (Figure 4). Along the west coast, the surface waters were 4–11ºF warmer than average in the summer of 2019 (Thoman and Walsh 2019).

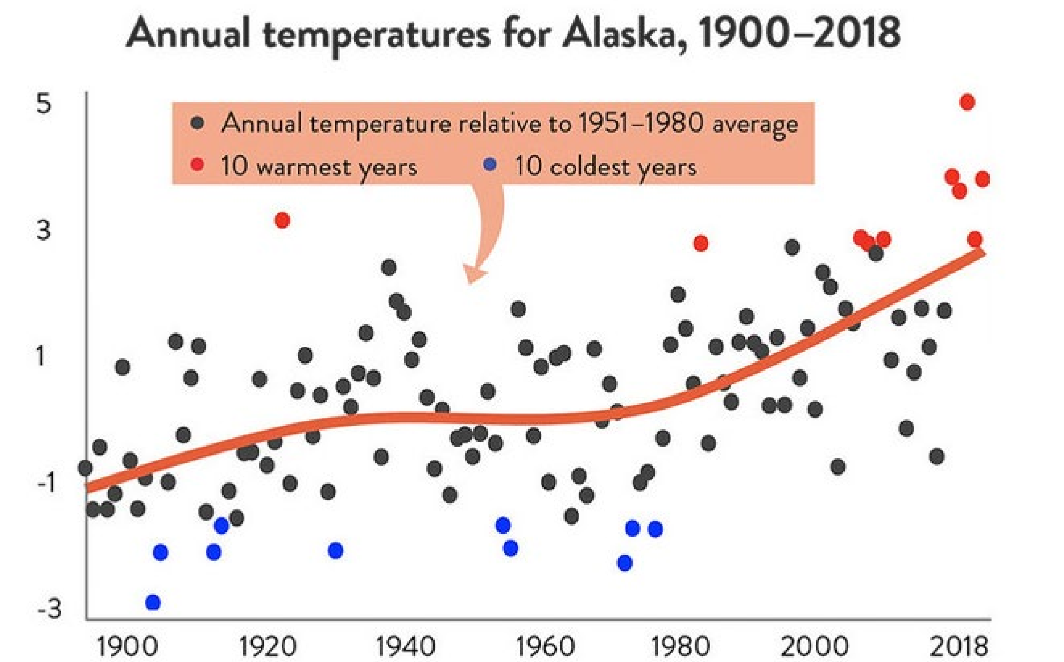


Figure 3. Alaska's ten coldest years on record (blue dots) all occurred before 1980. Nine of its ten warmest years on record have occurred since 1980. Graph by Rick Thoman, Alaska Center for Climate Assessment and Policy.

Warmer ocean water affects sea ice formation and melt. In the first decade of the 21st century, Arctic sea ice thickness and annual minimum sea ice extent (i.e., September sea ice extent) began declining at an accelerated rate and continues to decline at a rate of approximately minus 2.7 percent per decade (Stroeve et al. 2007, Stroeve and Notz 2018). Although Arctic sea ice loss has been well documented, the seasonal ice cover in Cook Inlet has not been characterized in as much detail, but we expect that the same general trend of later ice formation and earlier melt occurs in that body of water as well. Of the five species we are considering in this biological opinion, beluga whales would be most affected by changing ice conditions in Cook Inlet because their entire life is spent in this single body of water. How changing patterns of ice may affect belugas remains speculative.

In the Pacific Arctic, with the reduction in the cold-water pool in the northern Bering Sea, large scale northward movements of commercial stocks are underway as previously cold-dominated ecosystems warm and fish move northward to higher latitudes (Grebmeier et al. 2006, Eisner et al. 2020). Not only fish, but plankton, crabs and ultimately, sessile invertebrates like clams are affected by these changes in water temperature (Grebmeier et al. 2006, Fedewa et al. 2020).

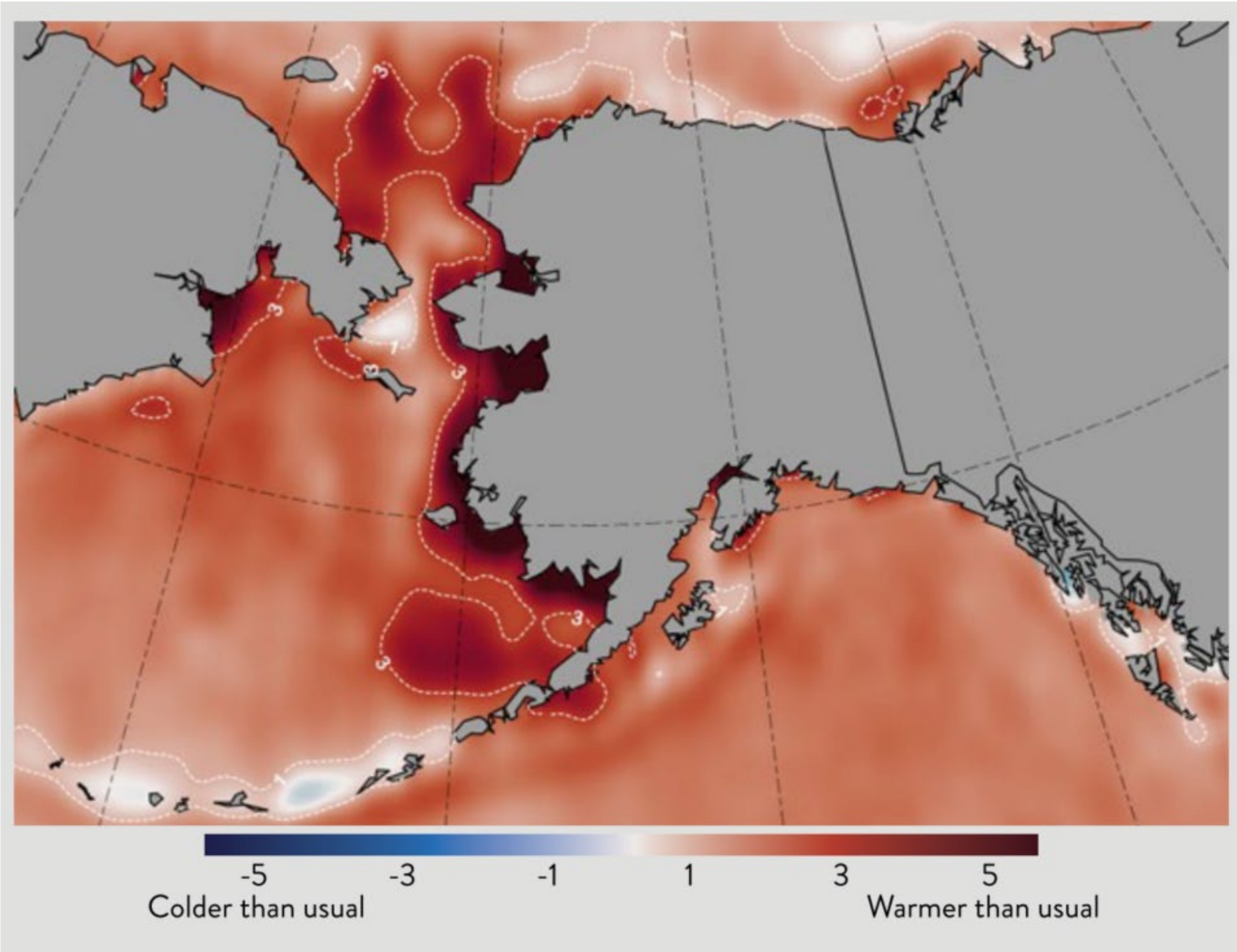


Figure 4.Shades of red indicate summer sea surface temperatures that were warmer than average during 2014-2018, especially along the west coast.

Another ocean water anomaly is described as a marine heat wave. Marine heat waves are described as a coherent area of extreme warm temperature at the sea surface that persists (Frölicher et al. 2018). Marine heatwaves are a key ecosystem driver and there has been an increase from 30 percent in 2012 to nearly 70 percent of global oceans in 2016 experiencing strong or severe heatwaves (Suryan et al. 2021). The largest recorded marine heat wave occurred in the northeast Pacific Ocean from 2013-2015 (Frölicher et al. 2018). Initially called "the blob" the northeast Pacific marine heatwave first appeared off the coast of Alaska in the winter of 2013-2014 and by the end of 2015 it stretched from Alaska to Baja California. In mid-2016, the Pacific marine heatwave began to dissipate, based on sea surface temperature data but warming re-intensified in late-2018 and persisted into fall 2019 (Suryan et al. 2021). Consequences of this event included an unprecedented harmful algal bloom that extended from the Aleutian Islands to southern California, mass strandings of marine mammals, shifts in the distribution of invertebrates and fish, and shifts in abundance of several fish species (Cavole et al. 2016). Cetaceans, forage fish (capelin and herring), Steller sea lions, adult cod, chinook and sockeye salmon in the Gulf of Alaska were all impacted by the Pacific marine heatwave (Bond et al. 2015, Peterson et al. 2016, Sweeney et al. 2018b).

The 2018 Pacific cod stock assessment[7] estimated that the female spawning biomass of Pacific cod (an important prey species for Steller sea lions) was at its lowest point in the 41-year time series, following three years of poor recruitment and increased natural mortality as a result of the Pacific marine heatwave. In 2020 the spawning stock biomass dropped below 20 percent of the unfished spawning biomass and the federal Pacific cod fishery in the Gulf of Alaska was closed by regulation to directed Pacific cod fishing (Barbeaux et al. 2020). Twenty percent is a minimum spawning stock size threshold instituted to help ensure adequate forage for the endangered western stock of Steller sea lions.

4.1.3 Ocean Acidification

For 650,000 years or more, the average global atmospheric carbon dioxide (CO_2) concentration varied between 180 and 300 parts per million (ppm), but since the beginning of the industrial revolution in the late 1700s, atmospheric CO_2 concentrations have been increasing rapidly, primarily due to anthropogenic inputs (Fabry et al. 2008, Lüthi et al. 2008) and have now reached 421ppm, a level not seen for millions of years[8]. The world's oceans have absorbed approximately one-third of the anthropogenic CO_2 released, which has buffered the increase in atmospheric CO_2 concentrations (Feely et al. 2004, Feely et al. 2009). Despite the ability of the oceans to absorb large amounts of atmospheric carbon, the CO_2 level continues to rise.

As the oceans absorb CO_2, the buffering capacity, and ultimately the pH of seawater is reduced. This process is referred to as ocean acidification. Ocean acidification reduces the saturation states of certain biologically important calcium carbonate minerals like aragonite and calcite that many organisms use to form and maintain shells (Bates et al. 2009, Reisdorph and Mathis 2014). When seawater is supersaturated with these minerals, calcification (growth) of shells is favored. Likewise, when the sea water becomes undersaturated, dissolution is favored (Feely et al. 2009).

High latitude oceans have naturally lower saturation states of calcium carbonate minerals than more temperate or tropical waters, making Alaska's oceans more susceptible to the effects of ocean acidification (Fabry et al. 2009, Jiang et al. 2015). Model projections indicated that aragonite undersaturation would start to occur by about 2020 in the Arctic Ocean and by 2050, all of the Arctic will be undersaturated with respect to aragonite (Feely et al. 2009, Qi et al. 2017). Large inputs of low-alkalinity freshwater from glacial runoff and melting sea ice contribute to the problem by reducing the buffering capacity of seawater to changes in pH (Reisdorph and Mathis 2014). As a result, seasonal undersaturation of aragonite was already detected in the Bering Sea at sampling stations near the outflows of the Yukon and Kuskokwim Rivers, and the Chukchi Sea (Fabry et al. 2009). Models and observations indicate that rapid sea

[7]NOAA Fisheries, Alaska Fisheries Science Center website. Available at https://apps-afsc.fisheries.noaa.gov/REFM/stocks/Historic_Assess.htm, accessed December 2, 2020.

[8] https://www.noaa.gov/news-release/carbon-dioxide-now-more-than-50-higher-than-pre-industrial-levels

ice loss will increase the uptake of CO_2 and exacerbate the problem of aragonite undersaturation in the Arctic (Yamamoto et al. 2012, DeGrandpre et al. 2020).

Undersaturated waters are potentially highly corrosive to any calcifying organism, such as corals, bivalves, crustaceans, echinoderms and many forms of zooplankton such as copepods and pteropods, and consequently may affect Arctic food webs (Fabry et al. 2008, Bates et al. 2009). Pteropods, which are often considered indicator species for ecosystem health, are prey for many species of carnivorous zooplankton, fishes including salmon, mackerel, herring, and cod, and baleen whales (Orr et al. 2005). Because of their thin shells and dependence on aragonite, under increasingly acidic conditions, pteropods may not be able to grow and maintain shells (Lischka and Riebesell 2012). It is uncertain if these species, which play a large role in supporting many levels of the Alaskan marine food web, will be able to adapt to changing ocean conditions (Fabry et al. 2008, Lischka and Riebesell 2012).

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 (Hinzman et al. 2005, Burek et al. 2008, Doney et al. 2012, Huntington et al. 2020). The physical effects on the environment described above have impacted, are impacting, and will continue to impact marine species in a variety of ways (IPCC 2014), including shifting abundances, changes in distribution, changes in timing of migration, changes in periodic life cycles of species. For example, cetaceans with restricted distributions linked to water temperature may be particularly susceptible to range restriction (Learmonth et al. 2006, Isaac 2009). Macleod (2009) estimated that, based on expected shifts in water temperature, 88 percent of cetaceans will be affected by climate change, 47 percent will be negatively affected, and 21 percent will be put at risk of extinction. Of greatest concern are cetaceans with ranges limited to non-tropical waters, and preferences for shelf habitats (Macleod 2009). These characteristics describe the habitat used by Cook Inlet beluga whales. Impacts of climate change on Cook Inlet beluga whales are further described in Section 5.11.

4.2 Status of Listed Species

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 further examines the condition of critical habitat throughout the designated area, and discusses the current function of the essential PBFs that help to form the conservation value for those listed species.

For each species, we present a summary of information on the population structure and distribution of the 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 an action's effects are likely to increase the species' probability of becoming extinct. For designated critical habitat, we present a summary of the critical habitat designation, the geographical area of the designation, and any physical or biological features essential to the conservation of the species, as well as any relevant threats and management considerations. That is, we rely on the status of critical habitat and its function as a whole to determine whether an action's effects are likely to diminish the value of critical habitat as a whole for the conservation of listed species.

4.2.1 Cook Inlet Beluga Whale

The endangered Cook Inlet beluga whale is the listed species most likely to be affected by this action, primarily from noise. In this opinion, we focus on aspects of beluga whale ecology that are relevant to the effects of this action.

The beluga whale is a small, toothed (Odontocete) whale in the family Monodontidae, a family shared with only the narwhal. Beluga whales are known as "white whales" because the adults are white. Beluga calves are born dark to brownish gray and lighten to white or yellow-white with age. Adult Cook Inlet beluga whales average between 3.6-4 m (12-14 ft.) in length, although Alaska Native hunters have reported some may grow to 6 m (20 ft.) (Huntington 2000).

A detailed description of the Cook Inlet beluga whales' biology, habitat, and extinction risk factors may be found in the endangered listing final rule for the species (73 FR 62919, October 22, 2008), the Conservation Plan for the Cook Inlet beluga whale (NMFS 2008b), and the Recovery Plan (NMFS 2016b). Additional information regarding Cook Inlet beluga whales can be found at:

Beluga Whale Species Description

Marine Mammal Stock Assessment: Cetaceans-Small Whales

2022 Status Review

2016 Recovery Plan

Cook Inlet Beluga Critical Habitat

4.2.1.1 Status and Population Structure

Beluga whales inhabiting Cook Inlet are one of five distinct stocks found in Alaska (Muto et al. 2018b). 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. 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).

A continued lack of population growth led NMFS to list the Cook Inlet beluga as endangered under the ESA on October 22, 2008 (73 FR 62919).

Scientists estimate that the population size is currently between 290 and 386, with a median best estimate of 331. In 2018, scientists estimated that the population size was between 250 and 317, with a median estimate of 279. Given the overlap in the range estimates, scientists cannot definitively say that the population increased from 2018 to 2022. However, an analysis of population trends for the most recent 10-year period suggests that the population may have increased slightly (0.2 percent per year). (The analysis looked at 2012–2022, excluding 2020 when the survey was canceled due to COVID and 2021 when survey coverage was limited due to poor weather.)

Based on an analysis of stranding deaths from 2005 to 2017 (95 individuals), McGuire et al. (2021) suggest a minimum mean annual mortality estimate of 2.2 percent (SE = 0.36 percent) calculated from the ratio of reported dead Cook Inlet beluga whales to aerial survey-based estimates of population size. This is a minimum estimate because reported dead Cook Inlet beluga whales are a subset of the total number that died because of the challenges in discovering stranded animals in Cook Inlet. Cook Inlet has over 2,400 km of shoreline (Zimmermann and Prescott 2014)and a tiny fraction of that coastline is bordered by roads, the railroad, recreational areas with coastal access for hiking, biking, or off-road vehicles or is regularly traversed by established flight paths or vessel routes where someone could spot and report a stranded animal. In addition, nearly all (96 percent) dead belugas were reported between April and October (only 4 from November through March) when visibility and access are better. It is reasonable to assume that some belugas die in the winter months and are never seen. Consequently, it is very likely that more belugas die than are found dead. McGuire et al. (2021) suggest the mean number of reported Cook Inlet beluga whale carcasses represents less than one third of the total number of dead belugas each year.

Reported mortality was greatest for adults of reproductive age, followed by calves, with fewer subadults and no adults older than 49 years in the stranding data set. (McGuire et al. 2021) note that this is an unusual result and that if the Cook Inlet beluga whale population was similar to other healthy mammal populations, higher mortality of the very old and the very young compared to other age groups would be expected. The results from McGuire et al. (2021) are consistent with Vos et al. (2019), suggesting that adult Cook Inlet beluga whales are dying (of as-yet unknown causes) at relatively younger but still reproductive ages, with few surviving to reach their potential lifespan of seventy plus years as reported in other beluga populations.

The Cook Inlet Beluga Recovery Plan (NMFS 2016a) examined potential obstacles to the recovery of Cook Inlet belugas. The Recovery Plan discusses the fact that there are inherent risks associated with small populations, such as loss of genetic or behavioral diversity. Small populations are 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 the inherent risks due to small population size. Based on a population viability analysis (PVA), NMFS determined that the Allee effect is not a relevant concern for the Cook Inlet beluga whale unless the population falls to less than 50 individuals and that inbreeding depression and loss of genetic diversity do not pose a significant risk unless the population is reduced to fewer than 200 individuals (Hobbs 2006). To date, no new data have become available that suggest this assessment should be revisited.

4.2.1.2 Presence in Cook Inlet

Cook Inlet beluga whales are geographically and genetically isolated from other beluga whale stocks in Alaska (Muto et al. 2021) (Figure 5). Their distribution overlaps with the 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 Delta, Knik Arm, Turnagain Arm, and Chickaloon Bay, Fire Island in the upper inlet (Shelden et al. 2015c, Castellote et al. 2016a, McGuire et al. 2020b), and the Kenai River Delta in the lower Inlet (McGuire et al. 2020b). During the winter, they are more dispersed, occurring 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. While ice formation in the upper inlet was once thought to restrict beluga's access to nearshore habitat (Ezer et al. 2013), tagging data, acoustic studies, and opportunistic sightings indicate that Cook Inlet belugas continue to occur in the upper inlet throughout the winter months, in particular the coastal areas from Trading Bay to Little Susitna River, with foraging behavior detected in lower Knik Arm and Chickaloon Bay, and also detected in several areas of the lower inlet such as the Kenai River, Tuxedni Bay, Big River, and NW Kalgin Island (C. Garner, pers. comm.; Castellote et al. 2011, Shelden et al. 2015c, Shelden et al. 2018, Castellote et al. 2020a, Castellote et al. 2021). 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 (Shelden and Wade 2019)(Figure 6). 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.

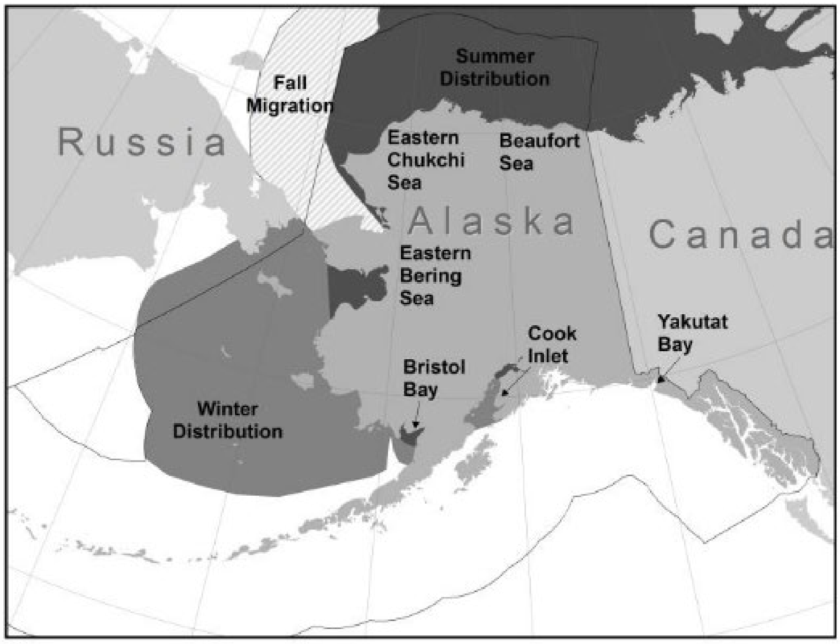


Figure 5. Approximate distribution of beluga whale stocks. Summering areas of the Cook Inlet beluga whale are shown in dark gray, wintering areas in lighter gray (from Muto 2021).

The Susitna Delta, in upper Cook Inlet, is a very important area for Cook Inlet beluga whales, particularly in the summer-fall months (Shelden et al. 2015c, Castellote et al. 2020a, McGuire et al. 2020b). Groups of 200 to 300 individuals – almost the entire population – including adults, juveniles, and neonates, have been observed in the Susitna Delta area (McGuire et al. 2014, McGuire et al. 2020b). 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.

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. 2015c), and throughout the summer by other researchers and local observers. In recent years, sightings in and near these rivers have been more typical in the spring and fall (Ovitz 2019, Castellote et al. 2020a). It is unknown if this seasonal change in sightings is due to increased monitoring efforts in spring and fall in the area or an increase in belugas using this area in these seasons. While visual sightings indicate peaks in spring and fall, acoustic detections

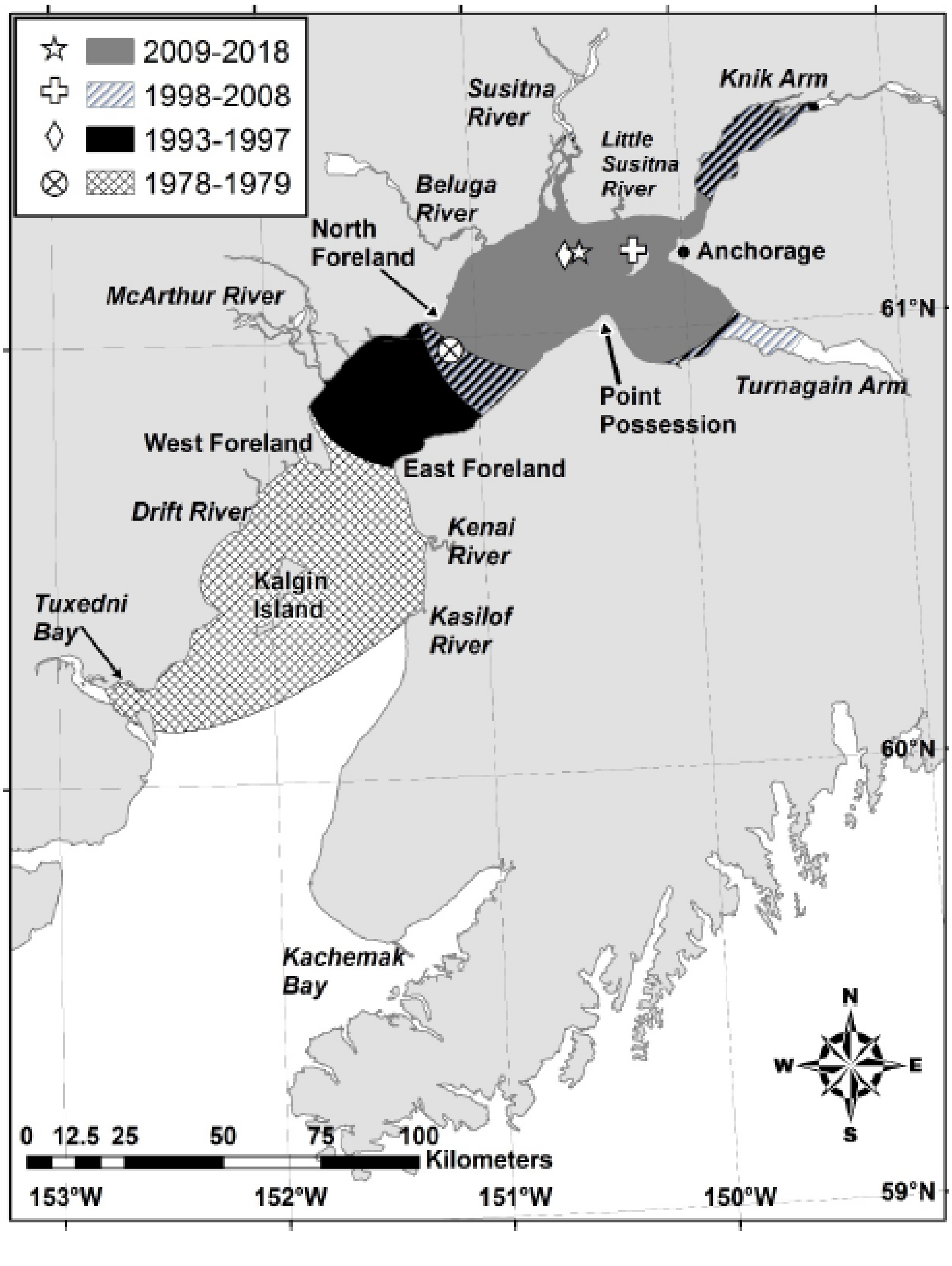


Figure 6. Summer range contraction over time as indicated by ADFG and NMFS aerial surveys. Adapted from Shelden and Wade (2019). The 95 percent core summer distribution contracted from 7,226 sq. km in 1978–79 to 2,110 sq. km in 2009–18 (29 percent of the 1978–79 range).

indicate that belugas can also be present in the Kenai River throughout the winter (Castellote et al. 2016a, Castellote et al. 2020a) (Figure 7). Despite the historic sightings (1970s – 1990s) of belugas from June through August in the area, recent acoustic detections and visual sightings indicate that there appears to be a steep decline in beluga presence in the Kenai River during the summer, in spite of an annual return of 1–2.4 million[9] sockeye and over 11,000 late run chinook salmon[10] in recent years, which are important beluga prey. The factors preventing the belugas from accessing this abundant food source remain unexplained.

Between 1993 and 1995, during the first 3 years of the NMFS aerial summer surveys, very few belugas (less than 3 percent of all of the annual sightings) were in lower Cook Inlet, south of East Foreland and West Foreland (Rugh et al. 2000), and in subsequent years, 1996-2011, hardly any (one whale in Tuxedni Bay in 1997 and two in Kachemak Bay in 2001) were seen in the lower inlet during these surveys (Shelden and Wade 2019). However, belugas may be present in Tuxedni Bay throughout the year, with peaks in January and especially in March (Shelden et al. 2015c, Castellote et al. 2016c) (Figure 8) . Belugas were seen in March 2018 and 2019, September 2019, and April 2021 in Tuxedni Bay during NMFS winter distribution aerial surveys (Gill et al. unpublished report; Figure 9). Tuxedni Bay is the southernmost location where belugas have been consistently observed in recent (2018-2021) aerial surveys (Gill et al. unpublished report) (Figure 9).

From December 2015 through January 2016, Tyonek Platform 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'd never seen them in the winter before the 2015 to 2016 season (S. Callaway, pers. comm. 01/19/2016). Hilcorp recently reported 143 sightings of beluga whales from May-August while conducting pipeline work in upper Cook Inlet (Sitkiewicz et al. 2018a).

(Castellote et al. 2020c)conducted passive acoustic monitoring of marine mammal vocalizations in lower Cook Inlet during Hilcorp's deep penetrating 3D seismic surveys in 2019. With four recorders surrounding the seismic area for 69 days, one beluga was acoustically detected for a total of five minutes at Port Graham, beyond the southern boundary of the species' normal range. Simultaneously, mitigation measures required Hilcorp to have Protected Species Obervers watching for all marine mammals during the seismic survey. The Protected Species Observers did not observe any live beluga whales during that period of time (1,386 hours of observation)

[9] https://www.adfg.alaska.gov/sf/FishCounts/index.cfm?ADFG=main.displayResults&COUNTLOCATIONID=40&SpeciesID=420

[10] https://www.adfg.alaska.gov/sf/FishCounts/index.cfm?ADFG=main.kenaiChinook&RunSummaryID=282

(Fairweather Science 2020). Two dead beluga whales were recorded but their level of decomposition indicated that the seismic survey was not the cause of death.

Since 1993 when the NMFS aerial summer surveys began, only two belugas have been recorded in Kachemak Bay (in 2001) during the surveys (Shelden and Wade 2019). However, there have been opportunistic observations of belugas in Kachemak Bay in 2001 (11), 2003 (7), 2006 (6-8), 2007 (6), 2015 (5), and 2018 (5-7). In 2021, 2-3 belugas were seen in Kachemak Bay; these were the first ones seen since 2018 (Jill Seymour, pers.comm 2023).

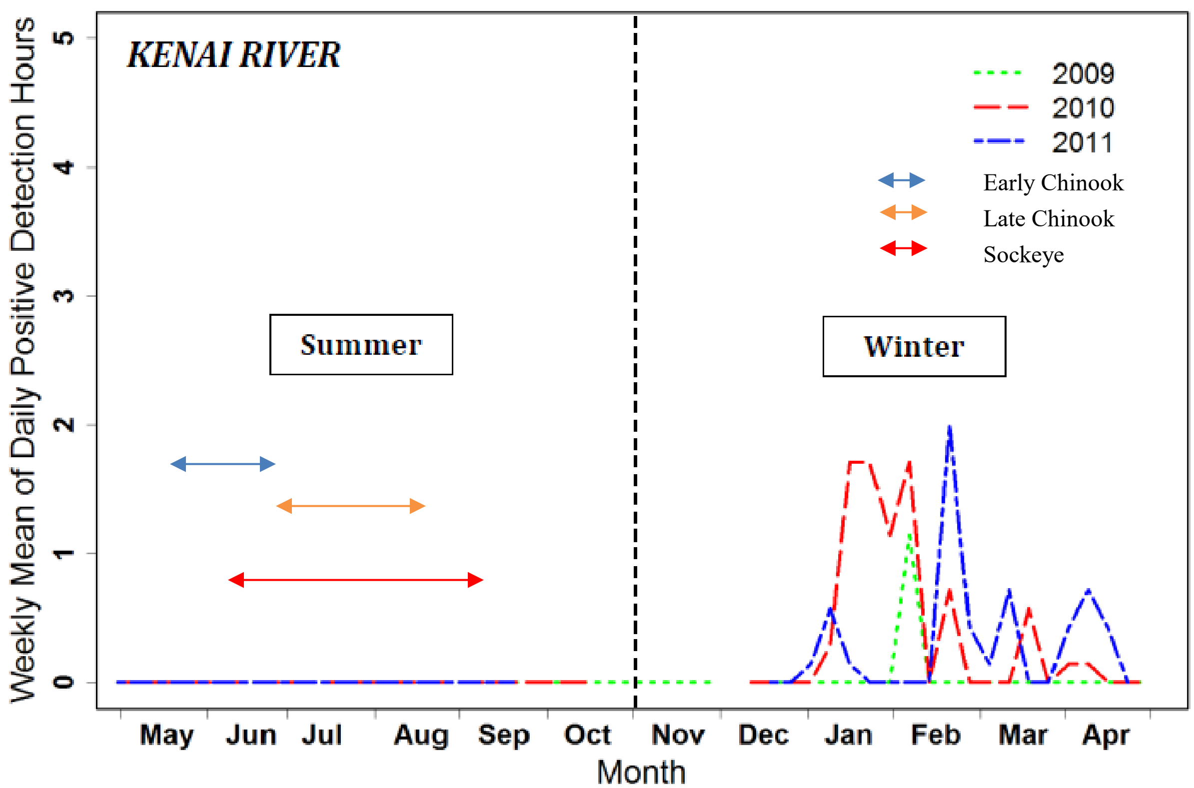


Figure 7. Acoustic detections of Cook Inlet beluga whales in the Kenai River from 2009 through 2011 compared to Chinook and Sockeye run timing. From Castellote et al. (2016) and fish run timing data at http://www.adfg.alaska.gov/sf/FishCounts/index.cfm?adfg=main.home (accessed August 3, 2017).

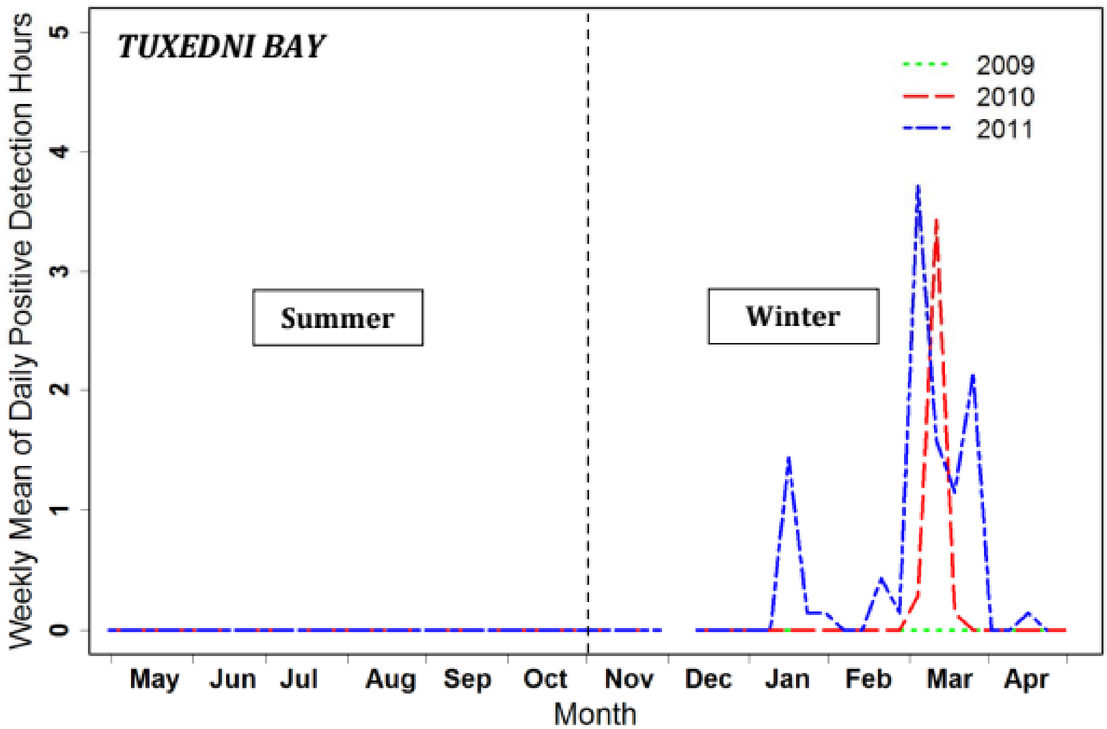
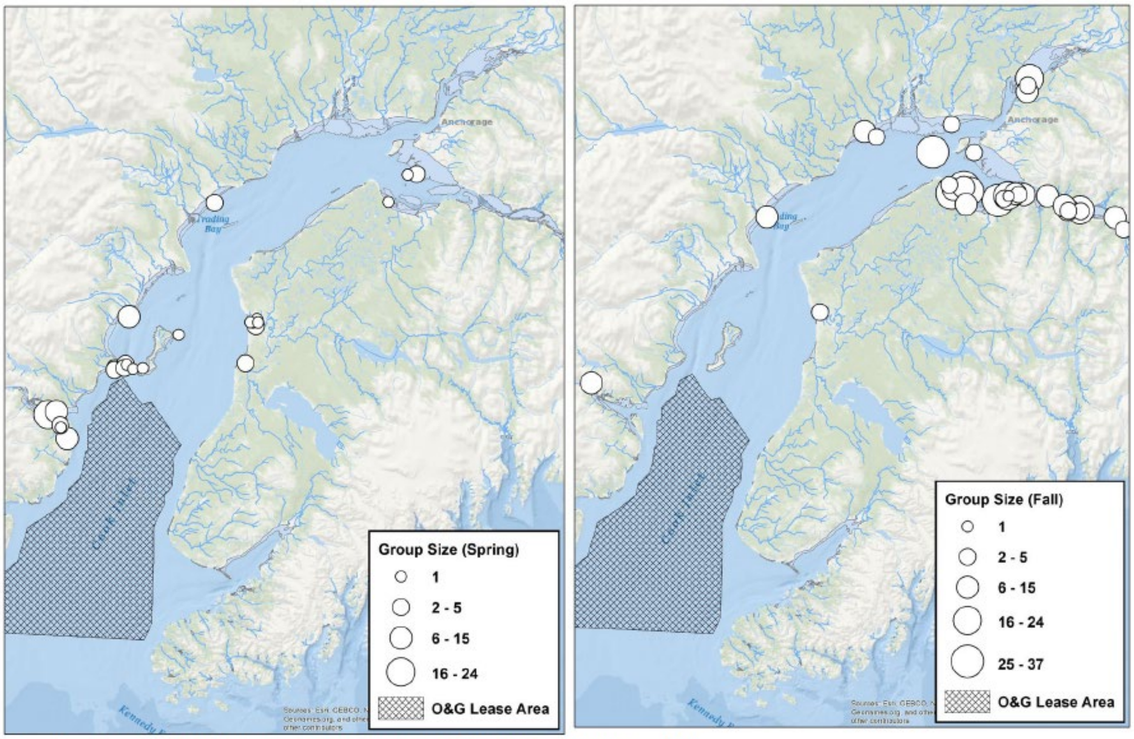


Figure 8. Detections of belugas in Tuxedni Bay using acoustic monitors from 2009-2011. (Figure 4G from Castellote et al 2015).

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 at that time) have been seen in the Susitna River Delta area. Mean 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. These patterns of high seasonal concentrations have continued to be documented since 2012 (McGuire et al. 2020b).



Note: From Aerial Survey Sightings Conducted in 2018–2021 by Gill et al., 2022.

Figure 9. Recent Cook Inlet beluga whale distribution in spring (left) and fall (right).

4.2.1.4 Reproduction

The age of reproductive maturity in Cook Inlet belugas is being actively investigated. Shelden et al. (2020a) examined 28 sexually mature female Cook Inlet belugas, which died by harvest or stranding, and ranged from 14-47 years old. Reproductive senescence, which is the transition to menopause (Ellis et al. 2018), was not evident, possibly because few females were older than 40 year old and declines in ovarian corpora counts and pregnancy rates in other beluga populations suggest senescence begins between 40-50 years old (Burns and Seaman 1986, Suydam 2009, Ferguson et al. 2020). Pregnant Cook Inlet belugas ranged in age from 14 to 41 years old. The uterus of a 10-year-old examined during necropsy was small and thick-walled, suggesting immaturity, though ovaries were not examined. Photo-identification records of a 14-year-old female show close association with a calf at ages 10 and 13 (McGuire et al. 2020a, Shelden et al. 2020a). It was not possible to conclusively determine the earliest age at first reproduction for Cook Inlet belugas because there have been few females younger than 10 years old sampled (Shelden et al. 2020a). However, the age of maturity in other beluga populations is approximately 8 years (Hobbs et al. 2015).

Two of the three documented observations of a Cook Inlet beluga whale birth occurred during July (2015, 2016) in the Susitna River Delta (McGuire et al. 2020a)[11], which corroborates the importance of the Susitna River Delta as a Cook Inlet beluga whale calving ground (McGuire and Stephens 2017, Shelden and Wade 2019, McGuire et al. 2020a). Shelden and Wade (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. 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. Recent comparisons of body measurements from living fetuses in pregnant belugas in aquaria to measurements from deceased Cook Inlet fetuses and newborns suggests that most Cook Inlet whales are conceived in March-May and are born in July-October (Shelden et al. 2020b). These periods match when most aquaria females were ovulating and conceiving (Robeck et al. 2005), when researchers observe newborns in Cook Inlet during photo-identification surveys (McGuire et al. 2020b) and when probably mating behavior has been photo-documented in Cook Inlet (April and May in Trading Bay) (Lomac-MacNair et al. 2016). 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). Cook Inlet beluga calves up to 8 years of age have been photographed alongside their mothers although most are 1–4 years old (McGuire et al. 2020a).

4.2.1.5 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. Primary prey species consist of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole. Belugas seasonally shift their distribution within Cook Inlet in relation to the timing of fish runs and seasonal changes in ice and currents (NMFS 2016a). Passive acoustic monitoring has been used to detect locations and timing of beluga foraging. Year-round passive acoustic monitors have been placed throughout Cook Inlet to detect beluga presence and foraging. These locations included Eagle Bay, Fish Creek, Six Mile Creek (Knik Arm), Cairn Point, Ship Creek, Point Woronzof, Little Susitna River, Susitna Delta, Beluga River, Chuitna River, Trading Bay, Point Possession, Bird Point, Six Mile Creek (Turnagain Arm), and Fire Island in the upper inlet; as well as Tuxedni Bay, Kalgin Island, Big River, Kenai River, Kasilof River, Chinitna Bay, Iniskin Bay, Port Graham, Homer Spit, and offshore in the lower inlet (Castellote et al. 2020a, unpublished data). Increased foraging activity coincided with anadromous fish runs from spring to fall. Recent (2018) data show intense foraging continues to occur at the Susitna Delta area (near the Beluga River and Little Susitna areas sampled in 2008-2013), with peaks in beluga foraging off the Susitna Delta in May, likely on smelt during the spawning run, and foraging June-September, likely on salmon during Chinook, pink, and coho salmon runs.

[11] The third documented birth was occurred on September 13, 2016, in Turnagain Arm (McGuire et al. 2020).

Acoustic studies of feeding activity in winter suggest that large prey aggregations may be absent, belugas are feeding in unmonitored waters, or are feeding on benthic prey. According to data from acoustic recorders deployed during 2008-2013, the most active foraging occurred at Little Susitna River, in the upper inlet, in May, July, and August, at Beluga River in June, and at Eagle Bay in September (Castellote et al. 2020a). Active foraging has also identified in April at Beluga River and December at Trading Bay (Castellote et al. 2020a). Other winter foraging areas in the upper inlet detected by the acoustic recorders include lower Knik Arm and Eagle Bay. Of the locations monitored in the lower inlet (Tuxedni Bay, Kenai River, and Homer Spit), the only area where winter foraging terminal buzzes were detected by acoustic recorders was Tuxedni Bay (Castellote et al. 2020a).

The seasonal availability of energy-rich prey such as eulachon and salmon is very important to the energetics of belugas (Abookire and Piatt 2005, Litzow et al. 2006, Norman et al. 2020). Eating fatty prey and building up fat reserves throughout spring and summer may allow beluga whales to sustain themselves during periods of reduced prey availability in winter or through times of stress when metabolic needs are higher (NMFS 2007). Saupe et al. (2014b) found that the biomass and individual sizes of benthic fauna available to beluga whales were low in Cook Inlet in the winter. They concluded based on the small body sizes and apparent low density of benthic fauna that belugas may not be acquiring a maintenance ration during winter, consistent with previous observations that belugas in the spring have much lower fat reserves than after feeding on abundant eulachon and salmon in the spring and summer (NMFS 2007, Saupe et al. 2014b).

4.2.1.6 Hearing, Vocalizations, and Other Sensory Capabilities

Like other odontocetes, 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 1999a, 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 (Ridgway et al. 2001). 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. 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). More recently, Mooney et al. (2020) used auditory evoked potentials to measure the hearing of a wild, stranded Cook Inlet beluga whale (now in captivity) as part of its rehabilitation assessment. This has been the first time hearing has been measured in a wild individual from the Cook Inlet population. The beluga showed broadband (4–128 kHz) and sensitive hearing (<80 dB) for a wide-range of frequencies (16–80 kHz), reflective of a healthy odontocete auditory system. Hearing was similar to healthy, wild adult belugas from the Bristol Bay stock measured during health assessments (Castellote et al. 2014, Mooney 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 sound levels (Au et al. 1985). Mooney et al. (2020) compared their hearing data with measurements of pile driving and container ship noise in Cook Inlet, two sounds sources of concern, and determined that masking is likely at frequencies belugas use for communication and navigation.

4.2.1.7 Cook Inlet Beluga Critical Habitat

NMFS designated critical habitat for the Cook Inlet beluga whale on April 11, 2011 (76 FR 20180). NMFS designated two areas as critical habitat (Figure 10). The action area is located within designated Cook Inlet beluga critical habitat (specifically, critical habitat Area 2).

Critical Habitat Area 1 (Figure 10; green hashed area) is located in the northernmost region of Cook Inlet and consists of shallow tidal flats, river mouths, and estuarine areas. Area 1 is important as foraging and calving habitats, and beluga whales are concentrated in Area 1 during spring and summer months for these purposes. Area 1 also has the highest concentrations of beluga whales from spring through fall (approximately March through October), as well as the greatest potential for adverse impact from anthropogenic threats.

Critical habitat Area 2 was designated for the area's importance to fall and winter feeding and transit. Area 2 includes the Cook Inlet waters south of Area 1 habitat, as well as Kachemak Bay and foraging areas along the western shore of lower Cook Inlet (Figure 10). The LS 258 area will occur near the southern boundary of the Area 2 of Cook Inlet beluga whale critical habitat that is primarily used by Cook Inlet belugas during the fall and winter months. Based on dive behavior and analysis of stomach contents from Cook Inlet belugas, it is assumed that Area 2 habitat is an active feeding area during fall and winter months when the spatial dispersal and diversity of winter prey likely influences the wider beluga winter range (NMFS 2008a). However, tagging data indicate use of Area 2 by belugas in all months except April and May, and the indicated absence of use of Area 2 in April and May is based upon tagging data from only 2 whales (MML unpublished data, April, 2017).

According to the preferred alternative in BOEM (BOEM 2022a), seismic surveys will not occur on any OCS block in the LS 258 area between November 1 and April 1, nor will exploration and delineation drilling and geohazard and geotechnical surveys occur on the 10 LS 258 OCS blocks within Cook Inlet beluga whale critical habitat between November 1 and April 1, which provides protection during with the fall and winter months when Area 2 of the critical habitat is primarily used by Cook Inlet beluga whales. In addition, seismic surveys will not occur on LS 258 OCS blocks within 10 miles of nearshore feeding areas associated with anadromous streams between July 1 and September 30, when beluga whales may be present and foraging along those nearshore areas on anadromous fish.

The Cook Inlet Beluga Whale Critical Habitat Final Rule (76 FR 20180, 20214) included designation of five Primary Constituent Elements (PCEs, referred to in this opinion as PBFs). These 5 PBFs were deemed essential to the conservation of the Cook Inlet beluga whale. 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.

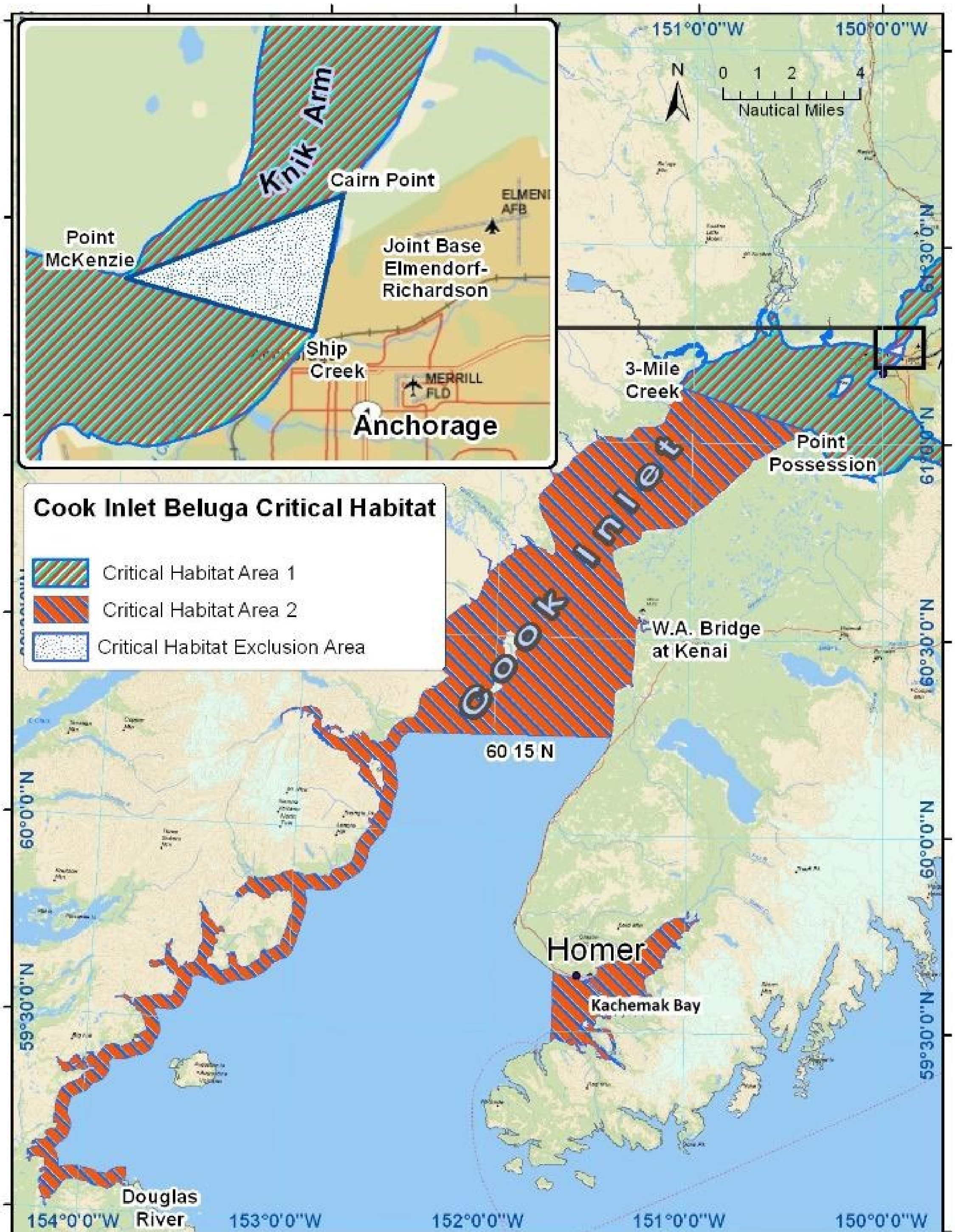


Figure 10. Critical Habitat for Cook Inlet beluga whales.

Cook Inlet beluga whales may be affected by a number of natural and manmade factors present in the Action Area. Many of these factors also have the potential to affect PBFs of Cook Inlet beluga whale critical habitat. Natural threats to critical habitat include environmental variability, catastrophic events, competition for prey resources, and exposure to naturally occurring toxins (e.g., HABs). Anthropogenic threats to critical habitat include: 1) reductions in prey due to competition with fisheries and/or climate change; and 2) habitat loss or degradation resulting from exposure to toxic substances, presence of anthropogenic noise, continued coastal development, and presence of vessel traffic and tourism. These threats may occur individually or collectively (NMFS 2016b), and may affect essential physical and biological features of their designated critical habitats that are essential to their conservation.

Belugas are not using critical habitat off of the Kenai River during the peak periods of large salmon runs (see Figure 28), even though one to two million sockeye salmon typically return to the Kenai River each summer and the number of late run chinook is typically greater than 11,000. It is unknown why belugas are not utilizing this resource to a greater extent. Currently, 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). For Upper Cook Inlet consistent annual salmon run data is only available for the Deshka River, a tributary to the Susitna River, where counts have been made since 1995. Those data show that an average of approximately 30,300 chinook salmon returned to the river from 1995 to 2006[12]. From 2007 to 2022 the average has been approximately 14,400, with a total count of 5,436 in 2022. The reasons for the declining numbers of salmon are being investigated. The potential effects of climate change on salmon production are discussed in section 5.11.

4.2.2 Fin Whales

Fin whales are distributed widely in every ocean except the Arctic Ocean (where they have recently begun to appear). In the North Pacific, fin whales are found in summer foraging areas in the Gulf of Alaska, Bering Sea/Aleutian Islands, and as far north as the northern Chukchi Sea (Muto et al. 2018b).

Additional information on fin whale biology and habitat is available at:

Fin Whale Species Description

Marine Mammal Stock Assessment Reports: Cetaceans-Large Whales

2019 Status Review

12 https://www.adfg.alaska.gov/sf/FishCounts/index.cfm?ADFG=main.displayResults&COUNTLOCATIONID=17&SpeciesID=410

4.2.2.1 Status and Population Structure

The fin whale was listed as an endangered species under the Endangered Species Conservation Act (ESCA) on December 2, 1970 (35 FR 18319), and continued to be listed as endangered following passage of the ESA (39 FR 41367). Critical habitat has not been designated for fin whales. A Final Recovery Plan for the Fin Whale was published on July 30, 2010 (NMFS 2010c).

There are no reliable estimates of current and historical abundances for the entire Northeast Pacific fin whale stock. Several studies provide information on the distribution and occurrence of fin whales in the Northeast Pacific, as well as estimates of abundance in certain areas within the range of the stock, however, many of these are over a decade or more old. Until recently, the best provisional estimate of the fin whale population west and north of the Kenai Peninsula in U.S. waters was 1,368 whales, the greater of the minimum estimates from the 2008 and 2010 surveys (Friday et al. 2013). However, the Gulf of Alaska surveys (Rone et al. 2017) are more recent. The higher of the two abundances computed for fin whales in this region, 3,168 whales (CV = 0.26), better represents a minimum abundance for the Northeast Pacific stock because it is more precise and because it represents a broader survey coverage. Using the best provisional estimate of 3,168 from the 2013 survey and the associated CV of 0.26 results in a minimum populations size of 2,554 whales. However, this is an underestimate for the entire stock because it is based on surveys which covered only a small portion of the stock's range (Muto et al. 2021).

Fin whales are usually observed as individuals traveling alone, although they are sometimes observed in small groups. Fin whales in the Cook Inlet have only been observed as individuals or in small groups. Fin whales are vulnerable to natural and anthropogenic variables. Impacts on prey quality and distribution could affect distribution and energetics. The natural range of fin whales could be expanded due to sea ice melting and expanded available habitat. This could also result in increased exposure to shipping and other commercial activities. Toxicity and resulting deaths, as seen in recent years, from harmful algal blooms producing biotoxins could result from warming waters (Muto et al. 2021).

4.2.2.2 Distribution

Fin whales are distributed widely in every ocean except the Arctic Ocean (where they have recently begun to appear). A migratory species, fin whales generally spend the spring and early summer feeding in cold, high latitude waters as far north as the Chukchi Sea, with regular feeding grounds in the Gulf of Alaska, Prince William Sound, along the Aleutian Islands, and around Kodiak Island, primarily on the western side. In the fall, fin whales tend to return to low latitudes for the winter breeding season, though some may remain in residence in their high latitude ranges if food resources remain plentiful.

Fin whales have been acoustically detected in the Gulf of Alaska year-round, with highest call occurrence rates from August through December and lowest call occurrence rates from February through July (Moore et al. 2006, Stafford et al. 2007). Ferguson et al. (2015a) identified areas around Kodiak Island, south of the mouth of Cook Inlet, as a Biologically Important Area (BIA) for fin whale feeding (Figure 11).

4.2.2.3 Occurrence in the Action Area

Fin whales are rarely observed in Cook Inlet and most sightings occur near the entrance of the inlet. During the NMFS aerial beluga whale surveys in Cook Inlet from 2000 through 2016, 10 sightings of approximately 26 individual fin whales in lower Cook Inlet were observed (Figure 12; (Shelden et al. 2013b, Shelden et al. 2015b, Shelden et al. 2017a)). However, there were eight sightings of 23 fin whales recorded in the 2019 Hilcorp lower Cook Inlet seismic survey in the fall, with group size ranging from one to 15 individuals (Fairweather Science 2020) (Figure 12). This higher number of fin whale sightings suggests these offshore waters of lower Cook Inlet may be utilized by fin whales in greater numbers than previously estimated, particularly during the fall period. Fin whales were very active acoustically during the seismic survey (Castellote et al. 2020c)which is consistent with the sightings made by the Protected Species Observers during the seismic survey (Fairweather Science 2020).

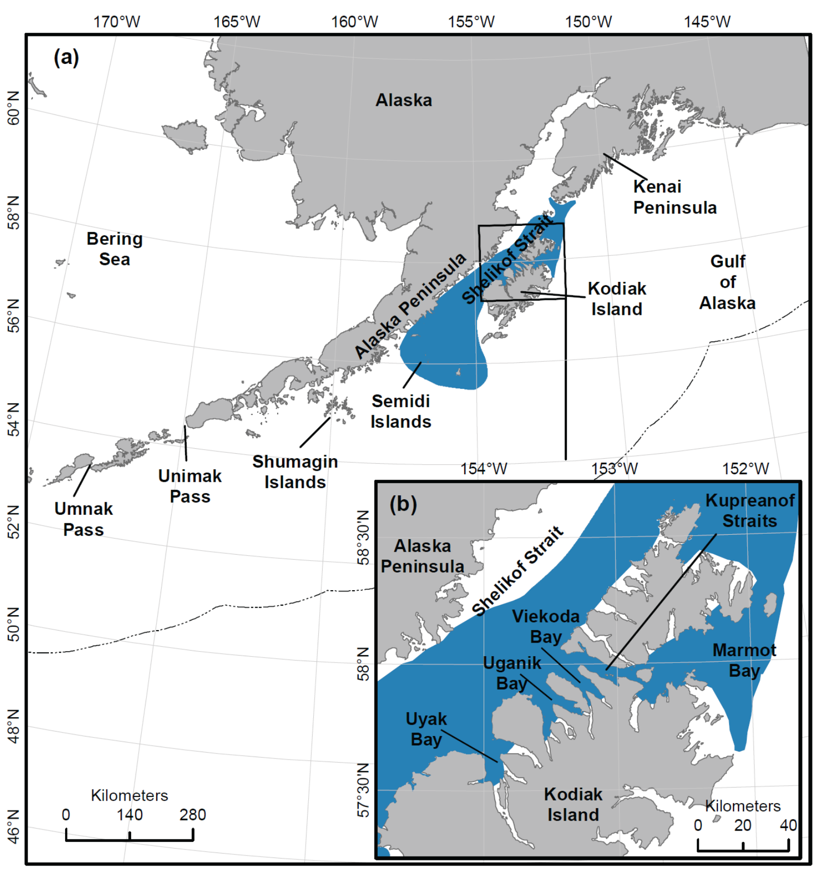


Figure 11. Fin whale Biologically Important Area for feeding identified by Ferguson et al. (2015c) around Kodiak Island in the Gulf of Alaska.

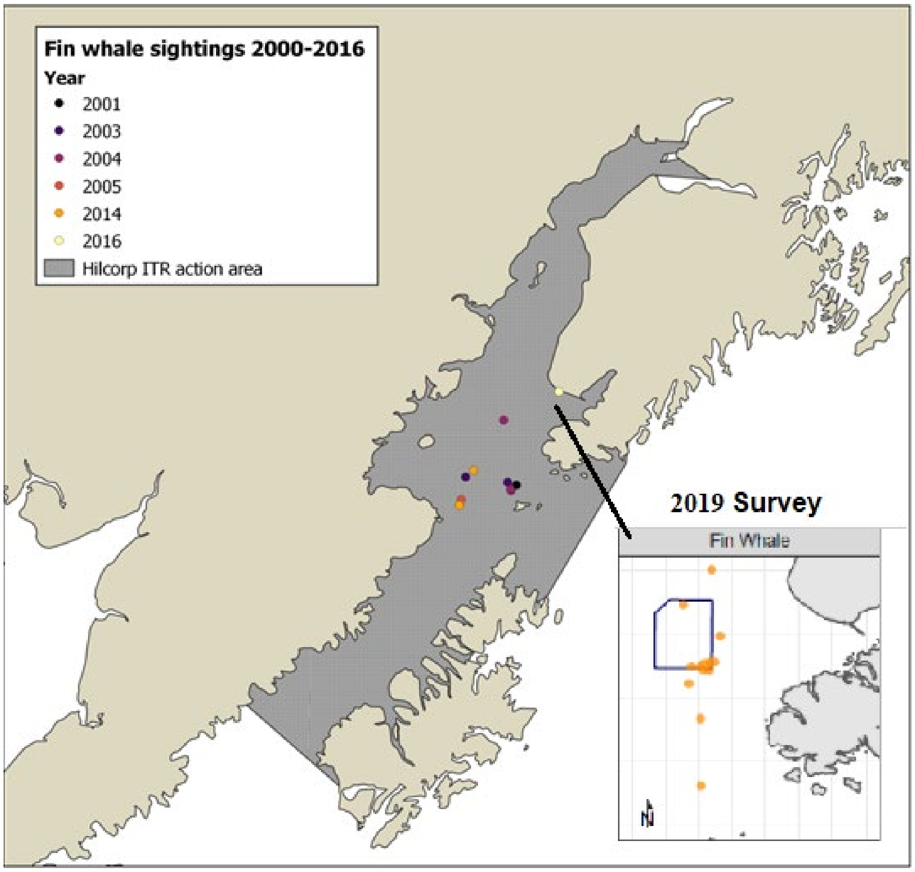


Figure 12. Fin whale sightings during aerial surveys for belugas from 2000-2016 (no fin whales were seen during 2000, 2002, 2006-2013). Sources: (Rugh et al. 2000, Rugh et al. 2005, Shelden et al. 2013c, Shelden et al. 2015a, Shelden et al. 2017b). Inset shows vessel-based fin whale sightings from Hilcorp 2019 lower Cook Inlet Seismic survey (Fairweather Science 2020).

4.2.2.4 Feeding, Prey Selection, and Diving Behavior

In the North Pacific, fin whales prefer euphausiids (mainly *Euphausia pacifica*, *Thysanoessa longipes*, *T. spinifera*, and *T. inermis*) and large copepods (mainly *Calanus cristatus*), followed by schooling fish such as herring, walleye pollock (*Theragra chalcogramma*), and capelin (Nemoto 1970, Kawamura 1980). Feeding may occur in shallow waters on prey such as sand lance (Overholtz and Nicolas 1979) and herring (Nøttestad et al. 2002), but most foraging is observed in high-productivity, upwelling, or thermal front marine waters (Panigada et al. 2008).

Fin whales, like humpback and blue whales, exhibit lunge-feeding behavior, where large amounts of water and prey are taken into the mouth and filtered through the baleen (Brodie 1993, Goldbogen et al. 2006, Goldbogen et al. 2008).

The percentage of time fin whales spend at the surface varies. Some authors have reported that fin whales make 5 to 20 shallow dives with each of these dive lasting 13-20 seconds followed by a deep dive lasting between 1.5 and 15 minutes (Gambell 1985, Stone et al. 1992, Lafortuna et al. 2003). Other authors have reported that the fin whale's most common dives last between 2 and 6 minutes, with 2 to 8 blows between dives (Watkins 1981, Hain et al. 1992). The most recent data support average dives of 98 m and 6.3 min for foraging fin whales, while non-foraging dives are 59 m and 4.2 min (Croll et al. 2001). However, Lafortuna et al. (2003) found that foraging fin whales have a higher blow rate than when traveling. Foraging dives in excess of 150 m are known (Panigada et al.).

4.2.2.5 Reproduction

Fin whale age to sexual maturity varies by region, and estimates range from 6 to 12 years. Reproductive females give birth about every two years. The gestation period is somewhat less than a year and calves are nursed for 6-7 months. The generation time may be as long as 25.9 years (NMFS 2019).

4.2.2.6 Hearing, Vocalizations, and Other Sensory Capabilities

Fin whales produce a variety of low-frequency sounds in the 10 to 200 Hz band (Watkins 1981, Watkins et al. 1987b, Edds 1988a, Thompson et al. 1992b). The low-frequency sounds produced by fin whales have the potential to travel over long distances, and it is possible that long-distance communication occurs in fin whales (Payne and Webb 1971, Edds-Walton 1997). Also, there is speculation that the sounds may function for long-range echolocation of large-scale geographic targets such as seamounts, which might be used for orientation and navigation (Tyack 1999c). While there is no direct data on hearing in low-frequency cetaceans, based on their vocalizations the applied frequency range is anticipated to be between 7 Hz and 35 kHz (NMFS 2018a). Synthetic audiograms produced by applying models to X-ray computed tomography scans of a fin whale calf skull indicate the range of best hearing for fin whale calves is from approximately 0.02 to 10 kHz, with maximum sensitivities between 1 to 2 kHz (Cranford and Krysl 2015).

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:

Humpback Whale Species Description

Marine Mammal Stock Assessment Reports: Cetaceans-Large Whales

Humpback Whale Critical Habitat

4.2.3.1 Status and Population Structure

In 1970, the humpback whale was listed as endangered worldwide, under the 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 (2021) 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). Humpback whales in Cook Inlet (which is considered part of the Gulf of Alaska summer feeding area) are comprised of approximately 89 percent Hawaii DPS individuals, 11 percent Mexico DPS individuals, and less than 1 percent Western North Pacific DPS individuals (Table 13).

Approximately 1,084 animals (CV=0.09) comprise the Western North Pacific DPS (Wade 2021). 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 comprised of approximately 2,913 animals (CV=0.07; Wade 2021) with an unknown population trend (81 FR 62260). The Hawaii DPS is comprised of 11,540 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 2021) .

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)
Kamchatka	91%	9%	0%	0%
Aleutian I/ Bering/ Chukchi Seas	2%	91%	7%	0%
Gulf of Alaska	<1%	89%	11%	0%

Southeast Alaska / Northern BC	0%	98%	2%	0%
Southern BC / WA	0%	69%	25%	6%
OR/CA	0%	0%	58%	42%

Critical habitat was designated for the Western North Pacific and Mexico DPSs on April 21, 2021 (86 FR 21082). Only one PBF was identified, adequate prey resources. Although humpback whales are generalist predators and prey availability can vary seasonally and spatially, data indicate that their diet is consistently dominated by euphausiid species and small pelagic fishes such as northern anchovy, Pacific herring, Pacific sardine, and capelin (86 FR 21082). Critical habitat for the Western North Pacific DPS humpback whale occurs in Shielikoff Strait at the lower end of the action area (Figure 13).

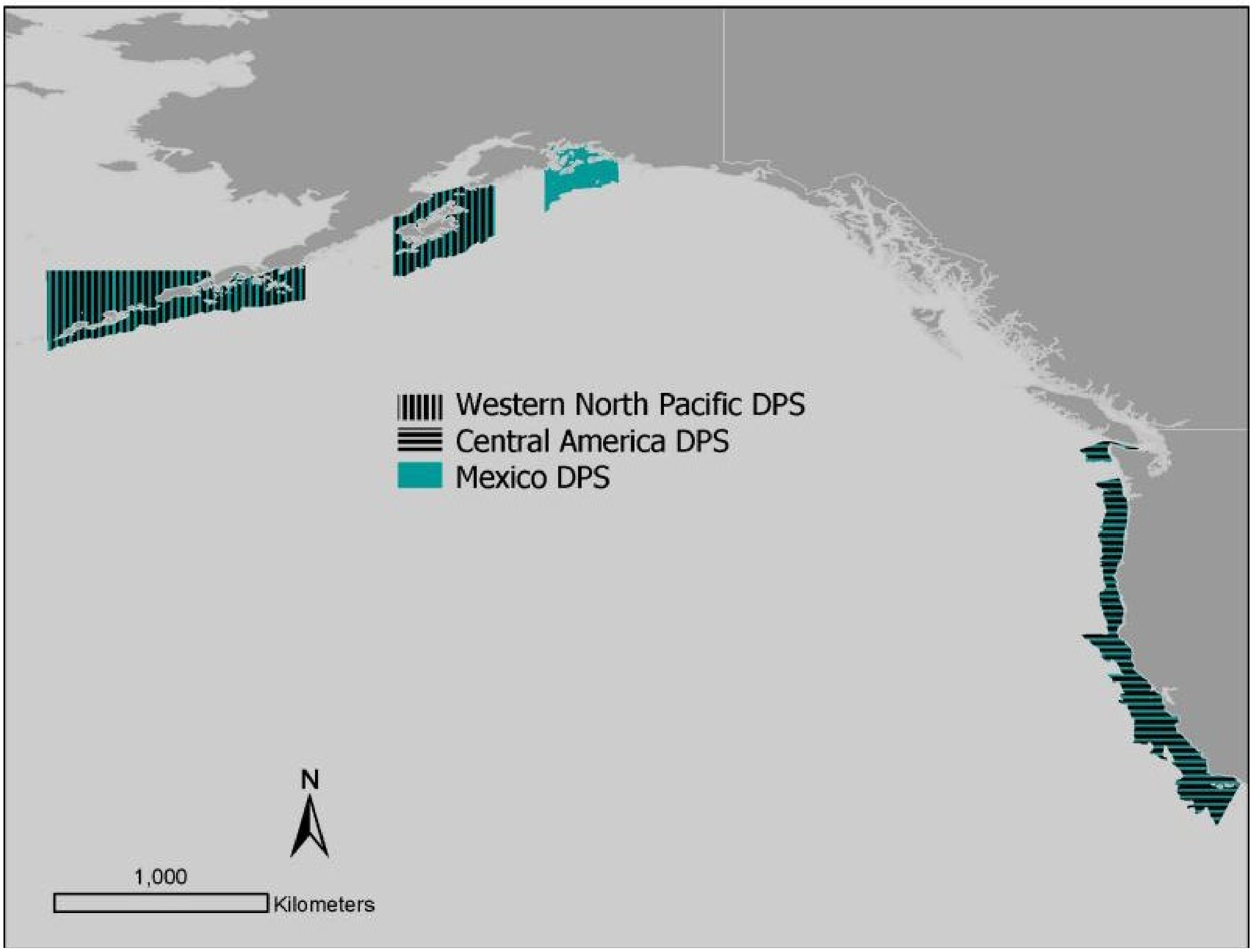


Figure 13. Critical habitat for humpback whales in Alaska and Pacific Coast of North America.

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 2021).

4.2.3.3 Occurrence in the Action Area

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 1993-2016, there were 88 sightings of an estimated 192 individual humpback whales (Figure 14). A large number of these sightings occurred in the vicinity of Elizabeth Island, Iniskin and Kachemak Bays, and there were also a number of sightings north of Anchor Point (Rugh et al. 2000, Rugh et al. 2005, Shelden et al. 2013c, Shelden et al. 2015a, Shelden et al. 2017b). Additionally, during the 2013 marine mammal monitoring program, marine mammal observers reported 29 sightings of 48 humpback whales (Owl Ridge 2014b), 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, (north and east 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 and are therefore potentially present and transiting through the action area. Marine mammal monitoring conducted north of the Forelands in May and June of 2015 reported two humpback whales (Jacobs Engineering 2017a). 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, some 31 miles (55 km) northeast of the Tyonek platform, 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 Cook Inlet Pipeline Extension (CIPL) project also included 3 humpback whale sightings near Ladd Landing, north of the Forelands (Sitkiewicz et al. 2018b). In spring 2019, a young humpback whale stranded in Turnagain Arm. It was able to free itself on a high tide but a few days later a humpback whale was found dead in Cook Inlet and it was likely the same animal. For the seismic surveys that Hilcorp conducted in 2019, PSOs had 14 sightings of an estimated 38 humpback whales (Figure 15) (Fairweather Science 2020).

4.2.3.4 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. (2015a) that are important feeding areas for humpback whales, the east side of Kodiak Island is the closest to the action area.

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 like bowhead whales (Goldbogen et al. 2008, Simon et al. 2012). When lunge feeding, whales engulf a large amount of prey-laden water and then purge and filter the water through their baleen plates.

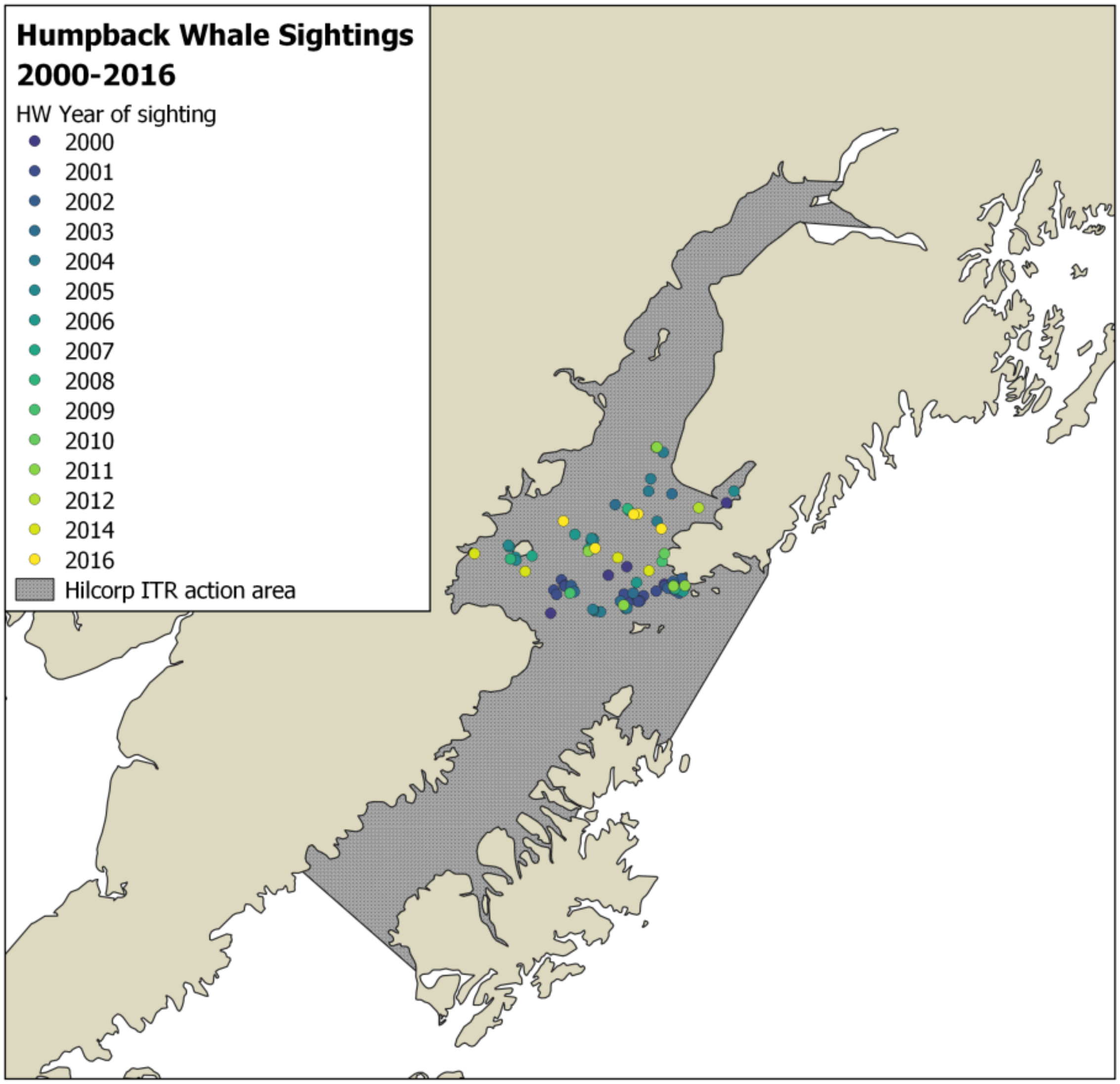


Figure 14. Humpback whale observations during aerial surveys for belugas in Cook Inlet, 2000-2016. (Rugh et al. 2000, Rugh et al. 2005, Shelden et al. 2013c, Shelden et al. 2015a, Shelden et al. 2017b)

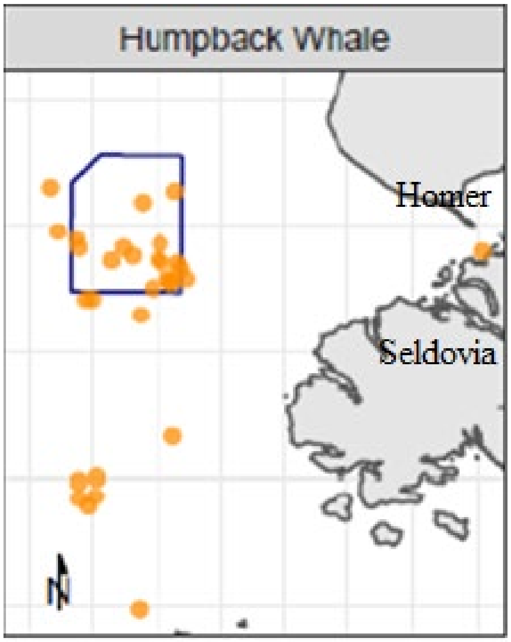


Figure 15. Humpback whale sighting during Hilcorp's seismic surveys in 2019 (Fairweather Science 2020)

4.2.3.5 Reproduction

Sexual maturity of humpback whales in the Northern Hemisphere occurs at approximately 5-11 years of age, and appears to vary both within and among populations (Clapham 1992, Gabriele et al. 2007, Robbins 2007). Average age of sexual maturity in the Southern Hemisphere is estimated to be 9-11 years. In the Northern Hemisphere, calving intervals are between one and five years, though 2-3 years appears to be most common (Wiley and Clapham 1993, Steiger and Calambokidis 2000). Estimated mean calving rates are between 0.38 and 0.50 calves per mature female per year (Clapham and Mayo 1990, Straley et al. 1994, Steiger and Calambokidis 2000) and reproduction is annually variable (Robbins 2007).

Humpback whale gestation is 11-12 months and calves are born in tropical waters (Matthews 1937). Lactation lasts from 10.5-11 months (Chittleborough 1965). Weaning begins to occur at about age six months and calves attain maternal independence around the end of their first year (Clapham and Mayo 1990). Humpback whales exhibit maternally directed fidelity to specific feeding regions (Martin et al. 1984, Baker et al. 1990)

4.2.3.6 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. 2007b). 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 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).

4.2.4 Steller Sea Lion, Western DPS

4.2.4.1 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) 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 2008e) and 5-year Status Review (NMFS 2020).

As summarized most recently by Muto et al. (2020), 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, legal and illegal shooting, predation, exposure to contaminants, disease, and ocean regime shift/ climate change (NMFS 2008f). 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. 2018a) estimated a total Alaska population (both pups and non-pups) of 52,932 (Muto et al. 2020).There are strong regional differences in trends in abundance of Steller sea lions, with positive trends in the Gulf of Alaska and eastern Bering Sea east of Samalga Pass (~170°W) and generally negative trends to the west in the Aleutian Islands. For the western Gulf of Alaska, which best represents the population trend in the action area, from 2002 to 2019, Steller sea lion pups increased at a rate of 3.37 percent per year and non-pups increased at a rate of 2.77 percent per year (Sweeney et al. 2019). The population of the Western DPS has continued to increase in this area (Muto et al. 2022).

4.2.4.2 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 16; (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 (Jemison et al. 2013, Muto et al. 2018a).

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 breeding 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. Sea lions move on and offshore for feeding excursions. 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 (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).

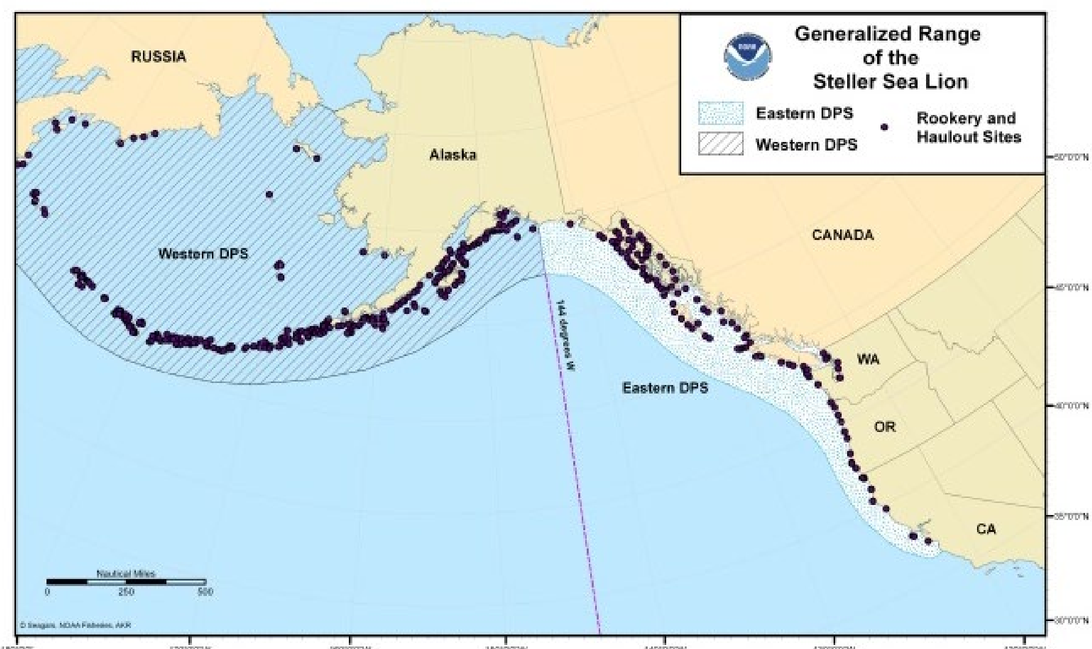


Figure 16. Generalized ranges of WDPS and EDPS Steller sea lions

4.2.4.3 Occurrence in the Action Area

Steller sea lions can be found throughout the action area, however they are more frequently observed in the mid and lower Inlet (Rugh et al. 2005, Shelden et al. 2013c, Shelden et al. 2015a, Shelden et al. 2017b). About 3,600 sea lions use terrestrial sites in the action area, with additional individuals venturing into the area to forage. There is no designated critical habitat for Steller sea lions in the mid or upper inlet (Figure 17).

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 2014b). 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. 2015a). One Steller sea lion was observed near Ladd Landing for the Harvest Alaska CIPL project during the summer (Sitkiewicz et al. 2018). Hilcorp recorded 5 Steller sea lions during seismic operations in 2019 (Fairweather Science 2020). During the POA Petroleum and Cement Terminal Project in 2020 and 2021, observers documented 6 and 8 Steller sea lions, respectively (61 North Environmental 2021, 2022a). An additional Steller sea lion was seen during NMFS monitoring efforts at the POA in 2021 (unpublished data).

4.2.4.4 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 ephemeral nature 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 2008f) and occasionally other marine mammals and birds (Pitcher and Fay 1982, NMFS 2008f).

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 2008f). 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.

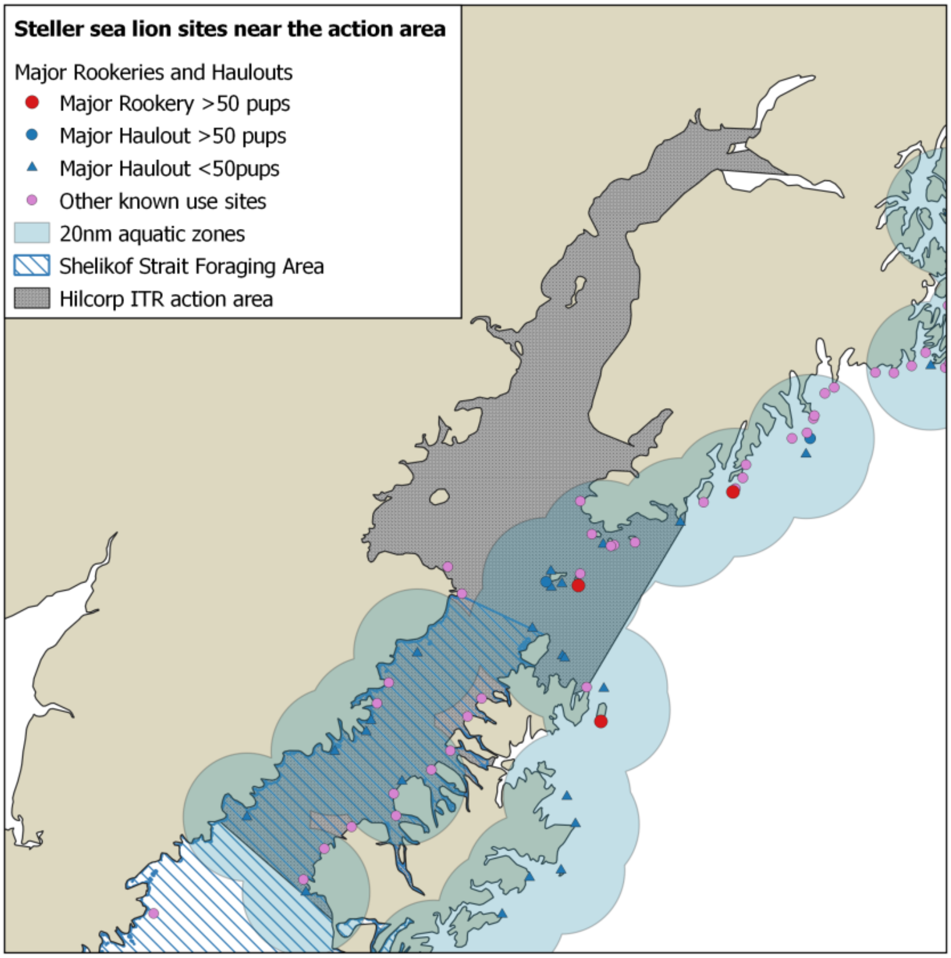


Figure 17. Steller sea lion sites near the action area. Designated critical habitat (50 CFR 226.202) includes the major rookeries, major haulouts, 20 nm aquatic zones around major rookeries and haulouts, and the Shelikof Strait aquatic foraging area.

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 or haul out in large groups of up to 45 individuals (Keple 2002). At sea, groups usually consist of females and subadult males as adult males are usually solitary (Loughlin 2002).

4.2.4.5 Hearing, Vocalizations, and Other Sensory Abilities

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 expected to be within the hearing range of Steller sea lions, whether the animals are in the water or hauled out.

4.2.4.6 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 18) 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). The 20-mile critical habitat radii around haulouts and rookeries serve to minimize disturbance around these important areas and also to provide an adequate food supply close to rookeries for lactating females, who alternate foraging trips at sea with nursing their pups on land. East of 144°W, Steller sea lion critical habitat includes aquatic areas 3,000 ft (0.9 km) seaward of each major haulout and major rookery.

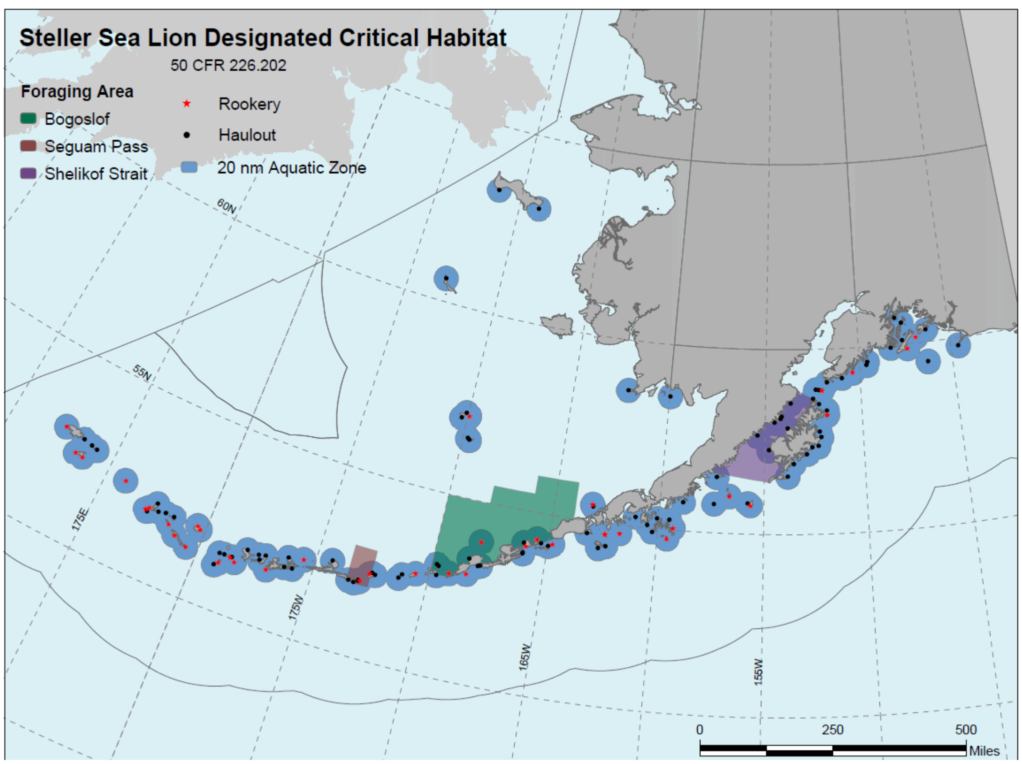


Figure 18. Designated Steller sea lion critical habitat west of 144°W.

The action area overlaps with a small portion of Steller sea lion critical habitat, including portions of the 20-nautical mile buffers of 16 major haulouts and 1 major rookery and part of the Shelikof Strait Special Aquatic Foraging Area (see 50 CFR §226.202(c)(1)). This also includes the terrestrial, air, and aquatic zones around the specified major rookery and major haulouts. The action area also includes 20 other known haulouts that are not part of the designated critical habitat (Figure 17, Figure 18, Figure 19).

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 proposed project may affect Steller sea lion critical habitat through vessel disturbance and exposure to potentially harmful materials.

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 of each major haulout and major rookery in Alaska that is east of 144ºW longitude.

4. Aquatic zones that extend 20 nautical miles seaward from each major rookery and major haulout 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).

Western DPS Steller sea lions may be affected by a number of natural and anthropogenic factors present in the action area. Many of these factors also have the potential to affect PBFs of this species' designated critical habitat. Natural threats to critical habitat include environmental variability, catastrophic events, competition with predators for prey resources, and exposure to naturally occurring toxins (e.g., HABs). Anthropogenic risk factors include: 1) reductions in prey due to competition with fisheries, and 2) habitat loss or degradation resulting from exposure to toxic substances, the presence of anthropogenic noise, continued coastal development, and the presence of vessel traffic and tourism. These threats may occur individually or collectively (NMFS 2008a; NMFS 2010b; NMFS 2015), and may affect essential physical and biological features of their designated critical habitats that are essential to their conservation.

Prey resources are the most essential feature of marine critical habitat for Steller sea lions (NMFS 2010a). The status of critical habitat is best described as the status and availability of the important prey resources contained within those areas, which include pollock, Atka mackerel, salmon, Pacific cod, arrowtooth flounder, Irish lord, rock sole, snailfish, herring, capelin, sand lance, other forage fish, squid, and octopus. Dominant prey items vary with region and season, but the most significant groundfish prey items for Steller sea lions in the Western DPS are Atka mackerel, pollock, Pacific cod, and arrowtooth flounder, each of which have at least a 10 percent frequency of occurrence in the Steller sea lion diet (NMFS 2010a).

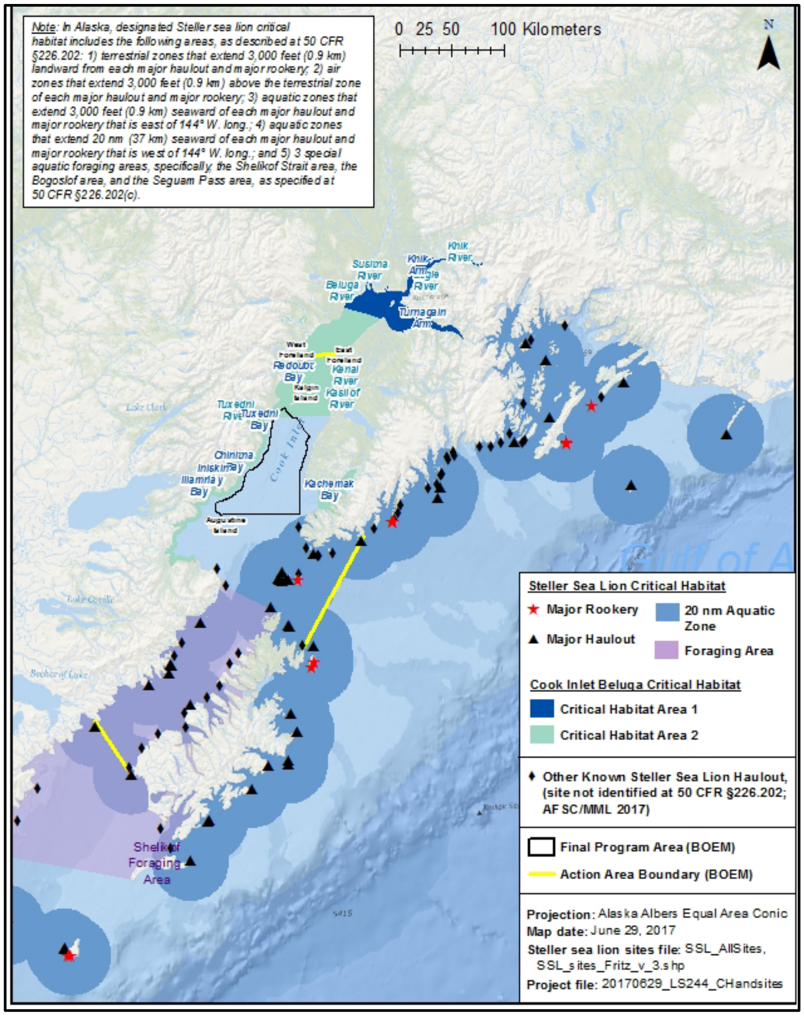


Figure 19. Steller Sea Lion Haul Out, Rookery Sites, and Critical Habitats. Figure by NMFS, Anchorage Field Office, 2017.

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 area 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 and near the action area and their influences on listed species that may be adversely affected by the proposed action. Species that may be affected by the proposed action include Cook Inlet beluga whales, Western North Pacific DPS humpback whales, Mexico DPS humpback whales, fin 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 (734,323) resides within southcentral Alaska or the Cook Inlet region[13]. 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, fisheries, ship strikes, sound pollution, water pollution, prey reduction, direct mortalities, and research, in addition to factors operating on a larger scale such as predation, and environmental change. The species may be affected by multiple threats at any given time, compounding the impacts of the individual threats.

5.1 Coastal Development

Southcentral Alaska is the State's most populated and industrialized area. Many cities, villages, ports, airports, treatment plants, oil and gas platforms and refineries, highways, and railroads are situated adjacent to, and in some cases in, Cook Inlet. Beluga whales and Western DPS Steller sea lions use nearshore environments to rest, feed, and breed and thus could be affected by any coastal development that impacts these activities. Some development has resulted in both the loss and alteration of nearshore habitat and changes in habitat quality due to vessel traffic, noise, and pollution. There is concern that increased development may prevent beluga whales and Western DPS Steller sea lions from reaching important feeding and breeding areas. 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. Humpback and fin whales mostly occupy areas offshore and are less likely affected by coastal development.

Construction noise in Cook Inlet is associated with activities such as dredging and pile driving. The majority of construction activities have taken place near Anchorage, north of the action area; therefore, most of the studies documenting coastal development-related construction noise in Cook Inlet have occurred outside of the action area. Additionally, these studies have focused on pile driving activities because of the major concerns of potential harassment to beluga whales from in-water noise produced by this activity. As a result there is very little to no documentation

[13] Alaska Department of Labor and Workforce Development Research and Analysis webpage. 2021 Population estimates by borough, census area, and economic region. Available from https://live.laborstats.alaska.gov/pop/, accessed February 15, 2022.

of noise levels from other coastal construction activity in Cook Inlet. Only one study recorded dredging noise near the Port of Anchorage (POA) (SFS 2009).

Anthropogenic activities related to coastal development may detrimentally affect Cook Inlet beluga and Steller sea lion 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 and Steller sea lion 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, 2010b; NMFS, 2015a).

Cities, villages, ports, airports, wastewater treatment plants, refineries, highways, and railroads are situated on or very near 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, 2011a). Steller sea lion critical habitat has little spatial overlap with areas of current and projected future coastal development, and designated sea lion no-entry zones within critical habitat (see 50 CFR §224.103(d)) help limit the amount of disturbance from vessels, aircraft, and human presence at these important sites.

5.2 Road Construction

Alaska Department of Transportation undertook Seward Highway improvements from Mile 75 to 107 (along Turnagain Arm north of the action area) beginning in 2015. These activities include geophysical and geotechnical testing, on-shore blasting, pile removal and installation at stream crossings, and fill placed into Turnagain Arm to facilitate roadway straightening. It also included construction of a restricted-access boat ramp at Windy Point for emergency response, but which will also serve as an easy-access point for non-motorized water sports such as wind surfing and kite surfing.

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. Roadway flaggers also heard beluga whales at the bridge site during nighttime hours, when no project activities were occurring. During the 2015 season, there were 18 observations of beluga whale groups, ranging in size from 3-30 animals. Shutdowns were typically implemented when beluga whales were at the mouth of the Twentymile River in order to prevent the animals from entering the harassment zone during in-water activities (HDR 2015). Beluga sightings at the mouth of the Twentymile River have been documented regularly by the Beluga Whale Alliance, Alaska Beluga Monitoring Partnership, and Cook Inlet Beluga Whale Photo-ID Project. The Cook Inlet Beluga Whale Photo-ID Project, including sightings data from the Beluga Whale Alliance and the Alaska Beluga Monitoring Partnership, reported: 14 sightings that totaled over 110 whales during the months of April, September, and October in 2018; 14 sightings that totaled over 100 whales during the months of April, August and September in 2019; 10 sightings that totaled 77 whales during the months of April, September, and October in 2020; and, 4 sightings that totaled 17 whales in April 2021 at the Twentymile River mouth[14].

The Seward Highway Milepost 75 to 90 Bridge Replacement project completed three bridge replacements by the end of 2019 during Phase 1. Phase 2 began in June 2021 and bridge work at Portage Creek #1 and the Placer River is expected to be completed this fall/winter. Bridge work at TwentyMile River is scheduled to begin in the winter of 2022/23 and is expected to be completed by October 2023. To avoid harassment of Cook Inlet beluga whales during the eulachon run, in-water work, including vibratory and impact pile installation and removal, will cease from May 15 to June 15, and any work conducted below mean high water (MHW) will require marine mammal monitoring.

The Seward Highway Milepost 105-107 Windy Corner project will realign a 3.2 km (2 mile) segment of the highway and railroad. In-water work includes land-based blasting and non-impulsive sound from fill placement. The project start has been delayed since the consultation was completed in 2015. According to the Alaska Department of Transportation website, this project is expected to occur between 2022 and 2023. In 2020, NMFS completed consultation for a mitigation project in Portage Creek #2 to compensate for impacts expected to occur from the Windy Corner Seward Highway project. Forty deteriorating timber piles that once supported the Alaska Railroad bridge over Portage Creek #2 will be removed to provide beluga whales unrestricted access to this salmon bearing creek. Project activities are restricted by seasonal timing to avoid the peak eulachon and salmon runs, and by daily tidal cycle to minimize potential interaction with belugas. Work is scheduled to begin in the late fall or early winter of 2022 and is expected to be completed by October 2023.

5.3 Port Facilities

Cook Inlet hosts port facilities at Anchorage, Point Mackenzie, Nikiski, Kenai, Homer, Seldovia, and Port Graham; barge landings are present at Tyonek and Anchor Point. Anchorage has a small boat ramp near Ship Creek, which was renovated in 2017, and 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 small boats access to Cook Inlet.

5.3.1 Port of Anchorage

The Port of Alaska (POA, previously referred to as the Port of Anchorage) is Alaska's largest seaport. The POA handles half of all Alaska inbound fuel and freight, moving more than four

[14] Cook Inlet Beluga Whale Photo-ID Project webpage. CIBW Sightings Page. Available at https://www.cookinletbelugas.com/cibw-sightings, accessed February 28, 2022.

million tons of material across its docks annually, which is distributed statewide and consumed by 90 percent of Alaska's population. Operations began in 1961 with a single berth, and have since expanded to include three cargo terminals, two petroleum terminals, one dry barge berth, two miles of rail-spur connected to Alaska Railroad, and two floating, small-vessel docks, plus 220 acres of land facility located in Anchorage[15].

The POA Expansion Project included pile driving and dredging from 2008 and 2011 (USACE 2009). Between 2009 and 2011, 40 beluga whales were observed within the designated 160 dB disturbance zones, and a single Steller sea lion was sighted at the facility. A test-pile program to evaluate sound attenuation devices for potential use during future port expansion efforts was conducted in 2016. Belugas were observed within the disturbance zones nine times: one four-minute delay of start of operations was implemented, and one authorized instance of harassment of a single whale occurred (Cornick and Seagars 2016). Construction of a new Petroleum and Cement Terminal (PCT) began in 2020 and was completed in 2021. In total, 61 beluga groups were present during or very near in time to in-water pile installation or removal, and 19 of those groups were exposed to sounds levels considered to meet the harassment threshold (61 North Environmental 2021, 2022a).

Maintenance dredging at the POA began in 1965, and is an ongoing activity from April through October in most years, affecting about 100 acres of substrate per year. The POA is dredged to the depth of minus 35 ft below mean lower low water (MLLW) and dredged materials are dumped 3,000 ft abeam of the POA dock face at the Anchorage in-water disposal site. To accommodate vessels berthing at the PCT location, transitional dredging to a depth of minus 40 ft MLLW began in 2018, and dredged material is deposited in a designated offshore disposal area (NMFS 2018c). 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 2019, USACE 2019). NMFS continues to analyze recently acquired data that may suggest belugas react to dredging operations.

Dredging operations occur annually at the Ship Creek Boat Ramp, located approximately 1.4 km (0.8 mi) southwest of the POA. "Dredging" at this site is done over a three to four day period during minus 3-foot tides when the area is dewatered. At this location, dredging consists of heavy machinery pushing sediment that has accumulated on the ramp within the intertidal zone back into the inlet from whence it came. Informal consultation for this project was completed in May 2020.

[15] Port of Alaska in Anchorage webpage. About Port of Alaska. Available at https://www.portofalaska.com/about-us/, accessed February 23, 2022.

5.3.2 Port MacKenzie

Port MacKenzie is along western lower Knik Arm, in upper Cook Inlet, north of the action area. Development on the port began in 2000 with the construction of a barge dock. Additional construction and bulkhead repair has occurred since then, and 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 include dry bulk cargo movement and storage. 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 ESA section 7 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. Pile driving was not occurring during these close approaches and there were no takes or no shut-downs recorded (Nuka Research and Planning Group 2016). Multiple groups of belugas were observed in this area between April and September 2020 and 2021 during marine mammal monitoring for the POA PCT construction (61 North Environmental 2021, 2022a).

5.3.3 Other Ports

The Drift River facility in Redoubt Bay (just beyond the northwest corner of the Lease Sale 258 area and within the action area) 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. In 2009, a volcanic eruption of Mt. Redoubt forced the evacuation of the terminal and an eventual draw-down of oil stored on-site. Hilcorp Alaska bought the facility in 2012 and, after numerous improvements, partially reopened the facility to oil storage and tanker loading operations.

Nikiski is home to several privately owned docks. 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 dock in Nikiski, referred to as the Rig Tenders Dock, in anticipation of increased oil and gas activity in Cook Inlet and to serve activities in the Chukchi and Beaufort seas.

Ladd Landing beach, located on the Western Cook Inlet beach near Tyonek, serves as public access to the Three Mile Subdivision, and as a staging area for various commercial fishing sites in the area. While it is outside of the action area, it is one of the few watercraft access points on Cook Inlet's western shore.

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 (which is not in the action area). Within the action area, port activities in Homer, Port Graham, and Nikiski are most likely to affect Western DPS Steller sea lions.

The proposed action will possibly include port activities in Nikiski, Kenai, and/or Homer, from which vessel and air transits to the LS 258 leasing blocks may occur; these ports are included in the action area.

5.4 Oil and Gas Development

Cook Inlet is estimated to have 500 million barrels of oil and over 19 trillion cubic ft of natural gas that are undiscovered and technically recoverable (Wiggin 2017). Schenk (2015) determined that there may also be unconventional oil and gas accumulations in Cook Inlet of up to 637 billion cubic ft of gas and 9 million barrels of natural gas liquids. Unconventional oil and gas accumulations: (1) have Estimated Ultimate Recoveries (EUR) 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), and prior to that 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; today there are 17 offshore oil and gas platforms Figure 20 shows the ongoing oil and gas activities in state waters as of January 2022. Active oil and gas leases in Cook Inlet total 207 leases encompassing approximately 424,215 acres of State leased land of which 331,970 acres are offshore[16].

State and federal oil and gas lease sales have been regularly held throughout Cook Inlet for over 50 years. Six federal oil and gas lease sales have been held in the Cook Inlet Planning Area in that time. The first lease sale in the Cook Inlet Planning Area occurred in October 1977, which resulted in 88 leases being issued. Since then three other lease sales led to bids and leases on 29 blocks, including in 2017 when Hilcorp bid on 14 of 224 blocks offered. Sales were also held in which no bids were received and sales were proposed and cancelled due to a lack of industry

[16] Alaska Department of Natural Resources webpage. Active oil and gas lease inventory. Available at https://dog.dnr.alaska.gov/Documents/Leasing/PeriodicReports/Lease_LASActiveLeaseInventory.pdf, accessed December 4, 2022.

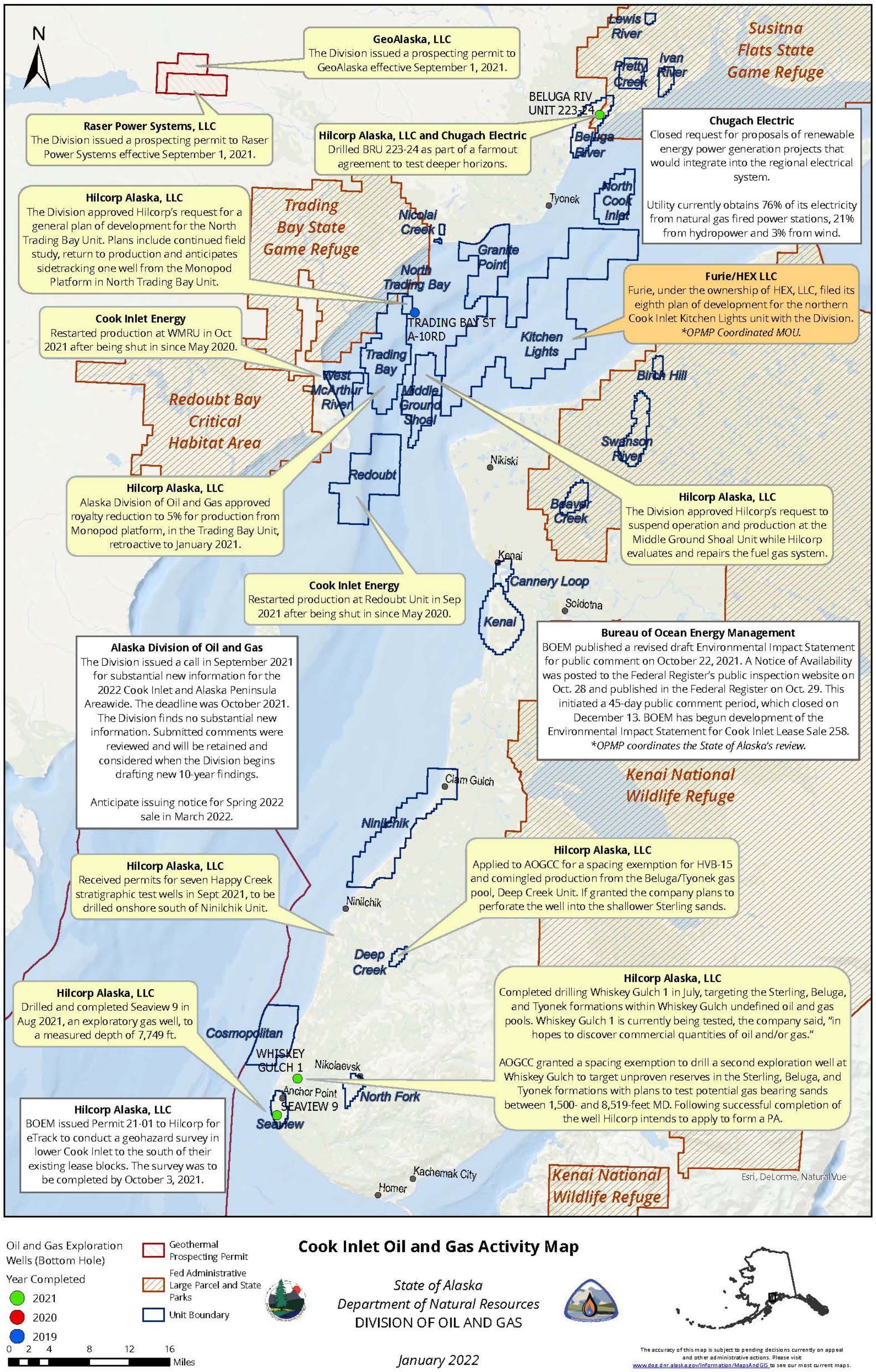


Figure 20. Oil and gas activity in Cook Inlet as of January 2022.

interest (BOEM 2022a). No production has occurred on the Cook Inlet OCS to date (BOEM 2022a).

The State of Alaska holds lease sales regularly. The most recent sale was held in May 2022 and yielded 2 new lease tracts. The Alaska Department of Natural Resources (ADNR) will hold the next oil and gas areawide lease sale in December 2022, which will offer acreage adjacent to LS 258. Industry lessees currently hold 424,000 acres on 207 leases within the State's Cook Inlet Area wide boundary. One hundred and six leases, encompassing more than 65,000 acres, are currently in production (ADNR 2022). Exploration on the OCS and exploration and production in state waters and onshore on both state and federal lands are occurring and are expected to continue throughout the next 40-years. Seismic surveys and exploration are recurrent in Cook Inlet and would also be expected to occur periodically throughout the next 40 years. In 2019 and 2021, Hilcorp conducted exploratory surveys – deep penetrating 3D seismic surveys and geohazard surveys, respectively.

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 the Cook Inlet beluga whale are unknown (NMFS 2008a). Potential impacts from oil and gas development on the Cook Inlet beluga whale include 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 2008a).

5.4.1 Kenai LNG Plant

The Kenai liquefied natural gas (LNG) liquefaction and terminal complex began operating in 1969 and, until 2012, was the only facility in the United States authorized to export LNG produced from domestic natural gas. LNG shipments from the terminal began declining and the plant has been in a warm-idle state since 2015. In early 2019, NMFS was informed that there were plans to bring the plant back into operation in the next few years. The Federal Energy Regulatory Commission approved Trans-Foreland's request to convert the facility to an importing plant in December 2020 and gave the company until December 2022 to place it into service. The Federal Energy Regulatory Commission received noticed from Trans-Foreland in July 2022 requesting an extension until December 2025 to complete the facility.[17]

5.5 Underwater Installations

There are approximately 365 km (227 mi) of undersea pipelines in Cook Inlet, including 125 km (78 mi) of oil pipelines and 240 km (149 mi) of gas pipelines (ADNR 2015). The majority of underwater installations in Cook Inlet are oil and gas pipelines, which are an essential part of oil and gas activities in Cook Inlet. The Cook Inlet basin is the source for all natural gas used in

[17] https://www.reuters.com/business/energy/marathon-seeks-more-time-build-lng-import-project-alaska-2022-07-11/. Accessed August 29, 2022

south-central Alaska (Figure 21). Communication cables have also been laid and a project to harness tidal energy is in the initial stages of development.

Installation of pipelines involves multiple vessels. After the trench is dug, pipe is welded together and laid over the back of a non-motorized barge into the trench. Anchors are used to hold the barge in place and anchor-handling tugs use their bow-thrusters to reposition the anchors as the barge is moved along. These projects involve disturbance to the substrate, increased turbidity in the vicinity of the trenching, and increased sound from the tugboats and pipe-laying equipment.

There is always a possibility of pipeline failures associated with oil and gas development, with resultant oil spills, gas leaks, or other sources of marine petrochemical contamination. For example, in 2022, we did an informal consultation (AKRO-2022-01568) with the Corps for the removal of an anchor that had lodged itself against a pipeline that crosses between Possession Point and Fire Island so that a pipeline puncture could be avoided.

5.5.1 Telecommunications

Alaska Communications Systems Group, Inc. (ACS) installed a fiber optic cable from Florence, Oregon to Anchorage, Alaska in 2019 to improve communication. A submarine cable extending from Nikiski on the Kenai Peninsula to Point Woronzof in Anchorage was installed. There was likely increased vessel traffic and sound during the installation; however the fiber optic cable now rests along the seafloor with a minimal footprint.

5.5.2 Hilcorp Cook Inlet Pipeline Cross Inlet Extension

Harvest, Alaska LLC, a subsidiary of Hilcorp Alaska, extended the existing undersea pipeline network in Cook Inlet and connected the Tyonek platform to the land-based pipeline located about 6.4 km (4 mi) north of the village of Tyonek in 2018. The cross-inlet extension included two steel subsea pipelines 25 cm (10 in) and 20 cm (8 in) in diameter, and 8.9 km (5.5 mi) in length. The existing 25 cm (10 in) subsea pipeline that crosses Cook Inlet between Kaloa Junction and the East Forelands Facility was also converted from natural gas service to oil service. 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 2018d). Between May 9 and September 15, 2018, PSOs observed 814 beluga whales, 3 humpback whales, and 2 Steller sea lions; however, of the 819 listed species observed, only 1 humpback was considered exposed to Level B harassment (Sitkiewicz et al. 2018a).

5.5.3 Trans-Foreland Pipeline

The Trans-Foreland Pipeline Co. LLC received approval from Federal, state, and regional agencies in 2014 to build the Trans-Foreland Pipeline, a crude oil pipeline from Kustatan Point on West Foreland to Nikiski on the east side of Cook Inlet. Multiple oil producers in western

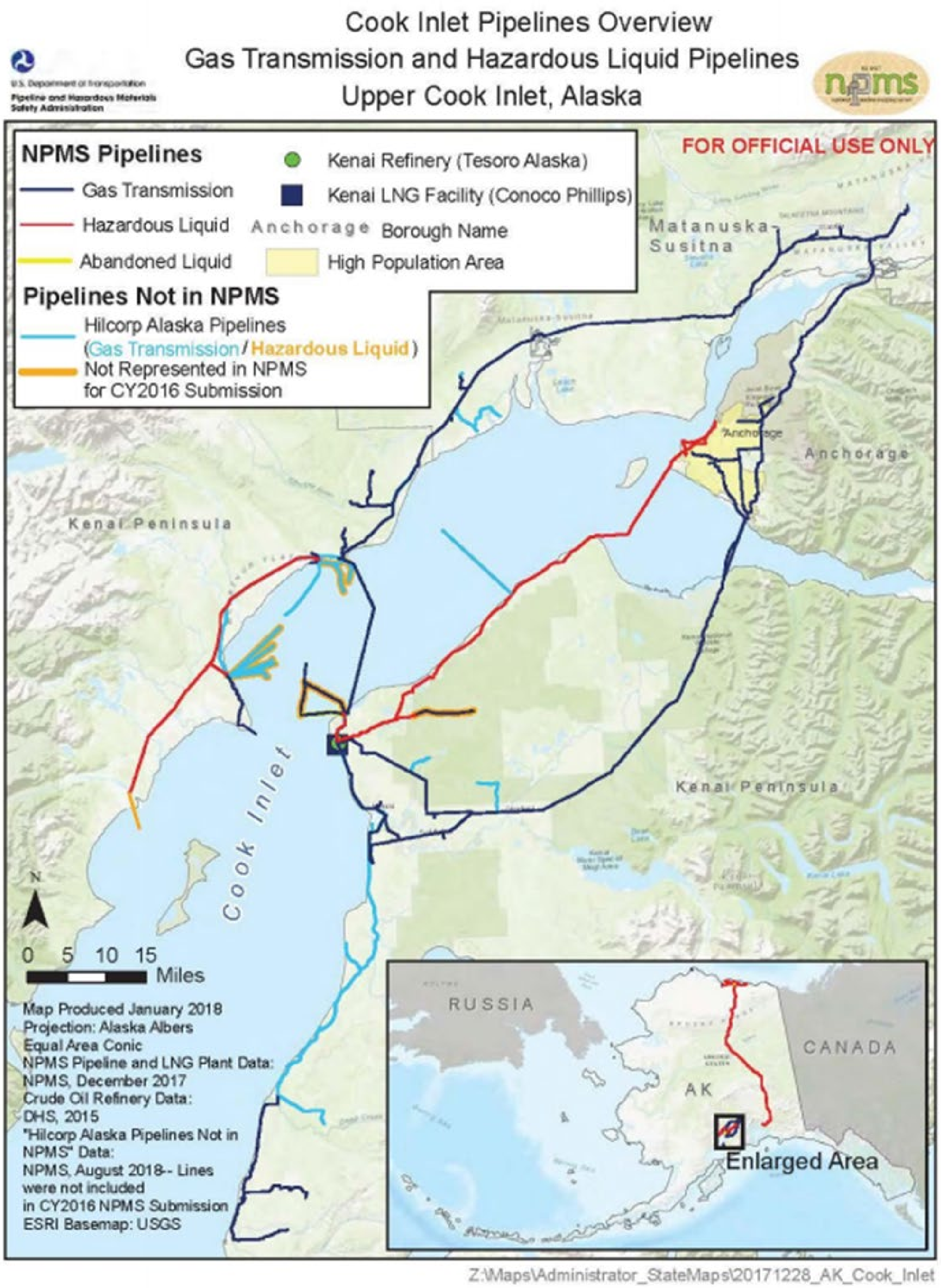


Figure **21**. Pipelines in Cook Inlet. Cook Inlet were expected to use the pipeline to transport oil from the Drift River Tank farm, which is now closed (NMFS 2014b). This project is not expected to occur.

5.5.4 Alaska LNG Project

The Alaska LNG Project proposes to carry natural gas from the North Slope to southcentral Alaska for export internationally, eventually shipping up to 2.4 billion cubic ft of LNG per day.

Proposed infrastructure includes an approximately 1,290 km (800 mi) long, large diameter pipeline from the North Slope that would cross Cook Inlet north of the Forelands and terminate at a proposed liquefaction facility in the Nikiski area on the Kenai Peninsula. Five years of construction are anticipated for the Cook Inlet portion of the project. ESA consultation was completed in June 2020; the project is expected to result in harassment of 61 Cook Inlet beluga whales, 1 Western North Pacific DPS humpback whale, and 1 Mexico DPS humpback whale over 5-years. One Mexico DPS humpback whale may also be exposed to sound levels exceeding the injury threshold. No effects to Steller sea lions are expected. As of yet, there is no planned project start date.

5.5.5 Tidal Energy Project

Ocean Renewable Power Company (ORPC), a developer of renewable power systems that harness energy from free-flowing rivers and tidal currents, submitted a preliminary permit application to the Federal Energy Regulatory Commission in May 2021. ORPC previously conducted site characterization and environmental studies in the region, and intends to develop a 5 MW pilot project near East Foreland to verify the technical performance and environmental compatibility of its proposed project. Project results will assist in planning a phased build-out of up to a 100 MW commercial-scale project[18]. ORPC will collaborate with Homer Electric Association, Inc. to sell the tidal energy produced.

In summary, coastal, marine, and off-shore development may affect Cook Inlet beluga whales, humpback whales, fin whales, and Steller sea lions directly or indirectly when new construction occurs (loss of habitat, sound), as a result of increased vessel traffic from port improvements and expansion (ship strike, sound), or from the increased likelihood of contaminants entering Cook Inlet as a consequence of expanded commercial and industrial activities adjacent to the marine environment.

5.6 Natural and Anthropogenic Sound

Because sound is a primary source of disturbance to marine mammals, 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 and off-shore development.

Underwater sound in Cook Inlet is categorized as physical sound, biological sound, and human-caused sound. Natural physical sound originates from wind, waves at the surface, currents,

[18] Renewable Energy Magazine webpage. ORPC plans to advance tidal energy in Cook Inlet. Available at https://www.renewableenergymagazine.com/ocean_energy/orpc-plans-to-advance-tidal-energy-in-20210526, accessed March 15, 2022.

earthquakes, ice movement, tidal currents, and atmospheric sound (Richardson et al. 1995b). Tidal influences in Cook Inlet are a predominant contributor of physical sound to the acoustic environment (Burgess 2014, BOEM 2016b).

Biological sound 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 sound includes vessel motor sounds, oil and gas operations, maintenance dredging, aircraft overflights, construction noise, and infrastructure maintenance noise. In general, ambient and background noise levels within the action area in Cook Inlet are less than 120 dB whenever conditions are calm, and exceed 120 dB during environmental events such as high winds and peak tidal fluctuations (Blackwell and Greene 2003, Illingworth & Rodkin 2014, Castellote et al. 2019, Castellote et al. 2020c).

Increased noise from seismic activity, vessel and air traffic and well drilling could result from oil and gas development. Oil produced on the western side of Cook Inlet is transported by tankers to the refineries on the east side. Refined petroleum products are then shipped to other parts of Alaska. Liquid gas is also transported via tankers once it is processed (ADNR 2009). Offshore drilling is generally conducted from drilling vessels or platforms.

5.6.1 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. Seismic surveys use high energy, low frequency sound in short pulse durations to characterize subsurface geology, 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 and displace prey species (ENGÅS and LØKKEBORG 2002).

Large airgun arrays of greater than 3,000 in^3, which can produce sound source levels exceeding 240 dB re 1 μPa rms, were previously used for seismic exploration in Cook Inlet. Smaller arrays are now being used because of the generally shallow water environment and the increased use of ocean-bottom cable and ocean-bottom node technology (Rigzone 2012). Shallow water surveys have employed 440, 620, and 880 in^3 arrays with source sound pressure levels less than 230 dB re 1 μPa_{RMS}. Measured radii to the 160 dB harassment isopleths have ranged from 3 to 9.5 km (1.8-5.9 mi).

5.6.1.1 Apache Seismic Exploration (2012-2014)

Apache Alaska Corporation (Apache) conducted over 1,800 hours of seismic activity in 2012 and reported zero takes of beluga whales and Steller sea lions; however, protected marine mammal sightings occurred within zones ensonified to greater than 120 and 160 dB prior to equipment power-down or shutdown (Lomac-MacNair et al. 2013). In 2014, observers recorded a total of 29 takes (12 beluga whales, 6 harbor porpoise, 9 harbor seals, and 2 humpback whales) from sound exposures (25 at ≥160 dB_{RMS} and 4 at ≥180 dB_{RMS}) during 3,029 hours of observation effort. Additionally, four beluga whale groups were recorded less than 500 m from the source vessel during seismic operations (Lomac-MacNair et al. 2014). The monitoring reportis ambiguous, and it is unclear if the seismic guns were firing while those four beluga groups were within 500 m of the source vessel. If the 1,760 in^3 airgun array was operating during these sightings, the groups were well within the MMPA Level A isopleth and Level A take occurred.

On April 25, 2014, the M/V *Peregrine Falcon* was operating the 1,760 in^3 airgun array at full volume when a humpback whale was observed 1.5 km (0.9 mi) from the sound source. Seismic operations were shut down immediately; however, it is estimated that the whale was exposed to at least 19 shots exceeding the 180 dB threshold (at the time) for Level A take[19] as the animal transited from the edge of the Level A isopleth (1.84 km; 1.1 mi) to the initial sighting location. Regardless of immediate power-down or shutdown actions, an animal is considered exposed if it enters the respective Level A or Level B isopleths while sound is occurring.

5.6.1.2 SAE 3D Seismic Exploration (2015)

Eight vessels, including two seismic source vessels and one mitigation vessel, conducted seismic operations in upper Cook Inlet from May 15 to September 27, 2015. Seven PSOs, stationed on the source and mitigation vessels, monitored during all daylight hours when seismic operations were occurring and throughout most of non-seismic activities. A trained passive acoustic monitoring (PAM) operator monitored during nighttime hours from 1 July through 27 September using a dipping or over-the-side hydrophone.

Of the total number of visual observations and acoustic detections, 207 marine mammals were confirmed within the MMPA Level B (160 dB) or Level A (190 and 180 dB) isopleths; 194 animals were exposed to sounds exceeding the harassment threshold and 13 animals were exposed to sounds exceeding the injury threshold (Kendall et al. 2015b). Species exposed to sounds exceeding the harassment threshold included an unidentified large cetacean, two belugas, harbor porpoises, an unidentified porpoise, harbor seals, and a Steller sea lion. Harbor porpoises, harbor seals, and a Steller sea lion were exposed to sounds exceeding the injury threshold. Mitigation measures (clearance, ramp-up, and shut down procedures) prevented take during an additional 70 sightings (Kendall et al. 2015b).

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

Hilcorp conducted a 3D seismic survey of approximately 790 km^2 (305 mi^2) over 8 Outer Continental Shelf (OCS) lease blocks in Lower Cook Inlet from September 10 to October 17, 2019. One source, two support, and one marine mammal mitigation vessel were deployed, and PSOs were stationed on the source and mitigation vessels. Daily aerial surveys were conducted to ensure that no marine mammals were seen within the project area. Table 14 shows vessel

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

sightings and estimated numbers of animals (including extrapolation) observed within the MMPA Level B isopleth during the project (Fairweather Science 2020). A Steller sea lion and a fin whale were observed in the Level A zone during seismic activity, however, permanent threshold shift or MMPA Level A take was unlikely because shut downs were implemented within a one-shot period. Level A thresholds are calculated with the assumption that an animal remains within the zone for 24 hours before an animal has a permanent threshold shift. Given the short duration of exposure it is unlikely that either animal had a permanent threshold shift. Although two beluga whales were seen, both were dead and it was determined that their deaths were unrelated to the seismic survey (Fairweather Science 2020).

Table 14. Sightings of ESA-listed marine mammals during 2019 Hilcorp seismic surveys.

ESA-listed species	# of sightings	Estimated # of Individuals	MMPA Level B Exposures
Fin whale	8	23	10.9
Humpback whale (Western North Pacific and Mexico DPS)	14	38	31.5
Beluga whale	2	2	0
Steller sea lion	5	5	4.9

(Fairweather Science 2020)

5.6.2 Oil and Gas Exploration, Drilling, and Production Noise

With frequencies generally below 10 kHz, operating sounds from the oil platform itself are louder than the sound generated by drilling. Noise from the platform is thought to be weak due to the small surface area (the four legs) in contact with the water (Richardson et al. 1995b), and that the majority of the machinery is on the deck of the platform above the water surface. Blackwell and Greene (2003) recorded underwater sound 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). Sound between 2 and 10 kHz was measured as high as 85 dB as far out as 19 km from the source. This noise is audible to beluga, humpback, and fin whales, and Steller sea lions.

5.6.2.1 EMALL (2016)

In 2016, ExxonMobil Alaska LNG LCC (EMALL) conducted geophysical and geotechnical (G&G) surveys in Upper Cook Inlet within the Susitna Delta Exclusion Zone (SUDEX). PSOs monitored for marine mammals prior to and during all vessel movements in the area, and G&G surveys did not occur within the SUDEX between April 15 and October 15. Three marine mammal sightings of five individuals were observed within the SUDEX, including two sightings of beluga whales (four individuals), and one sighting of a harbor seal. The sightings in the SUDEX occurred during non-operational periods (e.g., when no vibracore operations were occurring), and both beluga sightings were observed outside of the harassment zone (Smultea Environmental Sciences 2016).

5.6.2.2 Furie Exploration Drilling (2018)

NMFS completed formal consultation in 2017 for oil and gas exploratory drilling operations in the Kitchen Lights Unit (KLU) in upper Cook Inlet between June 2017 and December 2021 (NMFS 2017a). Actions included transport of a jack-up rig from winter storage locations in lower Cook Inlet to the drilling sites by up to three tugs, high-resolution geophysical surveys, pile driving at the drilling locations, drilling operations, vessel and air traffic associated with rig operations, fuel storage, and well completion activities.

Furie did not conduct exploratory drilling in 2017 and requested reinitiation in late 2017 after modifying the proposed actions; the jack-up rig would be stored in Nikiski during the winter, eliminating many of the potential impacts to listed species resulting from towing the rig from lower Cook Inlet to the KLU. Based on modifications to the proposed action and with implementation of revised mitigation measures, NMFS determined that the project may affect, but is not likely to adversely affect, ESA-listed species (NMFS 2018b). Continuous monitoring during drilling and well construction was not required after the initial start-up period; however, PSOs were required to monitor continuously during pile driving activities. PSOs monitored for approximately 23 hours between June 25 and 29, 2018 during pile driving, and observed 1 harbor seal, 2 harbor porpoises, and 1 dead beluga whale. The beluga carcass was unrelated to project activities, and was immediately reported to the NMFS Marine Mammal Stranding Network (Jacobs Engineering Group 2019). The KLU was purchased by HEX LLC at a December 2019 bankruptcy auction.

5.6.2.3 Hilcorp Oil and Gas (2019 - 2022)

The Hilcorp Incidental Take Regulations issued in 2019 included oil and gas exploration, development, production, and decommissioning activities in Cook Inlet, Alaska between July 30, 2019 and July 30, 2024. As discussed above, Hilcorp completed seismic operations in 2019. On September 17, 2019, Cook Inletkeeper and the Center for Biological Diversity filed suit in the U.S. District Court for the District of Alaska challenging NMFS's issuance of the ITRs and LOAs and supporting documents, including the ESA Biological Opinion. In a decision issued on March 30, 2021, the court ruled largely in NMFS's favor but found a lack of adequate support in NMFS's record for the agency's determination that tug towing of drill rigs will not cause take of beluga whales. The court issued its judgment and order on remedy on May 27, 2021, partially vacating and remanding the ITRs, environmental assessment, and biological opinion to NMFS for further analysis of tug use under the MMPA, ESA, and National Environmental Policy Act (NEPA). The court vacated Hilcorp's use of tugs towing a drill rig in connection with exploratory well drilling and in connection with all other production well drilling. The court remanded without vacatur Hilcorp's use of tugs towing a drill rig for production drilling in 2021 at the Tyonek platform and for well decommissioning (which partially occurred in 2021). All other activities under the ITR and Biological Opinion were remanded without vacatur.

In 2020, Hilcorp completed routine pipeline maintenance operations but did not observe any marine mammals. In 2021, Hilcorp transported the *Spartan 151* jack-up rig once in June from the Rig Tenders Dock in Nikiski to Well 17589 for plug and abandonment (P&A) activities and once in July from Well 17589 to the Tyonek platform for production drilling (this activity was analyzed in the 2019 biological opinion, and the court did not vacate that particular activity for 2021). P&A of Well 17589 began in 2021 but was not finished due to equipment sourcing issues. Hilcorp has since resolved the issue and intends to finish P&A activities in accordance with Alaska Oil and Gas Conservation Commission regulations. Also in 2021, Hilcorp completed a shallow hazard survey over lower Cook Inlet OCS leases to evaluate potential hazards; document any potential cultural resources; identify shallow hazards such as old pipelines or wrecks; obtain engineering data for placement of structures (e.g., proposed platform locations); and detect subsurface geologic hazards (e.g., faults and gas pockets; this activity was analyzed in the 2019 biological opinion, and in the court's order on remedy, the court did not vacate other Hilcorp activities not associated with the use of tugs towing drill rigs). The survey was conducted from 11 September 2021 to 24 October 2021; however, the geohazard portion of the survey that required use of the sound source concluded on 9 October 2021.

On April 28, 2022, Hilcorp notified NMFS that Hilcorp needed to begin tugging of a drill rig in May due to depleted energy reserves for the Southcentral Alaska region. NMFS concurred with Hilcorp's assessment that take of marine mammals by Level B harassment was unlikely to occur for the transport of the jack-up rig from the Rig Tender's Dock in Nikiski to the Tyonek platform in middle Cook Inlet. The letter did not authorize any take of marine mammals under the MMPA and was not subject to ESA section 7 consultation. Hilcorp moved the jack up rig from Nikiski to the Tyonek platform in June 2022.

Also in 2022, Hilcorp and Harvest requested informal consultation from the Alaska Region for routine oil and gas pipeline and infrastructure maintenance. Routine maintenance activities include: subsea pipeline inspections, pipeline stabilization, and repair and replacement; platform leg inspections and repairs; and anode sled installations. Work under the informal consultation will occur over a 5 year period from 2022 – 2027, the consultation process was completed on August 12, 2022.

5.6.3 Construction and Dredging Sound

Pile driving and dredging are the primary sources of construction sound in Cook Inlet. The Port of Alaska located outside of the action area, is dredged annually and extensive renovations, including significant amounts of pile driving, occurred in 2020 and 2021. Port MacKenzie, located two miles across Cook Inlet from the POA, has also undergone recent renovations and multiple emergency repairs requiring pile driving, including removal and installation of sheet piles (NMFS 2017b).

The majority of construction activities in upper Cook Inlet have taken place near Anchorage and most of the studies documenting construction sound in Cook Inlet have occurred in this area. These studies have focused almost exclusively on pile driving in order to evaluate potential harassment to beluga whales. A few studies have recorded dredging sound near the POA (Dickerson et al. 2001, URS 2007).

5.6.4 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 in Cook Inlet transits through the Ports of Kodiak, Homer, and Anchorage. Off-shore vessels, tug vessels, and tour boats represent 86 percent of the total operating days for vessels in Cook Inlet (BOEM 2016b). Vessel traffic density is concentrated along the eastern margin of the Inlet between the southern end of the Kenai Peninsula north to Anchorage (Figure 22). Eighty percent of large ship operations were made by only 15 vessels that regularly dock at Homer, Nikiski, or Anchorage. Vessel traffic was very consistent throughout the year along the Forelands. Kachemak Bay had the highest level of traffic activity in Cook Inlet with most large ships entering the mouth of the bay to pick up a marine pilot or await U.S. Coast Guard inspection. The bay was also a frequent and preferred port of refuge for ships and tugs while waiting out bad weather (Cape International 2012). The Drift River Terminal was decommissioned, which eliminated a substantial source of tanker traffic across Cook Inlet.

Blackwell and Greene (2003) recorded underwater sound 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 sound from ships generally exceeds 120 dB re 1 μPa_{RMS} to distances between 500 and 2,000 m (1,640 and 6,562 ft; Jacobs Engineering Group 2017); however, sound effects from transiting vessels are short term (BOEM 2017b). There are anecdotal reports of belugas with varying levels of reactions from vessel traffic. Observers noted that belugas sometimes seem habituated to vessels while other times they would dive, split up from their groups, and/or change direction when vessels crossed in front of or over the top of them (HDR 2015 unpublished data). Belugas may decrease or cease vocalizations in response to sounds from ships and other activities, or their vocalizations may be masked (Castellote et al. 2016c).

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 2017b). We are unaware of information characterizing the reactions of these species to vessels within the action area or the number of interactions between marine mammals and vessels that cause behavioral changes.

Cook Inlet belugas may be affected by the sound associated with shipping and transportation. Beluga prey species could be displaced from preferred habitat areas that contain features essential for the species, or that alter the quantity and/or quality of these essential features (NMFS 2014a, 2016a). Vessel traffic and tourism encroachment in areas could disturb and displace belugas and/or their prey species.

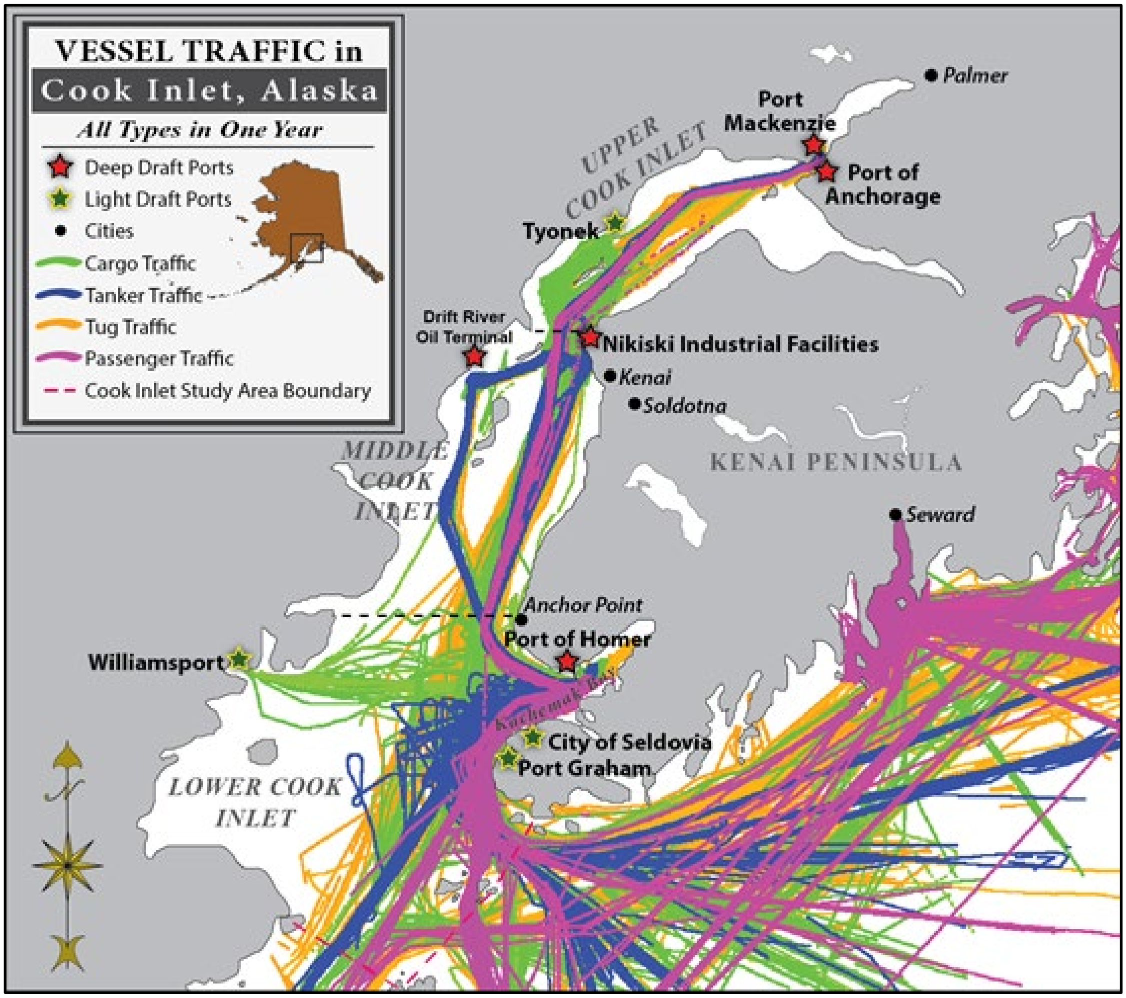


Figure 22. Summary of Cook Inlet Vessel Traffic by Vessel Type (Cape International, Inc. 2012, BOEM 2017b).

5.6.5 Aircraft Noise

The Cook Inlet airspace has significant aircraft traffic. Ted Stevens Anchorage International Airport, located directly adjacent to lower Knik Arm, is the second largest air cargo hub in the U.S. and receives high volumes of commercial air traffic. Joint Base Elmendorf-Richardson also has a runway and airspace directly over Knik Arm. Lake Hood in Anchorage is the largest and busiest seaplane base in the world, and the only seaplane base in the U.S. with primary airport status (Federal Aviation Administration 2016). Small public runways are located in Birchwood, Goose Bay, Merrill Field, Girdwood, the Kenai Municipal Airport, Ninilchik, Homer, and

Seldovia. Oil and gas operators frequently utilize helicopters and fixed-winged aircraft for transport of personnel and goods, as well as for surveys.

Airborne sounds do not transfer well to water as much of the sound is attenuated at the surface or reflected where angles of incidence are greater than 13°; however, loud aircraft sound can be heard underwater when aircraft are within or near the 13° overhead cone and surface conditions are calm (Richardson et al. 1995b). The sound and visual presence of aircraft may result in behavioral changes in whales, including diving, altering course, vigorous swimming, and breaching (Patenaude et al. 2002). Richardson et al. (1995b) observed beluga whales in the Beaufort Sea dive or swim away when low-flying (500 m (1640 ft)) aircraft passed above. During beluga aerial surveys in Cook Inlet, observers reported little or no change in swimming direction of the whales in response to the survey aircraft flying at approximately 244 m (800 ft; Rugh et al. 2000). Individual responses of belugas may vary depending on previous experiences, beluga activity at the time of the sound, and sound characteristics.

The responsiveness of baleen whales (humpbacks and fin whales) to aircraft is variable and may depend on behavioral state, habitat, and age class. Responses vary from no observed reaction to diving, turns, and other changes in behavior. Whales actively engaged in feeding or social behavior often appear insensitive. Whales with calves or in confined waters may be more sensitive. Single or occasional aircraft overflights do not seem to cause long-term displacement or abandonment by whales (Richardson et al. 1995). .

Aircraft may also disturb Steller sea lions, especially if hauled out. Disturbance of a rookery or haulout has the potential to result in serious injury or death, predominantly from trampling. Over 1,000 sea lions were observed stampeding off a beach in response to a large helicopter over a mile away (Withrow 1982).

5.7 Water Quality and Water Pollution

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. The main sources of pollutants likely include the 10 wastewater treatment facilities, stormwater runoff, airport de-icing, military training at Eagle Bay, and discharge from oil and gas development (Moore et al. 2000, NMFS 2008a). Many pollutants are regulated by either the EPA or the Alaska Department of Environmental Conservation (ADEC), who may authorize certain discharges under the National (or Alaska) Pollution Discharge Elimination System (NPDES/APDES; section 402 of the Clean Water Act of 1972). It is necessary to manage pollutants and toxins to protect and maintain the biological, ecological, and aesthetic integrity of these waters.

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 for ballast water management in Alaska can be found at: (Verna 2017)and https://www.circac.org/wp-content/uploads/2003nov-Cook-Inlet-Ballast-WAter-Catalogue-Nuka.pdf

Chemical analyses of water and dredging sediments from Cook Inlet found that contaminants analyzed were below management levels, and some were below detection limits. Cook Inlet beluga whales also generally have lower contaminant loads than belugas from other populations (NMFS 2016a). The comparatively low levels of contaminants documented in the Cook Inlet water and sediment samples, as well as in the belugas themselves suggests that the magnitude of the pollution threat appears low.

Upper Cook Inlet was designated as a Category 3 on the Clean Water Act Section 303(d) list of impaired water bodies by the 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).

5.7.1 Petrochemical Spills

According to the ADEC, oil spills to marine waters consist mostly of harbor and vessel spills, and spills from platform and processing facilities. A reported 477,942 L (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 Hillcorp 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 by The Glosten Associates and ERC (2012) 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. Historical rates ranged from 0.7 spills per year for tank ships to 1.3 spills per year for non-tank/non-workboat vessels (The Glosten Associates and ERC, 2012). Eight large spills (≥ 1000 bbl) from vessels (tankers and, in one case, a tug) are documented in Cook Inlet between 1966 and 2015 (BOEM 2016b). No large spills have occurred in the area in recent years (BOEM 2017b).

In February 2017, a natural gas leak was discovered in an eight-inch pipeline in Cook Inlet belonging to Hilcorp. A large rock caused the breach at a depth of 80 ft. The leak began in late December 2016, and the initial estimated leak rate was between 225,000 to 325,000 cubic ft per day (Hilcorp 2017b). A permanent repair was completed by mid-May 2017. Limited aerial wildlife surveys in the area did not detect marine mammals near the leak (Hilcorp unpublished data). The Anna Platform experienced a diesel tank spill of 441 gallons in January 2018; all of the diesel was recovered and recycled. The Hilcorp King Salmon Platform spilled 588 gallons of ethylene glycol in mid-April 2019; the glycol was recovered and recycled. The Hilcorp Platform A spilled 180 gallons of ethylene glycol in mid-June 2020; the glycol was recovered and recycled. The Hilcorp subsea pipeline that leaked in 2017 was again discovered to be leaking natural gas in early April 2021. The line was shutdown to stop the leak; however, 175,000 pounds were released. Federal regulators ordered Hilcorp to replace the 7-mile long aging pipeline.

In August 2022, a 645-ft container ship the Maunalei traveling to the Port of Alaska in Anchorage had a lubricant leak and was actively discharging hydraulic oil into Cook Inlet. The lubricant was considered to have minimal impacts to wildlife given the low toxicity of the biodegradable lubricant, the strong tidal currents, and slow release rate (six gallons per hour)[20]. A boom was deployed once the container ship was docked. The ship stayed at the Port for no more than 48 hours prior to leaving to receive repairs in the lower 48.

The ADEC Statewide Oil Spills Database[21] provides public access to data on all the spills reported in Cook Inlet or in tributaries to Cook Inlet. The types of spills recorded include jet fuel, crude oil, ethylene glycol, and produced water. Spills of as little as one gallon are reported and it is often reported that they are contained and disposed of properly. Two spills have been recorded through December 2022, 21 in 2021, 12 in 2020, and 18 in 2019.

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. Research indicates cetaceans are capable of detecting oil, but they do not seem to avoid it (Geraci and St. Aubin 1990b), and oil has been implicated in the deaths of pinnipeds, including Steller sea lions (St. Aubin 1990). An oil spill in Cook Inlet could also result in widespread habitat degradation, impacting beluga whales and putting the population at risk. Population level effects to the Western DPS of Steller sea lions and listed humpback and fin whales within Cook Inlet would be far less likely; however, individual animals may also be put at risk from a spill. Given the amount of oil and gas production and vessel traffic, spills of petroleum products are a threat to marine mammals inhabiting Cook Inlet.

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. Polycyclic aromatic hydrocarbons (PAHs), a group of contaminants found in petroleum products, combined with other contaminants, may cause cancer in beluga whales (Kingsley 2002). Cook Inlet belugas appear to be bioaccumulating

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[20] https://coastguardnews.com/coast-guard-monitors-container-ship-lubricant-leak-in-anchorage/, accessed August 15, 2022

[21] Alaska Department of Environmental Conservation webpage. PPR spills database search. Available at https://dec.alaska.gov/Applications/SPAR/PublicMVC/PERP/SpillSearch, accessed March 15, 2022.

PAHs from the environment and prey (Norman et al. 2015). Spill clean-up efforts could also result in displacement of whales from essential feeding areas.

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 that must emerge directly in oil appear substantially more affected. 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. Toxic substances, such as oil, may be a contributing factor in the decline of the Western DPS Steller sea lion population (NMFS 2008e). While the Exxon Valdez oil spill occurred after the current Steller sea lion population decline began, the spill almost certainly exacerbated the decline. Mortalities from toxic contamination are strongly linked to this spill; 12 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 2008e).

It is not known whether humpback whales or fin 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 and fin whales 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.

5.7.2 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 (EPOCs).

Wastewater treatment facilities undergo primary, secondary, or tertiary treatment prior to being discharged into a body of water. Primary treatment involves removing a portion of the solids from the wastewater prior to discharge. In addition to solids removal, secondary treatment involves biofiltration, aeration, and oxidation to further purify the water. Tertiary treatment involves both primary and secondary treatment as well as processes to remove inorganic compounds (e.g. nitrogen, phosphorus), metals and pathogens. 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.

The Anchorage John M. Asplund Wastewater Treatment Facility (AWTF) is the largest wastewater facility in Alaska and is located in upper Cook Inlet north of the action area. AWTF provides primary treatment only and removes approximately 80 percent of solids prior to discharge (Anchorage Waste Water Utility [AWWU] 2014). The facility was built in 1972, upgraded in 1982 (28 million gallons per day [mgd]), and then upgraded again in 1989 (58 million 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 (Figure 23). 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 (AWWU 2014). Sludge from the primary clarifiers is thickened and dewatered. The dewatered sludge and skimmings are incinerated and the ash disposed of in a sanitary landfill. If the incinerator capacity is exceeded, the excess sludge is dewatered and disposed of at the landfill. Regular monitoring of the influent, effluent, receiving water, and sediment is conducted. The annual monitoring reports are publically available[22].

The Village of Tyonek wastewater treatment facility, also located north of the action area but 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.

Figure 23. Route of outfall pipe into Cook Inlet for the Anchorage John M. Asplund Wastewater Treatment Facility.

There are other wastewater treatment facilities closer to the action area, including in Kenai. The City of Kenai wastewater facility is one of the larger wastewater treatment facilities in Cook

[22] https://www.awwu.biz/water-quality/cook-inlet-water-quality

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 (EPA 2007). The facility's design flow is 1.330 mgd with an average daily flow of 0.573 mgd (EPA 2007). The City of Kenai is planning to upgrade the facility by 2018 (ADEC 2014).

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 2008b, EPA 2015a). 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 2015a).

5.7.3 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.

5.7.4 Stormwater Runoff

Stormwater pollutants may include street and aircraft deicer, oil, pesticides and fertilizers, heavy metals, and fecal coliform bacteria. Municipality of Anchorage Watershed Management Services and Alaska DOT&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 2008b).

Numerous releases of petroleum hydrocarbons have been documented from the Port of Anchorage (POA), Joint Base Elmendorf Richard (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 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.

5.7.5 Aircraft De-icing

Operating throughout the year, the Federal Aviation Administration requires that the Ted Stevens International Airport deice aircraft and airfield surfaces. Deicing and anti-icing chemicals are used from October through May and may be used on aircraft, tarmacs, and runways. During the 2018-2019 reporting period airlines and ground service providers operating at the airport reported that they had applied 693,192 gallons of ADF to aircraft (99.9 percent propylene glycol and 0.1 percent ethylene glycol). Because one of the stormwater outfalls from the airport enters Knik Arm directly, deicing chemicals contribute pollutants to Cook Inlet.

Historically the primary airfield deicing ingredients were urea and potassium acetate (ADEC 2019). The Airport Authority continued to use pelletized urea until 2013, and now only potassium acetate is used for pavement deicing (ADEC 2019). In the first year of exclusively using potassium acetate, 1,390.5 tons were used. Switching to potassium acetate helped reduce nutrient discharges to receiving waters compared to the use of urea.

Snow removed from areas in contact with the deicing chemicals and other contaminants generally found around terminals is segregated and stored separately from snow removed from other areas on the airport property (e.g. streets, parking lots) (ADEC 2019). Contaminated snow disposal sites are selected for infiltration capacity and for the natural biodegradation of organic compounds that can occur prior to meltwater entering the storm water drainage system.

The Airport Authority began operating under the EPA Multi Sector General Permit (MSGP) industrial storm water general permit in December 1992. A Storm Water Pollution Prevention Plan (SWPPP) was prepared, as required by the permit, and certified in April 1993 (ADEC 2019). In October 2009, storm water permitting authority including the MSGP permit authority shifted from EPA to the Alaska Department of Environmental Conservation (DEC). DEC conducted inspections of the discharge from the outfall that discharges into Knik Arm in April 2009, May 2012, and April 2017 after complaints were received from the public (ADEC 2019). A frothy white foam with a sweet odor was prevalent and it was determined that the deicing chemicals were the cause. A Notice of Violation was recorded in all three years (ADEC 2019).

The current permit for the Ted Stevens Anchorage airport issued in 2020, requires monthly sampling and reporting of several water quality standards and an annual report for the outfall entering Knik Arm. When assessing impact to Cook Inlet beluga whales the DEC determined that the waters near the outfall were used by belugas primarily as a transit corridor, to travel in and out of Knik Arm, and that their exposure to elevated levels of contaminants in April and May when the majority of runoff occurs would be extremely limited (ADEC 2019).

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 2008c). Characterization of potential contamination from these facilities has not been done. It is likely that they all regularly contribute small amounts of pollutants to Cook Inlet through stormwater runoff.

5.7.6 Ballast Water Discharges

Globally, shipping has been found to be responsible for 69 percent of marine invasive species (Molnar et al. 2008). The impact of nonnatives in marine systems ranges from extirpation of native species through competition or predation, shifts in ecosystem food webs, to changes to the physical structure of the habitat (Norse and Crowder 2005). To address the issues related to the transport of invasive species the National Invasive Species Act of 1996 mandates that all ships arriving in U.S. waters complete and submit a ballast water information report to the National Ballast Water Information Clearinghouse (NBIC). The NBIC has been receiving ballast water reporting forms from ships that arrive to U.S. ports from overseas since July 1, 1999. An estimated 2.2 million metric tons of non-indigenous ballast water discharges were released in Cook Inlet each year between 1997 and 2001(Robertson and Crews 2003). A large portion of these discharges originated in Japan and the west coast of the United States; however, the origin of most of the discharges could not be determined (Robertson and Crews 2003). The NBIC reported that more than five million metric tons of ballast water was released in Cook Inlet, from Homer to Anchorage, between 1999 and 2003. In 2004 the US Coast Guard (USCG) established rules for controlling the discharge ballast water in U.S. waters, through publication of 33 CFR Part 151 and 46 CFR Part 162. Ships must manage their ballast water by the following treatment methods and good practices:

- Perform ballast water treatment, through installation and operation of an approved Ballast Water Treatment System (BWTS),
- Perform ballast water exchange 200 miles from shore,
- Avoid or minimize ballast water exchanges in risky or preserved areas,
- Clean ballast tanks regularly to remove sediments, rinse anchors and chains, and remove fouling from hull and piping,
- Maintain an approved Ballast Water Management Plan, as well as the written records of ballast water movements (uptake, transfer, discharge),
- Submit vessel and ballast water management information to USCG prior arrival in US harbors.

In addition, by law no discharges of any kind are allowed within three miles of land.

Surveys conducted in Kachemak Bay and Cook Inlet in 2000 found 13 invasive species in diverse taxonomic groups, including 3 hydroids, 1 bryozoan, 2 bivalves (one species – the cultured oyster – is not reproductive), and 7 species of vascular plants (Hines and Ruiz 2000). When compared to similar surveys from California to Washington, Ruiz et al. (2006) suggested that relatively few invasives are common in Alaska's coastal waters. However, in 2022, the European green crab (*Carcinus maenas*) was found in Alaska. This discovery was anticipated as its distribution has consistently been expanding north from California[23]. Dueñas et al. (2018) conducted a systematic literature review of the available scientific evidence on invasive species' interactions with all threatened and endangered species protected under the ESA. They did not find any studies indicating that ESA-listed marine mammals negatively impacted by invasive species.

The effects of discharged ballast water and possible invasive species from such discharges on fin whales, humpback whales, 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, ADF&G developed an Aquatic Nuisance Species Management Plan (Fay 2002). Information and statistics ballast water management in Cook Inlet can be found in Robertson and Crews (2003).

5.7.7 Contaminants Found in Listed Species

Studies conducted in upper Cook Inlet, in areas of high concentrations of beluga whales, found levels of polychlorinated biphenyls (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 2008b, 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

[23] https://www.adfg.alaska.gov/index.cfm?adfg=wildlifenews.view_article&articles_id=990

population are lower than levels found in other populations, the effects of these contaminants on this population are unknown (Becker et al. 2000, NMFS 2008b).

Polycyclic aromatic hydrocarbons (PAHs), a group of contaminants found in petroleum products, combined with other contaminants, may cause cancer in beluga whales (Kingsley 2002). High levels of PAHs have cytotoxic, genotoxic, immunotoxic, and carcinogenic effects on aquatic wildlife and are a concern with respect to the conservation and recovery of the Cook Inlet beluga whale. PAHs are ubiquitous in the environment, from both natural and anthropogenic sources, and are of special concern where they have the potential to be introduced at elevated concentrations from urban run-off, oil spills, municipal discharges, and from oil and gas exploration, development, or production activities. In Cook Inlet, anthropogenic sources of hydrocarbons include oil and gas activities (e.g. produced water discharges), municipal wastewater discharge, stormwater runoff from roads and industrial areas, vessels, and spills (Saupe et al. 2014a). The main known natural sources in Cook Inlet include coal, oil seeps, peat, and hydrocarbon bearing source rock that enter Cook Inlet directly from rivers and coastal erosion but also from advection into the Inlet (Saupe et al. 2014).

Some of the ways that belugas can be exposed to PAHs are through inhalation, direct contact with oil slicks or dissolved plumes, direct contact with contaminated sediments, or by ingesting contaminated prey. Beluga whales spend a significant portion of their time in intertidal and nearshore areas, where the risk is often highest for exposure to PAHs given that it is in the nearshore environment where most point-source hydrocarbon discharges occur, where natural and anthropogenic PAHs from non-point-source run-off enter the marine environment, and where oil spills are most common and can be retained in the habitat (Saupe et al. 2014a). Poirier et al. (2019) examined stained sections of intestines from belugas from St. Lawrence Estuary (SLE), Cook Inlet, the Arctic, and aquaria. The samples from SLE (where high levels of PAHs were discharged from aluminum smelters) and from Cook Inlet showed that SLE beluga and CI beluga had levels of intestinal PAH–DNA adducts significantly higher than Arctic and aquarium beluga ($P = 0.003$ and 0.02, respectively) (Poirier et al. 2019). A DNA adduct is a segment of DNA bound to a cancer-causing chemical. The presence of such an adduct indicates prior exposure to a potential carcinogen but does not by itself indicate the presence of cancer in the animal. Reynolds and Wetzel (2010) found elevated levels of PAHs in the liver CI beluga males, and in the blubber of females, and in two fetuses. Thus far, necropsies on CI beluga whales have not shown the high incidence of cancers that have been documented for the SLE belugas.

O'Shea and R. L. Brownell (1994) state that concentrations of organochlorine and metal contaminants in tissues of baleen whales are low, and lower than other marine mammal species. They further state that there is no firm evidence that levels of organochlorines, organotins, or heavy metals in baleen whales generally are high enough to cause toxic or other damaging effects. Baleen whales can accumulate lipophilic compounds (e.g., halogenated hydrocarbons) and pesticides (e.g., DDT) in their blubber, as a result of feeding on contaminated prey (bioaccumulation) or inhalation in areas of high contaminant concentrations (e.g., regions of atmospheric deposition; (e.g., regions of atmospheric deposition; Barrie et al. 1992, Wania and

Mackay 1993). Some contaminants (e.g., DDT) may be passed on maternally to young during gestation and lactation (e.g., fin whales, Aguilar and Borell 1994). The health effects of different doses of contaminants are currently unknown. There is evidence of detrimental health effects from these compounds in other mammals, including disease susceptibility, neurotoxicity, and reproductive and immune system impairment (Reijnders 1986, de Swart et al. 1996, Eriksson et al. 1998). Although there has been substantial research on the identification and quantification of such contaminants on individual whales, no detectable effect from contaminants has been identified in baleen whales.

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, but there have been no published reports of contaminants or pollutants (other than spilled oil) representing a mortality source for Steller sea lions (NMFS 2008d).

5.8 Fisheries

Cook Inlet supports several commercial fisheries, all of which require permits. Commercial fisheries are divided into the upper and lower Cook Inlet regions[24]. The upper region contains 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), and razor clams (hand-digging); however, sockeye salmon are the most economically valuable[25].

There are currently no federal fishing regulations governing salmon fishing in the Federal waters of Cook Inlet. In the absence of federal regulations, the State of Alaska regulates state-permitted vessels when fishing for salmon in both the State and Federal waters of Cook Inlet.

Recreational fisheries exist in the river systems on the western Kenai Peninsula for salmon (Chinook, sockeye, pink, and coho), both freshwater and marine Dolly Varden char, and rainbow trout/steelhead trout. In the marine waters throughout Cook Inlet, recreational fishing occurs for salmon (Chinook and coho), Pacific cod, and halibut. Many of the charter fishing vessels targeting salmon and halibut operate out of Homer, in lower Cook Inlet. A new recreational dipnet fishery began in 2020 on the Susitna River from July 10 to July 31 on Wednesdays and Saturdays for all species other than Chinook salmon.

[24] Alaska Department of Fish and Game webpage. Commercial fisheries overview, Cook Inlet management area. Available http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareacookinlet.main, accessed April 11, 2022.

[25] Alaska Department of Fish and Game webpage. Commercial fisheries overview, Upper Cook Inlet management area. Available at http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareauci.main, accessed April 11, 2022.

Personal use salmon fisheries in Cook Inlet resulted in harvest of an average of over 474,000 salmon per year from 2011 to 2021[26]. The commercial harvest of 1.2 million salmon (all species) in 2020 was approximately 70 percent less than the 1970–2019 long-term average annual harvest of 4 million, and the sockeye salmon harvest of 696,000 was 76 percent less than the 1970–2019 long-term average annual harvest of 2.9 million fish (Marston and Frothingham 2022). The 2020 upper Cook Inlet commercial harvest of all Chinook salmon stocks was 3,008 fish, which was 56 percent less than the previous 10-year average (2010–2019) and the second lowest harvest on record (Brenner et al. 2021). At this point, it is unknown if declining salmon returns are a reflection of natural variation or are an indicator of a more systematic shift and downward trend potentially caused by climate change. Because salmon are the primary prey item for Cook Inlet beluga whale, these numbers are a cause for concern; they indicate there are fewer salmon available for commercial fisheries, recreational, personal and subsistence use, and beluga whales. A significant reduction in the amount of available prey, whatever the cause, could impact Cook Inlet beluga whale energetics and recovery.

The sac roe herring fisheries are located in four subdistricts of the upper and mid Inlet (Upper, West, Kalgin Island, and Chinitna Bay subdistricts); however, the Upper subdistrict fishery is the most productive one. In 2007, the herring catch was 26,000 pounds and in 2020, 38.3 tons of herring were commercially harvested(Marston and Frothingham 2022).

There has been a sporadic fishery for eulachon since 1978 (taking between 300-100,000 pounds in 1978, 1980, 1998, and 1999). NMFS made recommendations to the Board of Fisheries (BOF) to discontinue this fishery effective in 2000, in part due to the lack of data on the eulachon runs into the Susitna River and due to the absence of any evaluation of the effect of this fishery on beluga whales in terms of disturbance/harassment or competition for these fish. Additionally, it was noted beluga whales may be heavily dependent on the oil-rich eulachon early in the spring (preceding salmon migrations) and that large eulachon runs may occur in only a few upper Inlet streams. The commercial fishery for eulachon was reopened in 2005, but is restricted to hand-operated dip nets in saltwater between the Chuit River and the Little Susitna River, with a total harvest of 100 tons or less. From 2006-2016, commercial harvest of eulachon has ranged from 39.1 to 107 tons harvested on 3-11 permits (Shields and Dupuis 2016). Approximately 200 tons of eulachon (200 tons is the current maximum allowable harvest) have been harvested from Upper Cook Inlet since each year since 2018 (Marston and Frothingham 2022)

Fisheries that compete with Cook Inlet beluga whales and Steller sea lions for prey species can potentially impact the conservation value of critical habitat if prey availability is significantly altered (including altering access to that prey). Any diminishment in the ability for belugas or Steller sea lions to reach or utilize feeding habitat, or reductions in the amount of available prey, may impact the ability of these animals to obtain sufficient calories to survive and reproduce, and

[26]http://www.adfg.alaska.gov/index.cfm?adfg=PersonalUsebyAreaSouthcentralKenaiSalmon.harvest

may diminish the conservation value of their designated critical habitat (NMFS 2011a, NMFS 2016d).

NMFS assumes that ADFG will monitor and regulate fishing in Cook Inlet to maintain sustainable stocks. The extent to which salmon, eulachon, and other species may be less available to Cook Inlet belugas due to removals by commercial, subsistence, personal use, and sport fishing or by human-caused habitat avoidance has not been investigated. Gathering pertinent data near the mouths of salmon and eulachon spawning streams where beluga whales congregate is especially important.

5.8.1 Entanglement

Reports of fatal takes of Cook Inlet belugas incidental to entanglement in fishing gear prior to the mid-1980s are documented in the literature (Murray and Fay 1979, Burns and Seaman 1986). There have been sporadic reports since the mid-1980s of single belugas becoming entangled in fishing nets; however, the only confirmed entanglement mortality was 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. Non-lethal entanglements have been documented; in 2005, a beluga entangled in an unknown object, perhaps a tire rim or a culvert liner, was photographed in Eagle Bay (McGuire et al. 2014), and another Cook Inlet beluga was repeatedly photographed in 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 known if these animals were able to disentangle themselves or if they died as a result of the entanglements (NMFS 2016a).

Humpback whales have been killed and injured during interactions with commercial fishing gear; however, the frequency of these interactions does not appear to have a significant adverse consequence for humpback whale populations. Most humpbacks become entangled with gear between early June and early September, while foraging in nearshore Alaska waters. A photographic study of humpback whales in southeastern Alaska found at least 53 percent of individuals showed some kind of scarring from fishing gear entanglement (Neilson et al. 2005). Fishing gear involved in humpback entanglements between 1990 and 2016 included gillnet gear (37 percent), pot gear (29 percent), and longline gear (1-2 percent). In 2015, a humpback whale was entangled in a salmon purse seine net in Cook Inlet but was cut free by the fisherman and was assumed to be unharmed (Delean et al. 2020). In 2017, a minke whale or small humpback whale was reported entangled near the Lands End hotel in Homer. In 2019 a humpback whale was reported entangled near the Homer Spit (NMFS unpublished data). These are the only known incident of interactions of humpback whales and fisheries in Cook Inlet.

One incidental mortality of a fin whale entangled in ground tackle of a commercial mechanical jig fishing vessel was reported to NMFS in Alaska, resulting in an estimated annual mortality of 0.2 fin whales per year between 2010 and 2014 (Muto et al. 2018b).

For Western DPS Steller sea lions, the minimum estimated mean annual level of human-caused mortality and serious injury for Western U.S. Steller sea lions between 2014 and 2018 is 254 sea lions: 37 in U.S. commercial fisheries, 0.8 in unknown (commercial, recreational, or subsistence) fisheries, 3.6 in marine debris, 3.6 due to other causes (illegal shooting, mortality incidental to MMPA-authorized research). An estimated 15 Western DPS animals/year were killed or seriously injured by state-managed fisheries when these fisheries were observed in 1990-1991 (Muto et al. 2022). This mortality and serious injury estimate results from an actual count of verified human-caused deaths and serious injuries and is a minimum because not all entangled animals strand nor are all stranded animals found, reported, or have the cause of death determined. Overall, the relative impact on the recovery of the WDPS of Steller sea lion due to entanglement is ranked as low (NMFS 2008e).

Approximately 400 observations of Steller sea lion entanglements and fishery gear interactions, many of which were repeat sightings, were documented and reviewed by ADFG based on standardized annual summer surveys conducted at nearly every sea lion haulout and rookery in Southeast Alaska, Prince William Sound, the Barren Islands, and Bristol Bay from 2013-2017 (Delean et al. 2020). From these observations, 228 incidents of seriously injured Steller sea lions were determined to be unique animals. Among these records, hooking and/or ingestion of fishing gear (n = 114) and entanglement/entrapment in fishing gear and marine debris (n = 107) were most prevalent; the remainder (n = 7) were dependent pups with seriously injured mothers (Delean et al. 2020). No incidents were documented in Cook Inlet during this time, where both observation effort and sea lion density are low.

5.9 Tourism

There are no commercial whale-watching companies operating in upper Cook Inlet, nor are we aware of proposals to begin such operations. Other tourism including aerial flights (such as guided hunting trips and aerial tours) may effect Cook Inlet belugas by circling belugas or flying at low altitudes. NMFS has initiated outreach efforts to educate local pilots of the potential consequences of such actions. Pilots are encouraged to maintain altitudes of 1,500 ft over belugas and not to circle over them.

Tourism continues to grow in lower Cook Inlet, with Homer and Kenai as two popular destinations. Fishing in the Kenai River is a major draw, and a number of commercial vessel-based tour companies operate in the marine waters of lower Cook Inlet, primarily out of Homer. The tour vessels range in size and capacity from six to over 100 passengers, and include fishing as well as wildlife viewing (including marine mammal watching) tours.

There are also a number of commercial flight-seeing tour operators out of Homer. Flights occur over land on the Kenai Peninsula, the waters of lower Cook Inlet (Kachemak Bay), and across the Inlet to places such as Katmai National Park and McNeil River State Game refuge. These planes have the potential to disturb marine mammals, including whales, but particularly pinnipeds on haulouts and rookeries.

5.10 Direct Mortality

Within the action area there are several potential sources of direct mortality, including shooting, strandings, fishery/gear/debris interactions, vessel collisions, predation, and research activities. NMFS is not aware of any illegal shootings of listed marine mammals in Cook Inlet (NMFS Alaska Regional Office Stranding Database accessed August 2022).

5.10.1 Subsistence Harvest

The ESA and MMPA allow for the harvest of marine mammals by Alaska Natives for subsistence purposes and for the creation and selling of authentic native articles of handicraft, providing such takes are not wasteful (16 USC §1371(b)). 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 best available statewide subsistence harvest estimates for Western DPS Steller sea lions are those from 2004 to 2008; annual statewide data on community subsistence harvest stopped being consistently 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 2014-2018 from St. Paul, St. George, and Atka Island, was 209 sea lions per year (Muto et al. 2021).

Past subsistence harvests of Cook Inlet belugas have had a significant effect on the population. An unknown amount of harvest occurred for decades or longer; however, the subsistence harvest increased substantially to unsustainable levels in the 1980s and 1990s. Harvests during 1994-1998 likely account for the population decline during that interval. Cook Inlet beluga whale subsistence harvest discontinued in 1999 as a result of both a voluntary moratorium by the hunters that spring, and the passage of Public Law 106–31, section 3022 (later made permanent by Public Law 106-553, section 627), requiring any taking of Cook Inlet beluga whales by Alaska Natives to occur pursuant to a cooperative agreement between NMFS and affected Alaska Native organizations. A co-management agreement allowed the harvest of two whales in 2005 and one whale in 2006; however, no whales were taken in 2006 due to poor weather and the 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.

With the exception of the harvest of bowhead whales by subsistence hunters in the Alaska Eskimo Whaling Commission's 11 member villages, subsistence hunters in Alaska are not authorized to take any species of great whales, which includes humpback and fin whales (Muto et al. 2021; pers comm G. Balogh), under the Whaling Convention Act (16 USC § 916 et seq.), which implements the International Convention for the Regulation of Whaling. However, one humpback whale was illegally harvested in Kotlik in October 2006, and another in Toksook Bay in May 2016.

5.10.2 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. NMFS maintains an enforcement presence in upper Cook Inlet; however, effective enforcement across such a large area is difficult. NMFS Enforcement has investigated several reports of Cook Inlet beluga whale harassment, but there have been no confirmed poaching incidents.

Historically, Steller sea lions have been poached and illegally harvested throughout their range. The NMFS Alaska Marine Mammal Stranding Program documented 60 Steller sea lions with suspected or confirmed firearm injuries in Southeast and Southcentral Alaska from 2000–2019 (Wright 2016, 2021). Western DPS Steller sea lions with gunshot wounds have been found stranded on shore along the outer Copper River Delta in recent years (Wright 2016, 2021), and two men were convicted for illegally shooting sea lions in that area[27]. It was determined that seven of nine pinnipeds stranded in the surveyed area in 2019 were intentionally killed (Wright 2021).

Few illegal harvests of humpback whales have occurred in Alaska (only 2 cases are known); subsistence hunters in western Alaska were under the misperception that they could legally harvest large whales other than bowheads (e.g., humpback, gray, and minke whales). NMFS knows of no instances of illegal harvest of fin whales.

5.10.3 Stranding

Cook Inlet beluga whales may be 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 occur when belugas attempt to avoid killer whale predation, when they chase prey into shallows and then become trapped by the receding tide, or as a result of injury or illness. From 1988 through 2015 an estimated 876-953 Cook Inlet beluga strandings led to 22 mortalities (NMFS 2016b). Over that same time frame, 214 floating or beached dead belugas were recorded in Cook Inlet (NMFS 2016b). In 2003, an unusually high number of beluga live stranding events (5) occurred in Turnagain Arm (Vos and Shelden 2005). The number of animals stranded ranged from 2 to 46 and led to 5 confirmed deaths (Vos and Shelden 2005). Because beluga groups can contain over 100 individuals, large stranding events involving over 50 individuals have been recorded several times (Vos and Shelden 2005). Even though deaths at the stranding site are recorded infrequently, stranding is a stressful event and may affect beluga health after the event. Stranding events may represent a significant threat to the conservation and recovery of this stock. In a summary of patterns of mortality, McGuire et al. (2020c) found that live stranding was the

[27] United States Department of Justice, The United States Attorney's Office, District of Alaska webpage. Two Alaska men charged with harassing, killing Steller sea lions and obstructing the investigation into their illegal activities. Available at https://www.justice.gov/usao-ak/pr/two-alaska-men-charged-harassing-killing-steller-sea-lions-and-obstructing-investigation, accessed April 11, 2022.

predominant assigned cause of death but represented only ~33 percent of deaths of known cause. Causal factors for the majority of deaths and live strandings are unknown.

In nearly all known cases, strandings of humpback whales represent animals that died at sea of various other causes and washed ashore. One 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.

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 2000a, Raum-Suryan et al. 2009, Muto et al. 2018a).

5.10.4 Predation

Killer whales are the only natural predators for beluga whales and Steller sea lions in Cook Inlet (Muto et al. 2020). Interviews with people who have fished the upper Inlet for 20 to 50 years reported few sightings of killer whales (Shelden et al. 2003). In his study of TEK, Huntington (2000) interviewed Alaska Native beluga hunters who reported that killer whales were rarely seen in the upper Inlet or near belugas. Killer whales were not observed in upper Cook Inlet during approximately 4,000 hours of land- and vessel-based surveys conducted from 2005 to 2017 (McGuire et al. 2020b) nor in Knik Arm by marine mammal observers on watch during construction activities at the POA in 2020. In 2021, from April 26 to September 29 (74 days of observation) 1 group of 2 killer whales was seen by observers (61 North Environmental 2022b). In addition, photographs taken of beluga whales over 13 consecutive field seasons (2005–17) in Cook Inlet did not record any with scars consistent with killer whale attacks (McGuire et al. 2020d). These observations indicate that killer whales are infrequent visitors to Upper Cook Inlet.

However, between June 2009 and May 2010, acoustic recorders detected killer whales 17 times. Most detections were in lower Cook Inlet near Homer Spit, with a single detection at the Tuxedni Bay and Beluga River locations in upper Cook Inlet. Castellote et al. (2016c) had no acoustic detections of beluga whales near Homer Spit from 2008-2013. Of the 17 killer whale detections between 2009-2010, only the one recorded near the Beluga River in upper Cook Inlet was likely from a transient killer whale, which has an acoustic behavior very different and distinguishable from resident killer whales (Barrett-Lennard et al. 1995, Castellote et al. 2016c). The killer whale detection was near Beluga River and was concurrent with the presence of belugas but there is no record of attacks on belugas that year. Transient killer whales prey on marine mammals whereas resident killer whales focus primarily on salmon (Barrett-Lennard et al. 1995). During marine mammal monitoring for a Hilcorp Seismic project killer whales were frequently recorded in Cook Inlet near the entrance of Kachemak Bay (Fairweather Science 2020).

Matkin (2011), in a study of killer whales in lower Cook Inlet in July of 2008, had four encounters with transients (marine mammal-eating) and six encounters with resident (fish-eating) whales. In 2009 all killer whale encounters were with resident killer whales. Two attacks were observed by the transients, one on a humpback whale which was unsuccessful and one on a sea otter. They had no sightings of beluga whales during their surveys in lower Cook Inlet. They noted that transient killer whales tend to use areas where prey is abundant. Because beluga whales are far less abundant than they once were and are concentrated in the upper Inlet which has hazardous conditions for killer whales, the likelihood of killer whale predation is reduced (Matkin 2011).

From 1982-2008, between 9 and 12 beluga whale deaths were suspected to be a direct result of killer whale predation (NMFS 2016b). From 2011 through 2020, NMFS received no reports of killer whale sightings in upper Cook Inlet or possible predation attempts. Prior to 2000, it was estimated that an average of one Cook Inlet beluga whale was killed annually by killer whales (Shelden et al. 2003). From 2001-2012 only three Cook Inlet beluga whales were reported as preyed upon by killer whales but for one of those deaths killer whale was a possible cause of death; the body condition was too poor to make a positive determination (NMFS 2016b). These results could be an underestimate 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). However, the very low number of sightings or acoustical detections in the upper Inlet over the last 20 years indicates that the threat from killer whale predation may be less than initially hypothesized or may have been greater when the beluga population was more robust. The contraction in Cook Inlet beluga summer range to the shallow waters of the upper Inlet may also reduce the opportunity for killer whales to pursue belugas in this area (NMFS 2016).

The risk to Western DPS Steller sea lions from killer whale predation is considered potentially high (Muto et al. 2020), and may be one of the causes contributing to population declines in areas outside of Cook Inlet (Barrett-Lennard et al. 1995). As noted above, an unsuccessful killer whale attack on a humpback whale was recorded in 2008 in lower Cook Inlet. Because the numbers of Steller sea lions and humpback whales are very low in Cook Inlet any isolated predation event that may occur would not have a population level effect.

5.10.5 Vessel Strikes

Beluga whales may be susceptible to strikes from commercial and recreational fishing vessels since both belugas and fishing activities occur where salmon and eulachon congregate. Cargo ships, oil tankers, and barges can also overlap spatially with belugas, creating a risk for vessel strike. 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. In an examination of 106 individuals, 37.7 percent had scars classified as either confirmed or from possible anthropogenic origin; 14 percent had signs of confirmed or possible vessel strike (McGuire et al. 2020d). A Cook Inlet beluga whale death in October 2007 was attributed to a potential vessel strike based on bruising consistent with blunt force injuries (NMFS unpublished data) and a beluga necropsy conducted in October 2012 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).

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 2008e). In 2007, a Steller sea lion was found in Kachemak Bay with two separate wounds consistent with blunt trauma, which may have been due to a boat collision (NMFS Alaska Regional Office Stranding Database accessed May 2022). The risk of vessel strike, however, has not been identified as a significant concern for Steller sea lions.

From 1978-2011, there were at least 108 recorded whale-vessel collisions in Alaska, with the majority occurring in Southeast Alaska (Neilson et al. 2012a). Between 2013-2017, Delean et al. (2020) found that 29 humpback whales were struck resulting in 11.92 mortalities or serious injuries in Alaska and the U.S. West Coast. 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 three documented large cetacean vessel collisions in Cook Inlet since 2001; one humpback whale, one fin 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; where the vessel collided with the whale is unknown. In 2005, a 28 ft charter boat hit an unidentified large cetacean (NMFS Alaska Regional Office Stranding Database accessed May 2022). In 2015, a dead fin whale was discovered at the Port of Anchorage on the bulbous bow of a ship traveling from Seattle; it is unknown where the strike occurred (NMFS Alaska Regional Office Stranding Database accessed May 2022). The very low number of humpback and fin whales in upper Cook Inlet greatly reduce the probability of vessel strike in this area; the risk of strike would be slightly greater in lower Cook Inlet where these whales are more often observed.

5.10.6 Research

Research is necessary to assist in the recovery of threatened and endangered species; however, research activities may also disturb the studied animal(s). Marine mammal research often requires the use of boats, which add to vessel traffic, sound, and pollution the area. Boat-based surveys, such as photo-identification studies, often require the boat to closely approach whales or whale groups. Aerial surveys may also disturb whales, especially when circling at low-altitudes to obtain accurate group counts.

Section 104 of the MMPA allows for the permitting or authorization of the directed take of marine mammals for research, enhancement, or public display, and as with incidental take authorizations, any such permit or authorization must comply with the ESA. Scientific research and enhancement permits that authorize take of ESA listed marine mammals, including Cook Inlet beluga whales, are issued as joint permits under section 104 of the MMPA and section 10(a)(1)(A) of the ESA. In limited situations, permits may be issued under the MMPA only for endangered species if the permit authorizes Level B harassment and it has been determined that the activities will not likely adversely affect the species under the ESA. From 2017 through 2021, 11 MMPA/ESA research and enhancement permits authorized take of Cook Inlet beluga whales; these permits on average authorized approximately 20,680 takes per year. However, the majority of these takes (99 percent) are for remote, non-invasive methods of research during aerial and vessel surveys to conduct population monitoring (see discussion of takes below). In 2019, to support ESA section 7 consultation, the Office of Protected Resources completed a programmatic biological opinion with an extensive analysis of research impacts on endangered cetaceans (NMFS 2019b). A key conclusion of that biological opinion was that proposed research efforts directed at any cetacean population listed as endangered or threatened under the ESA, including Cook Inlet beluga whales, were unlikely to cause a change in abundance or reproduction.

More invasive research activities include animal capture, collecting blood and tissue samples, and attaching tracking devices such as satellite tags. Between 1999 and 2002, NMFS attached satellite tags to 18 beluga whales in upper Cook Inlet (Hobbs et al. 2005). The satellite tags provided data on dive behavior and movement within Cook Inlet (Shelden et al. 2018); however, of the 18 tags deployed in the summer, only 4 provided data into spring. In 2002, a tagged beluga was found dead 32 hours after being tagged. Another two tagged beluga whales, with similar dive patterns and tagged in the same manner as the deceased whale, transmitted data for less than 48 hours, and it is unknown if these whales also perished or were fitted with defective tags (NMFS, unpublished data). The photo identification project, started in 2005, identified many of the tagged belugas; 5 of the 14 tagged whales in the photo-id catalog had visible signs of tag-site infection, 8 had signs of concavity of the dorsal crest above the tag site, and two showed damage to the left pectoral fins, likely caused by flipper bands applied during tagging (McGuire and Stephens 2016). In 2015, a tagged whale washed up dead with an infection at the tag attachment site, potentially the cause of death.

There are many remaining data gaps on Cook Inlet beluga whale biology and ecology, and research efforts will continue (NMFS 2016a). However, managers are cautious and only permit minimally invasive research techniques. Given the consequences of the tagging project and the status of the beluga population, it is unlikely that this type of project will be repeated.

Migura and Bollini (2022), assert that an increase in the authorized number of takes of Cook Inlet belugas projected to occur through 2025 is statistically correlated with the decreasing population size of this population. However, the authors did not evaluate the severity of the potential impacts from the authorized take. The vast majority of the authorized research takes (which comprise over 99 percent of the total authorized take in any year) are for remote, non-invasive methods such as photo-identification during aerial and vessel surveys that have the potential to result in only a minor degree of Level B harassment under the MMPA. Further, the programmatic biological opinion (NMFS 2019) prepared for NMFS' cetacean research and enhancement permitting program determined that these methods (aerial and vessel surveys) are not likely to adversely affect any ESA-listed populations or species, including Cook Inlet beluga whales. NOAA's Office of Protected Resources, Permits and Conservation Division will continue to closely analyze the number of takes requested and used by researchers each year.

In addition to activities involving free-ranging Cook Inlet belugas, a single individual is currently housed in captivity. "Tyonek," a young calf, live-stranded near Trading Bay in Cook Inlet in 2017. With authorization from NMFS, the Alaska Sealife Center and partners provided rehabilitative care; however, NMFS determined that the animal was non-releasable due to underlying medical problems. Tyonek is now permanently located at Seaworld San Antonio, Texas, pursuant to a scientific research and enhancement permit, which includes an educational component. NMFS considers this to be a unique incident; there are no plans to house additional Cook Inlet beluga whales in captivity in the foreseeable future. Therefore, the long-term holding of Tyonek in captivity does not contribute to the DPS's endangered status.

Since 2005, researchers from LGL Alaska Research, Inc. have photographed beluga whales in upper Cook Inlet as part of a photographic-identification project conducted for NMFS, the National Fish and Wildlife Foundation, Chevron, and Conoco Phillips Alaska, Inc. Photographs are taken from small boats and on land, and later analyzed and cataloged into an extensive database (McGuire et al. 2008, McGuire et al. 2009, McGuire et al. 2011, McGuire et al. 2013, McGuire et al. 2014, McGuire and A. 2016). In 2011, this project was expanded to include waters of the Kenai Peninsula Borough. Boat-based surveys, such as the photo-identification study, often require the boat to come within close proximity of a whale or group of whales being studied, likely increasing noise in the immediate area.

Various researchers have deployed hydrophones and collected acoustic data at and near Eagle Bay, Cairn Point (POA), Fire Island, Beluga River, Trading Bay, Kenai River, Tuxedni Bay, and Kachemak Bay (e.g., (Širović and Kendall 2009, HDR Alaska 2011, GSI 2012, Castellote et al. 2016b)). Passive acoustic monitoring often requires a boat to deploy and recover hydrophones. The boat temporarily increases noise in the immediate area during deployment and recovery, which may cause disturbance to nearby beluga whales. However, once the instruments are deployed, this type of monitoring remains noninvasive because the recording devices are generally anchored on the seafloor or suspended in the water column passively recording sound from the environment.

Several development projects (ongoing and planned) have conducted research or monitored the presence of Cook Inlet belugas and marine mammals in their respective action area. For instance, the Knik Arm Bridge and Toll Authority (KABATA) collected baseline environmental data on beluga whale activity to be used to evaluate the potential impact of a proposed bridge crossing in Knik Arm, north of Cairn Point. Boat and land-based observations were conducted in Knik Arm from July 2004 through July 2005 (Funk et al. 2005), and in the fall of 2011, KABATA conducted a "Proof of Concept" study to test visual and acoustic methods' abilities to detect beluga whales near the project site prior to implementing the full scale monitoring once construction begins (HDR 2011). In addition to KABATA's studies, land-based marine mammal observers have been utilized for other development projects. For example, the POA utilized marine mammal observers during the in-water work, and sponsored research on presence and habitat use of Cook Inlet belugas near the POA's expansion site (Cornick and Kendall 2008, Cornick and Saxon-Kendall 2009, Cornick et al. 2010). In 2009-2010, Ocean Renewable Power Company (ORPC) sponsored land-based observations from Fire Island documenting belugas near a potential hydrotidal project site (McGuire et al. 2011).

Although research could have an effect on beluga whales, it is expected that research will continue because there are many remaining data gaps on the biology and ecology of the Cook Inlet beluga (NMFS 2008b). Likewise, research will continue on other listed species in the action area.

There have been no known instances of research-related deaths of humpback or fin whales in the action area. 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. We have no knowledge of whether such stampedes associated with research have been caused within the action area.

5.11 Climate Change

Climate change can cause direct effects to listed species as well as changes in human activities that result in indirect effects. For example, less ice could lead to increased vessel activity with an associated increase in noise, pollution, and risk of ship strike.

Changes in prey availability to belugas may result from changes in the total availability, quality, species composition, and seasonality of prey. While the potential exists for human fishing pressure to change the abundance, seasonality, or composition of beluga whale prey, fisheries in Alaska are managed with the goal of sustainability. However, not all fish stocks are assessed, and it is unknown whether management of fisheries for optimal returns for humans provides sufficient densities in beluga feeding areas for efficient foraging by belugas (NMFS 2016).

Specific to Cook Inlet beluga whales, the greatest climate change risks may be potential changes in salmon and eulachon abundance. These changes could occur through regime shifts and changes in ocean ecosystems as discussed in section 4.2 and/or through changes in these species' freshwater habitat. Temperature and hydrology control several critical stages in the life cycle of salmonids in their freshwater habitats. During periods of rapid climate change, these can have significant effects on anadromous salmonid populations (Bryant 2009).

Temperature is the most important abiotic factor influencing the physiology of fishes and the pathogenicity of their disease organisms (Brett 1971, Marcogliese 2001). Consequently, fish are particularly vulnerable to mortality during periods of increased water temperatures. High water temperatures may cause mortality through several mechanisms, including increased virulence of pathogens, increases in metabolic rate that outstrip energy resources, and an oxygen demand that exceeds the heart's capacity to deliver oxygen (von Biela et al. 2020). Stream temperatures are closely related to air temperatures (Mohseni and Stefan 1999). October 2019 to September 2020 represented the second warmest 12-month period of observed surface air temperatures over the Arctic land during the last century (Ballinger et al. 2020). This continued the pattern of 7 consecutive years (and 9 of the last 10 years; 2014 to 2020) where the surface air temperature anomalies were at least 1ºC warmer than the 1981-2010 mean (Ballinger et al. 2020). June and especially July 2019 set air temperature records over much of Alaska and the southern Yukon Territory[28].

These warm air temperatures translated into warm stream temperatures in July 2019 across Alaska. Reports of salmon dying before they could spawn were recorded in the Yukon River (von Biela et al. 2020), the Koyukuk (Westley 2020), the Igushik River, a tributary to Bristol Bay where it was estimated that a minimum of 100,000 salmon died,[29] and the Kuskokwim.[30] The parasites *Ichthyophonus* (a protozoan) and *Henneguya* (a cnidarian) which cause tapioca disease were prevalent in the salmon from the Kuskokwim. Prespawning mortality has also been documented recently in several Pacific Northwest watersheds, including the Fraser River in British Columbia (Hinch et al. 2012, Martins et al. 2012) and streams in the Lake Washington Basin (Washington)(Barnett et al. 2020). Barnett et al. (2020) concluded that warming conditions during migration and spawning, in concert with other factors such as infections with pathogens, were responsible for the increased prespawning mortality of adult sockeye salmon high enough to threaten the population's viability.

Mauger et al. (2017) monitored stream temperature during open-water periods from 2008 to 2012 in 48 nonglacial streams across the Cook Inlet basin. They found that numerous nonglacial watersheds in the Cook Inlet region had stream temperatures that exceeded threshold maximum weekly maximum temperature (MWMT) ranges identified by the US EPA (EPA 2003) for the protection of salmon life stages. These criteria, above which chronic and sublethal effects become likely, are 13 °C for spawning and egg incubation, 16–18 °C for juvenile rearing, and 18–20 °C for adult migration (EPA 2003). Even in their relatively cool sampling period, MWMT at most sites exceeded the established criterion for spawning and incubation during every year of the study, which suggests salmon in some streams are already experiencing thermal stress in the Cook Inlet region (Mauger et al. 2017). Of note is that the Deshka River (tributary to the Susitna) had MWMT temperatures above 20°C in 3 of the 5 years of study and over 18°C in 4 years (Mauger et al. 2017). As stream temperatures gradually increase in response to increasing air temperatures, critical thresholds will likely be exceeded more often, especially when warm air temperature anomalies occur.

[28] https://www.ncei.noaa.gov/news/national-climate-201912

[29] https://www.alaskapublic.org/2020/01/15/in-some-bristol-bay-rivers-the-hottest-month-on-record-was-deadly-for-salmon/

[30] https://www.kyuk.org/post/record-warm-water-likely-gave-kuskokwim-salmon-heart-attacks

Thermal regimes in freshwater ecosystems will change as air temperatures increase regionally. As air temperatures increase, the distribution and intensity of precipitation will change which will in turn alter freshwater hydrology (Bryant 2009, Shanley and Albert 2014). Shifts in the amount, intensity, and form (more rain vs. snow) of precipitation are anticipated to alter the hydrological regimes of streams in southeast Alaska (Shanley and Albert 2014). In the future, predicted hydrologic change associated with climate change may be the biggest challenge to Pacific salmon conservation and management (Shanley and Albert 2014). In examining the decline of two Chinook populations in Alaska (Chena and Salcha rivers), Neuswanger et al. (2015) found that low productivity was strongly associated with high stream discharge during the summer of freshwater residency for young-of-the-year Chinook salmon. The association was more consistent with the hypothesis that sustained high discharge negatively affected foraging conditions than with acute mortality during floods. Productivity may have also been reduced in years when incubating eggs experienced major floods or cold summers and falls (Neuswanger et al. 2015).

An additional challenge to salmon production in Cook Inlet is exemplified by Alexander Creek and the Deshka River, tributaries to the Susitna River. Pike were illegally introduced to the Susitna River basin in the 1950s and occupy both streams (Sepulveda et al. 2015). Some of the worst declines in salmon populations from pike predation have occurred in Alexander Creek (Dunker et al. 2020). Sepulveda et al. (2015) found that salmonids constitute the major prey items for pike in the Deshka River and in the lower reach of Alexander Creek throughout the summer. They estimated that pike in Alexander Creek could consume 193,000–553,000 juvenile salmon each summer. These consumption estimates equal 45–100 percent of the Chinook salmon smolts produced by returning adults prior to their decline in 1999 (Sepulveda et al. 2015). Efforts are being made to keep the pike numbers in check through suppression (annual gillnetting) and eradication through the use of piscicides (Dunker et al. 2020). The Alaska Department of Fish and Game has written a management plan for controlling pike (ADFG 2007). Over half of the Susitna River Basin contains suitable habitat for pike and these streams are also important rearing habitats for juvenile salmon, especially chinook and sockeye which spend one, or one to four years in freshwater, respectively, before emigrating to salt water. Warmer water temperatures would favor pike in these streams.

Population modeling done by Norman et al. (2020) suggested that reproductive success of Cook Inlet beluga whales is tied to salmon abundance in the Deshka River. The mechanism model with the best fit was the sum of Chinook and coho in the year of beluga birth and year prior to birth. Simulations showed that if salmon runs remained at their current levels, the Cook Inlet beluga whale population would likely continue its current slow decline and per capita births would continue to be low. They suggest that the population is likely dependent on the Chinook run, and to a lesser degree, the coho run, because coho have less than one-quarter of the energy content of the Chinook (Norman et al. 2020). Although this analysis is informative, given that Cook Inlet beluga whales forage at several streams throughout the summer it is unlikely that their survival depends entirely salmon returns in the Deshka River. More likely they are dependent on the portfolio effect as first described for the Bristol Bay watershed (Schindler et al. 2010) but which applies to other ecosystems as well (Schindler et al. 2015). The concept is that aggregate systems are often less volatile than their components (Schindler et al. 2015). Individual streams may not have good returns on a given year but because of the size of the watershed and the physical and biological variability among the streams, the end result is a stable production of salmon. For the Cook Inlet beluga whales, most likely they are not totally dependent on production of one species in one stream within the Susitna watershed or only on the Susitna watershed alone, but rely on the combined escapement from multiple watersheds. The results from Castellote et al. (2020b) and the summer aerial surveys (Shelden and Wade 2019) supports this idea. However, the concept that food resources may be limiting a cetacean population is not new as reduced prey availability (Chinook salmon) has been directly linked to increased mortality and reduced health and survival of the Southern Resident killer whale (Ward et al. 2009, Wasser et al. 2017).

In summary, the effects of climate change will likely create several challenges to Cook Inlet beluga whales, primarily through impacts to their primary prey species, salmon. Warmer ocean temperatures, warmer stream temperatures, and warmer air temperatures will likely create many challenges and changes to the freshwater and marine ecosystems that salmon depend on. Pre-spawning salmon mortalities, reductions in returns, and shifts in run timing have already been documented. It remains to be seen how adaptable both salmon and belugas can be in the face of rapidly changing conditions.

Whether recent increases in the presence of humpback whales in Cook Inlet can be attributed to climate change, humpback whale population growth, and/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. 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 changes disproportionately benefit 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 of the Pacific marine heatwave. The mortalities were also concurrent with one of the strongest El Niño 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[31], 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 Niño-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 2010b, 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.

5.12 Natural Catastrophic Changes

The critical habitats for Cook Inlet beluga whales and Steller sea lions are 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 substantially affect Cook Inlet beluga and Steller sea lion critical habitat by: decreasing prey abundance as a result of direct mortality; rendering habitat unsuitable for Cook Inlet beluga and Steller sea lion prey species; directly removing habitat areas (e.g., elevation changes, landslides, and tsunamis could remove haulouts and rookeries or block access to critical habitat); and degrading habitat quality (e.g., volcanic ash outfall could affect siltation and water chemistry) (NMFS 2016b). Natural catastrophes are not known to have impacted these species.

5.13 Summary of Environmental Baseline

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

- Coastal development, particularly at the Port of Anchorage, has resulted in exposure of beluga whales to noise levels capable of causing harassment.

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

- Oil and gas development has resulted in 231 spills in the Cook Inlet region in the last 10 years.
- Seismic exploration has introduced anthropogenic sound into the marine environment of Cook Inlet, creating zones as large as 9.5 km-radius in which sound was sufficiently loud to cause harassment. Seismic exploration has resulted in harmful Level A sound exposure to both humpback and beluga whales. It has also resulted in the temporary degradation of Cook Inlet beluga whale habitat.
- Fisheries co-occur with concentrations of beluga prey and may compete 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.
- Commercial fisheries may reduce prey availability.
- Prior to 1999, subsistence whaling for Cook Inlet beluga whales by Alaska Natives represented the largest known anthropogenic mortality for the stock. The population had seriously declined since 1979, from about 1,300 whales to 347 whales at the time of the moratorium (NMFS 1999). The last beluga was harvested in 2005.
- 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 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.
- Propeller scars observed on belugas may have resulted from collisions with recreational or commercial fishing boats.
- Whether contaminants have resulted in the degradation of Cook Inlet beluga whale 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.
- One Cook Inlet beluga whale died shortly after attachment of a satellite transmitter in the early 2000s. Another two tagged beluga whales, with similar dive patterns and tagged in the same manner as the deceased whale, transmitted data for less than 48 hours, and it is unknown if these whales also perished or were fitted with defective tags (NMFS, unpublished data). Another died in 2015 with an infection at the tag attachment site. NMFS no longer authorizes invasive research with these tags (or similar tags) of Cook Inlet beluga whales, and 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. The feeding range of humpback and fin whales is larger than that of other species and consequently, as feeding generalists, it is likely that these two species may be more resilient to climate change than other species with more restricted ranges and foraging habits. Although the effects of climate change and other large scale environmental phenomena on Steller sea lion and Cook Inlet beluga whale habitat cannot be predicted with certainty, impacts to their prey from oceanic regime shifts, or changes in freshwater habitat (hydrologic changes, increased water temperature) are projected to occur.
- The beluga whale has undergone notable summer range restriction in recent years, and whales now occur predominantly in upper Cook Inlet.

The Cook Inlet beluga population has declined for unknown reasons, the population trend of Western North Pacific DPS and Mexico DPS of humpback whales is unknown, and the population trend of fin whales is unknown. In contrast, Western DPS Steller sea lions within Southcentral Alaska appear to be stable or increasing. Although we do not have information on other measures of the demographic status of Steller sea lions (for example, age structure, sex ratios, or the distribution of reproductive success) that would facilitate a more robust assessment of the probable impact of factors discussed in the Environmental Baseline,[32] we infer from their increasing abundance in the vicinity of Cook Inlet that no factor alone or in combination is preventing this population from increasing in this area.

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. 2020). 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 2016a) outlines multiple threats to Cook Inlet beluga whales. Many of the projects and issues discussed in this Environmental Baseline are specific examples of these types of threats (e.g., sound, habitat loss or degradation, pollution, cumulative effects, etc.).

[32] 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 are 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 exploration activities. Then we provide a description of the potential effects of development, production, and decommissioning that could arise from leases issued by BOEM/BSEE in LS 258 as those effects are currently understood. Future incremental steps (development, production, and decommissioning) are not considered reasonably certain to occur and would require additional NEPA analysis and additional consultation under the ESA.

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.

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

The first incremental step consists of activities associated with exploring and delineating a prospect on the block acquired during LS 258 (marine seismic, shallow geophysical, geotechnical surveys, and exploratory drilling).

Stressors are any physical, chemical, or biological phenomenon 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 proposed oil and gas exploration activities may cause these primary stressors to marine mammals:

1. Acoustic stressors; impulsive: 2D/3D seismic surveys, geohazard/geophysical surveys, tugs pulling a jack up rig, VSP, and pile driving;
2. Acoustic stressors; non-impulsive: support vessels, aircraft, and drilling and pumping operations;
3. Vessel strike;
4. Seafloor disturbance from drilling activities, equipment, or drill cuttings;
5. Introduction of trash and debris that may cause entanglement or harm through ingestion;
6. Pollution from unauthorized spills and authorized discharge; and
7. Oil spill drill activities

We evaluate stressors and determine if they are ‘minor’ or ‘major.’ Minor stressors are those in which the effects will be undetectable, minor, improbable, or rare. For endangered or threatened species, we consider the susceptibility of the species that may be exposed; for example, a stressor may be considered minor if species are exposed to sound produced by vessels or aircraft, but are not likely to exhibit physical, physiological, or behavioral responses given that exposure (at the combination of sound pressure levels and distances associated with an exposure).

Major stressors are those which may have more measurable effect on the species. First we discuss the minor stressors followed by major stressors (section 6.1.2). Because many of the activities in the future incremental steps are the same as those proposed for the first incremental step, we discuss both actions together as appropriate while highlighting any significant differences. Of the stressors listed above, most of the activities in number 1 represent major stressors (2D/3D seismic surveys, tugs pulling a jack up rig, and pile driving). However, geohazard/geophysical surveys nd the activities listed in stressors 2 through 6 represent minor stressors. A large or very large oil spill could be a major stressor and we discuss large spills in section 6.3.4 Spills in Future Incremental Steps.

6.1.1 Minor Stressors on ESA-Listed Species and Critical Habitat

6.1.1.1 Vessel noise

Mitigation Measures to Minimize the Likelihood of Exposure to Vessel Noise

As discussed in Section 2.3, the following mitigation measures will be required through BOEM and BSEE’s permitting process to avoid or minimize exposure of marine mammals to vessel noise:

1. PSOs are required on seismic source vessels, drilling vessels, and other vessels engaged in activities that may result in an incidental take through acoustic exposures;

2. Vessels in transit shall be operated at speeds necessary to ensure no physical contact with whales occurs. Vessels will avoid multiple speed changes and reduce speed to ≤10 kn when within 300 yards (274 m) of whales, especially during poor visibility, to reduce the potential for collisions; and

3. Vessels will not approach within 100 m of marine mammals.

4. Vessels will not be operated in such a way as to separate members of a group of marine mammals

General vessel transit includes geophysical and geotechnical survey transits, the vessels associated with the 2D and 3D seismic surveys, support vessels, vessels used for pipe laying, and vessels used for oil response exercises. In addition, vessels of various types and sizes are used for transport of crew and supplies to the rigs and platforms, and for other maintenance activities. Cook Inlet beluga, Western North Pacific DPS humpback, Mexico DPS humpback, fin whales, and Steller sea lions all occur in the action area and are expected to be exposed to noise associated with vessel transit. Vessels will likely pass through designated critical habitat for Cook Inlet beluga whales but they are unlikely to overlap with Steller sea lion critical habitat as project activities will be focused in Cook Inlet (north of their critical habitat) and vessel noise is not expected to extend beyond 100 m of the vessel. Vessel traffic in and out of the southern entrance to Cook Inlet is not expected; Homer is the port most likely to be used as the base for vessels as it is the closest port to the block sold.

BOEM indicated that during the first incremental step 5 vessel trips per week are expected, and for production, development, and decommissioning 7-42 boat trips per week are expected at each stage (BOEM 2022a). However, the higher estimates are tied to the development of up to 6 platforms which, is a very unlikely outcome given that only one lease block sold. For that reason we expect that the actual number of boat trips per week for each step will be at the lower end of the range provided (e.g. 7-10 trips per week).

The primary underwater sound associated with vessel operations is the continuous cavitation sound produced by the propeller arrangement. Bow thrusters are occasionally used for a short duration (20 to 30 seconds) to either push or pull a vessel in or away from the dock or platform. Other sound sources include onboard diesel generators and sound from the main engine, but both are subordinate to the thruster and main propeller blade rate harmonics (Gray and Greeley 1980). Vessel noise varies widely based on horsepower, vessel size, power source, condition and design of the propellers, and vessel speed (Kipple and Gabriele 2004, Abrahamsen 2012, Veirs et al. 2016, Halliday et al. 2021). In 2001, underwater sound measurements from vessels in transit were recorded in Cook Inlet. The highest source level reported was 150 dB re 1 µPa rms at 1 m (Blackwell and Greene 2003). The 120 dB isopleth was calculated using the practical spreading loss model (15 Log R), resulting in a radius of approximately 100 meters.

6.1.1.1.1 Cetacean exposure and response

Reactions of marine mammals to vessels often include changes in general activity (e.g., from resting or feeding to active avoidance), changes in surfacing-respiration-dive cycles, and changes in speed and direction of movement (NMFS 2013). Past experiences of the animals with vessels are important in determining the degree and type of response elicited from an animal-vessel encounter. Whale reactions to slow-moving vessels are less dramatic than their reactions to faster and/or erratic vessel movements(Clapham and Mattila 1993). Some species have been noted to tolerate slow-moving vessels within several hundred meters, especially when the vessel is not directed toward the animal and when there are no sudden changes in direction or engine speed (Wartzok et al. 1989b, Richardson et al. 1995a, Heide-Jorgensen et al. 2003). Vessels moving slowly and in directions not toward the whales usually do not elicit strong reactions (Richardson and Malme 1993).

Marine mammals may habituate to, tolerate, or avoid surface vessels moving toward them (Wartzok et al. 1989a, Clapham and Mattila 1993, Blackwell and Greene 2003). Animals have been observed reducing their visibility at the water's surface and moving horizontally away from the source of disturbance or adopting erratic swimming strategies (Williams et al. 2002, Lusseau 2003, 2006). Dive times increased, vocalizations and jumping decreased (with the exception of beaked whales), individuals in groups moved closer together, and swimming speeds increased (Kruse 1991, Evans et al. 1994). Most animals in confined spaces, such as shallow bays, tended to move towards more open, deeper waters when vessels approached. This movement likely provided more opportunities to avoid or evade vessels as conditions warranted. It is unclear if these responses are caused by the physical presence of the vessel, the underwater sound generated by the vessel, or an interaction between the two (Goodwin and Cotton 2004, Lusseau 2006). However, several authors suggest that the vessel sound is probably an important factor (Evans et al. 1992, Blane and Jaakson 1994, Evans et al. 1994).

Baleen whales vocalize at low frequencies over long distances, and masking is a concern as their communication frequencies overlap with anthropogenic sounds such as shipping traffic. Some baleen whales have adjusted their communication frequencies, intensity, and call rate to limit masking effects (Fournet et al. 2018, Gabriele et al. 2018). Baleen whales may also exhibit behavioral changes in response to vessel sound. Marine mammals that have been disturbed by anthropogenic sound and vessel approaches are commonly reported to shift from resting behavioral states to active behavioral states, suggesting an energetic cost to the affected animal. Humpback whales are especially responsive to fast moving vessels (Richardson et al. 1995b), exhibiting aerial behaviors such as breaching or tail/flipper slapping (Jurasz and Jurasz 1979). In Hawaii, humpbacks responded to vessels at distances of 2 to 4 km (Baker et al. 1983); however, feeding humpbacks showed no reaction at distances beyond 800 m (Watkins 1981, Kreiger and Wing 1986). Despite the presence of vessels, temporarily disturbed whales often remain in the area (Baker et al. 1988, Baker et al. 1992).

Fin whales have responded to vessels at distances of about 1 km (Edds and Macfarlane 1987). Watkins (1981) found that fin and humpback whales appeared startled and increased their swimming speed to avoid approaching vessels. Jahoda et al. (2003) studied responses of fin whales in feeding areas when they were closely approached by inflatable vessels. The study concluded that close vessel approaches caused the fin whales to swim away from the approaching vessel and to stop feeding. These animals also had increases in blow rates and spent less time at the surface (Jahoda et al. 2003). This suggests increases in metabolic rates, which may indicate a stress response. All these responses can manifest as a stress response in which the mammal undergoes physiological changes with chronic exposure to stressors. Stress responses can interrupt behavioral and physiological events, alter time budget, or cause a combination of all these stressors (Sapolsky 2000, Frid and Dill 2002). Mitigation measures for vessels associated with LS 258 would prevent vessels from approaching any whale or cutting it off greatly reducing interactions that might startle a whale.

Beluga whale responses to vessel sound varies greatly from tolerance to extreme sensitivity, depending on the activity of the whale and previous experience with vessels (Richardson et al. 1995b, Blackwell and Greene 2003). In the St. Lawrence River, where vessel traffic is common, belugas were more tolerant of vessels, but responded differentially to certain vessels and operating characteristics by reducing their calling rates (especially older animals). Belugas in pristine habitat of the Canadian high Arctic, were observed rapidly swimming away from ice-breaking vessels up to 80 km (49.7 mi) away. The whales also showed changes in surfacing, breathing, diving, and group composition (Finley et al. 1990). Because of the contraction of their occupied habitat and the rarity of sightings of belugas in lower Cook Inlet (2 in Kachemak Bay in 2001)(Shelden and Wade 2019) and because we expect the majority of vessel traffic associated with LS 258 will occur in the summer months when Cook Inlet belugas will be in upper Cook Inlet, the chances of beluga whales being exposed to vessel noise associated with LS 258 is exceedingly low. In addition, vessel noise is primarily low-frequency. The majority of the broadband sound from vessels occurs below the most sensitive portions of beluga whale hearing (Blackwell and Greene 2003).

Ships in transit travel in a consistent and predictable direction and speed, essentially providing acoustic warning of their arrival long before arriving at a given location. Consequently, we would not expect a startle response from any individual cetacean. Individuals 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 expected to be very short in duration and not likely to result in significant disruption of normal behavioral patterns.

Some fin or humpback whales could receive sound levels in exceedance of the acoustic threshold of 120 dB from the vessels or be disturbed by their visual presence. Because vessels will be in transit, the duration of the exposure will be very brief (a vessel with a source level of approximately 170 dB at 1 meter travelling at 10 knots will be audible at received levels exceeding 120 dB at a fixed point in space for a maximum duration of about 12 minutes). We anticipate that noise associated with transport vessels would drop to 120 dB in approximately 100 meters of most vessels associated with the proposed oil and gas exploration activities (Blackwell and Greene 2002). Considering that NMFS regulations restrict approaching humpback whales within 100 yards (see, e.g., 50 CFR §224.103(b)), and the mitigation measures require transiting vessels to stay 100 yards away from all marine mammals and reduce speed to ≤10 kn when within 300 yards (274 m) of whales, it is unlikely that fin or humpback whales will be exposed to harmful levels of sound. If animals do respond to a vessel, they may deflect away from the noise source, display short-term vigilance behavior, or increase the amplitude of their calls, but these behaviors are not likely to result in adverse consequences for the animals. The short duration of a low level of sound is not expected to be a significant disruption of important behavioral patterns such as feeding, breeding, or resting.

Over the life of the project (40 years), LS 258 could increase vessel traffic in lower Cook Inlet by approximately one vessel per day (BOEM 2022a). Based on the implementation of mitigation measures, the transitory and short-term exposure, and the expected low level of response, NMFS concludes that any disturbance of humpback and fin whales from vessel noise will be temporary and have a minor, if any, effect on their behavior and no long term effect on their survival or fitness. As explained above, the very low occurrence of beluga whales near the project area makes their exposure to vessel noise improbable.

6.1.1.1.2 Steller sea lion response to vessel noise

None of the planned activities related to LS 258 occur near a rookery or haul out where Steller sea lions would be more likely disturbed by vessel traffic. During Hilcorp's seismic operations in lower Cook Inlet in 2019, 60 percent of Steller sea lion sightings occurred during periods of no seismic activity, while 40 percent of sightings were observed during seismic activity, including during operation of the full airgun array. Two of the Steller sea lions showed detectable reactions, but these occurred during periods of no work; both animals exhibited a "look" reaction that appeared to be in response to vessel presence. The average sighting distance for Steller sea lions during periods of non-seismic activity was ~311 m, and ~1,928 m during seismic operations (Fairweather Science 2020). Richardson (1995) found vessel noise does not seem to strongly affect pinnipeds that are already in the water, explaining that hauled out seals often respond more strongly to the presence of vessels, typically fleeing into the water, increasing the risk of injury to themselves and smaller individuals that may be trampled. The same is true of Steller sea lions (NMFS 2010b).

The effects of vessel presence on sea lions in open water is likely to be temporary and transient in nature as the vessel approaches and passes sea lions. With the implementation of the mitigation measures, the low likelihood of exposure to noise that would significantly disrupt an animal's behavioral patterns, the short duration of spatial overlap, and low densities of Steller sea lions in the area, any impacts to sea lions from vessel sound are expected to be undetectable and minor.

6.1.1.1.3 Effects of Vessel Noise on Critical Habitat

As mentioned at the beginning of this section, vessel noise is not expected to overlap with critical habitat for Steller sea lions. However, vessels departing and returning to port in Homer would transit over Area 2 of critical habitat for beluga whales in Kachemak Bay. It is unlikely that vessels would need to enter the narrow strip of Area 2 critical habitat along the western edge of Cook Inlet. Area 2 was designated as it primarily supports fall and winter use areas.

The PBFs for Cook Inlet beluga whale critical habitat are:

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

The intent of this PBF is to protect important beluga feeding habitat. The shallow depths and bottom structure which can occur near the mouths of streams act to concentrate prey and aid in feeding efficiency by belugas. Vessel noise will not affect this PBF because vessel noise will not affect the ability of these areas to concentrate fish (i.e. noise will not change substrate structure). In addition, we do not expect vessels associated with project activities to be transiting across shallow intertidal mudflats in Cook Inlet.

- 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.

The acoustic disturbance from transiting vessels could impact beluga summer food resources (e.g. salmon and eulachon) as these anadromous fish transit through the action area on their migration to spawning streams. However, while vessel traffic may cause a momentary startle or flight response in these prey species, such effects are not expected to impact prey survival or productivity, and effects to them are expected to be undetectable.

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

Vessel noise will have no effect on toxins.

- Unrestricted passage within or between the critical habitat areas.

Vessel noise dominates the low-frequency bands and has a maximum sound level that ranges between approximately 160 to 220 dB re 1 μPa @ 1 m with maximum energy between 10 Hz to 1 kHz and a steep negative slope above 80 Hz. The majority of the broadband sound from vessels occurs below the most sensitive portions of beluga whale hearing, mitigating its effects to this PBF. It is very unlikely that vessel noise would impede beluga passage in an area that they seldom occupy.

- Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.

Vessel noise is expected to attenuate to levels not expected to harass beluga whales within about 100 m of the vessel, making it unlikely that vessel traffic would impede access to critical habitat areas or cause abandonment of these areas. Beluga whales have not abandoned waters near the Port of Anchorage where noise levels are much higher and it is very unlikely that the infrequent passage of vessels in lower Cook Inlet would cause abandonment of Area 2 critical habitat.

Although LS 258 will lead to an increase of approximately one vessel per day departing and arriving at the Homer port through the life of LS 258, the slight increase in noise that this will create is not expected to affect any of the PBFs of Cook Inlet beluga whale in a measureable way.

6.1.1.2 Aircraft noise

Mitigation Measures to Minimize the Likelihood of Exposure to Aircraft

As discussed in Section 2.3, the following mitigation measures will be required through BOEM and BSEE's permitting process to avoid or minimize exposure of marine mammals to aircraft noise:

1. Aircraft are required to operate at least 1,500 ft (457 m) above sea level when within 500 lateral yards (457 m) of marine mammals, except for an emergency or navigational safety. In addition, aircraft will avoid the Steller Sea Lion critical habitat air zones by remaining 3,000 feet above designated rookeries and major haulouts.
2. When weather conditions do not allow a 1,500 ft (457 m) flying altitude, such as during storms or when cloud cover is low, aircraft may be operated below 1,500 ft (457 m), but the operator should avoid known marine mammal concentration areas and take precautions to avoid flying directly over or within 500 yards (457 m) of marine mammals.
3. Helicopters will not hover or circle above marine mammals.
4. Support aircraft must avoid extended flights over the coastline to minimize effects on marine mammals in nearshore waters or the coastline.

Exploration surveys (including one airborne geophysical survey), drilling operations, and oil spill drill efforts may be supported by fixed-wing and rotary aircraft. Helicopters will be used for crew changes and delivery of supplies to platforms and drilling rigs. During the exploration step up to 14 aircraft flights per week could be required. During the development, production, and decommissioning stages, BOEM is projecting that 7-42 flights per week would be needed. However, as with vessel traffic, these numbers assumed up to 6 platforms would be built. It is more likely that a single platform might be built. For that reason we expect that the number of flights per week during development, production, and decommissioning are likely to be around 7 per week. Flights would originate from Homer or Nikiski.

Oil spill drills may also use aircraft. BOEM assumes 1-2 exercises per year, during the first incremental step and one per year for the future incremental steps, each lasting no more than one day. Oil spill response drills of the scope that would employ aircraft occur infrequently. The estimated flights per week (7) include those that might be needed for oil spill drills(BOEM 2022a). The number and type of aircraft would very dependent on the exercise. It is assumed aircraft would be staged out of shore bases in Kenai, Nikiski, Homer, or Anchorage (BOEM 2022a).

Helicopters generate sound from their engines, airframe, and propellers. Transmission of aircraft sound into the water is greatest directly below the aircraft, and much of the sound is reflected and does not penetrate at angles greater than 13 degrees from vertical. The duration of underwater sound from passing aircraft is also much shorter in water than air. A helicopter flying at an altitude of 152 m (~500 ft) is audible in air for 4 minutes, underwater at 3 m (10 ft) depth for 38 seconds, and underwater at 18 m (59 ft) depth for 11 seconds. Received sound levels in water from aircraft flying at an altitude of 152 m (~500 ft) were 109 dB re 1 µPa for a Bell 212 helicopter, 101 dB re 1 µPa for a small fixed-wing aircraft, 107 dB re 1 µPa for a twin otter, and 124 dB re 1 µPa for a P-3 Orion (four- engine turboprop)(Richardson et al. 1995b).

Helicopters would follow a direct route (to and from a platform) and will maintain an altitude of 450 m (1,500 ft) or higher for all aircraft operations, unless human safety is at risk or it is operationally impossible. During take-off and landing of a helicopter, we expect only a small amount of sound would penetrate the water for a short period of time because the helicopter will be moving nearly vertically over the helipad and most of the sound is reflected by the water surface back into the atmosphere, and does not penetrate water at angles greater than 13 degrees from vertical. Given the short amount of time that sound from aircraft is present in water and the shallow depth to which it is confined, given the required flight altitude (1,500 ft) acoustic disturbance to marine mammals is expected to be minimal.

6.1.1.2.1 Cetacean exposure and response

Marine mammals could be disturbed by the acoustic received sound or physical presence of low-flying aircraft. Airborne noise and visual cues are more likely to disturb individuals resting at the sea surface or hauled out on ice or land (BOEM 2012b). Marine mammals underwater at the time of exposure could also be disturbed by sound propagating beneath the surface of the water or by shadows of an aircraft flying overhead. Observations made from low-altitude aerial surveys report highly variable behavioral responses from marine mammals ranging from no observable reaction to diving or rapid changes in swimming speed/direction (Efroymson and Suter 2001, Smultea et al. 2008). In general, it is difficult to determine if behavioral reactions are due to aircraft sound, to the physical presence and visual cues associated with aircraft, or a combination of those factors (Richardson et al. 1995b).

Research into the responses of baleen whales to aircraft sound is limited. Reactions are likely influenced by group size and behavioral activity (Richardson et al. 1995b, Patenaude et al. 2002, Weilgart 2007, Luksenburg and Parsons 2009), with whales in larger feeding or social groups reacting less than whales in confined waters or with calves. Some humpback whales have shown a response to an aircraft at 305 m, while other whales have shown no response to an aircraft at 152 m (Richardson et al. 1995b).

During NMFS Marine Mammal Laboratory aerial surveys, conducted in a fixed-wing aircraft at 244 m (800 ft), belugas were often seen swimming in the same direction and speed without any observed change in activity while the aircraft circles (Rugh et al. 2000). Individual responses may vary, depending on previous experiences, beluga activity at the time of the sound, and sound characteristics.

The proposed project expects that aircraft use may increase by approximately one flight per day over the life of the project (BOEM 2022a). With the implementation of the mitigation measures we expect a low likelihood of exposure of cetaceans to sound that could cause a significant disruption of behavioral patterns. The brief exposure to very low intensity aircraft sound and brief visual exposure, would lead to reactions that are imperceptible or very mild and brief. The range of beluga whales has contracted northward; thus the number of belugas in lower Cook Inlet is extremely low greatly reducing the likelihood of their overlap with project specific aircraft. Fin and humpback whale densities are also very low in Cook Inlet (Table 17). We conclude that effects to beluga whales, humpback whales, or fin whales from the use of aircraft are expected to be minimal or undetectable.

6.1.1.2.2 Steller sea lion exposure and response

Steller sea lions are most susceptible to the effects of aircraft when they are hauled out on land and are frightened by the object overhead. Although there are Steller sea lion use areas in lower Cook Inlet south of Kachemak Bay, there are no haul outs or rookeries where Steller sea lions typically congregate in larger numbers near the project area; consequently, we do not expect that there would be any flights over a haul out or rookery as a consequence of this project. As explained above, very little acoustic noise is transmitted into the water from aircraft. This fact coupled with the knowledge that Steller sea lions do not rely on echolocation to communicate or find food like cetaceans do, leads us to conclude that there would be a very minimal effect to Steller sea lions swimming in the water from acoustic noise if an aircraft passed overhead. Likewise, at the mitigation altitude of 1,500 ft (457 m) we do not expect disturbance to them from in air sound. Steller sea lions might react to the visual presence of a plane or helicopter passing overhead but the passage would occur so quickly that any response would be very short-lived (e.g. a single dive underwater). For these reasons we conclude that the use of aircraft will not cause more than a temporary and/or minor effect on Steller sea lions.

6.1.1.2.3 Aircraft noise and critical habitat

No aspect of aircraft noise that may result from activities related to LS 258 is expected to affect critical habitat for Cook Inlet beluga whale. We expect minimal overlap with Area 2 critical habitat for beluga whales. The temporary, slight increase in sound in the water is not expected to affect the prey resources or the physical characteristics of critical habitat for beluga whales.

Four of the five PBFs for Steller sea lion are related to protecting their prey. These resources are concentrated around their rookeries and haulouts which are to the south of the lease sale boundary. Aircraft noise is not expected to overlap in an appreciable way with their prey. One PBF, air zones that extend 3,000 feet (0.9 km) above the terrestrial zone of each major haulout and major rookery in Alaska, potentially could be affected by aircraft. However, the nearest rookery (Sugarloaf Island) is 62 km south of lease sale border and the closest haulout (Ushagat Island) is 56 km south. There is no reason that aircraft associated with LS 258 exploration, development, or production would need to fly that far south outside of the lease sale area. The airport most likely to be used is in Homer. Consequently, we do not expect that aircraft associated with LS 258 will overlap with this PBF and thus, it will not be affected.

6.1.1.3 Vessel strike

Mitigation Measures to Minimize the Likelihood of Exposure to Vessel Strike

As discussed in Section 2.3, the following mitigation measures will be required through BOEM and BSEE's permitting process to avoid or minimize exposure of marine mammals to vessel strike:

1. PSOs will be used to monitor for marine mammals during all 3D seismic surveys.
2. Vessels in transit shall be operated at speeds necessary to ensure no physical contact with whales occurs. Vessels will avoid multiple speed changes and reduce speed to ≤10 kn when within 300 yards (274 m) of whales, especially during poor visibility, to reduce the potential for collisions; and
3. Vessels will not approach within 100 m of marine mammals.
4. Vessels will not be operated in such a way as to separate members of a group of marine mammals

As described for vessel noise, BOEM indicated that during the first incremental step 5 vessel trips per week are expected, and for production, development, and decommissioning 7-42 boat trips per week are expected for each stage (BOEM 2022a). However, the higher estimates are tied to the development of up to 6 platforms which, is a very unlikely outcome given that only one lease block sold. For that reason we expect that the actual number of boat trips per week for each incremental step will be at the lower end of the range provided (i.e. 7 trips per week).

Mortality and serious injury to marine mammals from ships correlates with vessel speed and size (Laist et al. 2001, Vanderlaan and Taggart 2007). Vessels transiting at speeds >10 knots present the greatest potential hazard of collisions (Jensen and Silber 2004a, Silber et al. 2009).

Vanderlann and Taggart (2007) demonstrated that the greatest rate of change in the probability of a lethal injury to a large whale occurs between vessel speeds of 8.6 and 15 knots. Most lethal and severe injuries resulting from large ships (e.g. 80 m or longer) traveling at 14 knots or greater (Laist et al. 2001).

6.1.1.3.1 Cetacean exposure and response

Between 1978 and 2011, there were 108 reports of whale-vessel collisions in Alaska waters (Neilson et al. 2012b). 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 three documented large cetacean vessel collisions in Cook Inlet since 2001; one humpback whale, one fin whale, and one unidentified large cetacean (NMFS Alaska Regional Office Stranding Database accessed May 2022).

The minimum mean annual mortality and serious injury rate due to ship strikes reported in Alaska for humpback whales between 2014 and 2018 was 2.9 whales (Muto et al. 2021). Most vessel collisions with humpbacks are reported from Southeast Alaska; however, there are also reports from the southcentral, Kodiak Island, and Prince William Sound areas of Alaska (Young et al. 2020). A humpback whale was discovered on the bulbous bow of a 710 ft container ship as it docked in the Port of Anchorage in 2001; it is unknown where the vessel collided with the whale (NMFS Alaska Regional Office Stranding Database accessed May 2019). The difference in ship strike rates between Southeast Alaska and other portions of the humpback whale range in Alaska may be due to differences in reporting, amount of vessel traffic, densities of animals, and/or other factors (Muto et al. 2021). These incidents account for a very small fraction of the total humpback whale population (Laist et al. 2001, Gende et al. 2018).

Around the world, fin whales are killed and injured in collisions with vessels more frequently than any other whale (Laist et al. 2001, Jensen and Silber 2004b, Douglas et al. 2008b). Differences in frequency of injury types among species may be related to morphology. The long, sleek, fin whale tends to be caught on the bows of ships and carried into port where they are seen and recorded in stranding databases (Laist et al. 2001). Based on ship-strike records, immature fin whales appear to be particularly susceptible to strike (Laist et al. 2001, Douglas et al. 2008a).

Ship strikes of smaller cetaceans are less common than large whales, possibly due to their smaller size and more agile nature. Cook Inlet beluga whales have been photographed with propeller scars (McGuire et al. 2014). Individual belugas photographed during the period 2005-2017, along with stranding records, were examined to determine prevalence of scars indicative of anthropogenic trauma (McGuire et al. 2020d). Scars were classified by likely source (e.g., entanglements, vessel strikes, puncture wounds, and research). Out of 78 whales examined, 6 had signs of trauma that were possibly from entanglement or from a vessel collision, 3 had signs of trauma possibly from a vessel collision or a predation attack, and 2 had signs of trauma consistent with a vessel collision. A Cook Inlet beluga whale death in October 2007 was attributed to a potential vessel strike based on bruising consistent with blunt force injuries

(NMFS unpublished data) and a beluga necropsy conducted in October 2012 indicated the most likely cause of death was “blunt trauma such as would occur with a strike with the hull of the boat” (NMFS unpublished data).

There may be an increased risk of vessel strike due to the increased traffic associated with the proposed action. Vessels would have a transitory presence in any specific location. The expected increase in traffic from all incremental steps of LS 258 is expected to be low, approximately one additional trip from a port (most likely Homer) per day. Because of the limited number of sightings of fin and humpback whales in action area, the implementation of the mitigation measures (i.e. not approaching marine mammals within 100 yards, not changing direction or speed and reducing speeds around marine mammals) to minimize cetacean exposure to vessel activities, and the rarity of collisions in Cook Inlet despite decades of spatial and temporal overlap between vessels and marine mammals, we conclude that the probability of a vessel striking a listed cetacean in the action area is extremely unlikely to occur and therefore impacts from vessel strikes on listed cetaceans is likewise improbable.

6.1.1.3.2 Steller sea lion exposure and response

In 2007, a Steller sea lion was found in Kachemak Bay with two separate wounds consistent with blunt trauma, which may have been due to a boat collision (NMFS Alaska Regional Office Stranding Database accessed May 2022). There are no other reported vessel collisions or prop strikes of Steller sea lions in Cook Inlet. While there are many causes of human mortality and serious injury to Steller sea lions in Alaska, entanglement in fishing gear and debris, are the most serious problems; vessel strike was not documented as a cause of injury or death in a recent report(Freed et al. 2022).

The agility of Steller sea lions is likely to preclude vessel strikes. Ship strike has not been identified as a significant concern for Steller sea lions (Loughlin and York 2000b). Because the vessels associated with LS 258 will not be operating near a rookery or major haul out where Steller sea lions are more concentrated, the risk of vessel strike is greatly reduced. We conclude that it is highly improbable that a Steller sea lion will be struck by a vessel.

6.1.1.4 Seafloor disturbance

The activities related to LS 258 are not expected to result in permanent loss of marine mammal habitat, but could temporarily alter the seafloor habitat and productivity. Seafloor disturbance and habitat alteration during the first incremental step could result from drilling exploratory and delineation wells, geotechnical surveys (coring), and from the placement of anchors, nodes, cables, and sensors for completion of exploration activities. During the development and production phases the installation of oil and gas pipelines would also cause seafloor disturbance. Mobile Offshore Drilling Units (MODUs) would be employed for exploration drilling. Examples of MODUs include drillships, semisubmersibles, and jack-up rigs. Areas of seafloor would be disturbed by placement and removal of jack-up rigs and anchors. The total area of seafloor disturbance will depend on the number of wells drilled from jack-up rigs. The area of disturbance will also vary based on ocean currents and other environmental factors, but in general includes disturbance from the mud cellar, the anchoring system for the legs of the jack up rig, displacement of sediments, and discharges from the drill hole. According to BOEM (2012), each set up of a jack-up rig disturbs a seafloor area of approximately 1 ha (2.5 ac). Assuming 8 exploration and delineation wells will be drilled with a jack-up rig, a total of approximately 8 ha (20 ac) of seafloor could be disturbed as a result of potential jack-up rig placement activities.

Although seafloor disturbance may occur from a variety of activities (e.g. construction of platforms, anchors, pipe laying, discharge of drilling mud, geotechnical surveys), the consequences for each are similar (sediment plume, redistribution of bottom substrate) and therefore, we discuss seafloor disturbance for all steps of the project from exploration, development, and production together. The primary difference among the various sources of seafloor disturbance is the amount of area that will be disturbed with geotechnical surveys (cores or grab samples) representing the least amount of area disturbed and pipelines the most.

For comparison, BOEM estimated that 2-3 platforms would be constructed for LS 244, in which 14 blocks were sold, while here, BOEM estimated that 1-6 platforms might be constructed for LS 258 (BOEM 2022a). Because only one block sold in LS 258 we expect that the number of platforms built will be at the low end of the range presented (1-2). These platforms would be in place for decades (years 7-39). It is expected that each production platform will be a steel-caisson platform. Total area of seafloor disturbed by a steel-caisson platform will depend on platform design. However, BOEM estimates each platform may disturb approximately 0.5 ha (0.14 ac) of seafloor (BOEM 2022a).

Drilling discharges (mud and fluids) can impact the area around the well. Drilling discharges will only be authorized during the exploration stage and will be recycled or reinjected during production operations (BOEM 2022a). A NPDES permit must be obtained from the US EPA in order to discharge drilling fluids and compliance with the terms and conditions in the permit is required. Fluids and muds are only discharged in the initial phase of drilling. Once the marine riser is in place, cuttings and fluid can be pumped up through the riser and back to the platform or drilling ship. The fluid and cuttings are then barged to shore for recycling and reuse (fluids) and disposal (cuttings), or they are reinjected into a service well. BOEM expects that the drilling fluids used for drilling initial well construction will be a common water-base mud of the generic composition (BOEM 2022a).

A wide range of discharge for drilling muds and cuttings was provided by BOEM (BOEM 2022a). However, given that a single block was sold, and discharge of muds and cuttings will only occur during the exploration stage, we expect that the amount of drilling muds and cuttings will be at the low end of the range provided, around 1,764 cubic yards of rock cuttings and 27,000 barrels of drilling fluids. Discharge of these materials will result in increased turbidity in the water column, alteration of sediment characteristics, and elevated concentrations of some trace metals. In locations with strong currents and soft substrates as we would expect to find in lower Cook Inlet, prior studies on the effects to benthic invertebrates from cuttings and mud have showed minimal impact (Neff 2010). Surveys performed at two months, and one year, after completion of a well drilling in the North Sea revealed no measurable adverse effects on the benthic community, even at stations as close as 25 m (80 ft) from the discharge. Only small amounts of cuttings were detected in sandy bottom sediments, suggesting that the mud and cuttings solids had been transported away from the site and diluted to non-detectable concentrations within two months after cessation of drilling. In a review of the impacts of water based muds, (Ellis et al. 2012) found variable results with effects on benthic communities ranging from 200 to 2000 m depending on substrate, water depth and current. BOEM projects burial and smothering are most likely to occur within a radius of approximately 500 m (1,640 ft) around each wellsite, affecting an area of 0.78 km^2 per wellsite (BOEM 2022a). Based on the results discussed in (Neff 2010) and (Ellis et al. 2012) and given the strong currents and unconsolidated substrate in lower Cook Inlet we expect the zone impacted may be smaller than estimated, and will decrease markedly within one year.

BOEM projects that there could be up to 80 miles of offshore pipeline built, and 40-120 miles of offshore gas pipeline constructed. Assuming a 9 m (30 ft) wide footprint for the pipeline placement, these pipelines could disturb up to 295 ha (728 ac) of seafloor. Although this is a large area, the amount of disturbance can be put into perspective. BOEM purposefully overestimated the level of development so actual miles could be far less (BOEM 2022a). Not all pipeline is built in one year but is expected to be spread out over 6 years diluting the impact that occurs in any one year, and finally the action area is approximately 2 million ha (5 million ac) so in terms of percent, the amount of seafloor that will temporarily be disturbed by the pipelines represents approximately 0.014 percent of the action area.

If possible, all pipelines will be trenched at least 1 m below the mudline. If trenching is not possible due to unsuitable sediments, anchors or concrete would likely be used to provide stability to the pipeline to resist strong tidal movements. It is not expected that pipelines will be removed at the end of their serviceable life; rather, they will be decommissioned (cleaned and plugged), and left in place. This practice prevents the additional disturbance to sediments and benthic communities which would occur if pipelines were removed (BOEM 2022a).

Several benthic invertebrate surveys of lower Cook Inlet have been done (Feder 1981, Foster et al. 2010, Saupe et al. 2014b). These studies have shown a rather depauperate fauna with low biomass. For example, in 9 trawls done in lower Cook Inlet within the action area Feder (1981) found that the average number of invertebrates per square meter was less than one (0.13) and the average biomass was 1.78 gm/m^2. Saupe et al. (2014b) found equally low biomass of invertebrates in winter time trawls. Feder (1981) found invertebrate species composition varied by site but was dominated by sand dollars (*Echinarachnius parma*), tanner crab (*Chionoecetes bairdi*) and sea pens (*Ptilosarcus gurneyi*) in central lower Cook Inlet. Shrimp of various species were found in very low numbers (Feder 1981).

Effects expected from seafloor disturbance are: a temporary increase in turbidity, injury and mortality to benthic invertebrates, and disruption of the substrate. No appreciable adverse impacts on benthic populations would be expected due in part to large reproductive capacities, naturally high levels of predation and mortality, and low initial biomass (Feder 1981). Any mortalities or impacts that might occur as a result of the proposed action is insignificant compared to the naturally occurring high reproductive and mortality rates of benthic organisms (BOEM 2015a). In addition, disturbed areas, depending on substrate types, community composition, and ocean current speed and direction, would begin the process of recolonization after the disturbance has ceased (Conlan and Kvitek 2005, Ellis et al. 2012, BOEM 2015a). Amphipods, copepods, shrimp, nematodes, and polychaetes are among the first to recolonize, taking generally less than a year for establishment in new locations (Trannum et al. 2011).

The pelagic habitat would temporarily be effected by the increase in turbidity. This could temporarily affect the ability of fish to feed effectively if they were to stay in the sediment plume. Models of tidal currents in Cook Inlet predict current speeds range from approximately 2 to 4 m/s (approximately 3.8 to 7.7 kn), generally flowing in a north-south direction. Based on this velocity and flow, suspended sediments would be removed from the area of impact almost immediately, reducing the level of impact on benthic fish and shellfish (BOEM 2016b).

The platforms and surface-laid pipelines would create hard substrate, and the area on and immediately around the platform would have habitat functions and biological communities very different from those in the pre-construction period (Gallaway and Lewbel 1982). Algae and sessile invertebrates (e.g., mussels, barnacles, bryozoans) would attach to the platform and would in turn attract hard bottom organisms (Bram et al. 2005)likely increasing local biodiversity over time. A literature review of studies of benthic community change around platforms suggests that benthic communities may return to baseline conditions within one year after decommissioning (Ellis et al. 2012).

6.1.1.4.1 Cetacean exposure and response

Effects to listed cetaceans are primarily related to prey. Humpback and fin whales forage primarily on zooplankton, although humpback whales will also consume small fish. Both species capture their prey from the water column, neither focus on benthic invertebrates or are bottom foragers like the gray whale. Consequently, any loss of benthic invertebrates through sea floor disturbance would have an immeasurable effect on prey available to humpback and fin whales. Trenching and pipe laying operations are expected to occur during the spring/summer season and should avoid spawning and migration timing for longfin smelt, Pacific herring, Pacific sand lance, eulachon, capelin, and numerous groundfish species, reducing potential effects to humpback whales. In addition, humpback and fin whales likely locate their prey through echolocation and communication with others that modality is not impaired by turbidity (Castellote et al. 2016a). Therefore, we would not expect that a localized increase in turbidity would affect their ability to locate prey. In localized areas, adult salmonid species may have to pass through areas of increased turbidity as they migrate through Cook Inlet to natal streams. However, we do not expect that this would negatively affect their health, survival, or ability to locate natal streams.

Based on the above, we would not expect any population level effects to listed fin or humpback whales, either directly through contact with patches of turbidity or indirectly through effects to their prey species from substrate alteration. Any effects would be localized primarily around the drilling platform or pipeline installation (areas of greatest disturbance) and because of the rapid dilution/deposition of materials and the recolonization of benthic invertebrates, the effects to fin and humpback whales are expected to be immeasurably small.

Belugas eat some benthic invertebrates, primarily in the winter when salmon are not available (section 4.2.1.5)(Saupe et al. 2014b, Quakenbush et al. 2015). Shrimp, polychaetes, and amphipods have been found in Cook Inlet beluga stomachs. However, salmon is their most important food resource. We expect that belugas would be in upper Cook Inlet in the summer when the majority of seafloor disturbing activities (e.g. pipe laying, platform placement, coring) would be done. Given the naturally low density of invertebrates in the action area and the absence of belugas in lower Cook Inlet, we do not expect that activities related to LS 258 which will disturb the seafloor will have a measureable effect on any beluga individual.

Because pipelines will be cleaned, plugged, and left in place, there should be no lingering effect on the area once wells have been plugged and abandoned, platforms removed, and subsea pipelines and all marine facilities properly decommissioned. Based on the above, we would not expect adverse effects to listed cetaceans from activities that disturb the seafloor we conclude this stressor is minor or minimal overall.

6.1.1.4.2 Steller sea lion exposure and response

Steller sea lions are generalist predators that eat a variety of fishes and cephalopods (Pitcher and Calkins 1981, Calkins and Goodwin 1988, NMFS 2008f). The extent to which they may use benthic resources in Cook Inlet is unknown, but given their energy requirements, we would expect them to target large invertebrates if they do eat them. In additions, it is likely that they focus their foraging in areas where prey density is highest and this unlikely to be near the lease block that sold mid-channel in Cook Inlet where habitat complexity and diversity is low and current velocity high. Higher prey density is more likely to be near the shoreline, especially near the mouths of streams where salmon would gather. Steller sea lions are agile swimmers and could easily avoid any sediment plume. Because seafloor disturbance is unlikely to affect Steller sea lion prey directly and because turbidity would be localized and temporary, we conclude that seafloor disturbance would have a minimal effect on Steller sea lions and their prey.

6.1.1.4.3 Effects of seafloor disturbance on critical habitat

Because of the distance between Steller sea lion critical habitat and the areas where seafloor disturbance will occur, we do not expect any effects of seafloor disturbance to reach their critical habitat and therefore, there will be no effect to it.

There could be 1-2 new pipelines to shore as a consequence of LS 258. We do not know where they would daylight but potentially they could cross Area 2 Critical Habitat for the beluga whale. This would not happen if the pipelines were directed across Cook Inlet to daylight along the western shore of Cook Inlet. But if a pipeline came ashore in Kachemak Bay or near Kenai, it could cross Area 2 of critical habitat. However, BOEM states that directional drilling (underground) would be used for these pipelines (BOEM 2022a) so effects to critical habitat may be avoided because directional drilling does not disturb the surface of the substrate/ground. If new pipelines to shore are needed in the future, BOEM and the applicant will have to work with NMFS to determine if there would be any effects to beluga critical habitat. If there were, future section 7 consultation would ensure the effects were minimized.

6.1.1.5 Trash and debris

Operations under the proposed action will generate trash comprised of paper, plastic, wood, glass, and metal mostly from galley and offshore food service operations. A substantial amount of waste products could be generated over the duration of the proposed action. It is thought that trash (especially plastic) is more common, widespread, and impactful than oil spills. If not handled responsibly, trash and debris could be released into the marine environment.

Marine debris is a threat to marine mammals worldwide. A 2014 global study found that ingestion of debris has been documented in 56 percent of cetacean species, with rates of ingestion as high as 31 percent in some populations (Baulch and Perry 2014). In Alaska, many species of cetaceans and pinnipeds are known to become entangled in or ingest marine debris (e.g. (Freed et al. 2022). Manufactured packing bands are a particular problem for pinnipeds and should always be cut before disposal to prevent neck entanglements.

All survey vessels performing work within U.S. jurisdictional waters are expected to comply with federal regulations that implement the International Convention for the Prevention of Pollution from Ships (MARPOL) as amended by the 1978 Protocol (MARPOL 73/78). Within MARPOL Annex V, Regulations for the Control of Pollution by Garbage from Ships, as implemented by 33 CFR Part 151, are requirements designed to protect the marine environment from various types of garbage generated on board vessels. These requirements include: a prohibition on the deliberate discharge of containers and other similar materials (i.e., trash and debris) into the marine environment unless it is passed through a comminutor that breaks up solids and can pass through a 25-mm mesh screen; a prohibition on the discharge of plastic regardless of size; markings on equipment, tools and containers (especially drums), and other material as well as recording and reporting of items lost overboard; and precautions for handling and disposing of small items and packaging materials.

In addition to MARPOL requirements, all vessel operators, employees, and contractors actively engaged in exploration surveys or drilling operations should receive instruction on marine trash and debris elimination. Although BOEM will not require operators, employees, and contractors to undergo formal training or to post placards, the operator will be required to ensure that its employees and contractors are made aware of the environmental and socioeconomic impacts associated with marine trash and debris and their responsibilities for ensuring that trash and debris are not intentionally or accidentally discharged into the marine environment.

Lessees are expected to exercise special caution when handling and disposing of small items and packaging materials, particularly those made of non-biodegradable closed loops that can be lost in the marine environment and present a risk of entanglement. Increasing worker awareness of the problem and emphasizing their responsibilities will help reduce litter and control the unintended loss of such items.

Because operators must comply with Federal regulations and BOEM’s trash and debris guidance, the amount of trash and debris occurring within the action area is expected to be minimal and distributed over a wide area resulting in an undetectable effect on the marine environment. As such exposure of listed species to trash and debris should be very unlikely. The impact of trash and debris is expected to be very minor, and adverse effects to ESA-listed species immeasurable.

6.1.1.6 Noise from drilling and pumping operations

Under the high development scenario, BOEM estimated 8 exploration/delineation wells, 8- 81 production wells and 4-27 service wells would be drilled (BOEM 2022a). However, given that only one lease block was bid upon and leased, we assume the lowest numbers in these ranges are a realistic approximation of what will occur. To put these numbers in perspective, a total of only 13 exploration/delineation wells have been drilled in the Cook Inlet OCS in the last 45 years, with the last well drilled in 1985 (BOEM 2022a). Consequently, even the lowest numbers given in these ranges are likely overestimates of what may occur on the single leased block.

Underwater marine sounds associated with drilling operations include strong tonal components at low frequencies averaging 10 to 500 Hz, and in some cases infrasonic frequencies (Richardson et al. 1995b). Jack-up rigs can be expected to produce noise from drilling, machinery, and maintenance operations. Marine sounds emitted by drilling rigs were found to be dominated by a mix of tones thought to be related to the drill string rotation rate. When drilling, the drill string represents a long vertical sound source. Noise levels vary with the type of drilling rig and water depth. Underwater noise from the jack-up rigs is expected to be relatively weak because a small surface area of equipment is in contact with the water; most of the machinery is on the rig deck well above the water surface.

Underwater acoustic measurements of new wells were performed by Furie Operating Alaska, LLC northeast of Nikiski Bay in the vicinity of the Spartan 151 in water depths of 24.4 to 27.4 m (80 to 90 ft; (Marine Acoustics Inc. 2011). Primary sources of rig-based acoustic energy were identified as coming from the D399/D398 diesel engines, the PZ-10 mud pump, ventilation fans, and electrical generators, which are all above water but can be heard in-water. The in-water source level of one of the loudest acoustic sources, the diesel generators, was estimated to be 137 dB re 1 μPa rms at 1 m in the 141 to 178 Hz frequency range. Sound source levels were also measured by JASCO for drilling and mud pumping from the Yost jack-up rig in 2016 in the Kitchen Lights Unit area for the drilling of a new well. The primary sources of continuous sounds measured in-water from the Yost were drilling (158 dB) and mud pumping (148.4 dB) that may produce 120 dB isopleths of 330 and 225 meters, respectively. The acoustic energy of drilling sound was found to be predominantly under 500 Hz (Denes and Austin 2016).

6.1.1.6.1 Cetacean exposure and response

Some characteristics of drilling sounds are similar to vessel sounds in that they are relatively low-level and low-frequency. It is thought that low frequency marine mammals such as fin and humpback whales are disproportionately affected by increases in low frequency noises, such as masking (Clark et al. 2009). However, the drilling will occur from a stationary platform in a location with low humpback and fin whale density. Any cetacean approaching the rig would be fully aware of its presence long before approaching. Drilling sound is naturally “ramped up” from an initial low rotation pressure, such that this non impulsive sound source is unlikely to startle an approaching animal. Additionally, a zone around the platform must be monitored before drilling starts, further reducing the likelihood of a startle reaction of any listed species in the area. There would be open water in all directions around the drilling locations and we are unaware of any specifically important habitat features in lower Cook Inlet that would encourage marine mammal use and exposure to higher levels of sound closer to the source.

In general, during the summer and fall, beluga whales occur in shallow coastal waters (Shelden et al. 2015c, Castellote et al. 2016a, McGuire et al. 2020b), so no overlap with belugas and drilling is expected in that time frame. Belugas once were found in lower Cook Inlet in deeper waters in the winter but aerial surveys that included lower Cook Inlet in winter and spring from 2018 through 2021 have not recorded belugas south of Tuxedni Bay (Gill et al. unpubl. report). Tuxedni Bay is approximately 40 km (25 mi) north of the block that was sold. In December 2015 through January 2016, personnel from the Tyonek Platform (S. Callaway, pers. comm. 01/19/2016) observed 200 to 300 Cook Inlet beluga whales, including calves, drift by the platform during a number of tidal cycles, suggesting production at these platforms does not deter or prevent belugas from occupying the area. Given the low frequency, small radius of expected ensonification (approximately 300 m), continuous sound production, and extremely low density of belugas where a well might be drilled, noise from drilling is not expected to have a meaningful effect on beluga whales.

We do not expect that sound from drilling operations will cause a significant disruption in cetacean behavioral patterns. Therefore, the impact of drilling sound is expected to be very minor, and any effects to Cook Inlet beluga, Mexico DPS and Western North Pacific DPS humpback, and fin whales is expected to be immeasurably small.

6.1.1.6.2 Effects of noise from drilling and pumping on Cook Inlet beluga whale critical habitat

One PBF for Cook Inlet beluga whale addresses in-water sound:

- Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.

We expect that a drilling and pumping that may occur for this project will be located at the block that was leased. There is no overlap between the lease block sold and Cook Inlet beluga critical habitat. Area 2 critical habitat occurs approximately 16 km (10 mi) to the west of the leased block and Area 2 critical habitat in Kachemak Bay is approximately 65 km (40 mi) to the east.

Underwater marine sounds associated with drilling operations include strong tonal components at low frequencies averaging 10 to 500 Hz, and in some cases infrasonic frequencies (Richardson et al. 1995b) which are far below the hearing capabilities of beluga whales. The combination of distance from critical habitat and the low frequencies that are produced by leads us to conclude that drilling and pumping will not affect Cook Inlet beluga whale critical habitat.

6.1.1.6.3 Steller sea lion exposure and response

Because Steller sea lions do not depend on echolocation to find food or communicate, continuous low frequency noise caused by drilling in not expected to have an appreciable effect on their behavioral patterns. The slow ramp up of operations and monitoring zone would prevent animals from being startled. We expect that if Steller sea lions were in the vicinity of drilling operations they would habituate to the noise and it would not disrupt their normal activities. These activities will not overlap with Steller sea lion critical habitat.

6.1.1.7 Exposure to Authorized Discharges

Authorized discharges from OCS activities during the first incremental step would include drilling fluids and cuttings, deck drainage, sanitary and domestic waste, desalination unit brine, cooling water, bilge and ballast water, and other miscellaneous discharges. Other discharges that could occur during exploration drilling include desalination unit discharges, well treatment, workover, or completion fluids, boiler blowdown discharges, excess cement slurry, and uncontaminated freshwater and saltwater (BOEM 2016d).

Not including drilling discharges, the major waste discharges produced during the first incremental step include bilge water, ballast water, fire control system test water, cooling water, sanitary and domestic wastes, and deck drainage (BOEM 2016d). Bilge water collects in the lowest part of a ship; it may be contaminated by oil that leaks from the machinery within the vessel and is required to be processed through an oil-water separator prior to discharge. All vessels with toilet facilities must have marine sanitation devices that comply with 40 CFR 140 and 33 CFR 159 for sanitary wastes. Waste solids must either be macerated so that the discharge contains <150 milligrams per liter (mg/L) of suspended solids and a bacteria count <200 per 100 milliliters (mL) or retained until it can be disposed of at proper onshore facilities. In State waters, state and local governments regulate domestic and gray water discharges that consist of materials discharged from sinks, showers, laundries, safety showers, eyewash stations, hand-wash stations, and galleys. The US EPA's NPDES program regulates discharges of sanitary and domestic waters in federal waters. Rainwater and other water falling on contaminated areas of drilling rigs or platforms will pass through an oil-water separator prior to discharge. NPDES permits generally require deck drainage to contain no free oil.

Most of these discharges would be rapidly diluted in receiving waters such that there would be very limited potential for effects on any listed marine mammals. Discharges are regulated through NPDES permits, and listed species and designated critical habitats are not likely to be adversely impacted by exposure to pollutants, suspended solids, or bacteria-containing effluents discharged in compliance with permit requirements. Additional consultation is required for the issuance of a NPDES permit (BOEM 2022a).

While exposure of belugas to discharges that contain PAHs is a concern (Saupe et al. 2014b), in comparison to other beluga populations for which contaminant data are available, Cook Inlet belugas have the lowest levels of polychlorinated biphenyls (PCBs), chlorinate pesticides, and concentrations of heavy metals were either lower or comparable to those of other groups of belugas (Becker et al. 2000, Saupe et al. 2014b). Sediment and fish prey PAH concentrations were investigated in four locations in northern Cook Inlet where belugas are regularly observed feeding in the summer (Saupe et al. 2014b). Total PAH levels were low, relative to other urban areas known to have environmental problems with PAH contamination. Several types of PAHs also occurred in a limited number of fish prey samples, including salmon, eulachon and saffron cod, with more lighter two-ringed compounds (relative to the higher-ringed compound) in the fish samples relative to sediments. The salmon and eulachon are seasonal in those areas, having migrated to return to freshwater rivers for spawning. Thus, it is difficult to attribute PAH in their tissues to local sources. Whole-fish PAH levels measured in research done by (Saupe et al. 2014b) indicate that resident fish in the Cook Inlet beluga whale winter feeding areas are likely not the vector for introducing PAHs to the whales. Sediment and water column PAH data from hundreds of sites in Cook Inlet (Lees et al. 2001, Saupe et al. 2014b) support this conclusion as they have not shown where hydrocarbons from oil industry operations are accumulating or concentrating relative to the ubiquitous PAH background.

Given regulatory requirements for discharges, the lack of evidence linking oil production to PAH accumulations in Cook Inlet sediments, prey of Cook Inlet belugas, or in the belugas we conclude that authorized discharges are do not have a meaningful effect on the survival or fitness of beluga whales. In contrast to Cook Inlet beluga whales which spend the entire year in Cook Inlet, fin and humpback whales spend only a few months in the inlet and we expect the effects of authorized discharges on them is even less than that for the belugas. Some Steller sea lions may spend the year in Cook Inlet, but given that levels of contaminants measured in fish is so low, we conclude that authorized discharges do not have a measurable effect on their behavior, health, or fitness. Likewise, because there is a lack of evidence linking oil production to PAH accumulations in Cook Inlet sediments or prey species for Cook Inlet beluga whales or Steller sea lions, we conclude that PAHs have an immeasurable effect on critical habitat for these species.

6.1.1.8 Geophysical surveys

Mitigation Measures for geophysical surveys

- Not allowed on any OCS blocks between Nov 1 and Apr 1.
- Not allowed on beluga whale nearshore feeding area OCS blocks between July 1 and Sept. 30.

Geophysical surveys using high resolution geophysical (HRG) sources are used to evaluate potential hazards on the ocean bottom and document any potential cultural resources or unique benthic communities. Geophysical equipment includes echosounders, side-scan sonar, sub-bottom profilers, and boomers. HRG sources typically operate at higher frequencies and lower power than airguns, leading to shallower subseafloor penetration (Ruppel et al. 2022). These survey methods introduce noise into the water. Two common characteristics of many HRG sources are very short pulse durations and directional transmitters (narrow beam sound sources). Many of these acoustic systems transmit sound as pulses on the order of milliseconds (ms) to a tenth of a second and then listen for a relatively longer period, meaning that active ensonification occurs in brief, intermittent spurts (Ruppel et al. 2022). NOAA has worked with action agency partners (e.g. U.S. Navy, BOEM) over the last several years and has determined that because of their operational characteristics the majority of these sources have been determined to be *de minimis*, meaning that when used as designed they are unlikely to harm or harass a marine mammal. Examples of *de minimis* sources are:

- Multibeam echosounders (hull-mounted or portable)
- Certain side-scan sonars
- Hull-mounted non-parametric SBPs (e.g., Knudsens)
- Parametric shallow penetration SBPs (e.g., Innomars)
- Fathometers for navigation
- Towed non-parametric SBPs/Chirp systems (e.g., Edgetech 424, Edgetech 512i)
- EK60/EK80 split-beam echosounders
- Pingers (acoustic locators) for locating over the side wireline instrumentation in the water column
- Acoustic releases (brief duration pinging), e.g., for moorings, landers, OBS
- Long baseline (LBL) and Ultra-short baseline (USBL) positioning equipment, e.g., for navigation of submersibles, ROVs, etc.
- All acoustic Doppler current profiling (ADCP) equipment
- All instrumentation on HOV/AUV/ROVs
- Pressure-equipped inverted echo sounders (PIES) and Pressure Monitoring Transducers (PMTs)
- Electromagnetic sources
- All instruments operated at 180 kHz or greater

These are the types of instruments we expect will be used for geophysical surveys for LS 258 (section 2.1.3). Decisions were made on these instruments based on frequency (i.e. above the hearing range of marine mammals), the narrow angle and downward facing direction of the beam, source level, transmission frequency, and pulse repetition rate (Ruppel et al. 2022). Given the directionality, short pulse duration, and narrow beam widths for these acoustic sources, only a few exposures at low received levels (below 160 dB) are anticipated for listed species. If exposed, whales and sea lions would not be expected to be in the direct sound field for more than one to two pulses (NMFS 2013). Most of the energy created by these potential sources is outside the estimated hearing range of whales, and pinnipeds generally (Southall et al. 2007a), and the energy that is within hearing range is high frequency; as such, it is only expected to be audible in very close proximity to the mobile source. These sources would either be attached to, or towed slowly, by a vessel and standard mitigation measures regarding vessel operation would apply further reducing the chance that a marine mammal would intercept these sound sources.

While the majority of HRG instruments have the characteristics described above and fall into the *de minimis* category, it is possible that one could be proposed for use that does not. In that situation, use of that instrument would be evaluated individually and if it were judged to produce harmful sounds in a way that would expose a marine to those sounds, section 7 consultation and mitigation measures specific to that source would be necessary. However, based on the typical and accepted use of these devices, their operational characteristics, and the limited time they need to be employed (usually one day per survey, 4 surveys total projected), we expect that intersection of beluga whales, fin whale, humpback whale, or Steller sea lions with these sound sources are improbable, but if it were to happen the exposure would be so brief that it would not have a measurable effect.

6.1.1.9 Exposure to Oil and Gas Spill First Incremental Step

As previously mentioned in the Environmental Baseline (section 5) of this opinion, pollutants in discharges from OCS facilities are regulated through the NPDES permit, and marine mammals are not expected to be adversely impacted by exposure to pollutants discharged in compliance with the permit requirement (NMFS 2010c, EPA 2015b). Spills are illegal and not authorized, but small spills commonly happen. Increased development logically leads to an increased chance of small spills occurring.

This analysis will focus on the probability of an unauthorized discharge of oil and gas, and the potential impacts associated with exposure of ESA-listed marine mammals under NMFS's authority to small, large, and very larger oil spill (VLOS) events during exploration activities in the action area. BOEM used spill occurrence probabilities to estimate the likelihood of a spill of a certain size category occurring based on a high level of development on 28 lease blocks. The probabilities were built on the historic spill occurrence rates for spills within specific size categories. Within each size category, spill probabilities are calculated from production rates and expressed as the number of spills per billion barrels of oil produced. The predicted probability of a spill would change based on a change in the total estimated production.

No Very Large Oil Spills were predicted to occur based on the total production values estimated for LS 258, and a change in production amount would not alter that conclusion. However, the probabilities for the other categories of oil spills would be greatly reduced with less development potential. The spill probabilities were estimated based on the high estimates of oil and gas production on 28 lease blocks and were not replicated for the low and medium production scenarios. Because only one block was leased and can be developed, we expect the probabilities of spills that BOEM calculated are exaggerated. However, BOEM was not able to provide revised probabilities based on a single block being developed.

We discuss oil and gas spills for the first and future steps separately. In the first incremental step only small spills are expected to occur. During production larger spills could occur. Ji and Smith (2021) conducted a detailed oil spill risk analysis for LS 258 which assumed a high level of development across the entire lease sale area. The results of that work are discussed below under major stressors (section 6.3.4)

Mitigation Measures to Minimize the Likelihood of Exposure to Oil and Gas Spill

Oil spills are considered accidental events, and the Clean Water Act and the Oil Pollution Act include both regulatory and liability provisions that are designed to reduce damage to natural resources from oil spills. As described in section 2.3, BOEM and BSEE have a suite of Lease Sale Stipulations, Notices to the Lessees, and Information to Lessees designed to protect sensitive marine areas. As a consequence of the Deepwater Horizon event, BOEM and BSEE instituted regulatory reforms including both prescriptive and performance-based regulation and guidance, as well as OCS safety and environmental protection requirements. The reforms strengthened the requirements for all aspects of OCS operations. Impacts to resources from oil spills or gas releases may be prevented or mitigated through oil spill prevention, preparedness, and response measures. The report, *Oil Spill Preparedness, Prevention, and Response on the Alaska OCS* (BOEM 2019), provides information on oil spill prevention and preparedness requirements, including spill drills, and response strategies that could be employed on the OCS.

At the lease sale stage, mitigation measures take the form of lease stipulations; post-lease activities may have mitigation measures imposed through conditions for approval of plans, permit conditions, or other mechanisms. As specific projects are proposed in this multi-stage oil and gas program, more precise information about the nature and extent of the activities – including the scale and location of the activities and a description of the particular technologies to be employed – will be considered and evaluated in additional ESA section 7 consultations and other analyses (such as NEPA) as appropriate. Additional mitigation measures and protections may be developed at any stage based on the specific details of the particular projects.

6.1.1.9.1 Behavior and Fate of Crude Oil

Because the lease block sold is in the main channel of lower Cook Inlet, we limit our discussion to cold open water, assuming that a spill related to LS 258 will occur in an area that does not freeze in the winter. Effects of oil are based on its chemical composition. Likewise, the composition of crude oil determines its behavior in the marine environment (Geraci and St. Aubin 1990a). Weathering (spreading, evaporating, dispersing, emulsifying, degrading, oxidizing, dissolution: (Figure 24)) and aging processes alter the chemical and physical characteristics of crude oil. The environment in which a spill occurs, such as the water surface or subsurface, spring ice overflow, summer open-water, or winter broken ice, will affect how the spill behaves (Payne et al. 1991, NRC 2014).

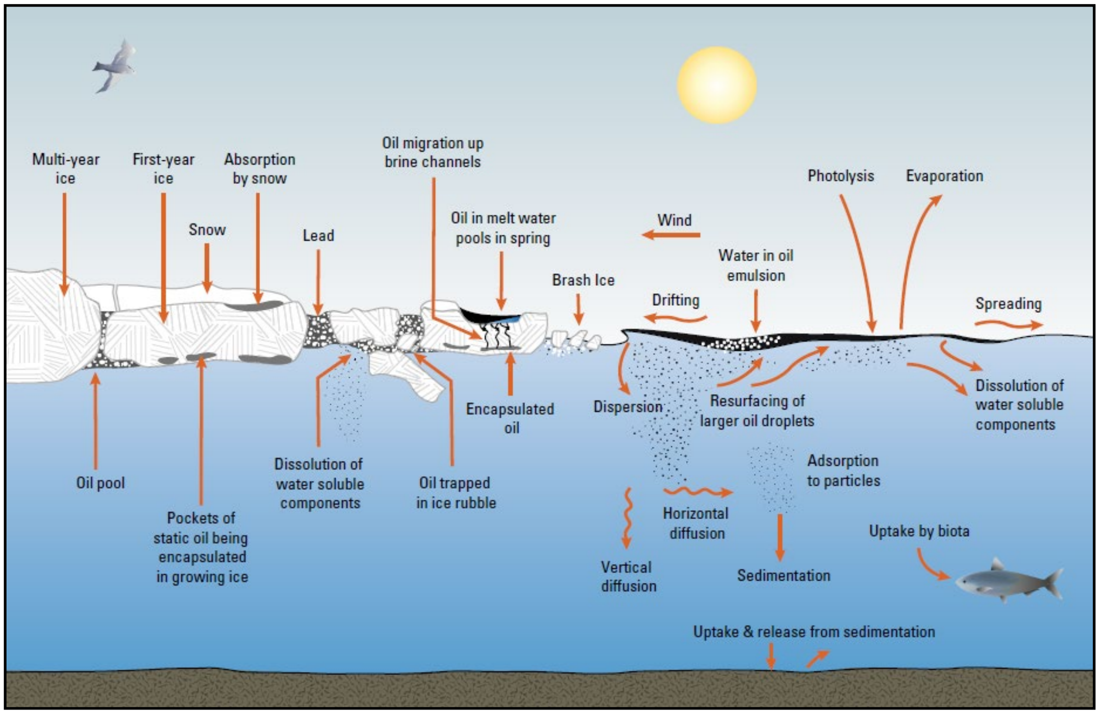

Figure 24. Diagram of some of the weathering processes that occur to oil spilled into the marine environment (NRC 2014).

Oil released at or near the surface will immediately begin to spread, or drift, horizontally in an elongated shape driven by wind and surface water currents (Elliott et al. 1986). If released below the water, oil will travel through the water column before it forms an oil slick at the surface. The rate of spreading is positively associated with increased temperature and wave action (Geraci and St. Aubin 1990a). Oil spills in the cooler waters are expected to spread less and remain thicker than in temperate waters due to increased viscosity of oil in colder temperatures (NRC 2014). The leading edge of the slick is typically thicker than the interior (Fannelop and Waldman 1972). The thicker oil tends to form patches that move downwind faster than the thinner part of the slick, eventually leaving it behind (Geraci and St. Aubin 1990a).

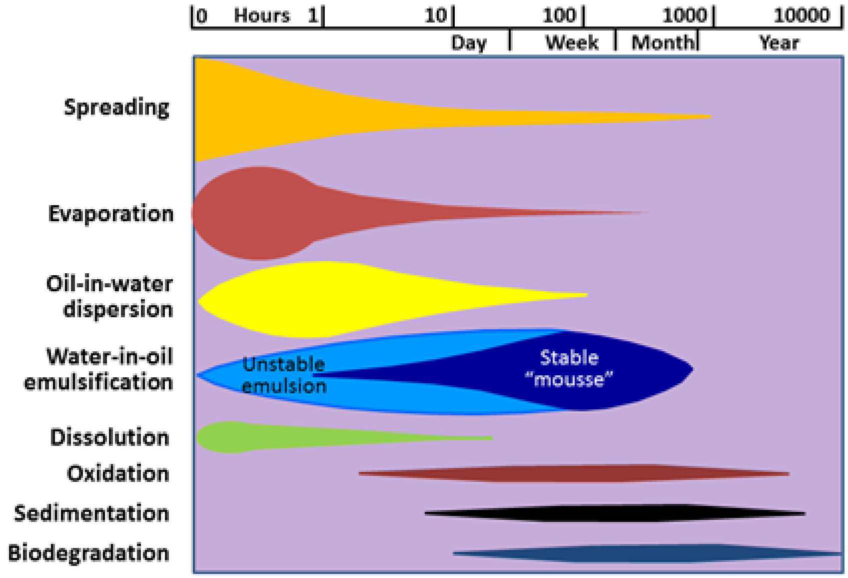

Figure 25. Schematic showing the relative importance of weathering processes of an oil slick over time (Brandvik et al. 2010). The width of the line shows the relative magnitude of the process in relation to other contemporary processes.

In the first few days following a spill, evaporation is the most significant weathering process, affecting the volume and chemical composition of oil (Geraci and St. Aubin 1990a) (Figure 25). The lighter, more volatile hydrocarbons evaporate most quickly, increasing the density and viscosity, and decreasing the toxicity and vapors of the oil (Mackay 1985). About 30-40 percent of spilled crude consists of volatile hydrocarbons that evaporate, with approximately 25 percent of the evaporation occurring in the first 24 hours (Fingas et al. 1979, NRC (National Research Council) 1985). Initial evaporation rate increases with increased wind speed, temperature, and sea state. Evaporation rates decrease when oil spills in broken ice conditions, and evaporation stops altogether if the oil is under or encapsulated in ice (Payne et al. 1987, Payne et al. 1991). In the spring, oil that has been trapped in ice will be released to the surface and evaporation will occur.

Approximately 2-5 percent of spilled crude oil is dissolved into the water column (Payne et al. 1987). Although this appears to be a small proportion of the crude oil, this dissolution process is significant because it brings the most toxic hydrocarbons into contact with marine organisms in a form that is biologically available to them (Geraci and St. Aubin 1990a).

Dispersion is the most significant weathering process in the breakdown of an oil slick already reduced by evaporation (Geraci and St. Aubin 1990a), and results in the transport of small oil particles into the water column (NRC (National Research Council) 1985). Increased wave action and water turbulence are directly associated with an increased rate of dispersion (Mackay 1985). Small oil droplets break away from the main oil slick and become dispersed in the water column. If the droplets become smaller than 0.1 mm in size they rise so slowly as to remain indefinitely dispersed in the water column (Payne and McNabb 1985). More viscous and/or weathered crude oil may adhere to porous ice floes, concentrating oil within areas of broken ice and limiting oil dispersion. However, the presence of a small amount of ice is thought to promote dispersion (Payne et al. 1987).

After weathering, some oils will accumulate and retain water droplets within the oil phase. This process is called emulsification, and the emulsified oil is typically referred to as 'mousse' (Mackay 1985). Mousse can form more quickly under certain conditions; with sufficient gas, turbulence, and mousse-forming precursors in the oils, oil spilled subsurface can form mousse by the time it reaches the surface (Payne 1982). The formation of mousse slows the subsequent weathering of oil by inhibiting evaporation, dissolution, and degradation (Geraci and St. Aubin 1990a). The presence of ice and turbulence increases emulsification (Payne et al. 1987).

Most oil droplets suspended in the water column will eventually be degraded by bacteria in the water column, or deposited to the seafloor. This deposition, or sedimentation, depends on many factors: suspended load in the water column, water depth, turbulence, oil density, and processing by zooplankton. Weathered oil can become heavier than seawater and sink (Boehm 1987). This process is enhanced when the density of water is lowered by input of fresh water from runoff or melting ice.

Biodegradation, or natural degradation by marine fungi and bacteria (microbial organisms), begins 1-2 days following a spill and continues as long as hydrocarbons remain in the water and sediments (Lee and Ryan 1983). All components of hydrocarbons spilled into the marine environment are degraded by microbial organisms in the water and sediments simultaneously, but at very different rates (Atlas et al. 1981, Bartha and Atlas 1987). The rate of biodegradation is influenced by oxygen concentration, temperature, nutrients (especially nitrogen and phosphorous), salinity, physical state and chemical composition of the oil, and history of previous oil spills at the site (Atlas 1981, Bartha and Atlas 1987). Biodegradation is a very slow process.

Solar radiation acting on oil on the water results in photo oxidation, or photolysis, of hydrocarbons. The molecular compounds in oil vary in their sensitivities to photolysis and are subject to photolysis at different rates. In general, photolysis decreases with decreasing water depths as light intensity decreases. In addition, photolysis is slower at higher latitudes where and when there is less sunlight, especially during the winter (Geraci and St. Aubin 1990a). At 60° N latitude (which lies just south of Ninilchik, bisecting the action area), there is approximately a tenfold decrease in the photolysis rate of benzo(a)pyrene between June and December (Zepp and Baughman 1978).

Persistence of oil from a spill in the marine environment can vary depending on the size of the spill, the environmental conditions at the time of the spill, the substrate of the shoreline, and whether the shoreline is eroding. The weathering for a 1-, 5-, 13-, or 50-bbl refined oil spill is estimated to last <1–2 days on the water. A crude oil spill of 125 bbl lasts 30 days (BOEM 2022b).

Offshore petroleum exploration activities have been conducted in State of Alaska waters and the OCS of Cook Inlet since the 1960s. However, historical data on offshore oil spills for Cook Inlet OCS consists only of small spills. BOEM does not anticipate a small spill would persist on the water long enough for the model to predict its path in a trajectory analysis. Therefore, for small spills BOEM estimates the type of oil and number and size of spill(s). For large spills ≥1,000 bbl BOEM has analyzed trajectory. To judge the effect of a large oil spill, BOEM estimates the general source(s) of a large oil spill (such as a pipeline, platform, or well), the location and size of the spill, the type and chemistry of the oil, how the oil will weather (naturally degrade in the environment), how long it will remain prior to naturally degrading, and where it may go (BOEM 2016b).

6.1.1.9.2 Approach to Estimating Exposures to Oil and Gas Spill

Estimating oil spill occurrence and potential effects on marine mammals is an exercise in probability calculations. Uncertainty exists regarding the location, number, composition, and size of small, large, and very large oil spills, and the wind and current conditions that could occur at the time of a spill.

BOEM developed hypothetical oil spill scenarios using technical data about Cook Inlet's oil and gas resources and data from spill events during activities similar to those proposed for LS 258. Scenario models predicted the probable spill volumes and geographical trajectories. The models were then used to evaluate the likely effects of spill events given seasonal timing (BOEM 2022b). Small spills are reasonably certain to occur, but large spills are unlikely. A very large oil spill is a highly unlikely event, and not reasonably foreseeable or reasonably certain to occur.

Small Oil Spills

BOEM estimated that 405 crude, condensate, or refined small oil spills could occur during the 32-years of development, production, and decommissioning. Of those, about 389 (96 percent) are <1 bbl, 14 range from >1 bbl up to 50 bbl (3.5 percent), and 2 range from >50 bbl up to <500 bbl (0.5 percent)(Table 5)(BOEM 2022b). Up to 6 small spills are estimated to occur during the first incremental step (BOEM 2022a). Small spills during exploration activities are expected to consist of refined oils because crude and condensate oil would not be produced during exploration (BOEM 2022a). Spills during exploration activities are estimated to be small (50 bbl or less) and consist of refined oils because crude and/or condensate oil would not be produced during exploration. Based on a review of potential discharges and on the historical oil spill occurrence data for the Alaska OCS, most spills were small. From 1975 to 2015, industry drilled 85 exploration wells in the entire Alaska OCS (BOEM 2016c). During this time the drilling industry has had approximately 53 small spills totaling about 32 bbl or 1,344 gallons. Of the 32 bbl spilled, approximately 24 bbl were recovered or cleaned up (BOEM 2022b).

6.1.1.9.3 Severity of Exposure

The severity of exposure that can result in impacts to listed marine mammals and their habitats depends on a number of factors:

- size of a spill (the flow rate and duration);
- volume of oil available to be released (reservoir size);
- type of oil;
- location;
- time of year;
- species, life history, or migratory stage; and
- manner of exposure (external only or ingestion, inhalation, or aspiration).

While marine mammals may show irritation, annoyance, or distress from oil, for the most part, an animal's need to remain in an area for food, shelter, or other biological requirements overrides any avoidance behaviors to oil (Vos et al. 2003). In addition, depending on the location of a spill, highly populated areas would be more susceptible than sparsely populated areas. Animals can be affected outside of a main spill area through oil transported by currents and oiled prey (Figure 26). The exposure to oil needs to be in sufficient quantity to produce adverse effects from either external oiling, internal absorption from ingestion of oil and prey, aspiration of oil, inhalation of volatile vapors in the air, and/or a combination of the above.

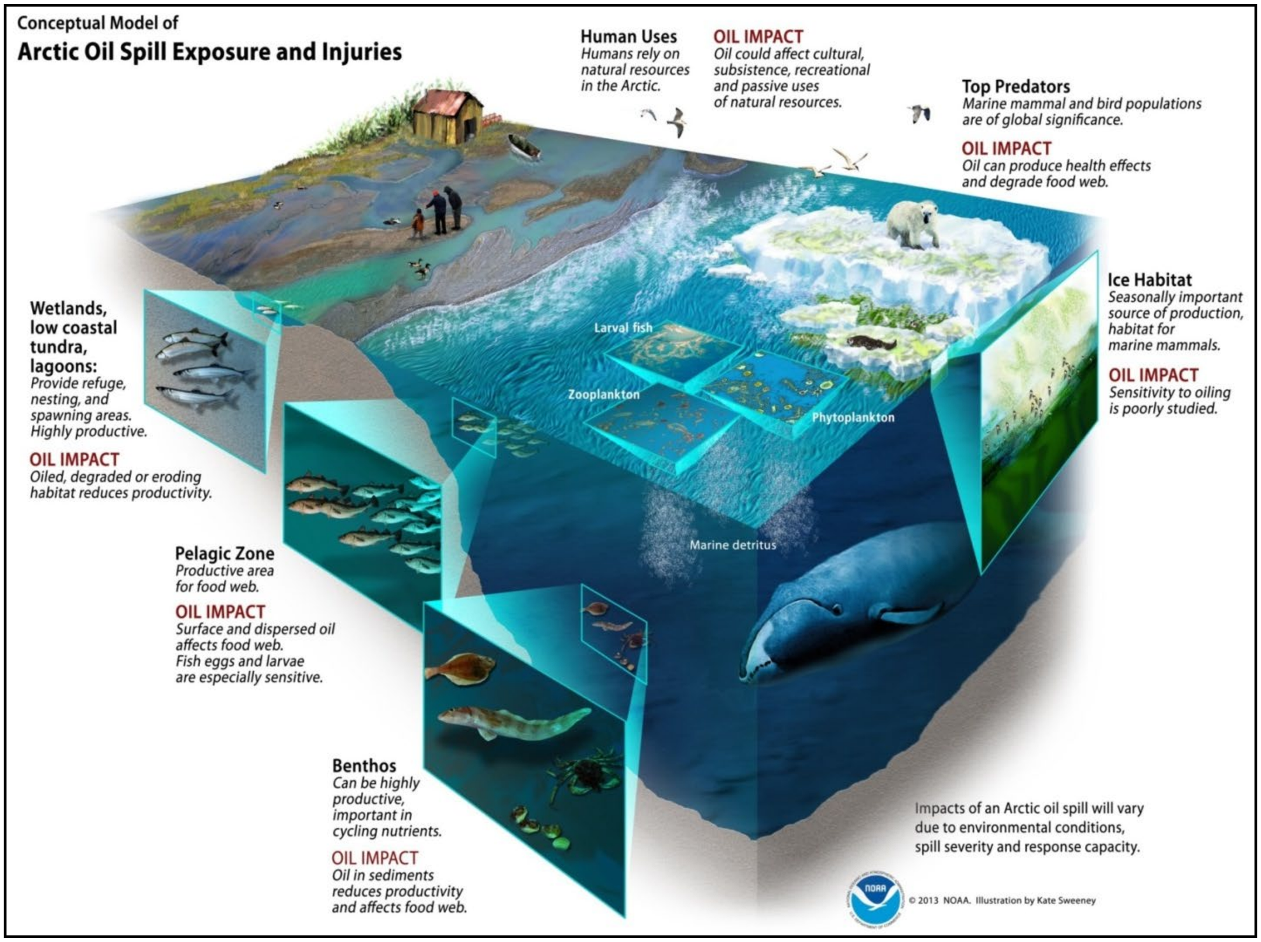

Figure 26. Conceptual model of the various pathways by which marine predators and their prey can be exposed to spilled oil.

In the following sections on expected oil spill exposures to listed species we qualitatively describe the potential for exposure. We use a qualitative rather than quantitative approach because we have estimates of the likelihood of the various sized oil spills occurring, but we do not have estimates on the potential for overlap between spills and listed species. We provide the following analysis considering that 96 percent of the small spills are expected to be less than one barrel, the predicted number of spills expected is overestimated, and that in 40 years 53 small spills, spilled about 32 bbl and approximately 24 bbl were recovered or cleaned up (BOEM 2022a).

6.1.1.9.4 Cetacean Exposure and Response

Some small spills could be in or close to areas used by beluga, humpback, and fin whales. However, small refined oil spills rapidly dissipate volatile toxic compounds within hours to a few days through evaporation, and residual components rapidly disperse in open waters. If individual beluga, humpback, or fin whales were exposed to small spills, the spills would likely have minimal effects on their health due to small spills sizes, weathering, and rapid spill dispersal.

Fin whales occur in low densities in Cook Inlet during the summer months (estimated at 0.000311 individuals per km^2), while humpbacks are present at an order of magnitude higher density (0.00177 individuals per km^2). The low density of fin and humpback whales in the action area further reduce the potential for exposure to oil spills (BOEM 2015a). Given the location of the lease block, density of belugas is extremely low (0.00002 individuals per km^2), greatly reducing their probability of exposure.

During the first incremental step, up to 6 small refined oil spills are anticipated. If an individual whale came in direct contact with spilled oil in offshore waters, it could experience inhalation and respiratory distress from hydrocarbon vapors, and less likely skin and conjunctive tissue irritation. Substantial injury and mortality due to physical contact inhalation and ingestion is possible; however, this is not likely with a small spill in Cook Inlet due to the small spill size, rapid dispersion, and evaporation, very low density of belugas in the action area, as well as the propensity for oil to not adhere to cetacean skin (BOEM 2017a). Depending on the spill location, a small refined spill in offshore waters could evaporate and disperse in 24-48 hours (BOEM 2016b) without reaching nearshore waters or shorelines.

Lower Cook Inlet within the action area is not on the list of impaired water bodies (ADEC 2012). In the action area, waters are generally free of toxins and other agents of a type and amount harmful to whales. Small accidental oil spills associated with the First Incremental Step may introduce toxins within the water but is limited by the number of vessels associated with the proposed action, and their fuel capacity. The probability that this action will release contaminants into the water in amounts sufficient to adversely affect whales is low because: (1) Cook Inlet has a large tidal exchange with a high degree of mixing; (2) There is a significant net outflow of water from the inlet due to large riverine inputs; (3) Project vessels have a small fuel capacity; and (4) There is a low probability that the vessels will release a significant volume of fuel into Cook Inlet waters due to implementation of oil spill response plans and mitigation measures.

A small fuel spill would be localized and would not permanently affect whale prey populations (e.g., forage fish and zooplankton). The amount of zooplankton and other prey lost in such a spill likely would be undetectable compared to what is available on the whales' summer feeding grounds. NMFS does not expect small spills of refined fuels at the rates predicted by BOEM to expose whales or their prey to a measureable level.

Based on the localized nature of small oil spills, the rapid weathering expected for refined oil, and the safeguards in place to avoid and minimize oil spills, the likelihood of a small spill affecting beluga, fin, or humpback whales during the first incremental step is low.

6.1.1.9.5 Steller sea lion Exposure and Response

Steller sea lions are commonly observed in lower Cook Inlet year-round. It is possible that some small spills may occur in, or close to, areas used by Steller sea lions. Based on the localized nature of small spills and the relatively rapid attenuation and dispersion of < 1,000 bbl of refined oil, the small number of predicted spills, the safeguards in place to avoid and minimize oil spills, and the small number of past spills, the likelihood of a small spill affecting Steller sea lions during the first incremental step of LS 258 is low. A small oil spill would be localized and would not permanently affect local fish and invertebrate populations that are Steller sea lion prey. The amount of fish and other prey lost in such a spill likely would be undetectable compared to what is available throughout the range of Steller sea lions.

We conclude that the probability of a BOEM/BSEE authorized activity within the action area causing a small oil spill and exposing Western DPS Steller sea lions during the first incremental step is sufficiently small as to be considered extremely unlikely to occur.

6.1.1.9.6 Cook Inlet Beluga Critical Habitat

There is no overlap between the lease block sold and Cook Inlet beluga critical habitat. Area 2 critical habitat occurs approximately 16 km (10 mi) to the west of the leased block and Area 2 critical habitat in Kachemak Bay is approximately 65 km (40 mi) to the east. The most likely location for a small spill is in Homer where vessels refuel. Area 2 critical habitat was designated based on fall and winter feeding and transit areas. Kachemak Bay was included in Area 2 critical habitat because of historical use of the area.

As discussed in section 4.2.1.2, aerial surveys have only recorded two belugas in Kachemak Bay (in 2001) (Shelden and Wade 2019). However, there have been additional opportunistic observations of belugas in 2003, 2006, 2007, 2015, and 2018 in Kachemak Bay. Since 2018, we are aware of only one observation of 2-3 belugas in Kachemak Bay (in 2021). It appears that beluga use of the area is very infrequent at this time. Given the high level of vessel activity at the Port of Homer and that the fueling station is in an enclosed harbor behind the spit, this area is probably the least likely location for belugas to utilize if they were to visit Kachemak Bay.

Based on the number of small spills expected (6) in the first incremental step, we expect that a spill would be a rare occurrence and that appropriate containment and clean up supplies would be readily available, minimizing or avoiding entry of the spill into the water at the Port of Homer. Given the tidal influence in Kachemak Bay, the 1 to 2 days needed for small spill weathering and dissolution, and the apparent absence of Cook Inlet belugas using Kachemak Bay as fall or wintering feeding habitat, we do not expect that a small spill from a vessel fueling at Homer would have an appreciable effect on Cook Inlet beluga critical habitat. Because of the distance of Area 2 critical habitat to the west of the lease sale block, the net outflow of water out of Cook Inlet, and the short time required for a small spill to dissipate, we also conclude that there would not be a meaningful impact to critical habitat along the western edge of Cook Inlet from a small spill.

6.1.1.9.7 Steller Sea Lion Critical Habitat

Small spills associated with LS 258 are not expected to reach Steller sea lion critical habitat. The Sugarloaf Island rookery is in the action area but is 98 km (60 mi) to the south of the leased block and is the closest major haulout to the lease sale area (Ushagat Island). Given the size of small spills and their rapid weathering, we do not expect that a small spill would reach these habitats in a concentration or volume to degrade the habitat or the prey upon which Steller sea lions depend. We conclude that small spills will have an immeasurable effect on Steller sea lion critical habitat.

6.1.1.10 Exposure to Oil Spill Response Practice

Oil spill response exercises or spill response practice activities may occur and could include oil spill response equipment deployment, vessels and/or aircraft traffic, unmanned aerial surveillance, and personnel or vehicle movement. The operator is required to carry out the training, equipment testing, and periodic oil spill response drills described in an Oil Spill Response Plan (OSRP).

Typical deployment exercises last only a few hours and are rarely longer that a day (BOEM 2017a). Deployment exercises are generally limited to a single skimming system involving one to six vessels, but can also be scaled up to require the operator to demonstrate their ability to carry out a larger scale response in accordance with their OSRP. A boom could be deployed; this includes up to 3,000 ft of ocean/conventional boom for offshore response tactics and up to 2,000 ft of coastal boom for near shore and shoreline protection tactics. This would represent a very large scale exercise that simultaneously tests the operator's competence in carrying out response operations in both types of environment. The most likely scenario would be much smaller testing of only a single tactic. An open water tactic would most likely require between 90 ft and 500 ft of conventional boom. A shoreline protection response would require between 250 ft and 500 ft of coastal boom. BSEE endeavors to coordinate with and include other Federal, State, and local agencies where appropriate to reduce impacts on government and industry (BOEM 2022a).

BOEM assumes drill exercises may range from one to three exercises per year, each lasting no more than a day. Effects associated with oil spill drill activities would be the same as those discussed above for vessel/aircraft traffic noise, and vessel strikes (see Sections 6.1.1.1-6.1.1.3), with the potential entanglement associated with deploying boom. However, it is not expected that equipment would be left unattended during the short duration of a practice drill. In addition, mitigation measures identified in the OSRPs which could include having observers on vessels, minimizing boom installation, and minimizing in water time would minimize the opportunity for entanglement and other potential effects from the drills.

Given their infrequency and small scale we expect that oil spill response drills will have extremely small, if any, effects on Cook Inlet beluga whales, fin whales, humpback whales, or Steller sea lions or their critical habitat. Potential effects come from minor stressors we discussed previously; vessel noise, vessel strike, and aircraft noise were discussed in sections 6.1.1.1 to 6.1.1.3. Those analyses included vessels and aircraft anticipated for oil spill drills. Our analysis and conclusions for those sections apply to oil spill drills. We expect immeasurably small effects to Cook Inlet beluga whales, fin whales, humpback whales, or Steller sea lions or their critical habitat.

6.1.2 Major Stressors on ESA-Listed Species

As discussed in Section 2, Description of the Proposed Action, BOEM/BSEE intend to authorize oil and gas leasing and exploration activities that create in-water noise (Table 1). In particular, 2D/3D seismic surveys, tugs pulling a jack up rig, VSP, and pile driving could create noise loud enough to cause harm to listed marine mammals.

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 has 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; 81 FR 51694; August 4, 2016). 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[33], expressed in root mean square[34] (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 re 1 μPa_{rms}
- non-impulsive sound: 120 dB re 1μPa_{rms}

Under the PTS/TTS Technical Guidance (NMFS 2018e), NMFS uses the following thresholds 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)) (Table 15). Different thresholds and auditory weighting functions are provided for different marine mammal hearing groups, which are defined in the Technical Guidance (NMFS 2018). These acoustic thresholds are presented using dual metrics of cumulative sound exposure level (L_E) and peak sound level (PK) for

[33] 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 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.

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

impulsive sounds and L_E for non-impulsive sounds. The generalized hearing range for each hearing group is in Table 16.

Table 15. PTS Onset Acoustic Thresholds for Level A Harassment (NMFS 2018e).

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

Table 16. 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)*	Humpback whale, Fin whale	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans *(dolphins, toothed whales, beaked whales)*	Cook Inlet beluga whale	150 Hz to 160 kHz
High-frequency (HF) cetaceans *(true porpoises)*	None	275 Hz to 160 kHz
Phocid pinnipeds (PW) *(true seals)*	None	50 Hz to 86 kHz
Otariid pinnipeds (OW) *(sea lions and fur seals)*	Steller sea lion	60 Hz to 39 kHz

[1]Respresents 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).

Level A harassment radii can be calculated using the optional user spreadsheet[35] associated with NMFS Acoustic Guidance, or through modeling.

In addition, NMFS uses the following thresholds for in-air sound pressure levels from broadband sounds that cause Level B behavioral disturbance under section 3(18)(A)(ii) of the MMPA:

- 100 dB re 20μPa$_{rms}$ for non-harbor seal pinnipeds

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 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,

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

breeding, feeding, or sheltering" (Wieting 2016). For future consultations that flow from this programmatic biological opinion, any exposure of ESA listed species to Level A or Level B disturbance sound thresholds under the MMPA may constitute incidental "take" under the ESA and would need to be authorized by an ITS (except that take is not prohibited for threatened species that do not have ESA section 4(d) regulations). For this consultation, an ITS is not needed, as explained in more detail in Section 10.

As described below, we anticipate that exposures to listed marine mammals from noise associated with the proposed action may result in disturbance and potential injury. No mortalities or permanent impairment to hearing are expected due to the implementation of standard mitigation measures. However, future issuance of IHAs or LOAs may authorize such takes, which would be subject to section 7 consultation.

In addition to major stressors related to sound, another major stressor is the effects that may occur from a large oil spill. First we discuss all the effects emanating from sound as those effects are the most likely to occur. In section 6.3.4 we discuss the effects related to a large oil spill.

6.2 Exposure Analysis

As discussed in the *Approach to the Assessment* section of this opinion, exposure analyses are designed to identify the listed species 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. For critical habitat, exposure analyses identify any designated critical habitat likely to co-occur with effects and the nature of that co-occurrence. In this step of our analysis, we try to identify the physical and biological features likely to be exposed to an action's effects. Because we lack specifics about the exact nature of these effects (e.g., intensity of noise at a given distance from the source), we strive in this section to present reasonable estimates of exposures using the best available information, noting that NMFS considers that an individual animal can be taken once per day by a given source.

6.2.1 Exposure Due to Major Noise Sources

6.2.1.1 Activity Definitions

BOEM/BSEE projected a level of exploration activities during the first incremental step based on industry's typical needs for exploring new leases. Although the levels of activities can be estimated, the particular strategy used by a company regarding when and where to explore for resources may change depending on what a company found during previous exploration activities, as well as market factors and changes in technology. Therefore, predicting and planning for levels of activity over a longer period of time (i.e. three or more years in the future) can be difficult. While NMFS and BOEM can estimate the level of future activity on an annual basis, there is some uncertainty in projections beyond that point. This is especially true in this consultation in which BOEM made estimates of activity based on 28 blocks being leased with a high level of development and in reality only one was sold. Consequently, we are using the lower estimates of activity which were presented in the BA (BOEM 2022a).

Because only one block was sold in LS 258, we expect that there will only one seismic survey. Although Hilcorp can survey a contiguous area greater than the block they bought (as was done for the seismic survey for LS 244), they must request and obtain an authorization for activities that could result in the "take" of marine mammals under the MMPA. At that point we would consult with BOEM again using data from sound sources measured from the equipment that would be used in the project. As a proxy, here we use a "typical marine seismic array" and "typical geohazard seismic array" which have been defined based on an analysis of previous airguns recently utilized in the Cook Inlet operations (e.g. (Austin 2019).

One seismic operation is anticipated to use a 2,400 in^3 airgun array with a 238 dB re 1 μPa rms source level. We note that Hilcorp used a 1,945 in^3 airgun array when they conducted their seismic surveys in 2019 (Fairweather Science 2020). Geohazard/geophysical seismic surveys are likely to be conducted with smaller arrays (e.g. 400 in^3). We made a similar assumption for VSP operations, although similar drilling operations in Alaska's Chukchi Sea used a 500 in^3 array with a source level of 228 dB re 1 μPa rms (see Table 3 for additional information). Thus our analysis of the range and intensity of effects presented below looks at the most impactful outcomes. Actual array output varies by seismic survey type and can be higher or lower depending on the number of arrays and airguns used. This could result in a decrease of the ensonified area, but given the array size we are assuming, a larger area is unlikely.

6.2.1.2 Level of Activity

For the first incremental step, BOEM anticipated the level of activity on LS 258 bulleted below (BOEM 2022a). However, these estimates were based upon the maximum amount of activity that might occur under the assumption that 28 blocks would be leased. Because only one block was sold, we expect that the level of activity will be less than these projections. However, BOEM was unable to provide estimates for how much the activities might be reduced so we are using the low end of the range of values they provided. As noted in the Appendix A of the BA (BOEM 2022a), the E&D Scenario was used to produce environmental analyses that overestimate, as opposed to underestimate, impacts of the proposed action and describes a level of activity that exceeds what is expected to result from LS 258. For example, the E&D Scenario estimates up to 8 exploration and delineation wells over a 3-year time period; however, a total of only 13 such wells have been drilled in the Cook Inlet OCS in the last 45 years, with the last well drilled in 1985 (BOEM 2022a). Activity estimates are as follows:

- One 2D/3D marine seismic survey (towed streamer, OBN, or OBC);
- Four geophysical and geotechnical surveys;

- One vertical seismic profiling survey;
- Eight casing conductor piles;
- Moving one drilling rig/drillship;
- Eight exploration and delineation wells;
- One airborne geophysical survey; and
- Maximum of three oil spill drill exercises per year, with a maximum total of 15 spill drills during the first five years.

Several of these activities have already been discussed in the Minor Stressors section (6.1.1). In this section we focus on major stressors, those which are capable of harming or harassing marine mammals through the input of harmful sound into the water. The activities we discuss in this section are:

- One 2D/3D marine seismic survey (towed streamer, OBN, or OBC);
- Four geotechnical/geophysical surveys
- One vertical seismic profiling survey;
- Pile driving eight casing conductor piles; and
- Moving one drilling rig/drillship

Off-lease seismic operations are outside the scope of the proposed action, but are subject to potential separate ESA section 7 consultations. Seismic work in Cook Inlet has traditionally been conducted during the ice-free months of April through November. A seismic survey may take up to 90 days, depending on environmental conditions, equipment operations, size of area to be surveyed, and other factors (Jacobs Engineering Group 2017). We note that Hilcorp's seismic survey over 42 OCS blocks in Cook Inlet took 38 days in 2019 (Fairweather Science 2020). Typically, data are not collected between 25 percent and 30 percent of the time because of equipment or weather problems. Because of the limited time period of open water, concurrent surveys might be conducted in the same general time frame and may overlap in time, but will not overlap in space for reasons regarding data integrity. Drilling operations are expected to take between 30 and 60 days at each well site (BOEM 2022a).

Geophysical surveys and vertical seismic profiling can often be completed in one day but can take longer, so we assume that they will take 2 days. One day was allotted for pile driving of each pile. Only one conductor pile is driven per exploration and delineation well (maximum of 8) but piles may also be driven during the installation of the platform. We assume that one platform might be constructed on the lease block and it would require up to 6 piles. A sound source verification study was recently completed for tugs moving a jack up rig in Cook Inlet. The SSV returned a source level of 167.3 dB re 1 μPa for the 20 percent power scenario and a source level of 205.9 dB re 1 μPa for the 85 percent power scenario. Assuming a linear scaling of tug power, a source level of 185 dB re 1 μPa was calculated as a single point source level for three tugs operating at 50 percent power output. We note that for activities that create harmful sound levels, especially for projects that occur in Cook Inlet, modeling is done after a sound source verification study is complete, to more accurately calculate the distance to which sounds will travel to important regulatory benchmarks (e.g. 120 dB or 160 dB), incorporating factors such as water depth, substrate, and a site specific transmission loss value. We have used 9.5 km as the radius of ensonified area for seismic surveys, vertical seismic profiling, and geophysical surveys as was done for LS 244. These are likely overestimates but provide a conservative analysis. For the tugs pulling a jack up rig we relied on the recent modeling done for Hilcorp which indicates that ensonification to the 120 dB level would occur out to 3,854 m given a sound source level of 185 dB rms re 1 μPa @ 1 m (Lawrence et al. 2021).

6.2.1.3 Density estimates

As part of our exposure analysis we must estimate the density of the animals that might be exposed to harmful or harassing sound levels. Densities were derived from Marine Mammal Laboratory beluga whale aerial surveys, typically flown in June, from 2000 to 2018 (Rugh et al. 2005, Shelden et al. 2013b, Shelden et al. 2015c, Shelden et al. 2017a, Shelden and Wade 2019). These surveys are focused on belugas and are concentrated for a few days in June annually, which may skew densities for seasonally present species. The aerial surveys focus on more coastal habitat, which introduces bias for density estimates of more pelagic species. Because large cetaceans are not the focus of these surveys, there is no visibility correction factor for large whales that may remain submerged throughout the entire passing of the survey aircraft. For all species, using densities to calculate exposure estimates assumes uniform distribution across an area, however many marine mammals travel in groups. Because these surveys have been done consistently for over 20 years, they remain the best available long-term dataset of marine mammal sightings in Cook Inlet. Density was calculated by summing the total number of animals observed and dividing the number observed within the survey area. The total number of animals observed accounts for both lower and upper Cook Inlet. Densities are presented in Table 17.

Table 17. Densities of marine mammals in lower Cook Inlet

Species	Density (indiv/km^2)
Humpback whale	0.001770
Fin whale	0.000311
Beluga whale (lower Cook Inlet)	0.00002
Steller sea lion	0.007609

Given the location of the block sold (Figure 1), the sporadic presence of a few beluga whales in lower Cook Inlet in the summer (Shelden and Wade 2019, Fairweather Science 2020)(Gill et al. unpublished report, NNMFS unpublished data), and the timing in which noise-producing activities are allowed (when belugas are expected to be in upper Cook Inlet), the density estimate of beluga whales is reasonable. Sixty-nine days of passive acoustic recording from four lower Cook Inlet locations yielded a 5 minute recording of a beluga whale at Port Graham. (Castellote et al. 2020c). In addition, as described in section 4.2.1.2, the range of Cook Inlet belugas has contracted into upper Cook Inlet over the last 20 years and they are rarely seen in lower Cook Inlet (Shelden and Wade 2019, Fairweather Science 2020)(Figure 27). Although there are instances when NMFS may expect increased exposures of beluga whales because they often are seen traveling in groups, for lower Cook Inlet, where so few have been documented in the last 20 years, there is no justification for making that kind of assumption and increasing the number of exposures based on group size.

Applying a single density estimate derived from June aerial surveys for beluga whales to our exposure calculations does not adequately account for densities variations across space and time for any of the species. While some animals may remain in close proximity to project activities for prolonged periods of time, others may simply transit through the area and others may not occur near project activities at all if they remain in upper Cook Inlet throughout the year. However, the values presented are based on the best available long-term dataset of marine mammal sightings available in Cook Inlet.

In conjunction with these density estimates, NMFS expects the following probability of occurrence for humpback whale DPSs in the action area: Hawaii DPS 89 percent, Mexico DPS 11 percent, and 1 percent Western North Pacific DPS individuals (Wade 2021).

6.2.1.4 Approach to Estimating Exposures to Major Noise Sources

We lack much of the information needed to accurately estimate take of listed animals due to exposure to noise associated with this action. We lack accurate source levels for equipment, as well as how noise from this equipment will propagate within the lease sale area. We also lack refined density estimates for potentially exposed marine mammal species throughout the duration of this action. These estimates do not take into account the possibility of multiple exposures of a single animal to different sources of take on the same day. Therefore, our estimates of exposure represent our best estimates given the information we have. Subsequent biological opinions for ancillary activities and future incremental steps will include refined exposure estimates as additional information, in particular SSVs related to specific equipment, is obtained.

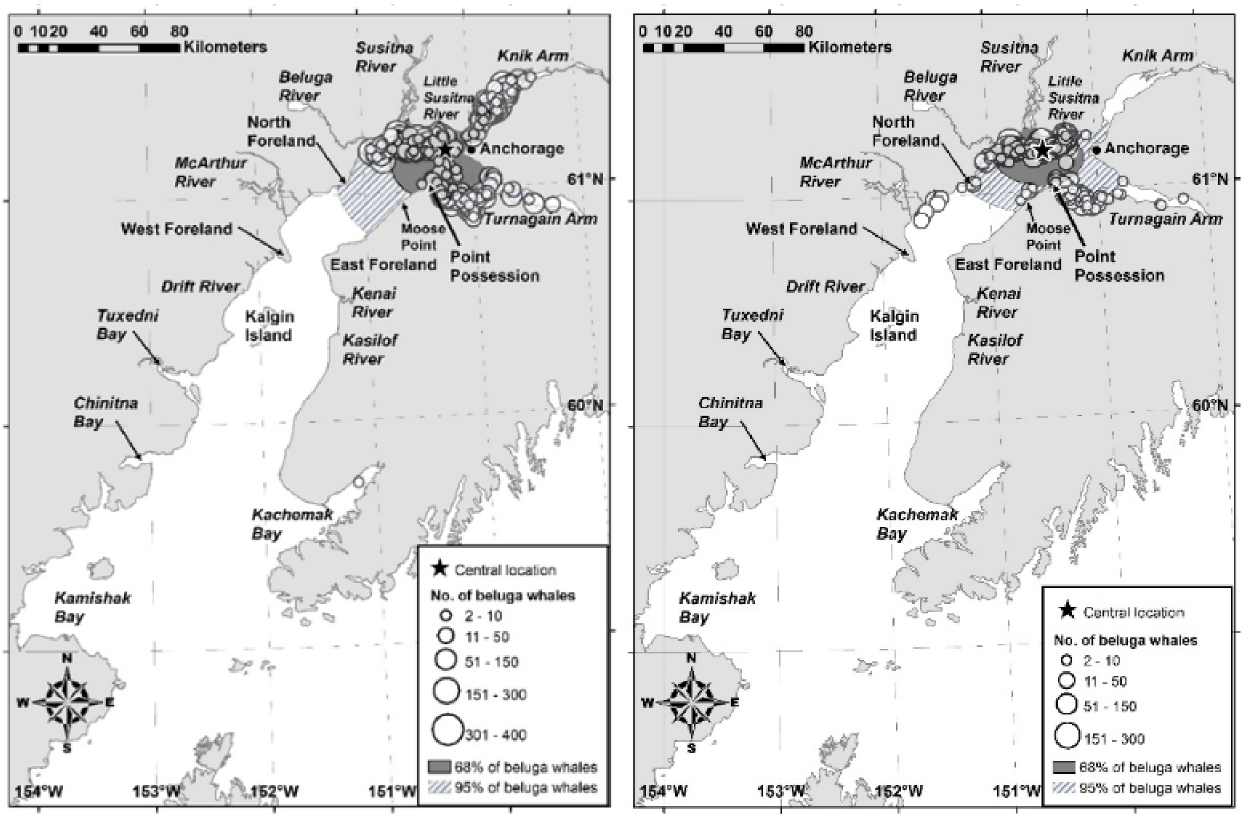

Figure 27. Areas occupied by belugas in Cook Inlet, Alaska, during systematic aerial surveys flown in June in 1998–2008 (left panel), and 2009–18 (right panel) from (Shelden and Wade 2019).

Table 18 contains a representative summary of exposures that are predicted to occur in Cook Inlet for each listed species based on activity scenarios provided by BOEM, and density and noise propagation information associated with recent oil and gas activity in Cook Inlet. Having determined the duration of each activity and its ensonified area on a per-day basis, we multiply this by the expected density of each species in the action area to arrive at the number of expected instances of exposure per species.

Table 18 indicates that for the given assumptions, about two (rounding up) Cook Inlet beluga exposures to harassment may occur as a result of activities associated with this action. Similarly, we estimate 130 total instances of exposure of humpback whales, one percent of which are expected to be Western North Pacific DPS humpback whales (one individual), 11 percent of which are expected to be Mexico DPS humpbacks (14 animals), with the remaining exposures occurring for non-listed Hawaii DPS animals. Twenty-three instances of fin whale exposures and 557 instances of Western DPS Steller sea lion exposures to Level B harassment levels could also occur. The sound source values for the seismic surveys, vertical seismic profiling, and pile driving were provided by BOEM (BOEM 2022a) and we agree they are reasonable proxy values. The source level and ensonified radius for moving the drill rig came from a recent SSV and subsequent modeling done for three tugs towing a jack-up rig in Cook Inlet (NMFS 2022). We assumed that the jack-up rig would be moved from Homer to the leased block.

Note that Table 18 presents estimates of Level B harassment exposures from project activities, but these estimates are not numbers of authorized take under the ESA. Authorized take will be calculated and provided in incidental take statements, if appropriate, during future ESA section 7 consultations. At that juncture, BOEM, BSEE, and NMFS will have more complete and detailed information on the specific number, location, timing, frequency, and intensity of actions associated with subsequent exploration, development, production, and decommissioning activities. In addition, when a project is proposed, there may be additional activities such as the use of specialized tools that also create underwater noise. These would be consulted on under both the MMPA and ESA, and appropriate zones would be described to avoid Level A harassment, minimize exposure to Level B harassment, and more accurately account for total incidental take numbers. We have presented the mostly likely activities that will occur.

Also, note that the estimates presented below all represent Level B behavioral exposures and assume no injury (or mortality) based on previous analyses using historical Level A harassment thresholds and assumptions about avoidance and mitigation. As described above, future authorizations and calculations using the revised auditory impact thresholds for Level A exposures will likely not result in much of a change to predicted numbers, but it is not appropriate to rule out the chance of PTS completely; there may be cases in the future, on a site specific basis, in which NMFS authorizes a small number of Level A harassment exposures for species other than Cook Inlet beluga whales. However, if so, it would not change the estimated exposure numbers in Table 18, as those potential Level A harassment exposures would come from the pool of exposures that would otherwise have been estimated as Level B harassment. At this time, we do not anticipate any level A exposure but if they were to occur, the numbers would be small we anticipate that any number of Level A exposures would be small, and so we do not expect that the small number of Level A exposures that may result from this action will have any measurable effects upon listed species populations. We also emphasize here that not all exposures are biologically significant and may not rise to the level of harassment under the ESA as set forth in NMFS guidance (Wieting 2016).

Table 18. Representative summary of exposures that were modeled or estimated to occur in Cook Inlet for each listed species based on activity scenarios provided by BOEM, and density and noise propagation information associated with recent oil and gas activity in Cook Inlet. Estimated instances of exposure of listed marine mammals due to received sound levels ≥120 dB re 1 µPa (rms) for continuous noise, or ≥160 dB re 1 µPa (rms) for impulsive noise associated with BOEM/BSEE LS 258.

							Density (animals/km²)				Estimated Exposure			
Action (I = impulsive, N= nonimpulsive) [1]	Source level (dB rms re 1 µPa @ 1 m)	Instances	Duration per instance (days)	Total duration	Radius of ensonified area (km)	Area ensonified per day (km²)	Humpback	Fin	Cook Inlet beluga	WDPS Steller sea lion	Humpback	Fin	Cook Inlet beluga	WDPS Steller sea lion
Seismic surveys (I)[2]	238	1	90	90	9.5	784	0.00177	0.000311	0.00002	0.007609	124.89	21.94	1.41	536.89
Vertical Seismic Profiling (I)[3]	228	1	2	2	9.5	458	0.00177	0.000311	0.00002	0.007609	1.62	0.14	0.02	6.97
Pile driving (I)[4]	216	14	1	14	5.4	91.61	0.00177	0.000311	0.00002	0.007609	2.27	0.40	0.03	9.75
Moving drill rig	185	1	1	1	3.85	500	0.00177	0.000311	0.00002	0.007609	0.88	0.16	0.01	3.80
Total											129.66	22.64	1.47	557.41

[1]For impulsive noise sources, the area ensonified extends outward to the 160 dB isopleth. For non-impulsive noises, the area ensonified extends outward to the 120 dB isopleth.
[2]Seismic exploration area ensonified per day assumes a 9 km x 9 km patch surveyed per day and a 9.5 km radius ensonified zone around that patch.
[3](BOEM 2022a)
[4]{NMFS, 2022 #17999

6.3 Response Analysis

As discussed in the section 3, Approach to the Assessment, of this opinion, response analyses determine how listed species/critical habitats 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. For critical habitat, our assessments try to identify which of the action's effects will impact or alter the physical and biological features of critical habitat and the magnitude of the impacts or alterations relative to the value of critical habitat as a whole for the conservation of a listed species. Ideally, our response analyses consider and weigh evidence of adverse consequences, beneficial consequences, or the absence of such consequences.

Of all of the stressors we consider in this opinion, the potential responses of marine mammals upon being exposed to low-frequency seismic noise from airgun pulses have received the greatest amount of attention and study. Nevertheless, despite decades of study, empirical evidence on the responses of free-ranging marine animals to seismic noise is very limited. We examine multiple sources of seismic noise from the proposed action (2D, 3D, geohazard, and VSP) and the potential responses of listed species to these sources in this section, and also consider effects on Cook Inlet beluga whale and Steller sea lion critical habitats.

Each stressor may result in similar or different responses. Possible responses by ESA-listed marine mammals to project activities in this analysis are:

- Auditory threshold shifts
  - Temporary threshold shift (TTS)
  - Permanent threshold shift (PTS)
- Non-auditory physical and physiological effects
  - Stress
  - Distress
- Behavioral responses
  - Change in vocalizations
  - Change in behavioral state
  - Avoidance or Displacement
- Auditory interference
  - Masking

Because 3D seismic surveys, vertical seismic profiling, and geotechnical/geohazard surveys all use impulsive sounds delivered from a vessel in motion, and we expect similar effects and responses to these sources, they are discussed together. Effects from pile driving and tugs moving a jack up rig are discussed individually.

Threshold Shifts

Exposure of marine mammals to very loud sound 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 sound 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 or from accumulated effects of non-pulsed sound from a continuous sound source. 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 and is considered "Level B harassment" under the MMPA. Behavioral effects may also constitute Level B harassment and are expected to occur at received levels that may not cause TTS.

Non-Auditory Physical or Physiological Effects

Marine mammals use hearing as a primary way to gather information about their environment and for communication; therefore, we assume that limiting these abilities is stressful. Individuals exposed can experience stress and distress; 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, multiple studies have investigated and documented the impact of vessels on marine mammals (both whale-watching and general vessel traffic sound) (Erbe 2002, Williams et al. 2002, Williams and Ashe 2006, Williams and Noren 2009, Pirotta et al. 2015). Williams and Noren (2009) indicated that vessel disturbance from whale-watching in the Johnstone Strait resulted in lost feeding opportunities for killer whales. Shipping traffic and associated ocean sound decreased along the northeastern U.S. following September 11, 2001. The decrease in ocean sound was associated with a significant decline in fecal stress hormones found in North Atlantic right whales, suggesting that chronic exposure to increased sound levels, although not acutely injurious, can produce stress (Rolland et al. 2012). Exposure to loud sound can also adversely affect reproductive and metabolic physiology; females appear to be more sensitive or respond more strongly than males in a variety of factors, including behavioral and physiological responses (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 preliminary because of the small numbers of samples collected, different types of sounds have been shown to produce variable stress responses in marine mammals. Stress responses may also occur at levels lower than those required for TTS (Southall et al. 2007b). Therefore, exposure to levels sufficient to trigger onset of PTS or TTS are expected to be accompanied by physiological stress responses (NRC 2003). 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 gun (Romano et al. 2004).

We expect that the proposed action may result in ESA-listed species experiencing Level B acoustic harassment and/or exhibiting 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 dissipate shortly after the individual leaves the area or after the cessation of the acoustic stressor.

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, 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 (e.g., Nowacek et al. 2007, Southall et al. 2007b, Southall et al. 2009, Ellison et al. 2012) address studies conducted since 1995 and 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 response; however, stress responses cannot be predicted due to a lack of data (see following section). Responses can overlap; for example, a flight response is likely to be coupled with an increased respiration rate. 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. This is reflected in a variety of aquatic, aerial, and terrestrial animal responses to anthropogenic sound that may ultimately have fitness consequences (Francis and Barber 2013).

Auditory Interference (masking)

Masking occurs when anthropogenic sounds and marine mammal signals overlap at spectral, spatial, and temporal scales. For the airgun sound generated from the proposed seismic surveys, sound will consist of low frequency pulses with extremely short durations (less than one second). Lower frequency anthropogenic sounds are more likely to affect detection of communication calls and other potentially important natural sounds such as surf and prey noise. There is little concern regarding masking near the sound source due to the brief duration of these pulses and relatively longer silence between airgun shots (approximately 5-6 seconds). However, at long distances (over tens of kilometers away), due to multipath propagation and reverberation, the durations of airgun pulses can be “stretched” to seconds with long decays (Madsen et al. 2006) (in much the way that distant thunder rumbles, although the sound results from one short burst of energy), although the intensity of the distant but prolonged sound is greatly reduced. This could affect communication signals used by low frequency mysticetes when they occur near the noise band and thus reduce the communication space of animals (Clark et al. 2009) and cause increased stress levels (Foote et al. 2004, Holt et al. 2009).

However, marine mammals are thought to be able to compensate for masking by adjusting their acoustic behavior by shifting call frequencies, and/or increasing call volume and vocalization rates. A few studies have demonstrated that marine mammals make vocal adjustments in the face of high levels of background noise. For example, two studies reported that some mysticete whales stopped vocalizing – that is, adjust the temporal delivery of their vocalizations – when exposed to active sonar (Miller et al. 2000, Melcon et al. 2012). Melcón et al. (2012) reported that during 110 of the 395 d-calls (associated with foraging behavior) they recorded during mid-frequency active sonar transmissions, blue whales stopped vocalizing at received levels ranging from 85 to 145 dB, presumably in response to the sonar transmissions. These d-calls are believed to attract other individuals to feeding grounds or maintain cohesion within foraging groups (Oleson et al. 2007). Beluga whales in the St. Lawrence increased the production of falling tonal calls and pulsed calls, increased the repetition of calls, and shifted call frequencies up in the presence of ship noise (Lesage et al. 1999). They also increased their call level (Lombard response) (Scheifele et al. 2005).

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 sound sources. They found that two commercial vessels passing through a North Atlantic right whale's optimal communication space decreased the size of that space by 84 percent. Subsequent research for the same species and location estimated that an average of 63 to 67 percent of North Atlantic right whale's communication space has been reduced by an increase in background noise levels, and that sound associated with transiting vessels is a major contributor to the increase in background noise (Hatch et al. 2012). Likewise (Gabriele et al. 2018)found that typical summer vessel traffic in Glacier Bay National Park causes substantial loss of communication space to singing whales (reduced by 13–28 percent), and calling whales (18–51 percent). (Fournet et al. 2018)found that as ambient sound level increased, humpback whales responded by increasing the source levels of their call (non-song vocalizations) by 0.81 ds for every 1 dB increase in ambient sound. In this study the increase in ambient sound was caused by vessel noise, primarily cruise ships.

Mitigation Measures to Minimize the Likelihood of Exposure to Acoustic Sources

Mitigation measures are described in Section 2.3. The following mitigation measures will reduce the adverse effects of exposure to major noise sources on marine mammals from the proposed oil and gas exploration activities.

1. PSOs are required on all vessels engaged in seismic survey, pile driving, anchor handling, drillship drilling, and dynamic positioning activities that may result in incidental take through acoustic exposure.

2. Establishment of zones associated with received sound level thresholds for Level A shutdown/power down for marine mammals under NMFS's authority, including the use of PSOs to monitor for, and take steps to minimize occurrence of, marine mammals within Level A harm and Level B harassment zones for seismic survey, pile driving, anchor handling, drillship drilling, and dynamic positioning activities that may result in incidental take through acoustic exposure.

3. Use of start-up, power-up and ramp-up procedures for airgun arrays.

4. Time/area restrictions for seismic survey operations to avoid Cook Inlet beluga presence.

Given the large size of baleen whales (humpback whales and fin whales), and their pronounced vertical blow, it is likely that PSOs would be able to detect these whales at the surface. Cook Inlet beluga whales and Steller sea lions are more difficult to visually detect. However, PSOs for Hilcorp's 2019 seismic survey observed 47 pinnipeds and 59 sea otters so we are confident that beluga whales and Steller sea lions can also be reliably detected (Fairweather Science 2020). The implementation of mitigation measures to reduce exposure to high levels of seismic sound, and the short duration and intermittent exposure to seismic airgun pulses, reduces the likelihood that exposure to seismic sound would cause take (e.g., a behavioral response that may affect vital reproduction or survival functions, or result in temporary threshold shift (TTS) or permanent threshold shift (PTS)).

6.3.1 Impulsive Seismic Survey Sounds

6.3.1.1 Cetacean Response

Combining instances of exposure associated with all seismic sources during the first incremental step (2D, 3D, and VSP) results in the following maximum instances of exposure: approximately 2 Cook Inlet beluga whale, 22 fin whale, 1 Western North Pacific DPS humpback whale, and 14 Mexico DPS humpback whales (Table 18). All instances of Level B harassment due to seismic exploration will occur at received levels ≥ 160 dB.

The sounds fin whales produce underwater are one of the most studied *Balaenoptera* sounds. Fin whales produce a variety of low-frequency sounds in the 10-200 Hz band (Watkins 1981, Watkins et al. 1987a, Edds 1988b, Thompson et al. 1992a). The most typical signals are long, patterned sequences of short duration (0.5-2s) infrasonic pulses in the 18-35 Hz range (Patterson and Hamilton 1964). Estimated source levels for fin whales are 140-200 dB re 1 µPa m (Patterson and Hamilton 1964, Watkins et al. 1987a, Thompson et al. 1992a, McDonald et al. 1995, Clark and Gagnon 2004). In temperate waters, intense bouts of long patterned sounds are very common from fall through spring, but also occur to a lesser extent during the summer in high latitude feeding areas (Clark and Charif 1998). Short sequences of rapid pulses in the 20-70 Hz band are associated with animals in social groups (McDonald et al. 1995). Each pulse lasts on the order of one second and contains twenty cycles (Tyack 1999b).

Fin whales are regularly seen in lower Cook Inlet ((Shelden and Wade 2019, Fairweather Science 2020)and we expect that they would overlap with seismic activities. We calculated that 23 fin whales would be exposed to seismic noise. Fin whales are low frequency specialists and of the species present in lower Cook Inlet their communication channel would be the most impacted by noise created by the air guns (Castellote et al. 2020c). Recordings taken at the same time as the seismic survey in 2019 showed vocalizations of fin whales peaked during the seismic survey period, and dropped off the same day the survey ended. This could indicate the whales left the area the same day the seismic survey ended or underwent a drastic reduction in vocalizations once the disturbance ended (Castellote et al. 2020c). Unfortunately, there are no baseline surveys of fin whale vocalizations for lower Cook Inlet, making conclusions difficult. Studies on fin whales elsewhere have shown an initial increase in detections and calling rates in the presence of seismic survey noise (Castellote et al. 2012), and may be a plausible explanation for the results seen (Castellote et al. 2020c). For the same seismic survey, 23 fin whales were seen, fifty percent of the sightings occurred during non-seismic activity, and 50 percent were observed when the full array was firing. PSOs reported that none of the fin whales sighted showed detectable reaction to the seismic activity. The average sighting distance for fin whales during periods of non-seismic activity was ~5,057 m, and ~2,938 m during seismic operations (Fairweather Science 2020).

Humpback whales produce a wide variety of sounds. During the breeding season, males sing long, complex songs, with frequencies in the 20-5000 Hz range and intensities as high as 181 dB (Payne 1970, Winn et al. 1970, Thompson et al. 1986). Source levels average 155 dB and range from 144 to 174 dB (Thompson et al. 1979). Social sounds in breeding areas associated with aggressive behavior in male humpback whales are very different than songs, and extend from 50 Hz to 10 kHz (or higher), with most energy in components below 3 kHz (Tyack and Whitehead 1983, Silber 1986). These sounds appear to have an effective range of up to 9 km (Tyack and Whitehead 1983). Humpback whales produce sounds less frequently in their summer feeding areas. Feeding groups produce distinctive sounds ranging from 20 Hz to 2 kHz, with median durations of 0.2-0.8 seconds and source levels of 175-192 dB (Thompson et al. 1986). These sounds are attractive and appear to rally animals to the feeding activity (D'Vincent et al. 1985, Sharpe and Dill 1997).

Humpback whales have also been regularly observed in lower Cook Inlet, and have the highest density of the whales we consider (0.00177 individuals/km^2) in lower Cook Inlet. We estimated 132 humpback whales could be exposed to the noise created by the various seismic surveys. Sixteen could be from a listed DPS (14 from the Mexico DPS, 1 from the Western North Pacific DPS), the remainder would be from the Hawaii DPS, which is not listed.

For the LS 244 seismic survey conducted in 2019, 21 percent of humpback whale sightings occurred during periods of no seismic activity, while 79 percent of sightings were observed during seismic activity including ramp up or full array. PSOs reported that humpback whales showed no detectable reaction to the seismic activity (Fairweather Science 2020). Thirty-eight humpback whales were seen during the seismic survey. Recordings taken on the west side of Cook Inlet during the seismic survey suggested a strong change in acoustic behavior or spatial displacement for humpback whales ((Castellote et al. 2020c). The results suggest humpback whales are sensitive to seismic survey noise, as these locations were 37.4 km and 8.5 km, respectively, from the nearest border of the survey area, and in very shallow waters where low frequency sound propagation is highly attenuated. There is at least one precedent where humpback whales have shown strong reaction to seismic survey noise. (Cerchio et al. 2014) described how singing behavior by humpback whales was disrupted by a seismic survey. Because the visual surveys continued to document humpback whales near the survey vessels (Fairweather Science 2020), it suggests that a change in humpback acoustic behavior is more likely than avoidance of the area.

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 40-120 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 10-75 kHz. Estimated source level for beluga click trains average peak to peak of 218 ±5 dB re 1 μPa m (Au et al. 1987).

Although the results from visual monitoring done during the 2019 Hilcorp seismic survey indicate little reaction by humpback and fin whales to the survey (Fairweather Science 2020), the recordings done at the same time indicate that there was likely a change in acoustic behavior (Castellote et al. (2020c). They concluded from the visual surveys that 10.9 fin whales and 31.5 humpback whales were exposed to Level B harassment. It is difficult to determine the energetic cost of a change in acoustic behavior. Neither fin nor humpback whales abandoned lower Cook Inlet during the surveys. We conclude that there will be an effect on individual fin and humpback whales if another the seismic survey occurs, but it is highly unlikely that it will affect their long term survival or fitness given their continued use of the area during the survey and the relatively short time frame of seismic surveys compared to the amount of time available to the whales to feed in the area.

Seismic surveys may only occur from April until the end of October. During this timeframe, beluga whales are typically in shallow coastal waters in the northern end of Cook Inlet, greatly reducing the chances of overlap with seismic surveys (Shelden et al. 2015c, Castellote et al. 2016a, Shelden et al. 2017a, McGuire et al. 2020b). Belugas once occupied lower Cook Inlet in the winter more consistently, but aerial surveys that included lower Cook Inlet in winter and spring from 2018 through 2021 did not observe belugas south of Tuxedni Bay (Gill et al. unpubl. report). Tuxedni Bay is approximately 40 km (25 mi) north of the lease block that was sold. No belugas were sighted in 1,386 hours of observation during a seismic survey conducted in lower Cook Inlet in 2019 (Fairweather Science 2020). We expected two exposures based upon our calculations (Table 18), but our calculation did not take into account the effects of mitigation measures in reducing the number of exposures (e.g., limits on when the seismic surveys can occur). While possible, it is highly unlikely that any beluga individuals will overlap with any of the seismic activities proposed for LS 258.

6.3.1.2 Steller Sea Lion Response

Combining estimated exposures associated with all seismic sources during the first incremental step (2D, 3D, and VSP) results in as many as 544 instances where Western DPS Steller sea lions may be exposed to sound capable of causing Level B acoustic harassment (Table 18). All instances of exposure are anticipated to occur at received levels ≥ 160 dB. These numbers of exposures are likely to be overestimates because they assume a uniform distribution of animals and do not account for avoidance.

While a single individual may be exposed multiple times, implementation of mitigation measures to minimize exposure to high levels of seismic sound reduces the likelihood that exposure to seismic sound would cause a behavioral response that may affect vital functions, or would cause TTS or PTS.

Steller sea lions traveling across a broad area may experience effects from seismic exploration activity on multiple occasions across time. It is not known if multiple disturbances within a certain timeframe add to the stress of an animal and, if so, what frequency and intensity may result in biologically important effects to those animals. There is likely to be a wide range of individual sensitivities to multiple disturbances, with some animals being more sensitive than others.

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 2018e). The auditory response for pinnipeds to underwater pulsed sounds has been examined in only one study (Finneran et al. 2003) where they measured TTS onset in two captive California sea lions exposed to single underwater pulses produced by an arc-gap transducer. A measurable TTS was not observed following exposures up to a maximum level of 183 dB re 1 μPa peak-to-peak (SEL 163 dB re 1$\mu Pa^2 s$).

Information on behavioral reactions of pinnipeds in-water to multiple pulses involves exposures to small explosives used in fisheries interactions, impact pile driving, and seismic surveys. Several studies investigating these reactions lacked matched data on acoustic exposures and behavioral responses by individuals. That is, behavioral responses could not be definitively attributed to acoustic exposures. As a result, the quantitative information on reactions of pinnipeds in water to multiple pulses is very limited (Southall et al. 2007a). However, based on the available information on pinnipeds in water exposed to multiple noise pulses, exposures in the ~150-180 dB re 1μ Pa rms generally have limited potential to induce avoidance behavior in pinnipeds (Southall et al. 2007a). We anticipate this would also apply to Steller sea lions. Received levels exceeding 190 dB re 1μ Pa are likely to elicit avoidance responses, at least in some pinnipeds (Harris et al. 2001, Blackwell et al. 2004, Miller et al. 2005). Harris et al. (2001) reported 112 instances when seals were sighted within or near the exclusion zone based on the 190 dB radius (150-250m of the seismic vessel).[36] The results suggest that seals tended to avoid the zone closest to the boat (<150m) (or to avoid noise levels greater than 190 dB). However, overall, seals did not react dramatically to seismic operations. Only a fraction of the seals swam away, and even this avoidance appeared quite localized (Harris et al. 2001). In the case of Steller sea lions exposed to sequences of airgun pulses from an approaching seismic vessel, we

[36] It should be noted that visual observations from the seismic vessel were limited to the area within a few hundred meters, and 79 percent of the seals observed were within 250 m of the vessel (Harris et al. 2001).

anticipate most animals would show little avoidance unless the received level was high enough for mild TTS to be likely (Southall et al. 2007a).

Monitoring studies in the Alaska and Canada Beaufort Sea during 1996-2002 provided considerable information regarding Arctic seal behaviors when exposed to seismic pulses (Moulton and Lawson 2002, Miller et al. 2005). The behavioral data from these studies indicated that some seals were more likely to swim away from the source vessel during periods of airgun operations, and were more likely to swim towards, or parallel to, the vessel during non-seismic periods. A consistent relationship was not observed between exposure to airgun noise and proportions of seals engaged in other recognizable behaviors (e.g., ‘looked,’ ‘dove’). Such a relationship might have occurred if seals tried to reduce exposure to strong seismic pulses, given the reduced airgun noise levels close to the surface, where “looking” occurs (Moulton and Lawson 2002, Miller et al. 2005).

Marine mammal sighting data during the Apache seismic surveys in Cook Inlet reported the most common behavior of harbor seals during non-seismic periods was “look/sink” followed by “travel,” whereas during periods of active seismic shooting, “travel” was more common than “look/sink” (Lomac-MacNair et al. 2014). The 2012 Apache seismic monitoring program observed four Steller sea lions during periods without seismic airgun activity. Marine mammal observations from the 2019 Hilcorp seismic survey only recorded “look” and “none” for Steller sea lion behavior (Fairweather Science 2020).

While the estimated instances of exposure suggest a high number of exposure events, the majority of these are anticipated to occur at received levels ≥ 160 dB re 1 µPa rms where previous studies have shown limited avoidance behavior in pinnipeds (Southall et al. 2007a). Even if exposure occurred at higher received levels, the tendency of Steller sea lions to raise their heads above water, or haul out to avoid exposure to sound fields, as well as mitigation measures, reduce the potential for harassment of this species. Of the Steller sea lions that may be taken due to seismic operations, some sea lions are likely to change their behavioral state. Steller sea lions that avoid these sound fields or exhibit vigilance are not likely to experience significant disruptions of their normal behavior patterns because the vessels are transiting and the ensonified area is temporary and because pinnipeds seem rather tolerant of low frequency noise. We anticipate that few (if any) exposures would occur at received levels >160 due to avoidance of high received levels and the implementation of shut down mitigation measures.

Seismic exposures are not expected to overlap with any rookeries or major haulouts. The proposed seismic activities will not take place in any special foraging areas designated as critical habitat. Very few Steller sea lions have been seen during aerial surveys of Cook Inlet (Rugh et al. 2004, Rugh et al. 2005, Rugh et al. 2006, Shelden et al. 2008, Shelden et al. 2009, Shelden et al. 2013a) and only 5 were seen during Hilcorp’s 2019 seismic survey in lower Cook Inlet (Fairweather Science 2020). For these reasons, the duration and intensity of a seismic survey is not likely to cause a response that is a significant disruption of their normal behavioral patterns.

6.3.1.3 Critical Habitat Response

Seismic surveys would not be done in critical habitat for any listed species. In considering the exposure of major noise sources upon Cook Inlet beluga whale and Steller sea lion critical habitat, we must consider the effects of that noise on their prey species. Because of the distance between Steller sea lion critical habitat and the lease block (approximately 100 km), we would not expect any direct effects of the noise created by project activities on their prey species. Prey of beluga whales would be in closer proximity to the seismic surveys. Because the leased block occurs within beluga nearshore feeding area (Figure 1), the Lessee(s), its operators and subcontractors are prohibited from conducting any on-lease seismic surveys between July 1 and September 30, when beluga whales are migrating to and from their summer feeding areas (BOEM 2022a).

Information on effects of sound upon prey items of Cook Inlet beluga whales and Western DPS Steller sea lions is limited. Fish that have swim bladders may be harmed by impulsive noise created by the seismic airguns or impact pile driving due to swim bladder resonance. As the pressure wave passes through a fish, the swim bladder is rapidly squeezed as the high pressure wave, and then the under pressure component of the wave, passes through the fish. The swim bladder may repeatedly expand and contract at the high sound pressure levels, creating pressure on the internal organs surrounding the swim bladder. Literature relating to the impacts of sound on marine fish species can be divided into the following categories: (1) Pathological effects; (2) physiological effects; and (3) behavioral effects. Pathological effects include lethal and sub-lethal physical damage to fish; physiological effects include primary and secondary stress responses; and behavioral effects include changes in exhibited behaviors of fish.

No seismic survey-related acoustic impact studies have been conducted to date on the fish species most likely present during the summer months in Cook Inlet, but studies have been conducted on Atlantic cod (*Gadus morhua*) and sardine (*Clupea* sp.). Davis et al. (1998) cited various studies and found no effects to Atlantic cod eggs, larvae, and fry when received levels were 222 dB; however, effects were found upon larval fish when they were within about 5.0 m (16 ft) from the sound source (air guns with displacement volumes between 49,661 and 65,548 cm^3 [3,000 and 4,000 in^3]). Similarly, effects to sardine were greatest on eggs and two-day-old larvae, but these effects were greatest at 0.5 ft (1.6 ft), and were limited to within 5.0 m (16 ft) of the sound source. Greenlaw et al. (1988) found no evidence of gross histological damage to eggs and larvae of northern anchovy (*Engraulis mordax*) exposed to seismic air guns, and concluded that noticeable effects would result only from multiple, close exposures. This suggests that acoustic injury to prey results from particle motion (which is highly localized, on the order of meters) rather than from sound waves.

McCauley et al. (2017) conclude that marine seismic surveys can have significant negative impacts upon zooplankton populations, upon which some prey species of belugaand Steller sea lion rely. However, given the limited spatio-temporal extent of the surveys compared to the area of Cook Inlet, and the rapid mixing/dispersal of plankton from tidal currents, we would not expect that use of the seismic air guns would cause a measurable effect on zooplankton. In addition, while a small number of fish prey may be temporarily effected by airgun use, the smaller sized guns proposed for use, the limited data indicating negative effects, and small area affected given the fish eggs, larvae, and adults need to be very close to the noise source, leads us to conclude that the use of the seismic air guns will not have a measurable effect on the prey resources of beluga whales or Steller sea lions.

6.3.2 Other Impulsive sounds (VSP, pile driving)

The other impulsive noises we consider in this consultation are those produced by vertical seismic profiling (VSP) and pile driving.

Mitigation Measures to Minimize the Likelihood of Exposure to Other Impulsive Noise Sources

Mitigation measures are described in Section 2.3. The following mitigation measures will reduce the adverse effects of exposure to vertical seismic profiling (VSP) surveys:

1. PSOs are required on all vessels engaged in activities that may result in incidental take through acoustic exposure, which will help implement steps to minimize the occurrence of marine mammals within Level A harm and Level B harassment zones.

6.3.2.1 Vertical Seismic Profiling (VSP)

Borehole seismic surveys, including 2D and 3D VSP, involve the use of a sound source near a wellhead to measure down-hole characteristics. Borehole surveys may be used during the exploration or development phase and occasionally during decommissioning when additional information is needed about the down-hole characteristics of a well.

Once the well is drilled, accurate follow-up seismic data may be collected by placing a receiver at known depths in the borehole and using a sound source, usually an airgun at the surface near the borehole. The acoustic characteristics of the transmitted signal can be translated into high-resolution images of the geological layers penetrated by the borehole and can be used to accurately correlate original surface seismic data with subsurface features. The actual size of the airgun array is not determined until the final well depth is known. The VSP seismic surveys require less sound energy because the seismic sensors are in a borehole, which is in a much quieter environment than towed sensors and are located nearer to the targeted reflecting horizons. Some VSP surveys take less than a day, and most are completed in a few days (BOEM, 2017).

BOEM does not think borehole surveys are a likely component of drilling activities related to the LS 258, but they could be conducted during exploration or development. BOEM expects no more than one borehole survey to be conducted. Should BOEM receive an application for a borehole survey as part of exploration activities, details of the survey will be provided to NMFS including equipment types, survey timing, duration, etc. and BOEM will ensure surveys are conducted in compliance with all mitigation measures agreed on in ESA consultation.

We estimated that no listed cetaceans would be exposed to VSP (Table 18) and that 7 Steller sea lions could be exposed. We would expect the same kind and level of response to VSP that we described above for the 3D seismic surveys. Given the mitigation measures that will be in place if a VSP is done, the smaller ensonified zone, the short time needed to complete the survey, and limited response recorded by Steller sea lions to the more impactful 3D seismic surveys, we conclude that if exposed to the impulsive sound from a VSP study, the effects will be temporary and will not compromise the fitness or survival of any exposed individual.

6.3.2.2 Pile Driving Operations

We expect pile driving could occur on the leased block that sold and that Cook Inlet beluga whales, humpback whales, fin whales, and Western DPS Steller sea lions could overlap with noise associated with impact pile driving activities. We estimate the total number of exposures (from all incremental steps) from pile driving as follows: 0 Cook Inlet beluga whales, 0 fin whales, 0 Western North Pacific DPS humpback whales, 0 Mexico DPS humpback whales,[37] and 10 Western DPS Steller sea lions (Table 18).

The effects of sounds from pile driving might result in one or more of the following: temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, and masking (Richardson et al. 1995a, Nowacek et al. 2007, Southall et al. 2007a). The effects of pile driving on marine mammals are dependent on several factors, including the size, type, and depth of the animal; the depth, intensity, and duration of the pile driving sound; the depth of the water column; the substrate of the habitat; the distance between the pile and the animal; and the sound propagation properties of the environment. Impacts to marine mammals from pile driving activities are expected to result primarily from acoustic pathways. As such, the degree of effect is intrinsically related to the received level and duration of the sound exposure, which are in turn influenced by the distance between the animal and the source. The further away from the source, the less intense the exposure should be. The substrate and depth of the habitat affect the sound propagation properties of the environment.

These instances of exposure assume a uniform distribution of animals and do not account for avoidance. The implementation of mitigation measures to reduce exposure to high levels of pile driving sound, the short duration of pile driving operations (one day per pile), and movement of animals reduce the likelihood that exposure to pile driving would cause a behavioral response that may affect vital functions (reproduction or survival), or would result in temporary threshold shift (TTS) or permanent threshold shift (PTS).

[37] Table 18 estimated a total of 2.3 humpback whales might be taken due to sound from pile driving operations. However, based on the probability of occurrence of Western North Pacific DPS (1 percent) and Mexico DPS (11 percent) animals in the area, we estimated zero of these exposures would accrue to ESA-listed humpback whales.

6.3.2.2.1 Cetacean Response

The combined data for mid-frequency cetaceans (e.g., belugas) exposed to multiple pulses (such as impact pile driving) do not indicate 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 (~80-90 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 beluga whales either in the field or the laboratory (Southall et al. 2007).

As discussed in the Status of the Species (section 4.2), we assume 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 2016c).

Of the other listed whales that may occur between 0 and 5.5 km of impact pile driving, some individuals are likely to 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).

We expect that no listed cetacean exposures to pile-driving would occur at received levels >160 dB due to the low density of animals in the area, the low percentage of listed humpback whales in the area, mitigation measures, and avoidance of the animals to high received levels. Given the limited number of piles to be driven, the short duration needed for pile driving, and ample space around the leased block for cetaceans to avoid unpleasant noise, we expect any exposure would be temporary and not have meaningful effects.

Prey

Of all known Cook Inlet beluga whale prey species, only coho salmon 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 1μPa) 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, at least in a laboratory environment. Hart Crowser Inc. et al. (2009) studied the effects on juvenile coho salmon from pile driving of sheet piles at the Port of Anchorage in Knik Arm of Cook Inlet. The fish were exposed in-situ (in that location) to noise from vibratory or impact pile driving at distances ranging from less than 1 meter to over 30 meters. The results of this studied showed no mortality of any of the test fish within 48 hours of exposure to the pile driving activities, and for the necropsied fish, no effects or injuries were observed as a result of the noise exposure (NMFS 2016b). Noise generated from pile driving can reduce the fitness and survival of fish in areas used by foraging marine mammals; however, given the small area of pile driving within the action area relative to known feeding areas in Cook Inlet, and the fact that any physical changes to this habitat would not be likely to reduce the localized availability of fish (Fay and Popper 2012), it is unlikely that beluga whales' prey would be affected. We consider potential adverse impacts to prey resources from pile-driving in the action area to be unlikely.

6.3.2.2.2 Steller sea lion Response

Information on behavioral reactions of pinnipeds in water to multiple pulses involves exposures to small explosives used in fisheries interactions, impact pile driving, and seismic surveys. Several studies lacked matched data on acoustic exposures and behavioral responses by individuals where behavioral responses could be linked to acoustic exposures. As a result, the quantitative information on reactions of pinnipeds in water to multiple pulses is very limited (Southall et al. 2007a). However, based on the available information on pinnipeds in water exposed to multiple noise pulses, exposures in the ~150-180 dB re 1µ Pa range (rms values over the pulse duration) generally have limited potential to induce avoidance behavior in pinnipeds (Southall et al. 2007a).

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 2016c).

The pinniped sighting data from the BlueCrest monitoring program in Cook Inlet reports Steller sea lions first approaching the drill rig and then turning away (Owl Ridge 2014a). They also reported that many seals interrupted their normal behavior to view the rig, and then continued along in a normal manner. Marine mammal sighting data during the Apache seismic surveys in Cook Inlet reported the most common behavior of harbor seals during non-seismic periods was "look/sink" followed by "travel," whereas during periods of active seismic shooting, "travel" was more common than "look/sink" (Lomac-MacNair 2014). Marine mammal observations from the 2019 Hilcorp seismic survey only recorded "look" and "none" for Steller sea lion behavior (Fairweather Science 2020).

During the open-water season when impact pile driving is anticipated to occur (May-July), Steller sea lions are occupying rookeries during their pupping and breeding season (late May to early July). No rookeries occur in the lease area where pile driving would occur, and although one major rookery designated as critical habitat is within the action area, that rookery is located well outside the impact zone for pile-driving activities.

Of the Steller sea lions that may occur within the sound field of impact pile driving, some sea lions may change their behavioral state. Sea lions that avoid these sound fields or exhibit vigilance and raise their heads above water are not likely to experience significant disruptions of their normal behavioral patterns because the ensonified area is only temporarily disturbed, with breaks between pile driving sessions as new sections of pile are welded into place. We expect that few (if any) exposures from pile-driving would occur at received levels >160 due to avoidance of high received levels and the implementation of shut down mitigation measures.

6.3.4.2.3 Critical Habitat

Designated critical habitat for Steller sea lions and Cook Inlet beluga whales are far enough away from the lease sale block that no direct effects to critical habitat would be expected. Effects to primary prey resources from pile driving operations is anticipated to be similar to other major impulsive source such as seismic operations. Effects on beluga prey are further analyzed above in section 6.3.2.2.1.

6.3.3 Moving a drill rig (Continuous noise)

Towing, Anchor Handling, and Dynamic Positioning

Given that only a single lease block was sold, we assume that if exploration or delineation wells were drilled it would be done from a single rig on that block. At this point we do not know if the source of noise associated with this action would originate from anchor handling, dynamic positioning, or from the tugs pulling a jack up rig. We recognize that anchor handling and dynamic positioning can created significant amounts of sound. However, because we have recent information from tugs pulling a jack-up rig in Cook Inlet, we use that project as a proxy for these types of actions. Once the rig and the method of transportation are known, if the sounds produced are expected to be harmful, future section 7 consultation will be required to refine the number of listed animals expected to be exposed and authorize take if necessary. We do not expect that use of these alternative drill rig options would lead to a level of exposures or take that would change our conclusions about this activity. As mentioned above, we assume that the rig used will come from Homer. We estimate that 1 humpback (no listed humpbacks), 0 fin, 0 Cook Inlet belugas, and 4 Steller sea lions would be exposed to harmful sounds (Table 18). These estimates of exposures assume a uniform distribution of animals, and do not account for avoidance or the effectiveness of mitigation measures.

For the jack-up rig, modeling was done that took into account bathymetry, currents, temperature, and other factors that can influence transmission loss and the distance noise will travel in water. Based solely on the literature review, a source level of 180 dB for a tug under load would be justified. However, because 3 tugs were going to be used, in which one or two tugs are primarily under load and the third tug sits off to the side, the source level increases to approximately 185 dB and this in the value used in their analysis (NMFS 2022). The results of the modeled distance to the 120 dB level was 3,850 m, the value we used in Table 18.

The primary sources of sounds from all vessel classes are propeller cavitation, propeller singing, and propulsion or other machinery. Propeller cavitation is usually the dominant noise source for vessels (Ross 1976). Propeller cavitation and singing are produced outside the hull, whereas propulsion or other machinery noise originates inside the hull. There are additional sounds produced by vessel activity, such as pumps, generators, flow noise from water passing over the hull, and bubbles breaking in the wake.

For continuous sounds (e.g. tug sound), NMFS generally uses a received level of 120 dB re 1 μPa (rms) as the threshold for estimating when Level B harassment is predicted to occur, though there are other qualitative factors that may be considered. Tugboats under load are slow-moving compared to typical recreational and commercial vessel traffic. Exposure to sound from the moving tugs is on the order of minutes for a fixed location (a 185 dB sound source moving at 4 knots, assuming a spherical spreading loss coefficient of 20, will exceed 120 dB received level at a fixed point for a maximum duration of 53.4 minutes).

The use of thrusters to position jack-up rigs for exploratory drilling can significantly elevate noise levels (Nedwell and Edwards 2004, BOEM 2016b, Denes et al. 2016). If production platform installation also requires the use of thrusters, noise levels may be temporarily elevated. However, specific development proposals would be further assessed and consulted upon incrementally for development as specific actions and action areas become known.

6.3.3.1 Cetacean Response

Listed cetaceans will have ample opportunity to avoid tugs towing rigs before the sound from them may cause harassment. However, other factors (such as feeding on schools of fish) may compel them to endure such acoustic exposure. It is the exposure of these animals to tug sound that we have estimated.

The slow, predictable, and generally straight path of the tug configuration (as straight of a path as feasible due to the logistical difficulties of navigating a multi-tug configuration) may further reduce the likelihood that exposures at the expected levels would result in the harassment of marine mammals.

Hilcorp used a multi-tug configuration to tug a jack-up rig in 2021 and 2022. There were no ESA listed species observed during these activities, however, other marine mammals were observed and their behaviors were documented. Previous movements of a jack-up rig through Cook Inlet have not documented any significant behavior changes in marine mammals. In July 2021, an unknown pinniped was observed 3,500 m (11,483 ft) away from the nearest tug while tugs were pulling the Spartan 151. The animal exhibited a looking behavior. A sea otter also exhibited a looking behavior approximately 500 m (1,640 ft) from the jack-up rig. The jack-up rig was self-supported and engaged in positioning activities. The tugs were not under load with the jack-up rig at the time of the sea otter sighting. The sea otter dove once, reappeared in same location and did not reappear after a second dive. A single harbor porpoise was observed on July 17, 2021. The animal exhibited traveling and diving behaviors approximately 1,000 m (3,281 ft) from the nearest tug while the tugs were sitting idle during jack-up rig positioning. No tugs were under load from the jack-up rig at the time of the harbor porpoise sighting. The harbor porpoise surfaced twice and did not reappear after a final dive. Harbor porpoise are known to be elusive, therefore, the fact that the harbor porpoise was not observed again is not considered unusual.

For humpback and fin whales that might be exposed to received levels ≥120 dB, some are likely to reduce the amount of time they spend at the ocean's surface, increase their swimming speed, change their swimming direction to avoid vessel operations, change their respiration rates, increase dive times, reduce feeding behavior, or alter vocalizations and social interactions (Richardson et al. 1986, Ljungblad et al. 1988, Richardson and Malme 1993, Greene et al. 1999, Frid and Dill. 2002, Christie et al. 2009, Koski et al. 2009, Blackwell et al. 2010, Funk et al. 2010, Melcon et al. 2012). Some whales may be less likely to respond if are feeding.

Based on animal density, in lower Cook Inlet there is a greater chance that fin or humpback whales and a lesser chance that beluga whales might overlap with this activity. The absence of beluga observations in recent years indicates that there is a very low probability that they would overlap with the movement of a rig that is expected to take one day. Based on observations made during previous tug towing a jack-up rig activities, it is not apparent whether this activity causes harassment to an extent that significantly disrupted normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (i.e. ESA harassment; Wieting 2016). Given the continuous noise source, the ability of the whales to avoid it, the limited spatio-temporal level of disturbance, and the implementation of mitigation measures, we do not expect a measurable effect on listed cetaceans.

6.3.3.2 Steller Sea Lion Response

Towing, Anchor Handling, and Dynamic Positioning

The estimate of exposure during the first incremental step due to towing, anchor handling, and dynamic positioning activities of Western DPS Steller sea lions was approximately 4 (Table 18). These estimates of exposures are likely to be overestimates because they assume a uniform distribution of animals (which is not representative of Steller sea lions that are more concentrated around haul outs and rookeries and less concentrated in the open water), do not account for avoidance or mitigation measures, and represent the sum of the exposures associated with multiple activities, some of which may co-occur.

Since towing, anchor handling, and dynamic positioning will be continuous noise sources, it is not expected that marine mammals would enter into an area where they would suffer from TTS or PTS. Mitigation measures restricting vessel speed and approach and requiring PSOs on board to spot nearby sea lions will minimize the chance of the exposure to harmful sound. Thus, the impact of tugs towing a jack up rig, or other means rig transport on DPS Steller sea lions is expected to be minor.

6.3.3.3 Critical Habitat

Effects from tugs towing jack-up rigs, drillship anchor handling, and dynamic positioning are unlikely to affect Cook Inlet beluga whale and Steller sea lion critical habitat directly. There is no overlap between Steller sea lion critical habitat and the amount of time a rig may impact Cook

Inlet beluga whale critical habitat would likely be a matter of minutes as the rig and tugs passed out of Kachemak Bay. Acoustic impacts would be fleeting and insignificant.

Sounds associated with these two activities are likely to have output at higher frequencies that are detectable by both winter and summer prey species of Cook Inlet beluga whales. As such, avoidance or a startle response of prey may be expected, but effects from such responses are not expected to be detectable by the time that Cook Inlet belugas make notable use of the southern portions of critical habitat, where such effects upon winter prey species may take place. Effects of these activities upon Cook Inlet beluga summer prey species are not expected to last until those affected summer prey reach the vicinity of their spawning streams in Upper Cook Inlet, where beluga whales are most likely to exploit concentrations of these prey items for food.

There will be overlap between Steller sea lion critical habitat and the calculated ensonified areas associated with these two activities, especially with the aquatic zone surrounding the Sugarloaf Island rookery. However, the vessels from which these sounds will emanate will be located well outside of Steller sea lion critical habitat boundaries. As such, while the calculated ensonified areas will overlap to a minor extent with designated critical habitat, we expect that the vessels producing these noises will be sufficiently far from Steller sea lion critical habitat to avoid impacts upon animals within critical habitat.

As with other fish, we expect Steller sea lion prey within Steller sea lion critical habitat to react to sound only after it exceeds their detection thresholds. Fish will react or alter behavior when the sound level increased to about 20 dB above the detection level of 120 dB (Ona 1988); however, the response threshold can depend on the time of year and the fish's physiological condition (Engas et al. 1993). Given that, we expect that sounds from anchor handling and dynamic positioning will have attenuated sufficiently to avoid eliciting a response in prey items within 5 km of the sound source (assuming a source level of 195 dB, practical spreading loss, and a fish disturbance threshold of 140 dB). This will result in an exceedingly small-to-zero overlap between the acoustic effects of anchor handling and dynamic positioning upon Steller sea lion prey within Steller sea lion critical habitat, with the amount of overlap depending upon the location of well sites within the lease sale area.

6.3.4 Spills in Future Incremental Steps (Oil and Gas)

6.3.4.1 Large Oil Spill

As discussed in section 6.1.1.7, small oil spills could continue to occur in future incremental steps. As mentioned, 405 small spills could occur over the life of the project. Six of those are projected for the first incremental step and additional small spills are expected to occur in the future incremental steps. The analysis presented for the first incremental step for small spills is applicable to the future incremental steps. Although not expected to occur, in this section we discuss the large oil spills.

Over the past 55 years (1966–2020) approximately sixteen large onshore and offshore oil spills were documented in the Cook Inlet area, including Joint Base Elmendorf-Richardson (JBER), Port of Anchorage, Nikiski, Drift River, and marine waters near Kenai, Nikiski, Drift River, Fire Island, and Anchorage (ADEC, 2007, 2020; BOEM, 2016; Robertson et al. 2020; Whitney, 2002). These include crude, diesel, jet and aviation fuel and other types of petroleum spills from various onshore and offshore sources, including pipelines, tanks, platforms, tankers, and other vessels. No large marine spills have been documented since the 1989 M/V Lorna B diesel spill, and no large onshore spills since the 1997 aviation fuel spill on JBER (BOEM 2022b).

Although a large oil spill is not expected, BOEM assumes one large spill (3,800 bbl) of crude, condensate, or refined (diesel) oil would occur during development and production activities (BOEM 2022a). They also assume one loss of well control or one pipeline rupture (offshore or onshore) over the 32 years of gas production. The gas release would result in loss of up to 30 million cubic feet of natural gas over one day. The chance of a 3,800-bbl spill occurring is estimated to be 19 percent over the E&D Scenario lifecycle and the estimated chance of a 30-MMcf gas release is 4 percent (BOEM 2022a). These estimates are based on historical data on spills ≥1,000 bbl, statistical estimates of the mean number of large spills from platforms and pipelines, the number and size of large spills on the OCS, and project-specific information from the E&D Scenario (BOEM 2022a).

Ji and Smith (2021) analyzed how and where large offshore spills move by using an Oil Spill Risk Analysis (OSRA) model, which calculates the probability of oil-spill contact (conditional probabilities) and occurrence and contact (combined probabilities) with specific geographic areas within and outside of Cook Inlet. In this approach, BOEM ran simulations of a large spill (≥1,000 bbl) originating from one of six Launch Areas and four Pipeline Segments – hypothetical locations in the Lease Sale Area shown in the FEIS ((BOEM 2022b)Appendix A). The locations were not meant to represent or suggest any particular development scenario or outcome. However, we note that because the whole lease sale area was included in the analysis and only one block was sold, four of the Launch Areas and two of the Pipeline Segments are not applicable to the leased block that sold. Consequently, it is very difficult to evaluate how the output (land segments and environmental resource areas receiving oil) applies to what might occur as a consequence of development and production from a single block. Additional risk analyses will be conducted on a project specific basis once the future incremental steps are developed and submitted. BOEM or BSEE will consider risk during the review of an operator's Exploration Plan, Development and Production Plan (or Development Operations Coordination Document), and/or Application for Permit to Drill.

Large condensate and diesel fuel spills would evaporate and disperse, generally within 1–10 days depending on size of spill. A large crude oil spill, however, is estimated to persist much longer: after 1-30 days, approximately 10 to 24 percent of its original volume would evaporate at both summer and winter temperatures. Because of lower average wind speeds over the LS 258 action area during summer, dispersion is slower than during winter in open water, ranging from 3-56 percent (Table 19). BOEM estimates that at higher wind speeds during winter (e.g., 15 m/s wind speed) three quarters of a large oil spill will be nearly removed from the sea surface within a day through evaporation and dispersion. Dispersion would be significantly reduced during the winter if broken ice were present but given the location of the leased block we expect little broken ice would occur in that location and do not include broken ice estimates. Table 19 presents how much product evaporates, disperses and remains after a large spill of diesel, condensate, and crude oil over 1, 3, 10, and 30 days. For spills of diesel and condensate, the product evaporates and dissipates quickly. As expected, crude oil is more persistent and could reach the coastline.

Table 19. Weathering of a large oil spill in the Cook Inlet OCS (Based on Table A-2 (BOEM 2022b). (na = not applicable because no oil is estimated to remain)

3,800 bbl Diesel Spill	**Summer Spill[1]**				**Winter spill[2]**			
Time after spill in days	1	3	10	30	1	3	10	30
Oil remaining (%)	40	1	na	na	10	0	na	na
Oil dispersed (%)	36	66	na	na	69	77	na	na
Oil evaporated (%)	23	33	na	na	21	23	na	na
3,800 bbl Condensate Spill	**Summer Spill[1]**				**Winter spill[2]**			
Time after spill in days	1	3	10	30	1	3	10	30
Oil remaining (%)	0	na	na	na	0	na	na	na
Oil dispersed (%)	29	na	na	na	29	Na	na	na
Oil evaporated (%)	71	na	na	na	71	Na	na	na
3,800 bbl Crude spill	**Summer Spill[1]**				**Winter spill[2]**			
Time after spill in days	1	3	10	30	1	3	10	30
Oil remaining (%)	86	75	55	24	79	57	23	3
Oil dispersed (%)	3	12	31	56	10	30	61	80
Oil evaporated (%)	11	13	16	20	11	13	16	17
Discontinuous Area (km^2)[3]	12	50	241	998	12	50	240	992
Estimated Coastline Oiled (km^2)[4]	35				26			

Notes: Calculated with the SINTEF OWM Version 4.0 of Johansen et al. (2010) and assuming an ultra-low sulphur diesel, Sliepner Condensate, or Endicott Crude of 23.1° API.

[1] Summer (April 1–October 31), 12-knot wind speed, 9 degrees Celsius, 1-meter wave height. Average Marine Weather Area A (Brower et al., 1988).

[3] Winter Spill (November 1–March 31), 16-knot wind speed, 5 degrees Celsius, Average Marine Weather Area A (Brower et al., 1988).

[4] Calculated from Equation 17 of Table 4 in Ford (1985) and is the result of stepwise multiple regressions for length of historical coastline affected. Compiled by BOEM, Anchorage, Alaska Office (2020).

The weathering of crude oil is discussed in detail in section (6.1.1.9.1 Behavior and Fate of Crude Oil). Severe, potentially widespread and long-lasting impacts to water quality and exceedances of Alaska's water quality standards for total aromatic hydrocarbons (TAHs) and total aqueous hydrocarbons would occur immediately after a large oil spill. The acutely toxic and highly volatile TAHs are likely to have a pronounced, short-term fluctuation and would likely rapidly dissipate from the spilled oil within a day. However, elevated levels of the less volatile and soluble PAH compounds would be expected in the water column for up to a month. These compounds are unlikely to persist in the water column for an extended period, but rather, are more likely to accumulate in sediments where they can remain for decades under some conditions (ADEC, 2015).

6.3.4.2 Very Large Oil Spill (VLOS)

A very large oil spill (≥120,000 bbl) in Cook Inlet associated with the proposed action over a 40 year duration is considered a low-probability, high impact event. BOEM estimates that the risk of such an event occurring in Cook Inlet is between > 10^{-4} and > 10^{-5} per well drilled (BOEM 2017b). Although the risk of a VLOS is estimated to be very small, we analyze the potential effects of BOEM's hypothetical VLOS scenario in the sections below to consider the effects of this low-risk, high-impact event. No special OSRA run was conducted to estimate the percentage of trajectories contacting resources from a hypothetical future catastrophic blowout and moderate volume, long-duration flow resulting in a VLOS.

Very large spills (> 120,000 bbl) may result from OCS development and production operations involving platforms, pipelines, and/or support vessels. Incidents with the greatest potential for catastrophic consequences are losses of well control with uncontrolled releases of large volumes of oil, where primary and secondary barriers fail, the well does not bridge (bridging occurs when the wellbore collapses and seals the flow path), and the flow is of long duration.

In general, historical data show that loss of well control events resulting in oil spills are infrequent and that those resulting in very large oil spills are even rarer events (Anderson and LaBelle 2000, Bercha Group 2006, Anderson et al. 2012, BOEM 2016b). The Norwegian SINTEF Offshore Blowout Database, which tracks worldwide offshore oil and gas blowouts, where risk-comparable drilling operations are analyzed, supports the same conclusion. Blowout frequency analyses of the SINTEF database suggest that the highest risk operations are associated with exploration drilling in high-pressure, high-temperature conditions. As the 2010 DWH event illustrated, there is a greater than zero risk of a very large spill occurring, likely causing catastrophic impacts (BOEM 2016b).

A fundamental challenge is to accurately describe this risk, especially since there have been relatively few large to very large oil spills that can serve as benchmarks. Prior to the DWH event, the three largest blowout spills on the OCS were 80,000 bbl, 65,000 bbl, and 53,000 bbl, and all occurred before 1971 (Anderson et al. 2012). From 1964 to 2010 there were 283 well control incidents, 61 of which resulted in crude or condensate spills (drilling mud or gas releases not included) (Table 20). Excluding the DWH event, less than 2,000 bbl of crude or condensate were spilled from fewer than 50 well control incidents after 1971. During the 1971–2010 period, more than 41,800 wells were drilled on the OCS and almost 16 Bbbl of oil produced (BOEM 2016b).

Table 20. Loss of well control by region during OSC activities from 1964-2010 (BOEM 2012c).

Region	Exploration Wells	Development Wells	Loss of Well Control Events	Loss of Well Control with Oil Pollution Events
Alaska	84	6	0	0
Atlantic	51	0	0	0
Gulf of Mexico	16,889	29,733	278	59
Pacific	324	1,372	5	2
Total	17,348	31,111	283	61

6.3.4.3 Large and Very Large Gas Releases

It is possible, though unlikely, that a loss of well control (LOWC) during natural gas production could cause a release of natural gas into the environment. A LOWC can result in a blowout, but blowouts do not always follow a LOWC incident. Also, the frequency of LOWCs can vary with the type of well drilled. The International Association of Oil and Gas Producers estimates the frequency of LOWC events at 3.6×10^{-4} gas blowouts per exploration well, and at 7.0×10^{-4} gas blowouts per development well drilled (IAOGP 2010). The production gas well-control blowout incident rate is an order of magnitude lower, estimated at 5.7×10^{-5} blowouts per well year (IAOGP 2010). Over the life of the proposed action, the estimated mean number of gas releases is less than one (0.04); the chance of no gas blowouts occurring is 96 percent and the chance of a gas release of ≥30 million cubic feet occurring is 4 percent (BOEM 2022b).

If a major release of natural gas would occur, this would cause a sudden decrease in gas pressure within system pipelines, which should automatically initiate procedures to close the valves on both ends of the ruptured segment of pipeline. Closure of the valves would effectively isolate the rupture and limit the amount of natural gas released into the environment. Given the daily flow rate and the estimated total number of valves, it is estimated that approximately 20 million cubic feet could be released within one pipe section between two valves (BOEM 2022a).

Little to no long term water quality impacts are expected during the short, 1-day duration of the gas release, but water and air quality could temporarily be impacted during the release. When natural gas (primarily methane) is released into the water, it rises through the water column as a function of pressure and temperature, temporarily displacing oxygen. When released at depth, the quality of the water would be altered temporarily and in deeper, colder waters some of the natural gas enters the water as a water-soluble fraction. Upon reaching the surface, the remainder would disperse into the atmosphere.

6.3.4.3.1 Cetacean Response to Large and VLOS

The Recovery Plan for the Cook Inlet Beluga Whale (NMFS 2016b) categorized oil spills and natural gas blowouts as a “high” potential threat to the recovery of the population, with the major effects being mortality, compromised health, reduced fitness, and reduced carrying capacity. Oil spills and natural gas blowouts may also impact Cook Inlet beluga whales by effects to their prey through changes to spawning or migration patterns, direct mortality, or potential long-term sub-lethal impacts (Marty et al. 1997; Moles, Rice, and Norcross 1994; Murphy et al. 1999 in (NMFS 2016b).

The primary potential effects to listed marine mammals from accidental oil spills include: (1) fouling of individuals (including fur and baleen), (2) ingestion/inhalation of oil, (3) habitat/prey degradation, (4) disruption of migration, and (5) oiling of skin, eyes, and conjunctive membranes (BOEM 2016b). Disruption of other essential behaviors, such as breeding, communication, and feeding, may also occur.

Depending on the timing, size, and duration of the spill, beluga, fin, and humpback whales could experience contact with fresh oil during feeding events and migration in the action area. If a spill were to occur during the summer on a lease area, beluga whales would be less likely to be exposed due to aggregation at feeding areas in upper Cook Inlet. A summer spill would increase the potential for exposure to fin and humpback whales in lower Cook Inlet.

Skin and eye contact with oil could cause irritation and various skin disorders. Toxic aromatic hydrocarbon vapors are associated with fresh oil. The rapid dissipation of toxic fumes into the atmosphere from rapid weathering of fresh oil and disturbance from response related noise and activity could limit the potential exposure of whales to prolonged inhalation of toxic fumes. Exposure of whales to toxic vapors, especially if calves are present, could result in mortality.

Cook Inlet beluga whale calves are born from mid-May (Calkins 1983) to October (Tamara McGuire, LGL, pers. comm, 2017), but calves have not recently been observed in the action area. Humpback whale calves have also been spotted in the action area (Campbell 2014). Calves could be more vulnerable than adults to vapors from a spill, because they take more breaths than do their mothers and spend more time at the surface (BOEM 2015a). Surface feeding whales could ingest surface and near surface oil fractions with their prey, which may also be contaminated with oil components. Incidental ingestion of oil factions that may be incorporated into benthic sediments can also occur during near-bottom feeding. To the extent that ingestion of crude oil affected the weight or condition of the mother, the dependent young could also be affected. Decreased food assimilation could be particularly important in very young animals, those that seasonally feed, and those that need to accumulate high levels of fat to survive their environment (Geraci and St. Aubin 1990b). Ingestion of oil may result in temporary and permanent damage to whale endocrine function and reproductive system function. If sufficient amounts of oil are ingested, mortality of individuals may occur (BOEM 2015a).

Exposure to aged winter spill oil (which has lost some or all of the toxic aromatic compounds to the atmosphere through the dynamic open water and ice activity) presents a much reduced toxic inhalation hazard. If a VLOS occurred in upper Cook Inlet, is possible that a winter spill would result in a situation where toxic aromatic hydrocarbons would be trapped in ice for the winter period and released in toxic amounts in the spring. If a VLOS were to occur during a time when many beluga whale calves were present, calves could die and recovery from the loss of a substantial portion of an age class cohort and its contribution to recruitment and species population growth could take decades. As the Cook Inlet beluga whale population is small and resident, any impact from direct or indirect effects from a large oil spill has the potential for population-level impacts (BOEM 2016b).

Injury and mortality to whales are most likely during the initial spill event. Contact through the skin, eyes, or through inhalation and ingestion of fresh oil could result in temporary irritation or long-term endocrine or reproductive impacts, depending on the duration of exposure. We expect that if a VLOS were to occur and overlapped with occupied habitat, the magnitude of the resulting impact could be high because a large number of whales could be impacted. The duration of impacts could range from temporary (such as skin irritations or short-term displacement) to permanent (e.g. endocrine impairment or reduced reproduction) and would depend on the length of exposure and means of exposure, such as whether oil was directly ingested, the quantity ingested, and whether ingestion was indirect through prey consumption. Displacement from areas impacted by the spill due to the presence of oil and increased vessel activity is likely. If the area is an important feeding area, such as designated critical habitat, the impacts may be higher magnitude (BOEM 2016b).

Although Cook Inlet beluga whales currently have lower contaminant loads (including PAHs) than other populations of beluga whales (Becker et al. 2000; Wetzel, Pulster, and Reynolds 2010), an increase in PAHs in the Cook Inlet environment from an accidental spill could cause some adverse effects. High levels of PAHs have been often considered as a factor in illness and mortality among beluga whales in the Saint Lawrence Estuary (Martineau et al., 1994, 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 1988a). 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 (BOEM 2016b).

A large crude oil spill (3,800 bbl) could displace beluga whales from, or prevent or disrupt access to, affected habitat areas. Because of much faster weathering (Table 19), a large spill of diesel or condensate is expected to have far fewer effects because of the reduced time of potential overlap with animals. The loss of nursing/calving habitats by female beluga whales with calves and juveniles could create additional stresses, both physical and psychological, that may reduce the fitness of some individual belugas over time. Some of the effects from displacement might not be easily recovered from, at the very least partially compromising the ability of the stock to recover. A large spill would have limited potential to affect Cook Inlet belugas due to the size of the spill, existing spill response plans, the unlikelihood of spills co-occurring in space and time with the seasonal occurrence of beluga in the action area, and the dispersion/weathering of the spill over hours or possibly days (for diesel and condensate) (BOEM 2016b).

In the case of a VLOS humpback whales are at highest risk from impacts to oil spills during the summer and fall in their feeding areas around Kodiak Island and in Biologically Important Areas (BIAs) for humpback and fin whale feeding (Ferguson et al. 2015b). The highest densities of humpback whales in this BIA occur from July through September (Witteveen and Quinn Ii 2007, Witteveen et al. 2011). Fin whale densities peak slightly earlier in the summer from June through August, although they have been observed year-round in the action area (BOEM 2016b). Because of their distribution, the primary potential adverse effect on humpback whales and fin whales would be from a large spill that contacted waters adjacent to Kodiak Island, including Shelikof Strait, especially during the summer and fall (BOEM 2016b).

Upon contacting spilled oil, humpback and fin whales may experience inhalation, ingestion, and skin and conjunctive tissue irritation similar to other whales. Because they also are mysticetes, humpback and fin whales may experience baleen fouling as well (BOEM 2016b).

Several investigators have observed various cetaceans in spilled oil, including humpback whales, fin whales, gray whales, dolphins, and pilot whales. Typically, the whales did not avoid slicks but swam through them, apparently showing no reaction to the oil. During the spill of Bunker C and No. 2 fuel oil from the M/V *Regal Sword*, Geraci and St. Aubin (1990b) saw humpback and fin whales, and a whale tentatively identified as a right whale, surfacing and even feeding in or near an oil slick off Cape Cod, Massachusetts.

Von Ziegesar et al. (1994) found no indication of a change in abundance, calving rates, seasonal residency time of mother-calf pairs, or mortality in humpback whales as a result of the Exxon Valdez Oil Spill, although they did see temporary displacement from some areas of Prince William Sound.

A large or very large oil spill could result in some individual humpback or fin whales coming into contact with oil (potentially resulting in inhalation of hydrocarbon vapors, baleen fouling, and ingestion of contaminated prey). Temporary and/or permanent injury and non-lethal effects could occur, but mortality is not likely. Temporary displacement from feeding and resting areas could also occur. Fin and humpback whale prey (schooling forage fish and zooplankton) could be reduced or contaminated, leading to modified distribution of these whales (BOEM 2015a, 2016b). Duesterloh et al. (2002) concluded that phototoxic effects on copepods could cause ecosystem disruptions that have not been accounted for in traditional oil spill damage assessments. As such, the greatest impact of an oil spill on humpback whales could occur indirectly (BOEM 2016b).

A large spill, depending on the timing and location relative to the distribution and aggregations of zooplankton, could reduce feeding opportunities for humpback and fin whales during the year of the spill. The significance of the loss of that opportunity to whales' health depends on major feeding opportunities humpback and fin whales may find later in the year to meet annual energy demands. Given that the OSRA model estimates that a large spill could contact the waters around Kodiak Island and the Shelikof Strait, a biologically important feeding area for humpback and fin whales, potential adverse impacts to their prey health and availability could occur (BOEM 2016b). In addition, Mizroch et al. (2009) concluded fin whales are probably present in waters of Shelikof Strait, off the Kodiak Archipelago, and other northerly areas in winter because of the prey presence and distribution in those areas. This suggests that a spill at any time of year may overlap with fin whales. Fate, recovery, and availability of zooplankton and fish populations to whales in similar quantities and locations as pre-spill conditions in LS 258 and the OSRA study area in subsequent years would depend on a variety of factors.

Beluga, fin, and humpback whales are thought to be vulnerable to incremental long-term accumulation of pollutants given their longevity. With increasing development within their range and long-distance transport of other pollutants, individual whales may experience multiple large and small polluting events as well as chronic pollution exposure within their lifetime (BOEM 2016b).

Although unlikely, BOEM estimates that a well control incident of a single well could result in the release of 30 million cubic feet of natural gas in one day during the development, production, or decommissioning phases. Most gas escaping and contacting water would dissipate quickly, likely resulting in no large-scale effects on marine mammals, although some fish in the immediate vicinity of a large natural gas release could be exposed to toxins and die before the gas could volatize. A gas release is expected to have negligible to minor effects on marine mammals (BOEM 2016b).

The disappearances (and probable deaths) of killer whales and the deaths of large numbers of gray whales coincided with the Exxon Valdez Oil Spill and with observations of members of both species in oil (Matkin et al. 2008). It is anticipated that if other odontocetes (e.g., Cook Inlet beluga) or baleen whales (e.g., humpback or fin whales) were exposed to a large spill, mortalities may also occur depending on the time of year, location of spill, and extent of the VLOS. Cook Inlet beluga whales may be severely impacted at the individual and population level by a VLOS event (BOEM 2016b). The Cook Inlet Beluga Recovery Plan indicated that a spill in higher use beluga habitat will increase the exposure of the animals and increase the severity of the impact, to the point that recovery of the population could be prevented or delayed (NMFS 2016b). We note that the location of the leased block in lower Cook Inlet greatly reduces the potential of a large or VLOS overlapping with Cook Inlet beluga whale individuals or effecting Area 1 critical habitat.

A low probability, high impact circumstance where large numbers of whales experience prolonged exposure to toxic fumes, and/or ingest large amounts of oil, could result in injury and mortality that exceeds the stock's potential biological removal (PBR), causing negative population-level impacts. However, due to the low likelihood of multiple large oil spills, and even lower predicted likelihood of a VLOS, the risk of exposure of a significant number of whales (relative to the size of the population) to such discharges of oil is equally low. In addition, past exposures to the Exxon Valdez VLOS provided no indication of a change in abundance, calving rates, seasonal residency time of mother-calf pairs, or mortality in humpback whales.

6.3.4.3.2 Steller Sea Lion Response to Large and VLOS

In the event of an oil spill, Western DPS Steller sea lions could be adversely affected to varying degrees depending on habitat use, densities, season, and various spill characteristics. The risk of exposure and response of Steller sea lions to small spills occurring in future incremental steps would be similar to descriptions in Section This section will focus on expected effects to Steller sea lions should a large or a VLOS occur.

Sea lions contacted by oil could absorb hydrocarbons internally through inhalation, contact and absorption through the skin, or ingestion directly or indirectly by consuming contaminated prey (Engelhardt 1987). Effects to pinnipeds from exposure to oil can include mortality, brain and liver lesions, skin irritation and conjunctivitis, increased PAH concentrations in blubber, increased petroleum related aromatic compounds in bile, and abnormal behavior such as lethargy, disorientation, and unusual tameness (Calkins et al. 1994a, Loughlin et al. 1996, BOEM 2016b).

Surface contact with petroleum hydrocarbons, particularly the low-molecular-weight fractions, to pinnipeds can cause temporary damage of the mucous membranes and eyes (Davis et al. 1960) or epidermis (Walsh et al. 1974, Hansbrough et al. 1985, St. Aubin 1988b). Contact with crude oil can damage eyes (Davis et al. 1960), resulting in corneal ulcers and abrasions, conjunctivitis, and swollen nictitating membranes (Geraci and Smith 1976a, b). Crude oil immersion studies resulted in 100 percent mortality in captive ringed seals (Geraci and Smith 1976a). Unlike the animals in the immersion study, pinnpeds in the wild would have haulouts as a resting/escape platform or, water depth and distance for escape routes from an oil spill, which some individuals might detect and avoid (Geraci and St. Aubin 1990a). Inhalation of highly concentrated petroleum vapors can cause inflammation and damage to the mucous membranes of airways, lung congestion, hemorrhagic bronchopneumonia, and pulmonary edema in severe cases (Zieserl 1979). After extreme exposure, asphyxiation may occur (Geraci and St. Aubin 1982).

Much of what is known about impacts of crude oil spills on Steller sea lions was learned from the Exxon Valdez Oil Spill. Sea lions did not seem to avoid the oil, and were observed swimming in or near slicks (Calkins et al. 1994b). After the Exxon Valdez Oil Spill, Calkins et al. (1994) recovered 12 Steller sea lion carcasses from the beaches of Prince William Sound and collected 16 additional Steller sea lions from haul-out sites in the vicinity of Prince William Sound, the Kenai coast, and the Barren Islands. The highest levels of PAHs were in animals found dead following the oil spill in Prince William Sound. Furthermore, sea lion bile samples collected 7 months after the spill had levels of PAH metabolites consistent with exposure to PAHs (Calkins et al., 1994).

A decline in Steller sea lions in past decades has been linked to reductions in prey biomass and quality, resulting in nutritional stress that subsequently decreased vital rates (Kucey and Trites, 2006). Depending on the extent of the reduction in quantity and quality of prey species resulting from an oil spill, the consequences of prey reduction could include: decreased rates of reproduction or survivorship by reducing individual condition or fitness, or displacement from their habitat due to loss of prey availability (BOEM 2016b).

Reduction or contamination of food sources would be localized relative to the area of the spill. Exposure to contaminated prey multiple times over the long lifetime of these sea lions could increase contamination of tissues through accumulation. A VLOS could affect large numbers of sea lions, because they would be exposed to contaminated prey in a large area for a sustained amount of time. Because the statistical probability of large and especially very large oil spills occurring is very small, any consumption of contaminated prey is unlikely to accumulate to levels that would harm individual sea lions.

Although unlikely, BOEM estimates that a well control incident of a single well could result in the release of 30 million cubic feet of natural gas in one day during the development, production, or decommissioning phases. Most gas escaping and contacting water would dissipate quickly, likely resulting in no large-scale effects on marine mammals, although some fish in the immediate vicinity of a large natural gas release could be exposed to toxins and die before the gas could volatize. A gas release is expected to have negligible to minor effects on marine mammals (BOEM 2016b).

A low probability, high impact circumstance where large numbers of Steller sea lions experience prolonged exposure to toxic fumes, and/or ingest large amounts of oil, could result in injury and mortality of a substantial number of sea lions. However, due to the low likelihood of multiple large oil spills, and even lower predicted likelihood of a VLOS, the risk of exposures of sea lions to such discharges of oil is equally low.

6.3.4.3.3 Cook Inlet Beluga Critical Habitat

The first and second essential features of Cook Inlet beluga critical habitat are focused on prey resources.[38] These PBFs may be adversely affected by oil spills. A spill in Cook Inlet could

[38] PBF 1: Intertidal and subtidal waters of Cook Inlet with depths <30 feet (9m) (MLLW) and within five miles (8 km) of high and medium flow 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 (50 CFR §226.220(c)).

affect fish through many pathways, including adsorption to the fishes' outer body, respiration through gills, ingestion, and absorption of dissolved fractions into cells through direct contact. The severity of effects to fish would depend on several factors including the type of oil/gas mixture, the thickness of the oil, the duration of exposure, the season of year, and the life stage of the fish. Consumption of contaminated prey and the reduction or mortality of local forage fish populations could create periods whereby some prey would not be available for an undetermined time period. The fish populations in Cook Inlet preyed on by beluga whales are vulnerable to oil contamination and subsequent ingestion by beluga whales. Oil components could be consumed by beluga whales feeding on prey anywhere in the contaminated water column to the seafloor. Impacts to the distribution and abundance of prey, if they occurred, could influence seasonal distribution and habitat use by beluga whales (BOEM 2017b).

6.3.4.3.4 Steller Sea Lion Critical Habitat

Because of the distance, it is unlikely that a large oil spill would reach Steller sea lion critical habitat as most of the toxic volatiles are expected to dissipate by the time a large spill (3,800 bbl) would reach critical habitat (Table 19). During the Exxon Valdez spill, oil was seen near numerous haul-out sites and fouled the rookeries at Seal Rocks and Sugarloaf Island (a major rookery). Insignificant amounts of oil were seen at each site during pup counts in late June 1989, but none were seen in 1990. Critical habitat could be compromised by a VLOS.

A VLOS may impact prey resources for Steller sea lions in and around critical habitat. The decline in Steller sea lions has been linked to reductions in prey biomass and quality, resulting in nutritional stress that subsequently decreased vital rates (Kucey and Trites 2006). Depending on the extent of the reduction in quantity and quality of prey species, the consequences of such a loss in the prey base could include decreased rates of reproduction or survivorship by reducing individual condition or fitness, or displacement from their habitats due to loss of prey availability (BOEM 2016b). The magnitude of impacts to prey would depend on the size of the spill, the composition of the spill, and the length of time that spill lasted.

6.3.5 Anticipated Effects of Future Incremental Steps

6.3.5.1 Decommissioning

Development and production logically flow if a leaseholder finds an economically-viable field. Under the E&D scenario, field development would occur between years 6 and 9, after which production would take place until the 34th year for oil and 39th year for gas. Decommissioning would commence after oil and gas reserves at a given platform are depleted, and income from production no longer pays operating expenses. To comply with BSEE regulations (30 CFR §250.1710—wells, 30 CFR §250.1716—wellheads/casings, and 30 CFR §250.1725—platforms and other facilities), lessees are required to remove all seafloor obstructions from their leases within one year of lease termination or relinquishment (30 CFR §§250.1740-.1743). BOEM and BSEE estimate that decommissioning activities would begin in the 35th year and continue through the 40th year (BOEM 2016b).

This schedule is ambitious and assumes no regulatory or scheduling delays and assumes immediate movement from exploration to development. The assumptions help ensure the potential impacts of future incremental steps will not be underestimated. However, the development of a prospect in the leased area would be determined by the lessee and could be affected by any delay.

Information on the precise number, location, timing, frequency, and intensity of subsequent projects is unknown at this time, so the effects from, and any incidental take resulting from, those future projects to be authorized, funded, or carried out under the program will be addressed in separate ESA section 7 consultations. In terms of future projects, (1) the subsequent authorization of geological and geophysical exploration permits, ancillary activities, exploration plans, permits to drill, and development and production plans may affect listed species and may require project-specific consultation associated with the issuance of Marine Mammal Protection Act Incidental Harassment Authorizations or Letters of Authorization; (2) if commercially recoverable reserves are found and are proposed for development, BOEM and BSEE may be required to initiate consultation on future incremental steps associated with development, production, and decommissioning activities that affect listed species.

6.3.5.2 Effects to Listed Species

The effects associated with decommissioning activities are expected to be similar to those described previously for minor stressors (sections 6.1.1.1 through 6.1.1.8) as decommissioning activities would likely require these activities. Production equipment would be disassembled and moved off the platform during the summer open-water season. These activities could affect listed species, but the effects are expected to be limited in time and space and have a very minor effect. As mentioned in the prior paragraph, depending on the activities authorized, future section 7 consultation may be required. After decommissioning, the area would be re-colonized by benthic invertebrates and fishes. The period of time it would take for re-colonization to occur would depend upon the size of the disturbed area and other factors (BOEM 2017b).

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 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).

7.1 Fisheries

Fishing, a major industry in Alaska, is expected to continue in Cook Inlet. As a result, there will be continued risk of prey competition, ship strikes, harassment, entanglement in fishing gear, and, perhaps most notably, displacement from former summer foraging habitat for the Cook Inlet beluga whales (e.g., waters within and near the outlets of the Kenai and Kasilof Rivers during salmon season) (Figure 28) (Castellote et al. 2016a). NMFS and the ADF&G will continue to manage fish stocks and monitor and regulate fishing in Cook Inlet to maintain sustainable stocks for fishermen. It remains unknown whether and to what extent prey may be less available to Cook Inlet beluga whales due to commercial, subsistence, personal use, and sport fishing, especially near the mouths of streams, up which salmon and eulachon migrate to spawning areas.

While they are likely engaged in recreational activities and in personal use sport fishing, watercraft operators have been observed to harass belugas in the Twentymile River during April. Harassment of belugas 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.

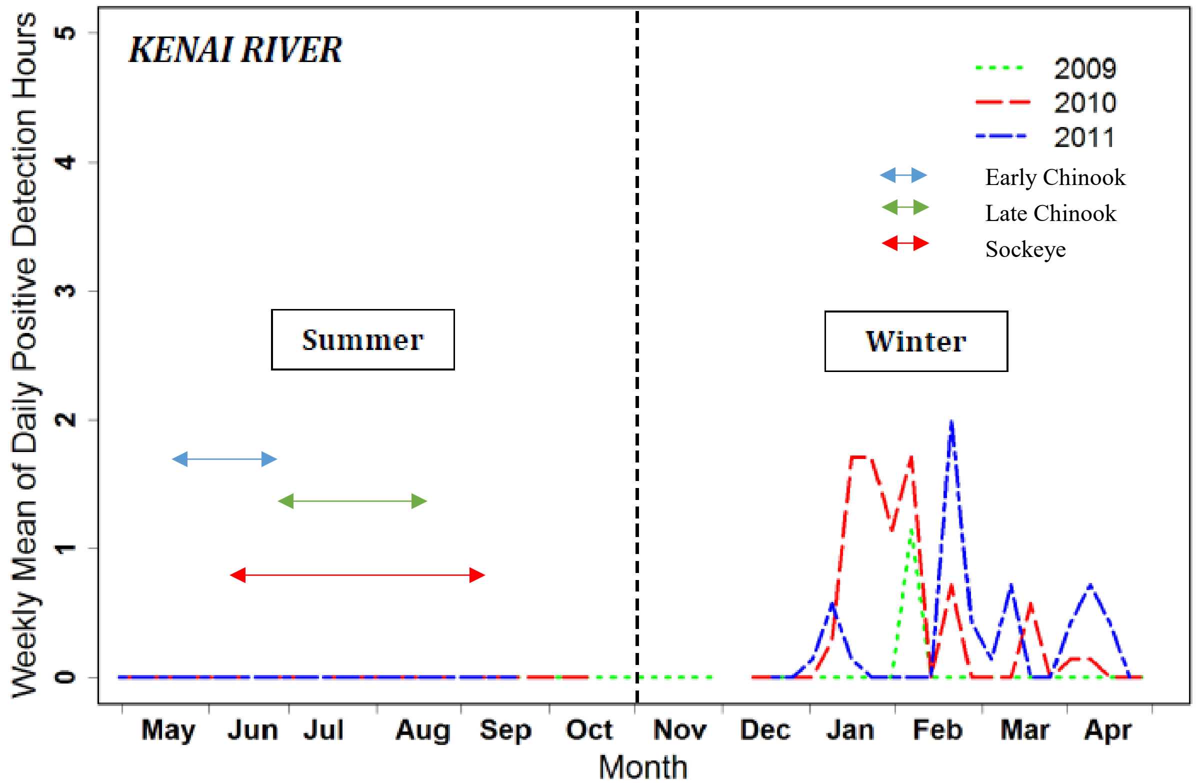

Figure 28. Acoustic detections of Cook Inlet beluga whales in the Kenai River from 2009 through 2011 compared to Chinook and Sockeye run timing. From Castellote et al. (2016) and fish run timing data at http://www.adfg.alaska.gov/sf/FishCounts/index.cfm?adfg=main.home (accessed August 3, 2017).

7.2 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 may be 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; such pollution is not federally-regulated. Pollutants can pass from streets, construction and industrial areas, and airports into Cook Inlet and beluga whale habitat. However, 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.

7.3 Tourism

There currently are no commercial whale-watching companies in upper Cook Inlet. It is unlikely this industry will ever reach the levels of intensity seen in Southeast Alaska because of upper Cook Inlet's climate and navigation hazards (e.g., shallow waters, extreme tides, high turbidity, and swift currents), the low density of beluga whales, and the low likelihood that vessel operators would be able to target them in a commercially viable way. 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.

Humpback whales are sufficiently numerous and easy to find within the action area such that whale watching may affect the behavior of some whales in lower Cook Inlet, primarily in the vicinity of Homer. Fin whales, being less common and arguably less charismatic than either humpback or beluga whales, are not likely to be a target for whale watching operations, but whale watchers would likely stop to observe those that they encountered.

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 2008b). 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 regularly approach Western DPS Steller sea lion non-major haulouts (haulouts that were not used in determining the extent of critical habitat) near Homer, but data are not available indicating whether such marine mammal viewing adversely affects the animals.

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 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 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, annual 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.

In addition to considering the effects of stressors associated with the activities proposed in the first incremental step, we analyzed the effects of the future incremental steps, including exploration, development, production, and decommissioning activities on LS 258, to determine if there is reasonable likelihood that the entire proposed action could violate section 7(a)(2) of the ESA (50 CFR §402.14(k)). However, considerable uncertainty remains concerning future activities. If project-specific effects on the listed species or designated critical habitat will occur in a manner or to an extent not considered in this opinion, reinitiation of this consultation would be required. Consultation is also required for all activities related to LS 258 that may affect listed species. In addition, activities that are expected to result in take of marine mammals under the Marine Mammal Protection Act will require the issuance (by NMFS) of an Incidental Harassment Authorization or Letter of Authorization. If the expected take includes listed marine mammal species, then a formal consultation on the issuance of those authorizations is required.

8.1 Cetacean Risk Analysis

Based on the results of the Exposure Analysis for the first incremental step, we expect Cook Inlet beluga whales, fin whales, and Western North Pacific DPS and Mexico DPS humpback whales may be adversely affected by exposure to seismic exploration noise, pile driving noise, and tug transport of drill rigs. Exposure to vessel noise (excluding tugs and drill ships), aircraft noise, noise from non-seismic geotechnical surveys, drilling and pumping, oil spill response exercises, seafloor disturbance, and small oil spills may occur, but the expected effects are considered minimal and would not likely result in take. We expect take will result from vessel noise associated with tug movement of jack-up rigs which served as a proxy for noise produced by other rig moving options. As discussed below, exposure to vessel strike is extremely unlikely to occur and therefore the expected effects are considered improbable. We have records of only one humpback having been struck in the action area, and perhaps one fin whale having been struck. Exposure to certain non-biodegradable marine debris, especially to closed loops such as packing straps, remains an unquantifiable threat, especially to smaller cetaceans such as beluga whales. Finally, large and very large oil spills are considered low probability, high-impact events.

Our consideration of probable exposures and responses of listed whales to oil and gas exploration activities associated with the first incremental step of LS 258 is designed to help us assess whether those activities are likely to increase the extinction risks or jeopardize the continued existence of listed whales.

The effects to Cook Inlet beluga, fin, and Mexico DPS and Western North Pacific DPS humpback whales associated with geophysical, geotechnical, pile driving, aircraft traffic, drilling operations, and small oil spills during future incremental steps (development, production, and decommissioning) are expected to be similar those effects described for whales during the first incremental step, but with increased sound exposures and risk of spill due to increased vessel and aircraft traffic, installation of production platforms and pipelines, and drilling operations. Mitigation measures required for pile driving, pipeline and platform installation, and drilling would reduce the impacts to listed whales at all stages (BOEM 2017b). In addition, the risk associated with large oil spills is expected to increase during future incremental steps. BOEM estimates that during future incremental steps, there is a 78 percent probability of no large spill occurring, and a 19 percent probability of one or more large spills (3,800 bbl) over the life of the project, with a far smaller chance that this spill will occur during the first incremental step, prior to the establishment of production wells. No VLOS is expected ($>10^{-4}$ to $<10^{-5}$ per well frequency of occurrence). The effects of a large oil spill would be significantly greater than small spills. A low probability, high impact circumstance where large numbers of whales experience prolonged exposure to toxic fumes, and/or ingest harmful or fatal amounts of oil, could result in injury and mortality that exceeds PBR. However, due to the low likelihood of multiple large oil spills, and even lower predicted likelihood of a VLOS, the risk of significant long term exposures of whales to accidental discharges of oil is extremely low. In addition, a number of regulatory changes have been put in place since Deepwater Horizon in an effort to reduce the risk of spills associated with oil and gas exploration and development activities.

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). Large whales such as fin and humpbacks have an ability to store substantial amounts of energy, which allows them to survive for months on stored energy during migration and while in their wintering areas, and their feeding patterns allow them to acquire energy at high rates. For smaller cetaceans, like Cook Inlet beluga whales, foraging is expected to occur year-round on seasonally available prey. During spring and summer, beluga whales congregate in upper Cook Inlet feeding mainly on anadromous fish, including eulachon and Pacific salmon near river mouths outside the action area. The individual and cumulative energy costs of the behavioral responses we have discussed are not likely to reduce the energy budgets of these whales (i.e., reduce the amount of time they spend at the ocean's surface, increase their swimming speed, change their swimming direction to avoid tug operations, change their respiration rates, increase dive times, reduce feeding behavior, or alter vocalizations and social interactions) and their probable exposure to noise sources are not likely to reduce their fitness or 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, and growth rates (or increase variance in one or more of these rates) of the populations those individuals represent.

Based on the exploration, development, and production scenario provided by BOEM/BSEE for LS 258 (Table 1, Table 6, Table 7), NMFS estimates exposures to harmful sound for two Cook Inlet beluga whales, 130 total exposures of humpback whales, one percent of which are anticipated to be Western North Pacific DPS humpback whales (one individual), 11 percent of which are expected to be Mexico DPS humpbacks (14 individuals), with the remaining exposures occurring for non-listed Hawaii DPS animals. Twenty-three instances of fin whale exposures to Level B harassment levels could also occur. No whales are expected to be exposed to sound levels that could result in TTS or PTS.

These estimates represent the total number of exposures that could potentially occur, but not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of the proposed action. These exposure estimates are likely to be overestimates because the estimates: 1) do not account for avoidance by the animals; 2) do not account for implementation of mitigation measures; 3) assume all activities are implemented; and 4) assume a higher level of development over a greater area within Cook Inlet.

Exposure to vessel noise from transit, aircraft noise, noise from non-seismic geophysical surveys, seafloor disturbance (including geotechnical surveys), and small oil spill discharge may occur as part of the proposed action, but the effects are considered undetectable and would not rise to the level of take. The occurrence of vessel strikes is considered unlikely due to the implementation of mitigation measures and rarity of occurrence in Cook Inlet. Exposure to harmful marine debris is unlikely, and exposure to non-biodegradable loops (such as uncut packing straps) remains an unquantifiable threat. Large and very large oil spills are considered low probability, high impact events.

Based on the localized nature of small oil spills, the relatively rapid weathering expected for <1,000 bbl of oil, the small increase of refueling activities, and the safeguards in place to avoid and minimize oil spills related to LS 258, we conclude that the probability of a BOEM/BSEE-authorized activity causing a small oil spill and exposing beluga, fin, Mexico DPS humpback, or Western North Pacific DPS humpback whales in Cook Inlet is sufficiently small as to be considered improbable. If exposure were to occur, due to the ephemeral nature of small, refined oil spills, NMFS does not expect detectable responses from whales, and we would consider the effects of a spill (of the size considered by BOEM in their spill analysis) during proposed action to be minor.

Because drilling is a continuous source of underwater noise and ramps up gradually, we expect that most marine mammals will be aware of a rig's presence and would not enter into an area where they would suffer from acoustic harassment unless they were compelled to do so (such as to take advantage of prey aggregations). We expect most marine mammals will deflect around the ensonified area.

Although the oil and gas exploration activities are likely to cause some 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, and social dynamics of individual whales in ways or to a degree that would reduce their fitness because it is expected that the whales will continue to actively forage in waters around the seismic operations or will seek alternative foraging areas, including the biologically important feeding areas around Kodiak Island.

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, fin, Mexico DPS humpback, or Western North Pacific DPS humpback whale. As a result, the activities BOEM and BSEE plan to authorize for LS 258 in Cook Inlet are not likely to appreciably reduce the Cook Inlet beluga, fin, Mexico DPS humpback, or Western North Pacific DPS humpback whales' likelihood of surviving or recovering in the wild.

The strongest evidence supporting the conclusion that exploration activities will likely have minimal impact on fin and humpback whale populations is the estimated growth rate of these populations in the sub-Arctic and North Pacific. Zerbini et al.(2006) estimated the rate of increase for fin whales in coastal waters south of the Alaska Peninsula to be around 4.8 percent (95 percent CI: 4.1-5.4 percent) for the period 1987-2003. It is more difficult to provide the rate of increase for humpback whales in Alaska because the DPSs designated under the ESA do not align with stocks that are defined under the MMPA. However the stock assessment reports indicate that for the two stocks that occur in Alaska, the Western North Pacific and Central North Pacific there, have been annual growth rates (depending on method, time frame, and stock) that range from 4.9 percent to 10 percent (Muto et al. 2022). However, it's difficult to provide the precise rate of increase for humpback whales in Alaska because, until recently, the DPSs designated under the ESA did not align with stocks that are defined under the MMPA (Muto et al. 2022). These rates suggest that despite exposure to oil and gas exploration activities in Cook Inlet since the early1960s, a small number of humpback and fin whale entanglements in fishing gear, and unauthorized subsistence take of small numbers of humpback whales in Alaska, that the stress regime these whales are exposed to in the action area has not prevented humpback and fin whales from increasing their numbers and expanding their range and frequency of occurrence in the action area.

Multiple activities described in the Environmental Baseline occur on the shoreline of Cook Inlet and within its waters. Activities that may affect water quality include coastal development, particularly at the Port of Anchorage, stormwater runoff, input from the wastewater treatment plant, road construction, and small spills from a variety of sources. Although there are multiple potential sources of contaminants from activities on the shores and within Cook Inlet itself, contaminant loads in the sediment, in the prey, and in Cook Inlet beluga whales are low compared to other stocks. Recreational and commercial fisheries co-occur with concentrations of beluga prey and may compete with the whales for their prey. Although subsistence harvest once occurred for beluga whales, the last beluga was harvested in 2005. Vessel traffic in Cook Inlet 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. Propeller scars observed on belugas may have resulted from collisions with recreational or commercial fishing boats. One fin and one humpback whale are known to have been killed by vessel strike in Cook Inlet.

Research activities involving tagging can have a negative impact on Cook Inlet beluga whales but current research activities are remote (aerial, vessel surveys), must be permitted, and are closely monitored. There are insufficient data to make reliable estimations of the impact of climate change on the cetaceans considered in this Biological Opinion. The feeding range of humpback and fin whales is larger than that of other species and consequently, as feeding generalists, it is likely that these two species may be more resilient to climate change than other species with more restricted ranges and foraging habits. Although the effects of climate change and other large scale environmental phenomena on Cook Inlet beluga, fin, and humpback whales habitat cannot be predicted with certainty, impacts to their prey from oceanic regime shifts, or changes in freshwater habitat (hydrologic changes, increased water temperature) are projected to occur. The beluga whale has undergone notable summer range restriction in recent years, and they now occur predominantly in upper Cook Inlet. The factors described in the Environmental Baseline are expected to continue into the future. Climate change and increasing levels of development are the two factors that are most likely to change over the life of this project.

As described in the Cumulative Effects section, activities that will likely not have a federal nexus, and therefore will not be regulated under the ESA are fisheries, increasing levels of pollution from increased development on the shoreline, and tourism. These activities currently occur and are expected to continue into the future.

The best current population estimate for Cook Inlet beluga whales ranges from 290 to 386 with a best estimate of 331. The 2-6 percent per year recovery that NMFS expected following the discontinuation of subsistence harvest did not occur. Summer range has contracted steadily since the late 1970s. 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. The Susitna River Delta area (including the Beluga and Little Susitna rivers) has become their core summer habitat, with additional high use areas in Knik and Turnagain Arms. Aerial surveys in Cook Inlet in late fall and early spring indicate use only as far south as Tuxedni Bay (Gill et al. unpubl. report). We know that beluga whales make use of the Kenai River from the mouth to about 10 miles upstream, when salmon runs (and various salmon fisheries) are not underway, and while they formerly made extensive use of this riparian habitat during salmon runs, they no longer do so. Coastal development, especially near

Anchorage, has the potential to disrupt beluga whale behavior, and may alter movements among important summer habitat patches through acoustic disruption. Boat traffic in the Twentymile River has been documented as having caused behavioral disruption of beluga whales present in the river, while they were presumably feeding there, but fled the river channel to Turnagain Arm when boats encountered them. Seismic exploration in upper Cook Inlet has caused both Level A and Level B takes of Cook Inlet beluga whales.

In the absence of a single threat clearly limiting recovery, the cumulative effects from multiple stressors limiting recovery is a most plausible explanation for why the Cook Inlet beluga population has not recovered (NMFS 2016a). Because of the unknown cause for the decline and recovery of Cook Inlet belugas, all actions with a federal nexus have undergone extensive evaluation to understand impacts and inform development of additional mitigation measures when necessary to reduce impacts to Cook Inlet beluga whales. In recent years, most applicants have implemented strict mitigation measures to shut down if a Cook Inlet beluga enters a behavioral disturbance harassment zone (i.e., zone within which MMPA Level B harassment may occur), even when take has been authorized, to further reduce the likelihood that the anthropogenic activity will reduce the fitness of an individual whale.

Threats associated with resource development activities such as oil and gas development were considered a factor in the decision to list the species as endangered, but the best available information indicated that these activities were not likely a major contributing factor in the population’s decline that preceded the listing (73 FR 62919; October 22, 2008). Oil and gas development 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.

Pollution and contaminants were listed as low relative concern for impeding the recovery of Cook Inlet beluga whales (NMFS 2016b, Muto et al. 2017). For the contaminants that have been studied, Cook Inlet beluga whales generally had lower contaminant loads than did beluga whales from other populations (Becker 2000, Becker et al. 2010, Reiner et al. 2011, Hoguet et al. 2013), 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 whales (Muto et al. 2022).

Due to the location of the lease area, as well as implementation of mitigation measures, exposures to noise at received levels that could cause harassment to listed species are expected to be minimal. Effects of this action would be greater on Cook Inlet beluga whale if the lease sale had been located further to the north. Data we have presented suggest that beluga whales are almost entirely absent from the LS 258 area during summer months but are present at low densities at the northern and western fringes of the LS 258 area during fall and winter. Mitigation measures will reduce exposure of listed species to noise from the action through project timing, and 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.

Fin, Mexico DPS humpback, and Western North Pacific DPS humpback whales occur in low densities in Cook Inlet, primarily during the ice-free season. Because the action will not reduce the reproduction, numbers, or distribution of the species, NMFS concludes that the proposed action is not expected to appreciably reduce the likelihood of survival or recovery of Mexico DPS or Western North Pacific humpback whales or fin whales.

Although seismic exploration, impact pile driving, and drill rig movement are 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.

The chance of a large (3,800-bbl) spill occurring is estimated to be 19 percent, and the chance of no large spills occurring is 81 percent over the E&D Scenario lifecycle. The estimated chance of a 30-MMcf gas release is 4 percent. These estimates are based on historical data on spills ≥1,000 bbl, statistical estimates of the mean number of large spills from platforms and pipelines, the number and size of large spills on the OCS, and project-specific information from the E&D Scenario. Although probabilities for spills were only provided for the E&D stages (first 5 years), because the oil spill analysis was based on the assumptions of a high level of development over 28 blocks, we feel that it is reasonable to assume that the risk of spills from development on a single block will be of a similar magnitude over time. Based on these factors, the risk of significant long term exposures of whales to accidental discharges of oil and gas is low.

A low probability, high-impact circumstance where large numbers of whales experience prolonged exposure to toxic fumes, and/or ingest large amounts of oil, could result in injury and mortality that exceeds potential biological removal. However, due to the low likelihood of multiple large oil spills, and even lower likelihood of a VLOS, the risk of significant long term exposures of whales to accidental discharges of oil is extremely low. In addition, a number of regulatory changes have been put in place since Deepwater Horizon in an effort to reduce the risk of spills associated with oil and gas development and production activities (e.g., prescriptive and performance based regulations and guidance, as well as OCS safety and environmental protection requirements (BOEM 2022a).

As discussed, the other stressors associated with future incremental steps are expected to have similar effects to those discussed during the first incremental step. Therefore, based on the best information currently available, the effects of future incremental steps, including development, production, and decommissioning activities, on LS 258 in Cook Inlet, are not reasonably likely to jeopardize the continued existence or appreciably reduce the likelihood of recovery of Cook Inlet beluga, fin, Mexico DPS humpback, or Western North Pacific DPS humpback whales.

8.2 Western DPS Steller Sea Lion Risk Analysis

Based on the results of the Exposure Analysis, during the first incremental step, we expect Western DPS Steller sea lions may be exposed due to impulsive seismic noise, pile driving noise, and noise associated rig movement. Exposure to vessel noise from transit, aircraft noise, noise from non-seismic geotechnical surveys, drilling and pumping, oil spill response drills, seafloor disturbance, and small oil spills may occur but are considered minimal effects and would not rise to the level of take. Exposure to vessel strike is extremely unlikely to occur. One Steller sea lion was reported from within the action area with two separate head wounds consistent with blunt trauma, with suspected vessel strike as the cause of the trauma (NMFS Alaska Regional Office Stranding Database accessed May 2017). There are no other reported vessel collisions or prop strikes of Steller sea lions in Cook Inlet. The incremental increase in ship traffic due to LS 258 is unlikely to change this pattern markedly. 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 not one that will cause jeopardy to Western DPS Steller sea lions. Best practices regarding waste management (cutting loops prior to disposal) will further reduce the impact of debris on Steller sea lions. Because the probability of large and very large oil spills are considered extremely unlikely to occur, the effects from those events are also considered improbable. Finally, large and very large oil spills are considered low probability, high-impact events.

The effects to Western DPS Steller sea lions associated with pile driving, aircraft traffic, drilling operations, and small oil spills during future incremental steps (development, production, and decommissioning) are expected to be similar to those effects described for Steller sea lions during the first incremental step. Mitigation measures required for pile driving would further reduce the impacts to listed sea lions. BOEM estimates a 19 percent chance of a large spill occurring (3,899 bbl) over the life of the project, with a far smaller chance that this spill will occur during the first incremental step, prior to the establishment of production wells. No VLOS is expected ($>10^{-4}$ to $<10^{-5}$ per well frequency of occurrence). The effects of a large oil spill would be significantly greater than small spills. A low probability, high impact circumstance where large numbers of sea lions experience prolonged exposure to toxic fumes, and/or ingest large amounts of oil, could result in injury and mortality that exceeds PBR. However, due to the low likelihood of multiple large oil spills, and even lower predicted likelihood of a VLOS, the risk of significant long term exposures of sea lions to accidental discharge of oil is low. In addition, a number of regulatory changes have been put in place since Deepwater Horizon in an effort to reduce the risk of spills associated with oil and gas exploration and development activities.

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 2008a). While the pupping and breeding season will likely overlap with some proposed action activities, no Steller sea lion rookeries or haulouts are within 90 km of the leased block. However, 12 major haulouts and one major rookery that are part of designated Steller sea lion critical habitat are within the action area. Steller sea lions occur in and around lower Cook Inlet, primarily near Kachemak Bay. However, the individual and cumulative energy costs of the behavioral responses we have discussed are not likely to reduce the energy budgets of 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, drilling, and seismic exploration/surveys 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 growth rates (or increase variance in one or more of these rates) of the population those individuals represent.

In total, the proposed action is expected to result in 557 exposures of Western DPS Steller sea lions at received sound levels ≥120 dB re 1 µPa rms for continuous noise sources and ≥160 dB re 1 µPa rms for impulsive noise sources during oil and gas exploration activities (Table 18).

No exposures of Western DPS Steller sea lions to these noise sources are expected to result in TTS or PTS. These estimates represent the total number of exposures that could potentially occur, not necessarily the number of individuals taken, as a single individual may be "taken" multiple times over the course of the proposed action. These exposure estimates are likely to be overestimates because the estimates: 1) do not account for avoidance by the animals; 2) do not account for implementation of mitigation measures; 3) assume all activities are implemented; and 4) assume a higher level of development over a greater area within Cook Inlet. Mitigation measures will reduce exposure of listed species to loud noise from the action through project timing, and 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.

Exposure to non-tug vessel noise from transit, aircraft noise, noise from non-seismic geophysical surveys, seafloor disturbance (including geotechnical surveys), and small oil spill discharge may occur as part of the proposed action, but are considered minor. Exposure to vessel strike is extremely unlikely to occur. The incremental increase in ship traffic due to LS 258 (one vessel per day) is unlikely to change this pattern markedly. 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 not one that will cause jeopardy to Western DPS Steller sea lions. Best practices regarding waste management (cutting loops prior to disposal) will further reduce the impact of debris on Steller sea lions. Large and very large oil spills are considered low probability, but high impact events.

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 safe guards in place to avoid and minimize oil spills, we conclude that the probability of a BOEM/BSEE authorized activity within the first incremental step causing a small oil spill and exposing Western DPS Steller sea lions on LS 258 in Cook Inlet sufficiently small as to be extremely unlikely to occur, and thus the effects are considered improbable. If exposure were to occur, due to the ephemeral nature of small, refined oil spills, NMFS does not expect detectable responses from sea lions from small oil spills and we would consider exposure minimal during the first incremental step of the proposed action.

For seismic, rig towing, and pile driving, PSOs are required. Because drilling is continuous source of underwater noise and ramps up gradually, we expect that most marine mammals will be aware of a rig's presence and would not enter into an area where they would suffer from acoustic harassment unless they were compelled to do so (such as to take advantage of prey aggregations). We expect most marine mammals will deflect around the ensonified area.

Oil and gas exploration activities are 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, it remains unknown whether these responses are 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 from the same or multiple sources multiple times over the course of the proposed action, the implementation of mitigation measures reduces the likelihood of exposure of animals to action-related noise capable of affecting vital life functions or causing TTS or PTS. In most circumstances, we assume Steller sea lions are likely to 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. (2007a) 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. 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, sound 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 described in the Cumulative Effects section, activities that will likely not have a federal nexus, and therefore will not be regulated under the ESA are fisheries, increasing levels of pollution from increased development on the shoreline, and tourism. These activities currently occur and are expected to continue into the future.

The strongest evidence supporting the conclusion that exploration activities will likely have minimal impact on Western DPS Steller sea lions is the continued growth of this population, especially in the western Gulf of Alaska, in spite of losses from entanglement, interactions with commercial fishing, and mortalities caused by non-fishery related and non-subsistence related causes during this same time. In addition, the density of Steller sea lions in the open water of Cook Inlet is very low, reducing the potential overlap of individual animals with project activities.

As we discussed in the Approach to the Assessment (section 3) 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 species; in this case, the Western DPS Steller sea lion. As a result, the leasing and exploration activities BOEM and BSEE plan to authorize during the first incremental step on LS 258 are not likely to appreciably reduce the Western DPS Steller sea lion's likelihood of surviving or recovering in the wild.

During future incremental steps, a low probability, high impact circumstance where large numbers of sea lions experience prolonged exposure to toxic fumes, and/or ingest large amounts of oil, could result in injury and mortality of a substantial number of individuals. However, due to the low likelihood of multiple large oil spills, and even lower predicated likelihood of a VLOS, the risk of significant long term exposures of sea lions to accidental discharges of oil is low. The other stressors associated with future incremental steps are expected to have similar effects to those discussed during the first incremental step. Therefore, based on the best information currently available, the effects of future incremental steps, including development, production, and decommissioning activities on LS 258 in Cook Inlet are not reasonably likely to jeopardize the continued existence or appreciably reduce the likelihood of recovery in Western DPS Steller sea lions.

8.3 Critical Habitat Risk Analysis (Cook Inlet Beluga, Steller Sea Lion)

As described in the Status of the Species and Critical Habitat (section 4), designated critical habitat for the Cook Inlet beluga includes five PBFs essential to the conservation of the species: intertidal and subtidal waters of Cook Inlet with depths <30 feet and within five miles of high and medium flow anadromous fish streams; primary prey species; waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales; unrestricted passage within or between critical habitat areas; and waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales (50 CFR §226.220(c)). The action area overlaps with Cook Inlet beluga critical habitat Area 2.

The primary threats that could affect the features identified as essential to conservation of Cook Inlet beluga whales were not addressed in the final rule designating critical habitat, but the recovery plan lists threats to both the species and its critical habitat. Threats to beluga whales of high and medium concern that may impact critical habitat include: catastrophic events such as oil spills, noise, habitat loss or degradation, and reduction in prey.

Steller sea lion critical habitat includes five PBFs including: terrestrial zones that extend 3,000 feet (0.9 km) landward from each major haulout and major rookery in Alaska; air zones that extend 3,000 feet (0.9 km) above the terrestrial zone of each major haulout and major rookery in Alaska; aquatic zones that extend 3,000 feet (0.9 km) seaward of each major haulout and major rookery in Alaska that is east of 144º W longitude; aquatic zones that extend 20 nm (37 km) seaward of each major haulout and major rookery in Alaska that is west of 144º W longitude; and three special aquatic foraging areas (Shelikof Strait area, the Bogoslof area, and the Seguam Pass area) (50 CFR §226.202). Within the action area, terrestrial, air, and aquatic zones out to 20 nm, and Shelikof Strait foraging area may overlap with oil spill and vessel traffic. Although a small amount of Steller sea lion critical habitat occurs within the action area (Figure 17), none is near the leased block associated with this action.

The primary threats that could affect the features identified as essential to conservation of Steller sea lions include: wildlife viewing, boat and aircraft traffic, research activities, commercial, recreational and subsistence fishing, timber harvest, hard mineral extraction, oil and gas development, coastal development, including pollutant discharges, and subsistence harvest.

The overall functioning of essential habitat features in the action area appears to be relatively high. Continued increases in Steller sea lions in the eastern Aleutians, Alaska Peninsula, and Southcentral Alaska suggest that habitat in these areas is currently capable of supporting more animals than it currently does. For Cook Inlet beluga whales, the functioning of essential features is less clear. The beluga population declined slowly despite the removal of the threat that was assumed to have been the primary cause of the dramatic decline during the 1990s. While petroleum spills remain a low risk event, with all else equal, the probability of a catastrophic spill increases as oil and gas development increases. This action portends such an increase in oil and gas development within the action area. In-water noise in upper Cook Inlet is likely increasing, but noise trends in lower Cook Inlet are poorly documented. Cook Inlet is not classified as an impaired water body, but the reason for this classification is that adequate water quality information is lacking. Although belugas may have abandoned critical habitat off of the Kenai River during summer salmon runs, they make heavy use of salmon runs elsewhere in Upper Cook Inlet, where abundance and trends in salmon returns remain largely unknown. This first incremental step associated with LS 258 is not expected to measurably affect salmon returns within the action area, nor is it expected to have more than a minimal impact upon other PBFs for Cook Inlet beluga whale critical habitat.

Because of physical separation, the proposed action is unlikely to cause physical and acoustic effects which could alter the quality of the essential features of designated critical habitat, or render portions of it temporarily unsuitable.

As part of the proposed action, BOEM/BSEE will not authorize seismic surveys within LS 258 blocks between November 1 and April 1, nor will they occur on OCS blocks containing beluga whale nearshore feeding areas between July 1 and September 30 (BOEM 2022a). Geophysical and geotechnical surveys will not occur on beluga whale critical habitat OCS blocks between November 1 and April 1. While not expected, waivers to these stipulations may be obtained from BOEM. These time and area restrictions will reduce potential overlap between project activities and beluga whale winter feeding habitat during the times of year that belugas will most likely be using those habitats. They will also reduce impacts to salmon populations that are migrating towards their spawning streams.

Small spills are not expected to have a measurable impact upon beluga whale or Steller sea lion critical habitat because they are expected to evaporate, degrade, and disperse prior to reaching that habitat. BOEM estimates a 19 percent chance of one or more large spills occurring over the life of the project. No very large oil spills are expected ($>10^{-4}$ to $<10^{-5}$ per well frequency of occurrence) (BOEM 2022a). If a large spill were to occur, it could significantly impact Cook Inlet beluga designated critical habitat at any time of the year, by introducing toxins and other harmful agents in amounts harmful to beluga, and/or by contaminating/destroying food resources, another essential feature. Steller sea lion designated haulouts, rookeries, and aquatic zones, and foraging areas may be impacted. However, a large oil spill would still be localized to a portion of the overall habitat and depending on the composition of the spill it could dissipate rapidly before reaching critical habitat. One large oil spill will not likely adversely modify designated critical habitat due to the relatively small proportion of the habitat that would be impacted, the temporary nature of oil in water or ice, and cleanup and response activities.

Depending on the size and scale of a spill, it could require multiple seasons to return the essential features to their original quality. Areas within the pathway of the spill would be most impaired while areas outside of the pathway would be affected less. The essential feature of primary prey resources for both Steller sea lions and Cook Inlet beluga would likely take longer to recover from a large or very large spill, due to potential effects on prey populations and reproduction (BOEM 2017b).

A very large oil spill in Cook Inlet has the potential to adversely modify designated critical habitat if it were to occur. A very large oil spill could affect an area extending across a major portion of the lower and middle Cook Inlet. A large or very large oil spill is not expected to extend north into Cook Inlet beluga whale critical habitat in the upper inlet. While strong winds and strong tides could result in some product from a very large oil spill extending north of the Forelands, the net outflow of inlet waters from freshwater inputs in upper Cook Inlet are expected to preclude such incursions of spilled oil into this area. The impacts upon designated beluga whale critical habitat could be at a level that destroys the value of the habitat for multiple years to a degree that a significant proportion of the Cook Inlet beluga whale DPS is not able to successfully reproduce or survive, risking the recovery or stability of the DPS. Population level effects to Steller sea lion may be minor to severe depending on timing and location of a spill. However, BOEM estimates that the chance of a VLOS occurrence is extremely low due to a number of factors, including historical occurrence, limited number of activities being authorized, and safety measures in place (BOEM 2022a). Based on likelihood, NMFS concludes that oil spills resulting from the first incremental step of the proposed action are likely to be small spills of refined petroleum products. These products are expected to evaporate, weather, and dissipate before causing any measurable effect to either Cook Inlet beluga or Steller sea lion critical habitat. Oil spills that may occur during future incremental steps are more likely to be large and composed of crude oil, with the potential to cause more serious adverse effect to critical habitat. However, due to the low predicted likelihood of large or VLOS, oil spills resulting from future incremental steps are not likely to adversely modify designated critical habitat.

Based on our analyses of the information available, the quantity or availability of the essential features of critical habitat are not likely to decline as a result of being exposed to oil and gas exploration activities during the first incremental step, or activities associated with future incremental steps. Because the leased block does not overlap with Steller sea lion or beluga critical habitat (the closest beluga critical habitat is about 15 km to the west of the block), physical and acoustic disturbance of critical habitat is unlikely. Due to the low increase in the number of vessels expected, the limited use of towing rigs, the low probability of spill, the size and quality of the remaining habitat, the high tolerance of pinnipeds to drilling and seismic operations, the temporary impact to prey resources, and the application of standard mitigation measures to avoid adverse impacts, we conclude that the proposed action is not likely to destroy or adversely modify designated critical habitat for either Cook Inlet beluga whales or 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 the Cook Inlet beluga whale (*Delphinapterus leucas*), fin whale (*Balaenoptera physalus*), Western North Pacific DPS humpback whale (*Megaptera novaeangliae*), Mexico DPS humpback whale (*Megaptera novaeangliae*), or Western DPS Steller sea lion (*Eumetopias jubatus*).

In addition, the proposed action is not likely to destroy or adversely modify the designated critical habitat for Steller sea lions or Cook Inlet beluga whales.

10 INCIDENTAL TAKE STATEMENT

Under NMFS's section 7(a)(2) implementing regulations (80 FR 26832, May 11, 2015; ITS rule), an Incidental Take Statement is not required at the programmatic level for framework programmatic actions where precise information on the specific number, location, timing, frequency, and intensity of actions is unknown, and any incidental take resulting from any actions subsequently authorized, funded, or carried out under the program will be addressed in separate ESA section 7 consultations (see 50 CFR §402.14(i)(6)). A framework programmatic action means, for purposes of an incidental take statement, a Federal action that approves a framework for the development of future action(s) that are authorized, funded, or carried out at a later time, and any take of a listed species would not occur unless and until those future action(s) are authorized, funded, or carried out and subject to further section 7 consultation (50 CFR §402.02).

Lease Sale 258 in and of itself will not affect marine mammals and will not alone result in the incidental take of marine mammals. However, the subsequent authorization of geological and geophysical exploration permits, ancillary activities, exploration plans, permits to drill, and development and production plans may affect listed species and require BOEM and BSEE to initiate project-specific consultation associated with the issuance of Marine Mammal Protection Act Letters of Authorization or Incidental Harassment Authorizations (16 USC §1371(a)(5)(A)&(D)). In addition, subsequent authorizations at the exploration stage, including G&G permits, exploration plans, and a permit to drill, may affect listed species and warrant project-specific consultation for specific actions under this first incremental step. If commercially recoverable reserves are found and are proposed for development, BOEM and BSEE also may initiate consultation on future incremental steps associated with development, production, and decommissioning activities that affect listed species. Therefore, consultation will be required for all activities related to the LS258 program that may affect listed species. For each subsequent consultation, NMFS will determine whether a future activity under this program is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of the critical habitat of such species.

At each step under this program (LS 258), project-specific information will aid in the assessment of effects on listed species and the amount and extent of incidental take resulting from that project; project-specific information also will aid in the development of sufficiently specific and meaningful terms and conditions for each project and will ensure an accurate and reliable trigger for reinitiation of consultation (80 FR 26832, 26835-36; May 11, 2015). In addition to the mitigation measures provided in this opinion, additional mitigation measures may be included in subsequent section 7 consultations.

NMFS will compare the effects of project-specific actions and associated take levels to the effects expected under this overarching LS 258 opinion. If the amount or extent of incidental take that is proposed to be authorized through individual projects exceeds the levels estimated and analyzed here, or if the project-specific effects on the listed species or designated critical habitat will occur in a manner or to an extent not considered in this opinion, reinitiation of consultation on the LS 258 biological opinion will be required (50 CFR §402.16(a)).

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 the 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). Conservation Measures 1-4 are directed at future activities that will flow from this consultation.

1. BOEM/BSEE should ensure that vessel crew members are instructed in marine mammal identification and are instructed to keep watch for them and report their presence whenever feasible.

2. BOEM/BSEE should ensure that all synthetic materials are kept out of marine waters, and that packing straps and other plastic or fibrous loops are cut prior to being discarded.

3. BOEM/BSEE should implement the following measures to help standardize the Protected Species Observer Program (Baker et al. 2013):

    - Implement standardization for data collection methods, electronic forms, and software used in collaboration with NMFS and non-federal stakeholders;
    - Develop permits or agreements detailing expectations and data collection and reporting of third-party PSO provider companies, including performance standards, conflicts of interest, and standards of conduct;
    - Implement quality assurance standards and submit PSO data for annual data analysis;
    - Develop a mechanism, procedure, or regulation to ensure that selected PSO providers are being compensated prior to deployment of approved observers;
    - Develop a debriefing and evaluation system for observers.

4. Work with NMFS and other resource agencies to track oil and gas spills/releases into Cook Inlet associated with the proposed action, and implement timely response in open-water and in-ice conditions.

5. Under the BOEM Environmental Studies Program, consider studies specifically designed to assess the effects of oil and gas activities on Cook Inlet beluga whales in mid to lower Cook Inlet, including winter distribution studies and assessment of prey contaminant loads.

6. Under the BOEM Environmental Studies Program, consider studies specifically designed to update density estimates for humpback whales, fin whale, and beluga whale in lower Cook Inlet.

7. Continue to support aerial surveys in lower Cook Inlet, especially in the fall and spring.

In order to keep NMFS's Protected Resources Division informed of actions minimizing or avoiding adverse effects, or benefitting listed species or their habitats, BOEM/BSEE should notify NMFS of any conservation recommendations they implement.

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, including the granting of waivers to lease stipulations, 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, BOEM and BSEE, 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 Part 402.

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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