Alaska Outer Continental Shelf **OCS EIS/EA**
BOEM 2025-035

Cook Inlet Planning Area

Oil and Gas Lease Sale 258
In Cook Inlet, Alaska

Final Supplemental Environmental Impact Statement

Chapters 1–5
Appendices A, B, and C

Prepared by
Bureau of Ocean Energy Management
Alaska OCS Region

U.S. Department of the Interior
Bureau of Ocean Energy Management
Alaska OCS Region

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COVER SHEET

Cook Inlet Lease Sale 258

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U. S. Department of Interior, Bureau of Ocean Energy Management

Area of Potential Effect Offshore marine environment, Cook Inlet region, and the Kenai Peninsula Borough of Alaska.

Prepared by: Bureau of Ocean Energy Management (BOEM), Alaska OCS Region

Cooperating Agency: Bureau of Safety and Environmental Enforcement

Participating Agency: National Park Service

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Certifications

Page Limits: I certify that BOEM has considered the factors mandated by NEPA; that the supplemental environmental impact statement represents the bureau's good-faith effort to prioritize documentation of the most important considerations required by the statute within the congressionally mandated page limits; that this prioritization reflects the bureau's expert judgment; and that any considerations addressed briefly or left unaddressed were, in the bureau's judgment, comparatively unimportant or frivolous.

Deadlines: I certify that this supplemental environmental impact statement represents the bureau's good-faith effort to fulfill NEPA's requirements within the Congressional timeline; that such effort is substantially complete; and that, in the BOEM's expert opinion, it has thoroughly considered the factors mandated by NEPA; and that, in the BOEM's judgment, the analysis contained therein is adequate to inform and reasonably explain BOEM's decision regarding the proposed Federal action.

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Michael D. Bradway
Acting Regional Director
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ABSTRACT

This Supplemental Environmental Impact Statement (SEIS) has been prepared by the Bureau of Ocean Energy Management (BOEM) in response to a July 2024 ruling by the U.S. District Court for the District of Alaska (Court), which found that the 2022 Final EIS (FEIS) for Cook Inlet Oil and Gas Lease Sale 258 (LS 258) violated the National Environmental Policy Act (NEPA) in certain respects. The Court concluded that BOEM's cumulative effects analysis was arbitrary in its treatment of Cook Inlet beluga whales and directed BOEM to conduct a revised analysis that considers cumulative impacts on this species separately from other marine mammals. The Court also ordered BOEM to analyze additional alternatives that reduce the lease sale area to meaningfully reduce anticipated impacts and to provide further analysis of the effects of vessel noise on Cook Inlet beluga whales.

While the Court remanded the FEIS and Record of Decision (ROD) without vacatur, it suspended the lease issued to Hilcorp pending completion of this SEIS. The Court retained jurisdiction and directed BOEM to submit status reports every six months until the supplemental NEPA review is complete.

This SEIS supplements the 2022 FEIS, which assessed the potential environmental impacts of offering 224 unleased Outer Continental Shelf (OCS) blocks—approximately 1.09 million acres—in the northern portion of the Cook Inlet Planning Area. The FEIS evaluated a range of alternatives, including a no action alternative, and options to exclude or mitigate impacts to beluga whale and sea otter critical habitat and the gillnet fishery. It also analyzed potential impacts from routine oil and gas activities and unlikely events such as large oil spills. This SEIS builds upon that analysis by addressing the deficiencies identified by the Court and ensuring compliance with NEPA and the Court's directive. This SEIS was prepared in accordance with the Department of the Interior's NEPA Implementing Regulations and NEPA Handbook, which became effective on July 3, 2025.

EXECUTIVE SUMMARY

Introduction

The U.S. Department of the Interior (USDOI), Bureau of Ocean Energy Management (BOEM), has prepared this Supplemental Environmental Impact Statement (EIS) to reassess the Proposed Action evaluated in the 2022 Final Environmental Impact Statement (FEIS) for Cook Inlet Oil and Gas Lease Sale 258 (LS 258). The lease sale area is located in the northern portion of the Cook Inlet Planning Area and consists of 224 Outer Continental Shelf (OCS) blocks, encompassing approximately 442,537 hectares (1.09 million acres), within a broader planning area of approximately 2.1 million hectares (~5.3 million acres).

BOEM initially issued a Record of Decision (ROD) for LS 258 in November 2022 and conducted the lease sale on December 30, 2022, resulting in one lease issued to Hilcorp Alaska, LLC. However, subsequent litigation filed by non-governmental organizations alleged deficiencies under the National Environmental Policy Act (NEPA). On July 16, 2024, the U.S. District Court (Court) for the District of Alaska found that BOEM's 2022 FEIS was deficient in its analysis and remanded the FEIS and ROD without vacatur for further review.

This SEIS addresses the Court's findings and provides environmental analysis of three additional alternatives to support compliance with NEPA for LS 258. While the lease sale occurred in 2022, this analysis does not incorporate the outcome of that sale and instead evaluates impacts based on the hypothetical Exploration and Development (E&D) Scenario to ensure a comprehensive and independent review and cure the deficiencies identified by the Court.

Purpose and Need for the Proposed Action

The purpose and need for the Proposed Action have not changed from the 2022 LS 258 FEIS. The purpose of the Proposed Action addressed in this SEIS is to offer for lease certain OCS blocks located within the federally owned portion of Cook Inlet that may contain economically recoverable oil and gas resources.

The need for the Proposed Action is to meet the purposes of the Outer Continental Shelf Lands Act of 1953 (OCSLA), as amended (43 United States Code (USC) 1331 et seq.). The OCS lease sale in Cook Inlet may lead to oil and gas exploration, development, and production. Oil and gas from the Cook Inlet Planning Area could help meet regional and national energy needs and lessen the need for imports.

BOEM prepared this SEIS to address the deficiencies identified in the Final EIS for LS 258 by the U.S. District Court for the District of Alaska. Since BOEM began preparing this SEIS, *the One Big Beautiful Bill Act (OBBBA, Pub. L. No. 119-21)* was enacted, which requires BOEM to hold 6 lease sales in Cook Inlet through 2032, and specifies the minimum acreage, lease terms, conditions and stipulations for those sales. This SEIS may be relied on, as appropriate, for actions related to LS 258 or the OBBBA mandated sales, including but not limited to incorporation by reference or for tiering in NEPA analyses conducted for post-lease approvals (e.g., plans and permits) in Cook Inlet.

Public Involvement

Under Department of Interior regulations implementing NEPA (43 Code of Federal Regulations (CFR) Part 46) and updated practices and procedures, scoping is not required but discretionary for a SEIS. The scope of the FEIS for Lease Sale 258 and the remand by the Court establish the scope for this SEIS.

Regulatory and Administrative Framework

BOEM's OCS oil and gas leasing activities are governed by OCSLA and its implementing regulations. In addition to NEPA, proposed actions on the OCS must comply with a broad framework of federal, state, and local environmental laws and policies. This SEIS has been developed within legal and regulatory context, ensuring that all alternatives considered are consistent with applicable requirements and informed by judicial direction.

Additional Alternatives

The Proposed Action and alternatives analyzed in the LS 258 FEIS were re-evaluated using updated information. In the FEIS, Alternative 6—designated the Preferred Alternative—combined multiple mitigation and exclusion measures: Alternatives 3A, 3C, 4A, 4B, and 5. In this SEIS, Alternative 6 is being retained since it was included in the FEIS as the preferred alternative. In response to deficiencies identified by the court, three additional alternatives (Alternatives 7 through 9) were developed and subjected to detailed analysis in this SEIS.

ALTERNATIVE 7 – NORTHERN AREA EXCLUSION

Under Alternative 7, all blocks in the lease sale area south of an east/west line crossing Cook Inlet from Anchor Point to the west side of Cook Inlet south of Chinitna Bay would be offered for lease. The 117 OCS blocks at the northern end of the lease sale area would be excluded from the lease sale. The excluded OCS blocks represent 49.0 percent of the total lease sale area.

ALTERNATIVE 8 – THE TUXEDNI BAY/CHINITNA BAY BUFFER EXCLUSION

Under this alternative, lease sale blocks that overlap a 10-mile buffer from the mouths of Tuxedni Bay and Chinitna Bay would be excluded from leasing. These bays are adjacent to each other along the western coast of Cook Inlet. All or part of 56 OCS blocks in two areas along the western boundary of the lease sale area would be excluded. This exclusion would reduce the lease sale area by 22.5 percent.

ALTERNATIVE 9 – NORTHERN FEEDING AREAS 5-MILE EXCLUSION

This alternative excludes lease blocks that overlap a 5-mile buffer zone along the coast north of an east/west line crossing Cook Inlet from Anchor Point to the west side of Cook Inlet south of Chinitna Bay. This exclusion protects major anadromous streams that provide feeding areas for Cook Inlet beluga whales as well as travel corridors between feeding areas. The Northern Feeding Areas 5-Mile Exclusion would exclude 62 whole or partial blocks or 20.9 percent of the lease sale area.

Affected Environment and Environmental Consequences

The Affected Environment describes the physical environment, biological environment, socioeconomic, and sociocultural systems that could be affected by the Proposed Action. The following resources are included: air quality; water quality; coastal and estuarine habitats; fish and invertebrates; birds; marine mammals; terrestrial mammals; recreation, tourism and sport fishing; communities and subsistence; economy; commercial fishing; and archaeological and historic resources.

This SEIS also includes an updated greenhouse gas (GHG) analysis that is in accordance with recent Executive Order 14154 Unleashing American Energy (Appendix C).

Over the life of the hypothetical exploration, development, and production activities that could follow a lease sale, additional effects could result from unlikely events such as a large accidental oil spill or natural gas release. For the purposes of this SEIS, BOEM continues to rely on the E&D Scenario to frame the range and scale of oil and gas activities that could result from LS 258. The E&D Scenario is a hypothetical but realistic projection of activities and outcomes that may result from LS 258. It is described in Section 4.1 of the 2022 LS 258 FEIS (Appendix B) and remains unchanged for the purposes of this SEIS. Under this scenario, BOEM assumes that one large spill of crude, condensate, or refined oil could occur during development and production. This assumption is supported by historical data indicating that large spills (≥1,000 barrels) have occurred on the OCS during similar activities (ABS Consulting, 2016), as well as statistical estimates of the mean number of large spills (0.21) from platforms and pipelines. Although unlikely, BOEM also assumes a natural gas release could occur. Specifically, one loss of well control or pipeline rupture (offshore or onshore) is assumed over the 32-year gas production period, releasing 20–30 million cubic feet of natural gas over a single day. The impact conclusions associated with a large oil spill remain consistent with the 2022 FEIS, ranging from minor to major, while impacts from a large gas release are expected to range from negligible to moderate, with most resources experiencing minor impacts and moderate impacts anticipated for air quality.

Comparison of Impact Levels among Proposed Action and Action Alternatives for Environmental Resources

-	- - - -	Action Alternatives - - - -								
Environmental Resource	Proposed Action	3A	3B	3C	4A	4B	5	7	8	9
Air Quality	🟢	▨	▨	▨	▨	▨	▨	▨	▨	▨
Water Quality	🟢	▨	▨	▨	▨	▨	▨	▨	▨	▨
Coastal and Estuarine Habitats	🟢	▨	▨	▨	▨	▨	▨	▨	▨	▨
Fish and Invertebrates	🟢	↓	↓	↓	↓	↓	↓	↓	↓	↓
Birds	🟢 – 🔵	↓	↓	↓	↓	↓	↓	↑	↓	↓
Marine Mammals*	🟡 – 🟢	↓	↓	↓	↓	↓	↓	↓	↓	↓
Beluga Whales	🟡 – 🟢	↓	↓	↓	↓	▨	↓	🟡	🟡	🟡
Terrestrial Mammals	🟢	▨	▨	▨	▨	▨	▨	▨	▨	▨
Recreation, Tourism, and Sport Fishing	🟢	▨	▨	▨	▨	▨	▨	↓	↓	↓
Communities and Subsistence	🟢	▨	▨	↓	▨	▨	↓	↓	▨	↓
Economy	🟡 – 🔵	▨	▨	▨	▨	▨	▨	▨	▨	▨
Commercial Fishing	🟢 – 🔵	🟢	🟢	🟢	↓	▨	🟢	↓	↓	↓
Archaeological and Historic Resources	🟡 – 🟢	▨	▨	▨	▨	▨	▨	▨	▨	▨

Notes: Table summarizes the Impact Levels from each of the Action Alternatives (Proposed Action and Alternatives 3–9) for each environmental resource, as analyzed and concluded in Sections 4.3–4.15. The Key shows that the overall resource impact levels for the Proposed Action (including activities, small spills, and spill response preparedness activities (aka. spill drills) associated with the E&D Scenario) are represented with color symbology, and the overall resource Impact Levels for each Alternative are represented by color symbology, cross-hatching, or arrows as described.

Key

*	Includes Beluga Whales
●	Impact Level is Major
🔵	Impact Level is Moderate
🟢	Impact Level is Minor
🟡	Impact Level is Negligible
○ – ○	Impact Level is a Range
▨	Impact Level is **same as** that of the Proposed Action
↑	Impact Level is the same as that of the Proposed Action. However various effects are **somewhat greater**, but not being so great as to increase the overall Impact Level.
↓	Impact level is the same as that of the Proposed Action. However various effects are **somewhat less**, but not so much less as to decrease the overall Impact Level.

Cumulative Effects

In response to the ruling by the U.S. District Court for the District of Alaska, BOEM has updated the cumulative impact scenario originally presented in the 2022 LS 258 FEIS to reflect new activities and proposed projects in the Cook Inlet region. Additionally, as directed by the Court, this SEIS includes a separate, detailed Cumulative Effects Analysis for the Cook Inlet beluga whale to address its unique vulnerabilities. The cumulative impacts analysis evaluates the incremental effects of the Proposed Action when combined with the impacts of past, present, and reasonably foreseeable future actions, including oil and gas development, renewable energy activities, mining, commercial harvest, residential and community expansion, scientific research, military and homeland security operations, and climate change. The overall range of cumulative impact conclusions spans from negligible to moderate under typical scenarios, and from negligible to major in the event of a large spill.

Very Large Oil Spill: ≥120,000 bbl

Very large oil spills (VLOS) are very low probability, but high impact events and not part of the Proposed Action or any of the alternatives analyzed. The VLOS scenario was developed in the LS 244 Final Environmental Impact Statement (BOEM, 2016), which modeled a hypothetical release of 120,000 barrels (bbl) of oil over 80 days due to a loss of well control. This is an appropriate comparison because the lease sale areas are the same in LS 244 and LS 258. Information contained in Section 4.12 of the LS 244 FEIS concluded that the potential effects of a VLOS on environmental, social, and economic resources ranged from minor to moderate for a few resources to major for most resources. Similarly, should a VLOS occur as a result of LS 258, all resources analyzed could be affected and impacts could range from minor to moderate for a few resources to major for most resources.

Consultation and Coordination

BOEM has engaged in a number of consultation and coordination processes with federal agencies, Tribes, and Alaska Native Claims Settlement Act (ANCSA) Corporations regarding proposed activities under Lease Sale 258. Below is a brief summary of how BOEM has satisfied, or will satisfy, its consultation obligations under the applicable statutory requirements.

Tribal and ANCSA Corporation Consultations

During development of the 2022 LS 258 FEIS, BOEM initiated opportunities for Government-to-Government tribal consultations. These efforts included communications with Tribes, ANCSA Corporations, Tribal entities, and local governments in the Cook Inlet and Kodiak Island region that may be affected by lease sale activities. BOEM held a formal Government-to-Government consultation with the Kenaitze Indian Tribe, which expressed opposition to the Proposed Action through Resolution No. 2021-74, citing concerns over oil spills, climate change, and impacts on culturally significant resources. BOEM also received written input from the Seldovia Village Tribe regarding sensitive marine species and important subsistence and commercial fishing areas, despite the Tribe not requesting formal consultation. In addition, BOEM contacted all 9 federally recognized Tribes associated with Kodiak Island to assess interest in the lease sale; 6 of the Tribes requested to be kept informed of future activities. For the purposes of this SEIS, BOEM has contacted the Tribes, ANCSA Corporations, Tribal entities, and local governments in the Cook Inlet and Kodiak Island region to reinitiate new communication and remains committed to continued engagement with Tribes and ANCSA corporations as appropriate.

Section 7, Endangered Species Act Consultation

BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) completed Endangered Species Act (ESA) Section 7 consultations with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) for LS 258. Both agencies requested incremental step consultation to ensure that early lease activities—such as seismic surveying, ancillary activities, and exploration drilling—would not jeopardize listed species or adversely modify designated critical habitat. The USFWS and NMFS each issued a Biological Opinion in 2023 concluding that reasonably foreseeable LS 258 activities would not result in jeopardy or adverse modification. USFWS issued an Incidental Take Statement (ITS) for take of Steller's eiders and northern sea otters during exploration activities; NMFS did not issue an ITS at this stage due to the programmatic nature of the consultation. BOEM and BSEE will continue to closely evaluate and assess risks to listed species and designated critical habitat based on the most recent and best available information to ensure compliance of LS 258 with the ESA and will reinitiate consultation as necessary with NMFS and/or USFWS in the future.

Essential Fish Habitat Consultation

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) (as amended) requires federal agencies to consult with NMFS regarding actions that may adversely affect designated essential fish habitat (EFH). BOEM prepared an EFH assessment that identified adverse effects to designated EFH from potential oil and gas exploration activities in the LS 258 sale rea. This assessment was provided to NMFS on January 20, 2022. NMFS responded on February 24, 2022, concurring that the lease sale itself was unlikely to adversely affect EFH, but that future development may have variable effects. BOEM provided a formal response to NMFS on October 14, 2022. During the preparation of the SEIS, BOEM revisited the 2022 consultation documents and determined that no additional activities or geographic scope would be added to the scenario presented in the FEIS. Therefore, BOEM determined that the EFH consultation would not need to be reopened. On July 31, 2025, BOEM notified NMFS of the scope of this SEIS and of its assessment that reinitiation of EFH Consultation was not warranted. To date, NMFS has not responded with concurrence.

Section 106, National Historic Preservation Act Consultation

BOEM recognizes that lease sales constitute undertakings under Section 106 of the National Historic Preservation Act (NHPA) (54 U.S.C. § 306108) and its implementing regulations at 36 CFR Part 800. However, lease sales themselves are not the type of activity that have the potential to cause effects on historic properties. In a letter dated September 23, 2020, BOEM conveyed this determination to the Alaska State Historic Preservation Officer (SHPO), who agreed via email on November 16, 2021.

In alignment with that understanding, on June 30, 2025, BOEM provided the SHPO with an informational notice regarding the development of this SEIS. At this time, BOEM is not requesting formal Section 106 consultation, as no exploration, development, or production plans are under review or will be authorized immediately as part of LS 258. BOEM will continue to evaluate future site-specific activities submitted under any resulting lease in accordance with NHPA Section 106, including consultation with SHPO as appropriate.

Appendices

Appendix A – Oil Spill Risk Analysis (OSRA) Report

Appendix B – Exploration and Development (E&D) Scenario

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List of Acronyms and Abbreviations

μg/m^3	micrograms per cubic meter
μPa	microPascal
3D	three dimensional
AAQS	Ambient Air Quality Standards
AAC	Alaska Administrative Code
ac	acres
ADF&G	Alaska Department of Fish and Game
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
AERMOD	American Meteorological Society/EPA Regulatory Model
ADOG	Alaska Division of Oil and Gas
AIS	Automatic Identification System
ANCSA	Alaska Native Claims Settlement Act
APA	Administrative Procedure Act
AQCR	Air Quality Control Region
Area ID	Area Identification
ASAP	Alaska Stand-Alone Natural Gas Pipeline
AUD INJ	auditory injury
bbl	barrel(s)
Bcf	billion cubic feet
BLM	Bureau of Land Management
BO	Biological Opinion
BOEM	Bureau of Ocean Energy Management
BP	before present
bpd	barrels per day
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH$_4$	methane
CINGSA	Cook Inlet Gas Storage Alaska
CIRI	Cook Inlet Region, Inc.
cm	centimeter
CMP	Conflict Management Plan
CO	carbon monoxide
CO$_2$	carbon dioxide
Court	U.S. District Court, District of Alaska
CWA	Clean Water Act
cy	cubic yards

dB	Decibel
DPP	Development and Production Plan
DPS	distinct population segment
E&D	Exploration and Development
EFH	essential fish habitat
EIS	environmental impact statement
EO	Executive Order
EMF	Electromagnetic Field
EP	Exploration Plan
EPA	U.S. Environmental Protection Agency
ERA	environmental resource area
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
ft	foot/feet
FR	Federal Register
G&G	geological and geophysical
GHG	greenhouse gas(es)
GIUE	Government Initiated Unannounced Exercise
GLS	grouped land segment
GOA	Gulf of Alaska
ha	hectares
HAB	Harmful Algal Bloom
HAPC	Habitat Areas of Particular Concern
Hg	mercury
HighGold	HighGold Mining, Inc.
Hilcorp	Hilcorp Alaska, LLC
HOP	hydrocarbon oxidation product(s)
HPAI	Highly Pathogenic Avian Influenza
Hz	hertz
IBA	Important Bird and Biodiversity Area
in	inch
IRA	Inflation Reduction Act or Indian Reorganization Act
ITL	Information to Lessees and Operators
ITS	Incidental Take Statement
IWG	Interagency Working Group on the Social Cost of Greenhouse Gases
JBER	Joint Base Elmendorf-Richardson
JT Deposit	Johnson Tract ore deposit
kHz	kilohertz
km	kilometers
KPB	Kenai Peninsula Borough
L_E	cumulative sound pressure level

L_{pk}	peak sound pressure level
L_{pk-pk}	peak-to-peak sound pressure level
L_{rms}	sound pressure level
LNG	liquefied natural gas
LS	lease sale or land segment
LS 244	Lease Sale 244
LS 258	Lease Sale 258
m	meters
m^3	cubic meters
Mbbl	thousand barrels
MHW	marine heat wave
mi	miles
mi^2	square miles
MMbbl	million barrels
MMcf	million cubic feet
MODU	mobile offshore drilling unit
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MT	magnetotellurics
MW	megawatts
N/A	not applicable
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
nmi	nautical mile
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPP	National Park and Preserve
NTL	Notice to Lessees and Operators
NWR	National Wildlife Refuge
O^3	ozone
OBBBA	One Big Beautiful Bill Act
OCD5	Offshore and Coastal Dispersion Model 5
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act of 1953
O&G	oil and gas
ORPC	Ocean Renewable Power Company, Inc.
OSRA	oil spill risk analysis
oxyPAHs	oxygenated polycyclic aromatic hydrocarbons

PAH	polycyclic aromatic hydrocarbons
PAM	Passive Acoustic Monitoring
Pb	lead
PCB	polychlorinated biphenyls
P&D	power and data
PFAS	polyfluoroalkyl substances
PLP	Pebble Limited Partnership
PM$_{2.5}$	particulate matter equal to or less than 2.5 micrometers
PM$_{10}$	particulate matter equal to or less than 10 micrometers
PMH	Pacific Marine Heatwave
POPs	persistent organic pollutants
PPRFFA	past, present, and reasonably foreseeable future actions
PSD	Prevention of Significant Deterioration
PSO	protected species observer(s)
PTS	permanent threshold shift
rms	root mean square
ROD	Record of Decision
RSLP	Regional Supervisor, Leasing and Plans
RTSF	Recreation, Tourism, and Sport Fishing
Sale CI	Cook Inlet Planning Area Lease Sale in October 1977
SEIS	Supplemental Environmental Impact Statement
SEL	sound exposure level
SEL$_{24}$	sound exposure level over a 24-hour period
SEL$_{ss}$	single strike sound exposure level
SHPO	State Historic Preservation Office
SIP	State Implementation Plans
SO	Secretarial Order
SO$_2$	sulfur dioxide
SOA	State of Alaska
SPL	sound pressure level(s)
SSV	sound source verification
SW	southwest
TSS	total suspended solids
TTS	temporary threshold shift
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDOI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
UV	ultraviolet
VLOS	very large oil spill

Chapter 1 PURPOSE AND NEED

1.1 Introduction

The Bureau of Ocean Energy Management (BOEM) has prepared this Supplemental Environmental Impact Statement (EIS) to reanalyze a proposed Federal action, the Cook Inlet Outer Continental Shelf (OCS) Oil and Gas Lease Sale (LS) 258 previously analyzed in the Cook Inlet Planning Area: Final Environmental Impact Statement (2022 LS 258 FEIS). The entire planning area encompasses approximately 2.1 million hectares (ha) (~5.3 million acres (ac)) (Figure 1-1). The LS 258 area includes 224 OCS blocks that encompass approximately 442,537 ha (hectares) (1.09 million ac).

In 2017, the Secretary of the Interior issued the 2017–2022 National OCS Oil and Gas Leasing Proposed Final Program (Proposed Final Program). The Proposed Final Program included one sale in the Cook Inlet Program Area. During the development of the Proposed Final Program, BOEM conducted region-specific reviews by Program Areas (i.e., the portions of the OCS planning areas that remained in consideration for leasing during the Proposed Final Program development process); consequently, BOEM prepared the OCS Oil and Gas Leasing Program: 2017–2022 Final Programmatic Environmental Impact Statement (BOEM, 2016) to support individual lease sale decisions.

In September 2020, BOEM initiated the preparation of an EIS for LS 258. BOEM published a Draft EIS for LS 258 in October 2021. On May 11, 2022, the Secretary of the Interior cancelled the lease sale due to a lack of industry interest in leasing in the area. On August 16, 2022, the Inflation Reduction Act of 2022 (IRA) (Pub. L. No. 117-169) was enacted directing BOEM to hold the LS 258 by December 31, 2022. The 2022 LS 258 FEIS was completed on October 28, 2022, and the Principal Deputy Assistant Secretary, Lands and Mineral Management signed the Record of Decision (ROD) on November 26, 2022. On December 30, 2022, BOEM held LS 258; one block received a bid and was leased to Hilcorp Alaska, LLC (Hilcorp) (chronology available at the BOEM website at https://www.boem.gov/ak258/).

On December 21, 2022, five non-governmental organizations—Cook Inletkeeper, Alaska Community Action on Toxics, Center for Biological Diversity, Kachemak Bay Conservation Society, and Natural Resources Defense Council, Inc.—filed a lawsuit in the U.S. District Court, District of Alaska, 9th Circuit (Court), under the Administrative Procedure Act (APA). The plaintiffs contended that BOEM's environmental review of LS 258 and the subsequent ROD violated the National Environmental Policy Act (NEPA).

On July 16, 2024, the Court ruled partially in favor of the plaintiffs (Inletkeeper v. United States DOI, 740 F.Supp. 3d 767 (D. Alaska 2024)), finding that BOEM violated NEPA in certain respects in its 2022 LS 258 FEIS. The decision identified the following three deficiencies:

1. BOEM did not adequately consider a reasonable range of alternatives that would offer for lease a reduced number of blocks that would meaningfully reduce overall impacts.
2. BOEM failed to take the requisite hard look at the impact of vessel noise on Cook Inlet beluga whales.
3. Because Cook Inlet beluga whales have been impacted differently than other marine mammals in Cook Inlet by past actions, BOEM should have considered the cumulative impacts on Cook Inlet beluga whales separately from other marine mammals.

As such, the Court remanded, without vacatur, the 2022 LS 258 FEIS and the LS 258 ROD for BOEM to Supplement the EIS to address the deficiencies, and modify the ROD as warranted. The Court also suspended Hilcorp's lease while the SEIS was being developed. In addition, the Federal Defendants were directed to file a status report with the Court every 6 months until the SEIS is complete.

This SEIS reassesses LS 258 in the Cook Inlet Planning Area in light of the Court's decision. While LS 258 took place in December 2022 and resulted in one lease being issued for a single block, neither the development of additional alternatives nor the environmental analyses in this SEIS considered the outcome of LS 258, including the existence or location of that lease block. This approach allows BOEM to consider the impacts comprehensively despite having knowledge of the results of the lease sale. Therefore, this SEIS is prepared to update and review the environmental analysis of the 2022 LS 258 FEIS; and remedy the deficiencies identified by the Court. The analysis is built around a detailed hypothetical Exploration and Development (E&D) Scenario (Appendix B), which serves as the framework for evaluating potential impacts. This SEIS incorporates by reference all of the relevant material in the 2022 LS 258 FEIS.

A notice of intent (NOI) to prepare this SEIS was published in the Federal Register (FR) on April 4, 2025. In the NOI, BOEM stated that consistent with Department of Interior's (DOI) regulations implementing NEPA (43 Code of Federal Regulations (CFR) Part 46), scoping is not required but discretionary for a SEIS. The scope of the FEIS for Lease Sale 258 and the remand by the Court establish the scope for this SEIS.

Following the publication of the NOI, the Council on Environmental Quality rescinded its NEPA implementing regulations effective April 11, 2025, 90 FR 10610 (Feb. 25, 2025), and on July 3, 2025, the DOI NEPA implementing regulations and procedures handbook were updated, effective immediately, 90 FR 29498 (July 3, 2025). The DOI Handbook of NEPA Implementing Procedures are available at https://www.doi.gov/oepc/national-environmental-policy-act-nepa. A second (amended) NOI was published in the FR on September XX, 2025, to inform the public that BOEM will comply with these revised DOI NEPA regulations, procedures, and handbook in preparing this SEIS. As such, a notice of availability for the draft SEIS was not issued for public comment, nor were public hearings held.

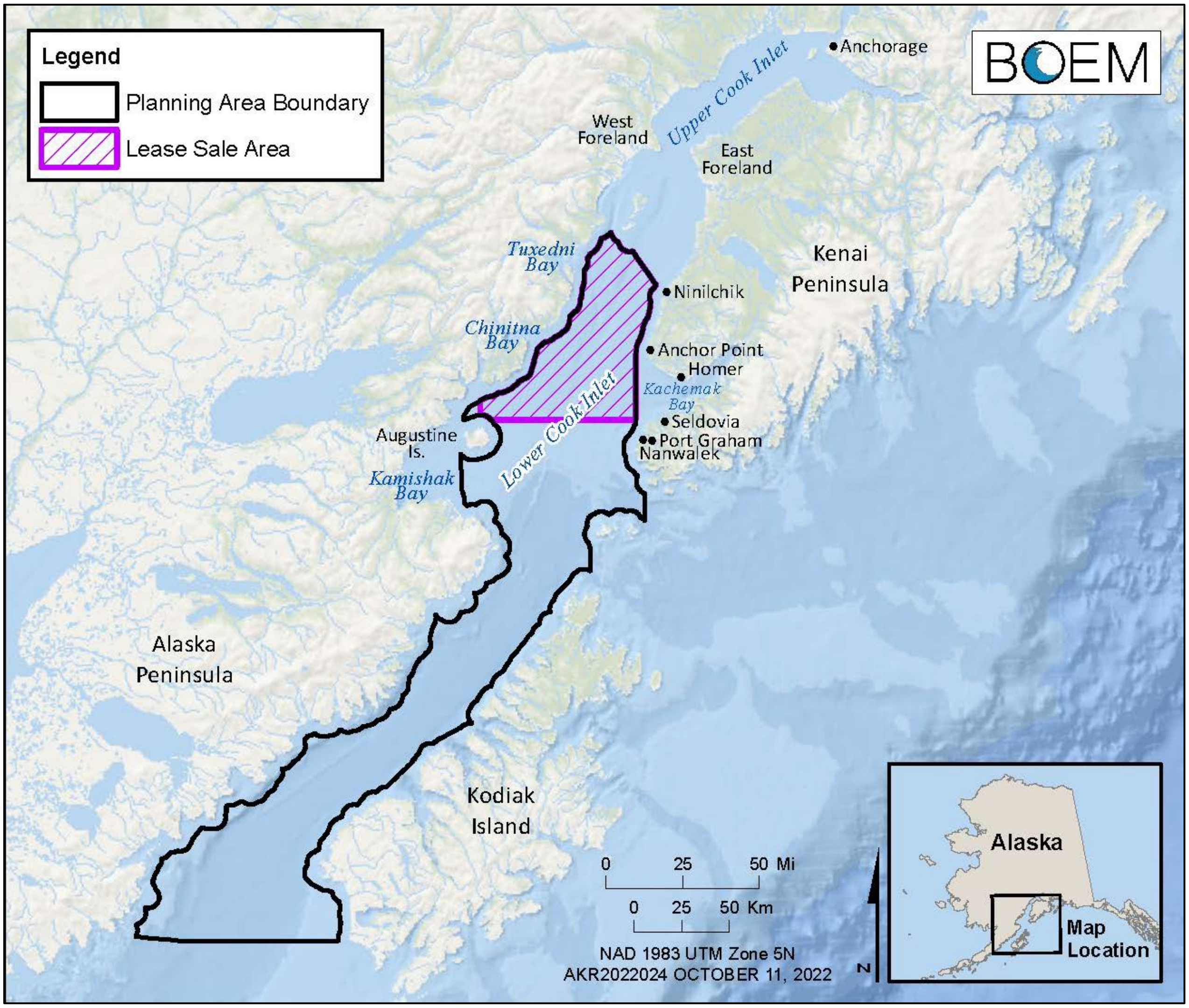

Figure 1-1: Cook Inlet Planning Area, Southcentral Alaska

1.2 Purpose and Need for the Proposed Action

The Purpose and Need for the Proposed Action has not changed from that described in the 2022 LS 258 FEIS. The purpose of the Proposed Action addressed in this SEIS is to offer for lease certain OCS blocks located within the federally owned portion of Cook Inlet that may contain economically recoverable oil and gas resources.

The need for the Proposed Action is to meet the purposes of the Outer Continental Shelf Lands Act of 1953 (OCSLA), as amended (43 United States Code (USC) 1331 et seq.). The OCS lease sale in Cook Inlet may lead to oil and gas exploration, development, and production. Oil and gas from the Cook Inlet Planning Area could help meet regional and national energy needs and lessen the need for imports.

BOEM prepared this SEIS to address the deficiencies identified in the Final EIS for LS 258 by the U.S. District Court for the District of Alaska. Since BOEM began preparing this SEIS, the One Big Beautiful Bill Act (OBBBA, Pub. L. No. 119-21) became law and requires BOEM to hold 6 lease sales in Cook Inlet through 2032, and specifies the minimum acreage, lease terms, conditions, and stipulations for those sales. This SEIS may be relied on, as appropriate, for actions related to LS 258 or the OBBBA mandated sales, including but not limited to incorporation by reference or for tiering in NEPA analyses conducted for post-lease approvals (e.g., plans and permits) in Cook Inlet.

Chapter 2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This Chapter briefly summarizes the Proposed Action, and the alternatives analyzed in the 2022 LS 258 FEIS. It also introduces three additional alternatives for analysis addressing Deficiency 1 (Chapter 1.1) identified by the Court in its 2024 Decision and Order (Inletkeeper v. United States DOI, 740 F.Supp. 3d 767 (D. Alaska 2024)). A comparison of potential impacts of all alternatives derived from both the 2022 LS 258 FEIS and this SEIS is provided at the end of this Chapter.

The U.S. DOI's 2012–2017 OCS Oil and Gas Leasing Program introduced a targeted leasing model to the Alaska OCS lease sale process and continued the model in the 2017–2022 National Program. Targeted leasing identifies areas considered for leasing that have high resource potential and clear indications of industry interest, while appropriately weighing environmental protection and subsistence use needs. The goal of targeted leasing is to focus oil and gas leasing on the most promising OCS blocks, while protecting important habitats and critical subsistence activities. The result is an area that is more geographically limited in scope and that eliminates many areas of environmental concern. BOEM used this information to develop the Area Identification (Area ID) for this lease sale. The Area ID was published in the FR on January 15, 2021 (85 FR 4116). The Area ID is the lease sale area analyzed in the 2022 LS 258 FEIS and this SEIS (Figure 1-1).

As a result of targeted leasing, the lease sale area:

- focuses on areas closer to existing infrastructure needed to support oil and gas activities;
- focuses on areas closer to active OCS and State of Alaska (SOA) oil and gas leases;
- avoids the majority of the Endangered Species Act (ESA)-designated critical habitat for the beluga whale and northern sea otter;
- completely avoids critical habitat for the Steller sea lion;
- reduces effects to national parks, preserves, and wildlife refuges by placing the area considered for leasing away from the Katmai National Park and Preserve (NPP), Kodiak National Wildlife Refuge (NWR), and Alaska Maritime NWR; and
- excludes much of the subsistence use area for the Alaska Native villages of Nanwalek and Port Graham that were first identified during the Lease Sale 191 (held in 2004) (MMS, 2003) environmental (or NEPA) review process.

Because many of the areas of environmental concern have already been removed or addressed through targeted leasing, BOEM developed alternatives for the 2022 LS 258 EIS and this SEIS that are targeted at specific resources in Cook Inlet. Consequently, the alternatives analysis provides important distinctions between the alternatives. The SEIS is not a decision document; it provides the decision-maker with additional analysis to determine whether to affirm the preferred alternative from the LS 258 FEIS or to select a different alternative for the lease sale's terms and conditions.

The alternatives subject to detailed analysis are described below and analyzed separately in Chapter 4. The decision maker may choose any of the alternatives, combine alternatives, or select unique aspects of any alternative, in making the final decision.

Alternatives subject to detailed analysis are described below. Although the alternatives are analyzed separately in this SEIS, the decision could incorporate elements of multiple alternatives.

2.1 Proposed Action

The Proposed Action would offer for lease all available OCS blocks in the northern portion of the Cook Inlet Planning Area (Figure 2-1). The lease sale area covers approximately 442,537 ha (1.09 million ac), representing approximately 20 percent of the total Cook Inlet Planning Area, 224 OCS blocks (85 FR 55861, September 10, 2020).

Figure 2-1: Cook Inlet Lease Sale 258 Area

2.2 Alternative 2 – No Action

Alternative 2 is the "No Action" alternative and is equivalent to cancellation of the Proposed Action (Figure 2-1). Under this alternative, LS 258 would not have occurred. The opportunity for development of potential oil and gas resources under the Proposed Action, along with its environmental impacts and benefits, would have been precluded or postponed to a future lease sale decision under a new National Program.

2.3 Alternatives 3A, 3B, and 3C – Beluga Whale Critical Habitat Exclusion, Critical Habitat Mitigation, and Northern Feeding Areas Mitigation

Alternatives 3A, 3B, and 3C were developed to address potential impacts to the Cook Inlet Distinct Population Segment (DPS) of the beluga whale (herein "belugas" or "beluga whales" unless another population is specifically mentioned). Public input during scoping for both LS 258 and the previously held Lease Sale 244 (LS 244) (BOEM, 2016) indicated concern for the beluga whale. The following alternatives were identified for detailed evaluation:

Alternative 3A – Beluga Whale Critical Habitat Exclusion. Under this alternative, the 10 OCS blocks that overlap with beluga whale critical habitat at the northern tip of the lease sale area would be excluded from the lease sale (Figure 2-2). Beluga whale critical habitat within the excluded OCS blocks represents approximately 0.85 percent of the total area of the beluga whale critical habitat.

Alternative 3B – Beluga Whale Critical Habitat Mitigation. Under this alternative, all available blocks in the lease sale area would be offered for lease. The 10 OCS blocks that overlap beluga whale critical habitat at the northern tip of the lease sale area would be included in the lease sale; however, no on-lease seismic surveys or exploration drilling would be conducted between November 1 and April 30, when beluga whales are most likely to be present.

Alternative 3C – Beluga Whale Nearshore Feeding Areas Mitigation. Under this alternative, all available blocks would be offered for lease with seasonal mitigation to protect beluga whales. Certain seasonal mitigations would be applied to all OCS blocks between November 1 and April 1. Additional seasonal mitigation would be applied to the 146 OCS blocks located wholly or partially within 10 miles (mi) of major anadromous streams. The following mitigations would be applied:

- On all blocks offered for lease, no on-lease seismic surveys would be conducted between November 1 and April 1, when beluga whales are most likely to be present and distributed across the lease sale area; and,
- On blocks within 10 mi of major anadromous streams, no on-lease seismic surveys would be conducted between July 1 and September 30 (when beluga whales are migrating to and from their summer feeding areas) (Figure 2-2).

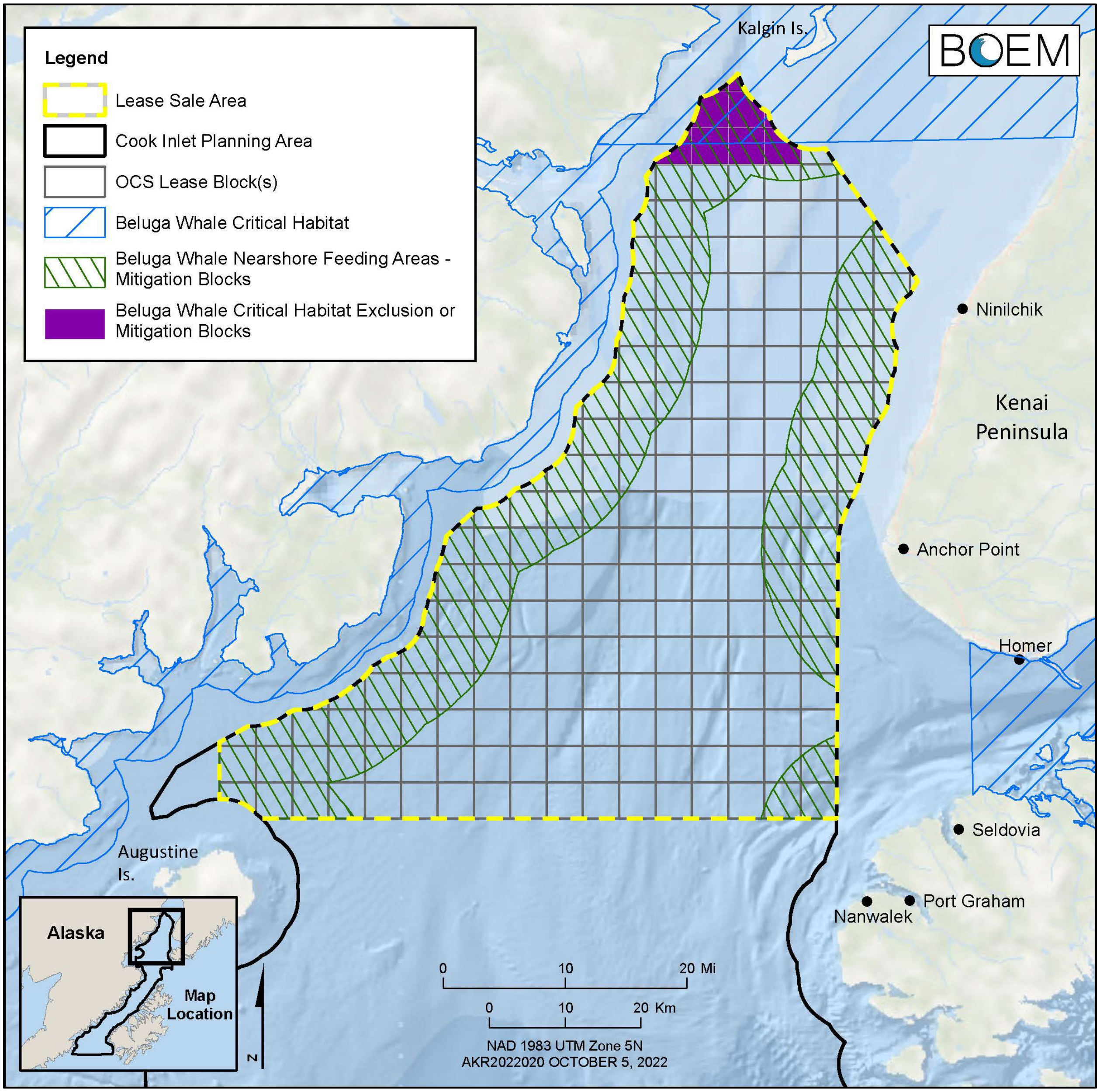

Figure 2-2: Beluga Whale Alternatives 3A, 3B, and 3C

2.4 Alternatives 4A and 4B – Northern Sea Otter SW Alaska DPS Critical Habitat Exclusion or Mitigation

Scoping for LS 258 and Lease Sale 244 indicated a concern for the northern sea otter. Alternatives 4A and 4B were developed to address potential impacts to the southwest (SW) Alaska DPS (also referred to as SW DPS) of the northern sea otter. The following alternatives were identified for detailed evaluations:

Alternative 4A – Northern Sea Otter Critical Habitat Exclusion. Under this alternative, the 7 OCS blocks that overlap with northern sea otter SW Alaska DPS critical habitat would be excluded from the lease sale (Figure 2-3).

Alternative 4B – Northern Sea Otter Critical Habitat Mitigation. Under this alternative, all available OCS blocks would be offered for lease with additional mitigation on the 14 OCS blocks that contain or are located within 1,000 meters (m) of northern sea otter critical habitat. On these 14 OCS blocks, the discharge of drilling fluids and cuttings and seafloor-disturbing activities (including anchoring and placement of bottom-founded structures) would be prohibited.

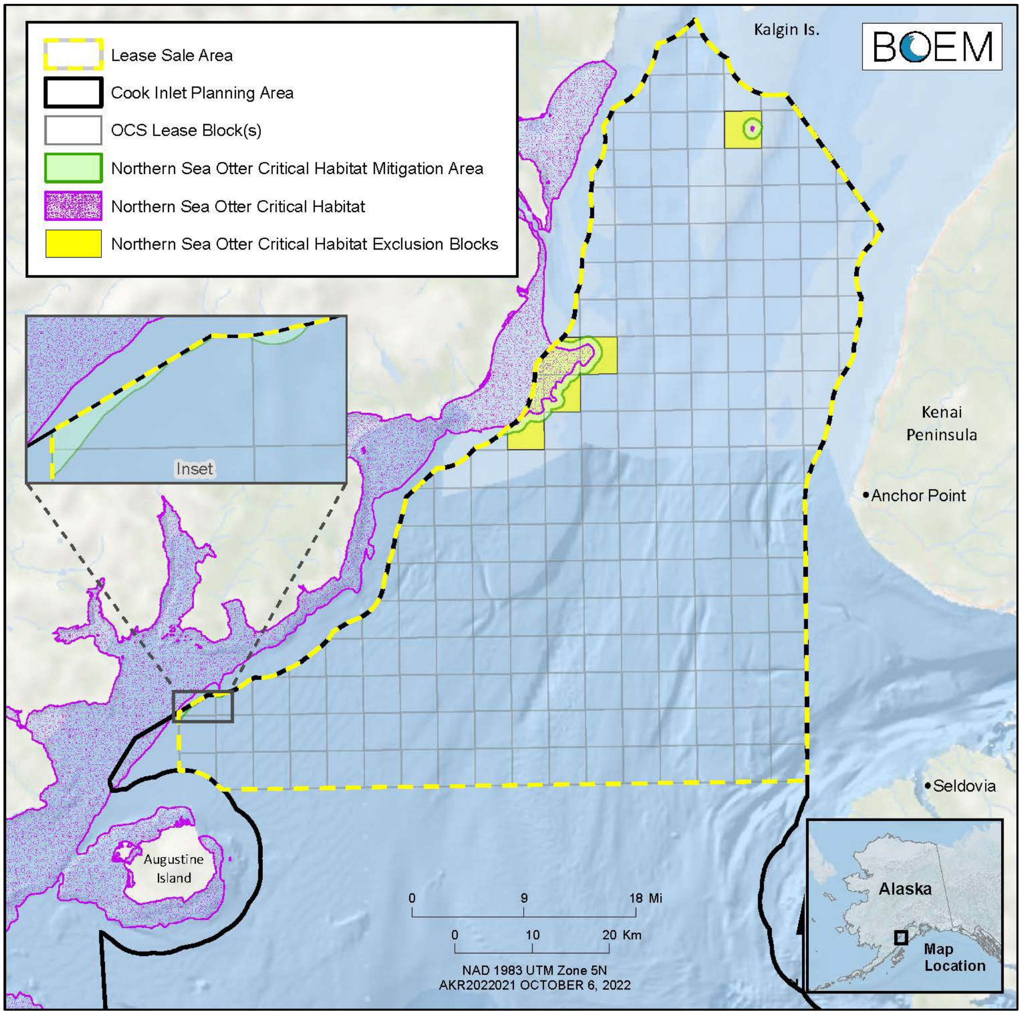

Figure 2-3: Northern Sea Otter Alternatives 4A and 4B

2.5 Alternative 5 – Gillnet Fishery Mitigation

Under Alternative 5, all available OCS blocks in the lease sale area would be offered for lease, but additional mitigation measures would be required in all OCS blocks north of Anchor Point to reduce the potential for conflicts with the Cook Inlet drift gillnet fishery. This alternative would affect 117 whole or partial OCS blocks with an area of 203,779 ha (503,550 ac) or 46.0 percent of the lease sale area (Figure 2-4). The following mitigation measures would be applied to the 117 whole or partial OCS blocks:

- No on-lease seismic surveys would be conducted during the drift gillnetting season as designated by the Alaska Department of Fish and Game (ADF&G) (approximately mid-June to mid-August).
- United Cook Inlet Drift Association must be notified of any temporary or permanent structures planned during the drift gillnetting season.

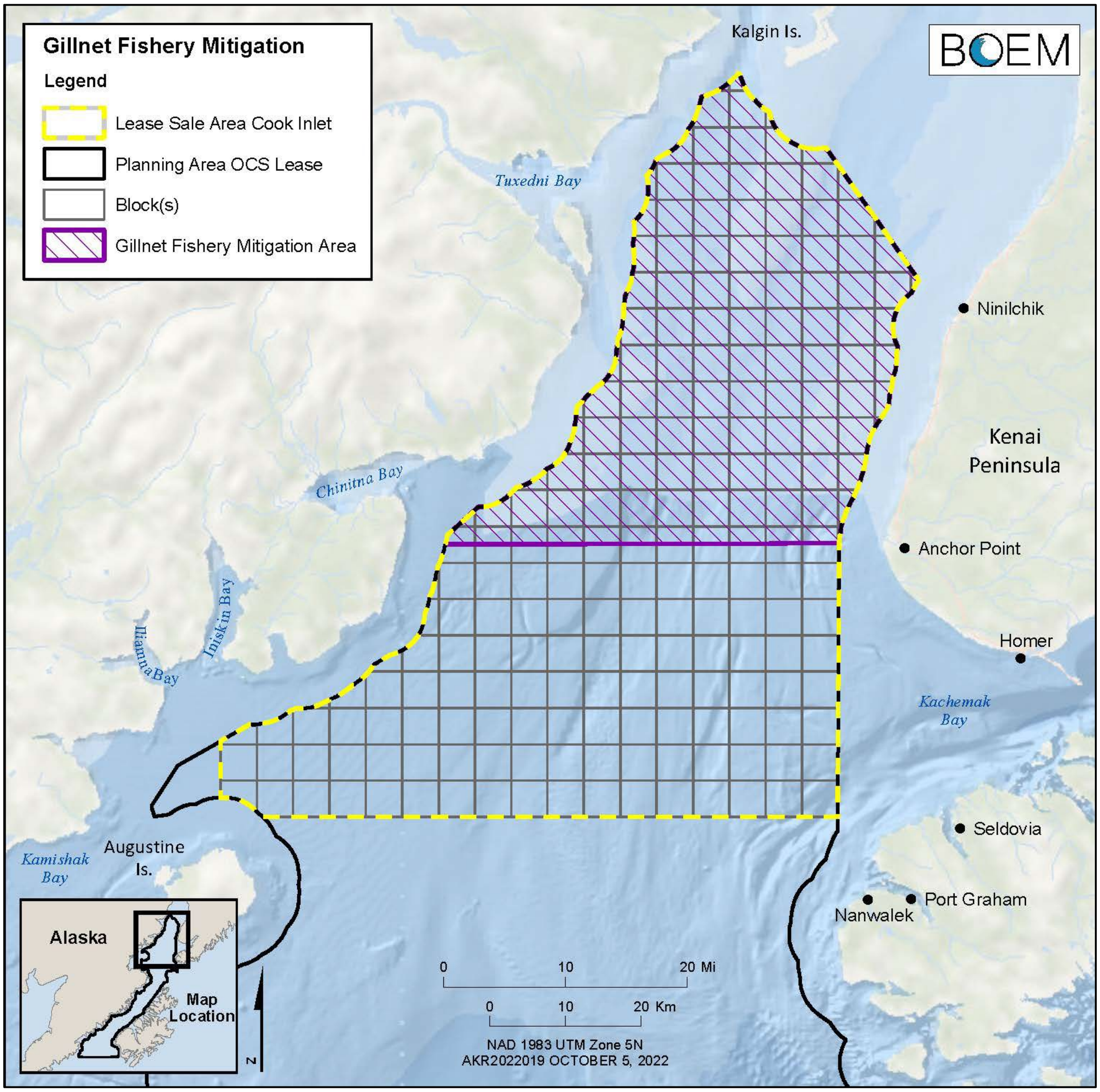

Figure 2-4: Alternative 5 – Gillnet Fishery Mitigation

2.6 Alternative 6 – Preferred Alternative

Alternative 6 was designated as the preferred alternative in the 2022 LS 258 FEIS.

After considering public comments on the Draft EIS for LS 258, BOEM developed the Preferred Alternative in the FEIS, which combines the two critical habitat exclusion alternatives with three mitigation alternatives: Alternative 3A (Beluga Whale Critical Habitat Exclusion), Alternative 3C (Beluga Whale Nearshore Feeding Areas Mitigation), Alternative 4A (Northern Sea Otter Critical Habitat Exclusion), Alternative 4B (Northern Sea Otter Critical Habitat Mitigation), and Alternative 5 (Gillnet Fishery Mitigation) (Figure 2-5). In this SEIS, Alternative 6 is being retained, but it is not being separately analyzed. The analyses included herein for Alternatives 3A, 3C, 4A, 4B, and 5 remain applicable to the Preferred Alternative identified in the FEIS. To avoid unnecessary duplication, BOEM is not repeating them verbatim, but directs the decisionmaker and reader to those analyses to be considered together as the impacts and benefits of Alternative 6.

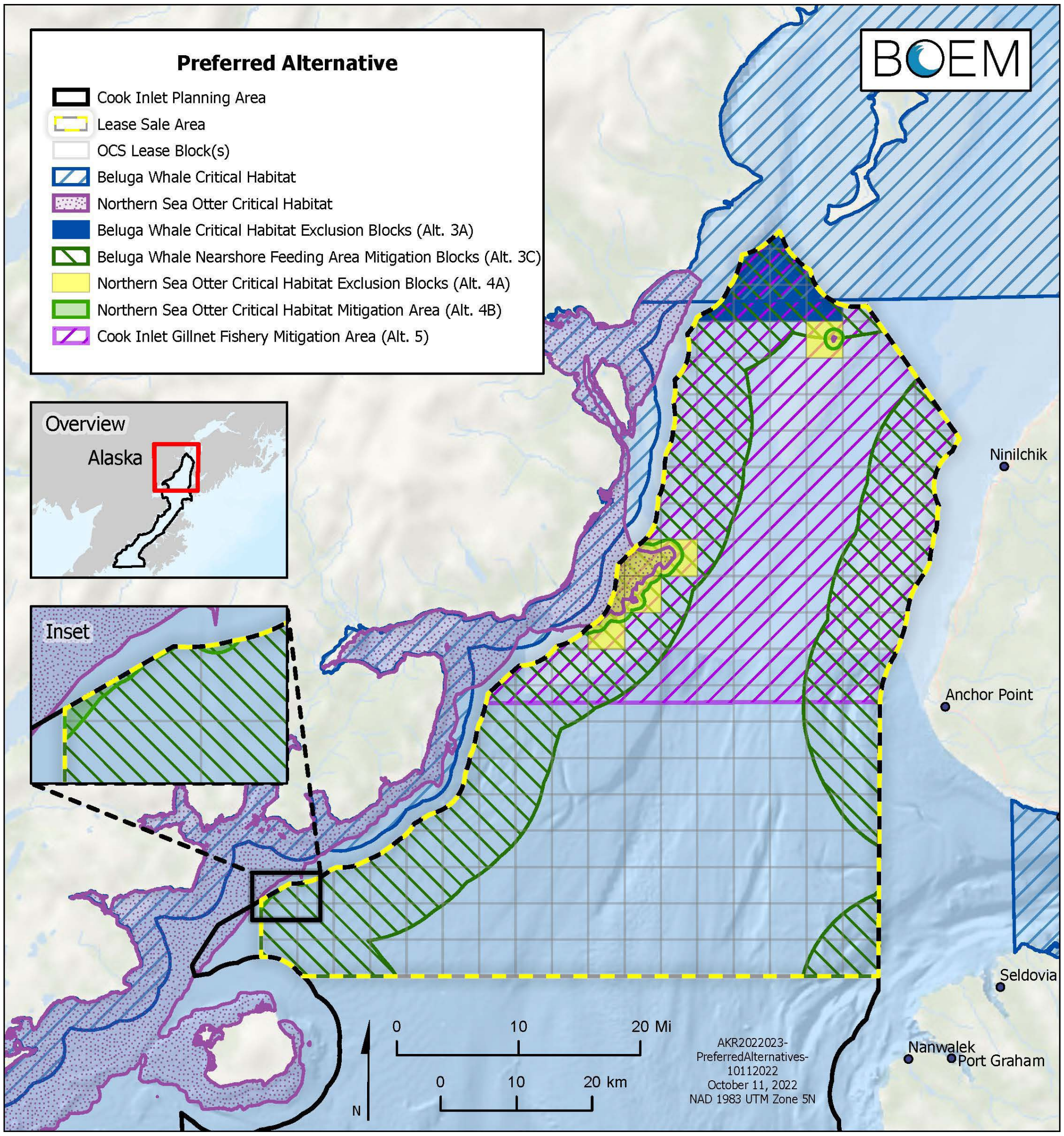

Figure 2-5: Alternative 6 – Preferred Alternative

The following Alternatives (7–9) were developed to address deficiencies identified by the court.

2.7 Alternative 7 – Northern Area Exclusion[1]

Under Alternative 7 all blocks in the lease sale area south of an east/west line crossing Cook Inlet from Anchor Point to the west side of Cook Inlet south of Chinitna Bay would be offered for lease. The 117 OCS blocks at the northern end of the lease sale area would be excluded from the lease sale (Figure 2-6). The excluded OCS blocks represent 49.0 percent of the total lease sale area.

This Northern Area Exclusion alternative would provide a high level of spatial separation between belugas and most activities resulting from oil and gas development. Most of the core habitat for belugas occurs in upper Cook Inlet north of the East and West Forelands. The designated critical habitat of the beluga primarily occurs north of Clam Gulch. The Kenai and Kasilof river mouths and Tuxedni Bay are used seasonally for feeding. These areas are all 20 miles or more north of an east-west line crossing Cook Inlet at Anchor Point.

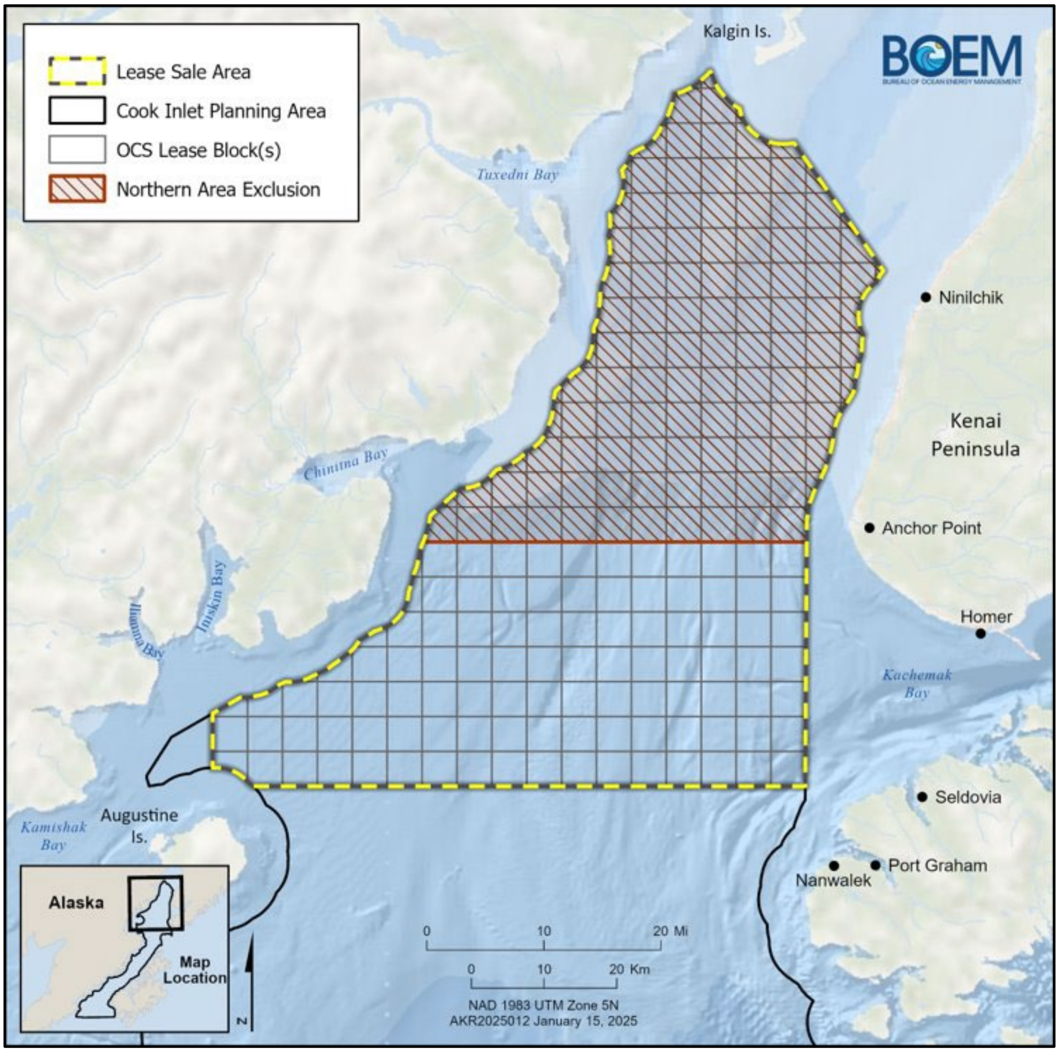

Figure 2-6: Alternative 7 – Northern Area Exclusion

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[1] Alternative 7 overlaps and excludes the one block leased from LS 258.

2.8 Alternative 8 – The Tuxedni Bay/Chinitna Bay Buffer Exclusion[2]

Under this alternative, lease sale blocks that overlap a 10-mile buffer from the mouths of Tuxedni Bay or Chinitna Bay would be excluded from leasing. These bays are adjacent to each other along the western coast of Cook Inlet. This alternative includes all or part of 56 OCS blocks in two areas along the western boundary of the lease sale area (Figure 2-7). This exclusion would reduce the lease sale area by 22.5 percent.

The Tuxedni Bay/Chinita Bay Buffer Exclusion alternative provides a large spatial buffer between oil and gas activities and the Tuxedni Bay and Chinitna Bay areas. Tuxedni Bay is the southernmost area known to be occupied seasonally and used for foraging by a sizeable number of belugas. Chinitna Bay is suspected of being occupied seasonally.

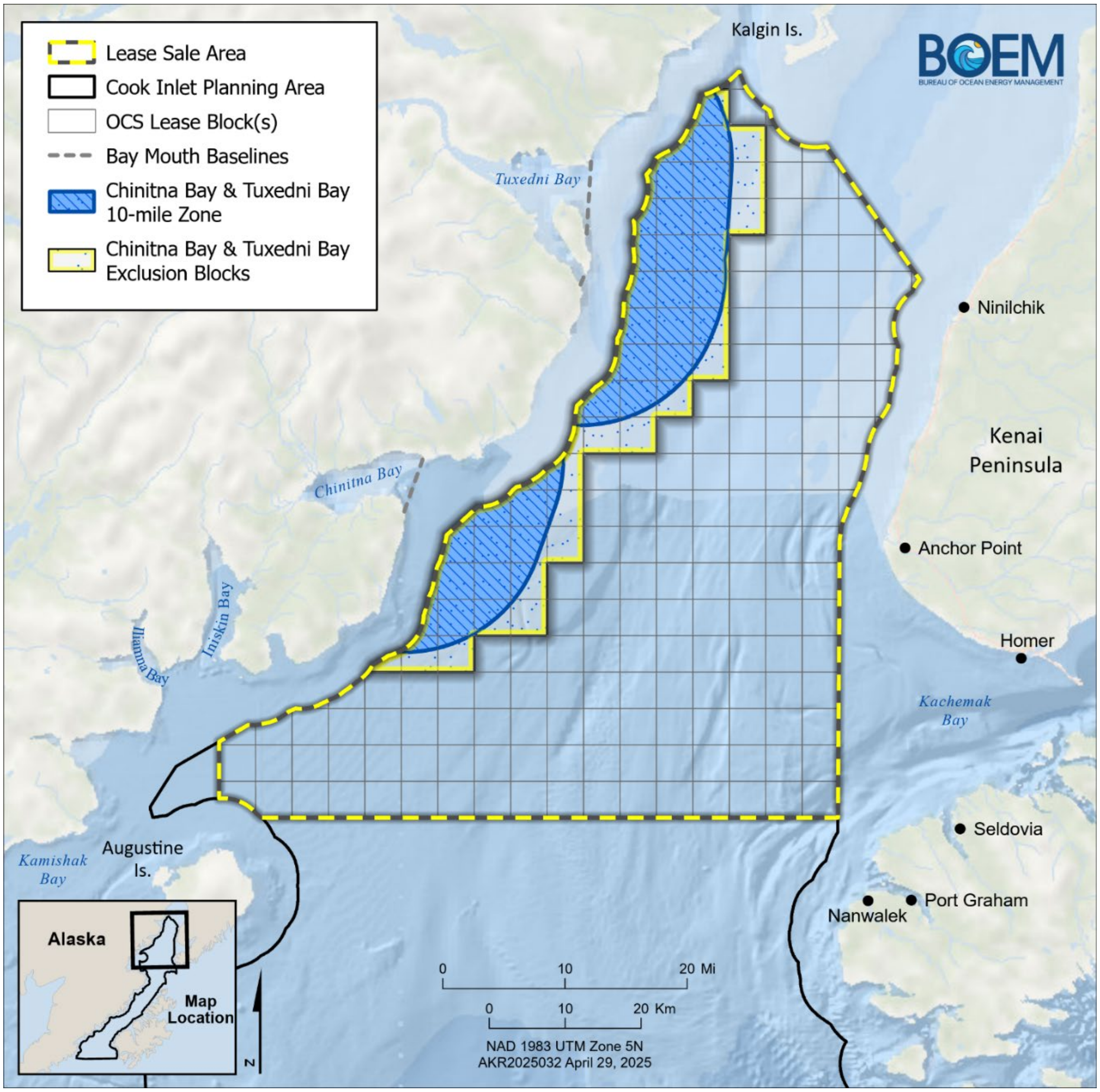

Figure 2-7: Alternative 8 – Tuxedni Bay/Chinitna Bay Buffer Exclusion

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[2] Alternative 8 overlaps and excludes the one block leased from LS 258.

2.9 Alternative 9 – Northern Feeding Areas 5-Mile Exclusion

This alternative excludes lease blocks that overlap a 5-mile buffer zone along the coast north of an east/west line crossing Cook Inlet from Anchor Point to the west side of Cook Inlet south of Chinitna Bay. This exclusion protects major anadromous streams that provide feeding areas for Cook Inlet beluga whales as well as travel corridors between feeding areas (Figure 2-8). The Northern Feeding Areas 5-Mile Exclusion would exclude 62 whole or partial blocks or 20.9 percent of the lease sale area.

The Northern Feeding Area 5-mile Exclusion alternative was created to provide protection for beluga whale feeding areas around anadromous streams. The buffer zone was extended 5 miles from coastal areas near these streams to create and protect a generally continuous corridor along the coast where belugas might be foraging or travelling between feeding sites.

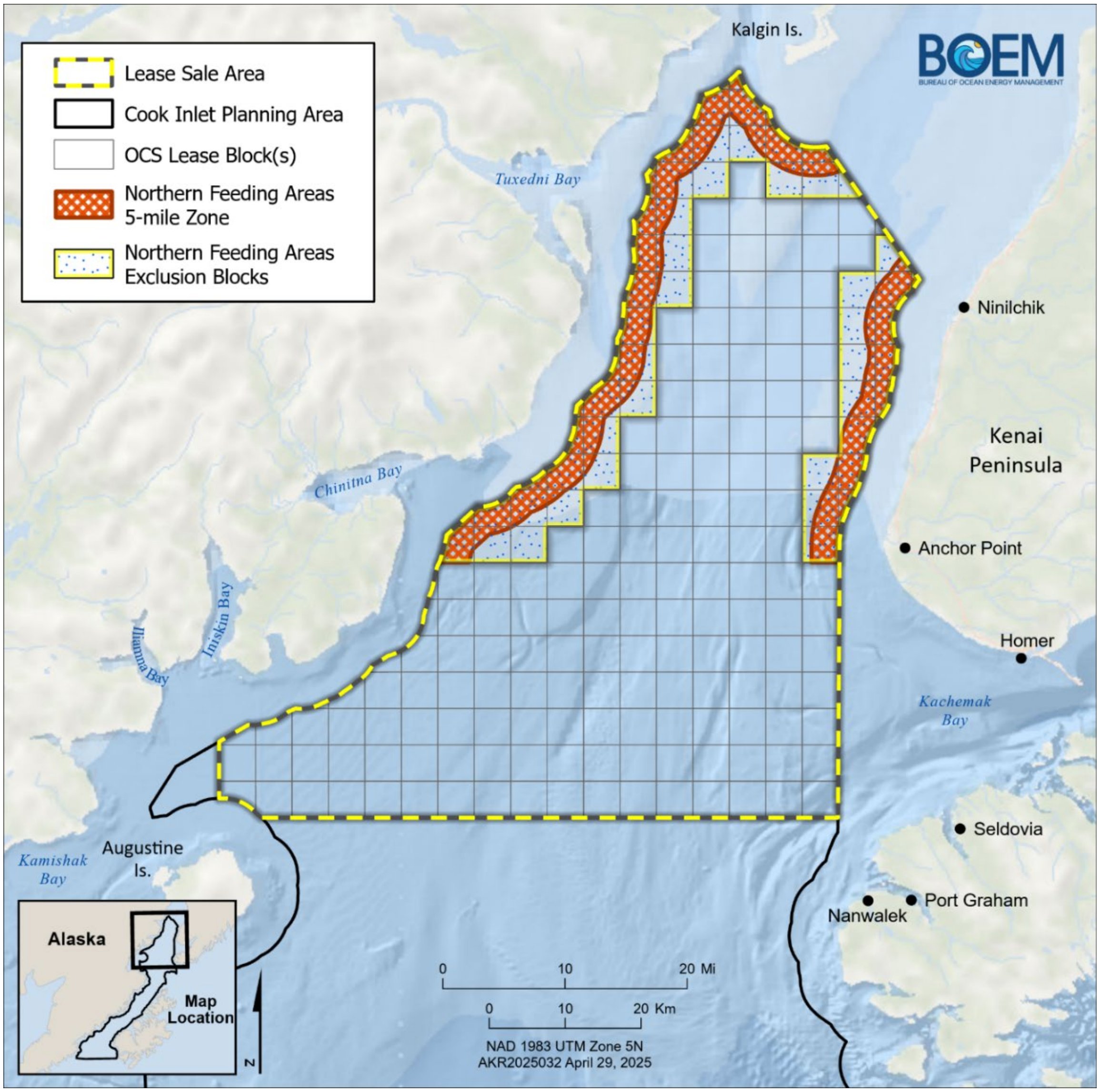

Figure 2-8: Alternative 9 – Northern Feeding Areas 5-Mile Exclusion

2.10 Alternatives Considered but Dismissed from Detailed Analysis

BOEM considered six alternatives in the LS 258 FEIS that were eliminated from detailed analysis and are described in Section 2.7 in the FEIS. One of the eliminated alternatives, the Northern Area Exclusion (Section 2.7.5, 2022 LS 258 FEIS), is being considered in this SEIS in light of the Court's decision on the 2022 LS 258 FEIS (see Section 1.1). The following additional alternatives were considered by BOEM but were eliminated from detailed analysis in the SEIS.

2.10.1 Expanded/Condensed Northern Area Exclusion

BOEM considered whether a larger exclusion area should be created by moving the boundary of the Northern Area Exclusion farther south. Beluga sightings south of Anchor Point continue to be rare. This alternative was dismissed because expanding the exclusion area further south than Anchor Point would have excluded areas from the lease sale that are not frequently used by belugas and therefore would not be expected to provide them with additional protection.

BOEM considered if the Northern Area Exclusion could be reduced by moving its boundary farther north while still protecting belugas. However, this alternative was dismissed due to the presence of beluga whales in the Chinitna River. Seymour and Gill (2024) noted that volunteer observers and anecdotal sightings have reported belugas in the Chinitna area. Castellote et al. (2024) documented beluga whales in Chinitna River in September, October, December, February, and June of 2022. Before the early 1990s, both Chinitna and Tuxedni bays were important habitats for belugas (Rugh et al., 2000), but sightings became rare as the population declined and moved to upper Cook Inlet (Rugh et al., 2010). It was unclear if belugas still used the Chinitna River until Castellote et al. (2024) conducted their study, which reported only 38 detections in Chinitna River compared to 540 detections in Tuxedni Bay and River. BOEM decided against condensing the Northern Area Exclusion because the significance of Chinitna Bay and River for the beluga population remains uncertain.

2.10.2 Tuxedni Bay Exclusion Area

BOEM considered an exclusion of lease blocks that overlap a 5-mile coastal buffer that extended from the mouth of Tuxedni Bay. This alternative would have excluded approximately eight whole or partial lease blocks and less than four percent of the lease sale area. This alternative was not retained because it was unlikely to satisfy the Court's criteria for alternatives that offer a reduced number of lease blocks. The Court's expectation is that the alternatives will exclude areas from leasing that comprise a reduced number of blocks and meaningfully reduce impacts. The first criterion was better met by the Tuxedni Bay/Chinitna Bay Buffer Exclusion (Alternative 8) that is being considered in this SEIS, than the Tuxedni Bay exclusion alone. The Tuxedni Bay exclusion was therefore removed from further consideration. It is difficult to predict with certainty how much of a reduction in impacts will be realized because the current and future level of use of Chinitna Bay by belugas is not well known. Discussion with the National Marine Fisheries Service (NMFS) (Seymour and Gill, 2024) indicated use of Chinitna Bay may be greater than currently documented in survey data and published literature, in which case there could be a greater reduction in impacts to belugas from excluding both Tuxedni and Chinitna bays.

2.10.3 Northern Feeding Areas 10-Mile Exclusion

BOEM considered an alternative in which all blocks within the lease sale area that overlap a 10-mile buffer from the coast north Anchor Point would be excluded from the lease sale. This alternative was dismissed in favor of the Northern Feeding Areas 5-Mile Exclusion (Alternative 9) for several reasons. A 10-mile buffer is similar to the already analyzed Alternative 3C and the Tuxedni Bay/Chinitna Bay Buffer Exclusion (Alternative 8). The Court remanded the EIS to allow BOEM to consider a range of alternatives that would offer for lease a reduced number of blocks and would reduce overall impacts. Multiple similar 10-mile buffer alternatives may add confusion and ambiguity to the analysis without providing distinct differences that alter impact conclusions. A 5-mile buffer (Alternative 9) provides an alternative that is substantially different than the other alternatives and reduces impacts in the areas known or suspected to be important to belugas. NMFS has scientific expertise and regulatory jurisdiction over belugas, and in their comments on the Draft EIS for LS 258, they indicated that a 5-mile buffer would be protective for beluga feeding areas. Specifically, they recommended seismic surveys and drilling should not occur within Cook Inlet beluga whale critical habitat at any time, nor within 5 miles of any fish-bearing streams from July 1-September 30 (Mecum, 2021). This recommendation was also used to formulate Alternative 3C, which prohibits on-lease seismic surveys on blocks within 10 miles of major anadromous streams between July 1 and September 30. Therefore, BOEM dismissed the Northern Feeding Areas 10-Mile Exclusion in favor of the Northern Feeding Areas 5-Mile Exclusion (Alternative 9) because a 5-mile coastal buffer follows scientific recommendations for protecting beluga whales, provides a meaningfully different option from previously analyzed alternatives, and avoids creating redundant or confusing choices.

2.10.4 All Lease Sale Area 5-Mile Exclusion

This alternative would have excluded from the lease sale blocks that overlap a 5-mile coastal buffer along the entire Cook Inlet coastline. The intention of this alternative was to provide spatial separation between on-lease activities and foraging habitat and travel corridors used by belugas. This alternative would have excluded areas of Cook Inlet south of Anchor Point that are not known or suspected to be used by belugas. Excluding these areas would further reduce the size of the lease sale area but would provide no meaningful reduction in impacts over the Northern Feeding Areas 5-Mile Exclusion alternative (Alternative 9). This alternative was dismissed in favor of the Northern Feeding Areas 5-Mile Exclusion alternative.

2.11 Comparison of Impact Levels of Alternatives

A comparison of the levels of impact of the different Action Alternatives (i.e., Proposed Action and Alternatives 3A, 3B, 3C, 4A, 4B, 5, 7, 8, and 9) on each environmental resource has been summarized and provided in Table 2-1. Each resource analysis in Sections 4.3–4.15 results in the relatively broad determination of an overall impact level expected for each of the Alternatives. Overall impact level for each environmental resource is designated as negligible, minor, moderate, or major (or a range of impact levels) using the impact scale definitions found in Section 4.2.

Table 2-1 also demonstrates that a more nuanced comparison of Alternatives' impacts can result from a closer examination of the various unique disturbance, noise, habitat alteration, and/or other types or scopes of effects on each resource that combine to determine its impact level. For each resource, whether differences in a given Alternative's specific effect(s) may cause it to have somewhat greater or lesser effects than the Proposed Action without the differences being so significant as to result in a completely different overall impact level, is indicated (with arrows) in Table 2-1.

Table 2-1: Comparison of Impact Levels among Proposed Action and Action Alternatives for Environmental Resources

-	- - - -				Action Alternatives				- - - -
Environmental Resource	Proposed Action	3A	3B	3C	4A	4B	5	7	8	9
Air Quality	🟢	▨	▨	▨	▨	▨	▨	▨	▨	▨
Water Quality	🟢	▨	▨	▨	▨	▨	▨	▨	▨	▨
Coastal and Estuarine Habitats	🟢	▨	▨	▨	▨	▨	▨	▨	▨	▨
Fish and Invertebrates	🟢	↓	↓	↓	↓	↓	↓	↓	↓	↓
Birds	🟢 – 🔵	↓	↓	↓	↓	↓	↓	↑	↓	↓
Marine Mammals*	🟡 – 🟢	↓	↓	↓	↓	↓	↓	↓	↓	↓
Beluga Whales	🟡 – 🟢	↓	↓	↓	↓	▨	↓	🟡	🟡	🟡
Terrestrial Mammals	🟢	▨	▨	▨	▨	▨	▨	▨	▨	▨
Recreation, Tourism, and Sport Fishing	🟢	▨	▨	▨	▨	▨	▨	↓	↓	↓
Communities and Subsistence	🟢	▨	▨	↓	▨	▨	↓	↓	▨	↓
Economy	🟡 – 🔵	▨	▨	▨	▨	▨	▨	▨	▨	▨
Commercial Fishing	🟢 – 🔵	🟢	🟢	🟢	↓	▨	🟢	↓	↓	↓
Archaeological and Historic Resources	🟡 – 🟢	▨	▨	▨	▨	▨	▨	▨	▨	▨

Notes: Table summarizes the Impact Levels from each of the Action Alternatives (Proposed Action and Alternatives 3-5 and 7-9) for each environmental resource, as analyzed and concluded in Sections 4.3–4.15. The Key shows that the overall resource impact levels for the Proposed Action (including activities, small spills, and spill drills associated with the E&D Scenario) are represented with color symbology, and the overall resource Impact Levels for each Alternative are represented by color symbology, cross-hatching, or arrows as described.

Key

*	Includes Beluga Whales
●	Impact Level is Major
🔵	Impact Level is Moderate
🟢	Impact Level is Minor
🟡	Impact Level is Negligible
○ – ○	Impact Level is a Range
▨	Impact Level is **same as** that of the Proposed Action
↑	Impact Level is the same as that of the Proposed Action. However, various effects are **somewhat greater** but not so great as to increase the overall Impact Level.
↓	Impact level is the same as that of the Proposed Action. However, various effects are **somewhat less** but not so much less as to decrease the overall Impact Level.

Chapter 3 ASSUMPTIONS FOR ANALYSIS

Chapter 3 of the 2022 LS 258 FEIS describes in detail the assumptions upon which BOEM analysts based their effects analyses and are hereby incorporated by reference. This chapter summarizes the hypothetical scenarios of the types of activities that BOEM analysts use as a reasonable and consistent basis for their effects analyses. Section 3.1 summarizes the Oil Spills and Gas Release Scenario (which has not changed from that of the 2022 FEIS), and Section 3.2 summarizes and updates the past, present, and reasonably foreseeable future actions which informed BOEM's cumulative effects analyses. Section 3.3 describes the regulatory and administrative framework in which post-lease activities would occur. Section 3.4 describes the lease stipulations considered for inclusion on all issued leases and identifies assumed and proposed mitigation measures considered in the analyses. The assumptions summarized below, with the addition of the E&D Scenario described in Appendix B, provide the basis for analysis in this SEIS for each action alternative.

In this SEIS, the alternatives being considered that exclude blocks from the lease sale do not change the expected amount of oil and gas production or related activities. Even though these alternatives could exclude a significant portion of the sale area, there is no correlated decrease in production by the same percentage. For example, a 49 percent reduction in the sale area will not result in a 49 percent reduction in activities under the E&D Scenario. Interest in leasing and the resulting post-lease activities would be expected to shift to areas that remain available. BOEM does not know where reserves are located, but modeling suggests that reserves could be discovered in any leased block and potentially produce the full estimated volumes. The E&D Scenario is based upon a field that will be discovered and developed. Since it is possible that development will occur, BOEM must consider the full potential of production. However, recoverable resources cannot be determined until an exploratory well is drilled.

3.1 Oil Spills and Gas Release Scenario

Oil spills and gas releases are unlawful, accidental events. Except for rare events, both the number of spills and the volume of oil entering the environment from accidental spills have decreased in recent decades, even as petroleum consumption has risen or remained flat (ABS Consulting, 2016; USCG, 2012; EIA, 2020).

The effects of oil spills and a gas release that could result from the high activity estimate provided in the E&D Scenario (Appendix B) (production of 192.3 MMbbl (million barrels) of oil and 301.9 Bcf (billion cubic feet) of gas) are analyzed in Section A-3 of Appendix A of this SEIS, and further discussed in Section 3.1 of the 2022 LS 258 FEIS. A summary of the spill and gas release assumptions are presented below in Sections 3.1.1 through 3.1.5.

3.1.1 Small Oil Spills: <1,000 Barrels (bbl)

Assumptions for analysis of small oil spill effects are described in Table 3-1. Approximately 410 small spills are estimated to occur over the 40-year E&D Scenario.

Table 3-1: Small Spill Scenario Assumptions

Variable	Assumption for Purposes of Analysis
Number	Approximately 410 total – Rounded to nearest 10.
Activities	Small, refined oil spills occur during G&G activities, exploration and delineation drilling activities, development and production activities, and decommissioning activities. Small crude and condensate oil spills occur during development and production activities.
Timing	Small, refined oil spills during G&G or exploration and delineation activities could occur any time of the year. Small, refined and crude oil spills during development and production could occur any time of the year.
Size	G&G Activities: most would be <1 bbl; one would be up to 13 bbl. Exploration and Delineation drilling: most would be 0 up to 5 bbl; one would be up to 50 bbl. Development and Production: most would be <1 bbl, 14 would be 3 bbl, and 2 would be 125 bbl each and assumed to occur from either offshore or onshore facilities.
Media Affected	Vessel or facility and then the water or ice; open water; broken ice; on top of or under solid ice; shoreline; or snow.
Weathering	50 bbl diesel spill evaporates and disperses within 3 days. Diesel spills of <1 bbl evaporate and disperse within 6–24 hours. 125 bbl crude spill evaporates and disperses over 30 days.

Notes: bbl = barrel G&G = geological and geophysical

3.1.2 Exploration

Table 3-2 depicts the estimated total number and volume of small spills over the life of the E&D Scenario, as well as annual spill estimates. During exploration, it is estimated that up to 6 refined oil spills could occur and range in size from <1 bbl to 50 bbl per spill.

Table 3-2: Total and Annual Potential Small Spills throughout Life of the E&D Scenario

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	0–15	0–1	0–<1 or ≤13
Exploration and Delineation Drilling	Refined	0–3	0–60	0–1	0–<5 or ≤50
Development and Production, Decommissioning	Refined, Crude, or Condensate	0–405	0–310	0–13	0–10

3.1.3 Development and Production

An estimated 405 crude, condensate, or refined small oil spills could occur during development, production, and decommissioning (Table 3-2 and Table 3-3). Of those, about 389 are <1 bbl, 14 range from >1 bbl up to 50 bbl, and 2 range from >50 bbl up to <500 bbl.

Table 3-3: Generalized Size, Oil Type, and Timing of Potential Spill or Release over E&D Scenario Lifespan

<table>
<tr><th rowspan="3">Spill Size</th><th rowspan="3">Oil Type</th><th colspan="2">Exploration (Years 1-5)</th><th colspan="4">Development and Production (Years 6-13)</th><th>Production (Years 14-34)</th><th colspan="3">Production and Decommission (Years 35-40)</th></tr>
<tr><th colspan="10">YEARS 1 THROUGH 40</th></tr>
<tr><th>1-2</th><th>3-5</th><th>6</th><th>7-8</th><th>9-10</th><th>11</th><th>12-34</th><th>35-38</th><th>39</th><th>40</th></tr>
<tr><td rowspan="4">Small</td><td rowspan="3">Refined</td><td colspan="2">G&G Surveys</td><td></td><td>🟩</td><td></td><td>🟩</td><td></td><td>🟩</td><td>🟩</td><td>🟩</td></tr>
<tr><td></td><td>Drilling</td><td colspan="8"></td></tr>
<tr><td colspan="2"></td><td colspan="8">Development, Production and Decommissioning</td></tr>
<tr><td>Crude Condensate</td><td colspan="3"></td><td colspan="5">Oil Production</td><td colspan="2"></td></tr>
<tr><td>Large</td><td>Crude Condensate</td><td colspan="3"></td><td colspan="5">Oil Production</td><td colspan="2"></td></tr>
<tr><td>Large</td><td>Diesel</td><td colspan="3"></td><td colspan="5">Oil and Gas Development and Production</td><td colspan="2"></td></tr>
</table>

3.1.4 Large Oil Spill: ≥1,000 bbl

The assumptions BOEM uses to analyze the potential effects of a large crude, condensate, or refined oil spill (≥1,000 bbl) are summarized in Table 3-3 and Table 3-4.

Table 3-4: Large Spill Scenario Assumptions

Variable	Assumption for Purposes of Analysis
Number	One large spill occurring during the 32 years of oil and gas production (Section 3.1).
Percent Chance of One or More Large Spills Occurring	Percent Chance of One or More Large Spills Occurring: 19% chance of one or more large spills occurring; 81% chance of no large spills occurring (Ji and Smith, 2021).
Activities	A large spill occurs during development or production. No large spill occurs during geological and geophysical activities, exploration and delineation drilling activities, or decommissioning activities.
Timing	A large spill occurs any time of the year. A large crude, condensate, or diesel spill could occur during the 32 years of crude oil, natural gas liquid condensate, or gas production.
Source, Size, and Oil Type	Pipeline or platform 3,800 bbl crude, condensate, or diesel oil.
Medium Affected	Production facility and then the water or ice; open water; broken ice; on top of or under solid ice; shoreline; or snow.
Weathering After 30 days	Condensate and diesel oil will evaporate and disperse much more rapidly than crude oil, generally within 1–10 days. After 30 days in open water or broken ice, BOEM assumes the following weathering for crude oil: 17%–20% evaporates, 19%–80% disperses, and 3%–61% remains.
Chance of Large Spill Contacting and Timing	Time to contact and chance of contact from a large oil spill are estimated from an oil spill trajectory model (Ji and Smith, 2021; Appendix A, Tables A.2-1 through A.2-60). Assuming a large spill occurs, the chance of contact is analyzed from the location where it is highest when determining impacts.
Chance of One or More Spills Occurring and Contacting	The overall chance of one or more large oil spills occurring and contacting is calculated from an oil spill risk analysis (OSRA) model (Ji and Smith, 2021; Appendix A, Tables A.2-61 through A.2-64).
Spill Preparedness, Prevention, and Response	The OSRA model does not account for preparedness, prevention, response, cleanup, or containment and therefore may overestimate the chance of a large spill contacting ERAs, LSs, or GLSs. In *Oil Spill Preparedness, Prevention, and Response on the Alaska OCS*, OCS Report 2019-006 (BOEM, 2019), Sections 5.3.4 and Section 7 are incorporated by reference and summarized in Appendix A, Section A-1. Spill drills, including GIUEs, response, and cleanup actions could require multiple technologies including surveillance and monitoring, waste management, wildlife response, source containment, and both mechanical and non-mechanical countermeasures. Drills and Spill Response are analyzed in Section 3.4.

Notes: OSRA = Oil Spill Risk Analysis ERA = Environmental Resource Area LS = Land Segment
GLS = Grouped Land Segment GIUE = Government Initiated Unannounced Exercise

3.1.5 Gas Release

For purposes of this environmental document, one loss of well control or one pipeline rupture (offshore or onshore) is assumed over the 32 years of gas production releasing 20–30 million cubic feet of natural gas over one day (detailed in Appendix A, Section A-2).

3.1.6 Opportunities for Intervention and Spill Response

In the event of an accidental oil spill, response operations could occur that may result in a reduction of the spread of spilled oil, thereby potentially decreasing the environmental effects of the spill. These potential mitigating factors are described in detail in Section 3.1.4 of the 2022 LS 258 FEIS. Response operations are not factored into the oil spill trajectory analysis or the oil spill and gas release impact assessment. Information regarding spill response preparedness activities (spill drills) and spill response can be found in Section 5.3.4 of BOEM’s 2019 report *Oil Spill Preparedness, Prevention, and Response on the Alaska OCS*, and Section 7, *Description of Potential Response Actions*, in the *Bureau of Safety and Environmental Enforcement’s BSEE) Oil Spill Response Plan Drills*, which are incorporated by reference.

Spill drills, including BSEE government-initiated unannounced exercises (GIUEs) and other spill response practices, are considered part of the Proposed Action and are analyzed in Chapter 4. These activities could include oil spill response equipment deployment, vessel and aircraft traffic, unmanned aerial surveillance, and personnel or vehicle movement.

3.1.7 Very Large Oil Spill: ≥120,000 bbl

Very large oil spills (VLOS) and gas releases are very low probability, but high impact events. Although very unlikely (frequency of spill exceeding 120,000 bbl is >0.00001–<0.0001 per well) and not reasonably foreseeable as a result of the LS 258 Proposed Action or any alternatives, BOEM considered a hypothetical long duration loss of well control resulting in 120,000 bbl of oil and released gas by relying on the analyses completed for the LS 244 FEIS (BOEM, 2016). This is an appropriate comparison because the lease sale areas are the same in LS 244 and LS 258; and the methodology and assumptions used for the LS 244 VLOS (described in LS 244 FEIS, Appendix A, Section A-7, *Very Large Oil Spills*; and Appendix B, *Very Large Oil Spill (VLOS) Estimate for an Exploration Well in the (Federal) Cook Inlet Planning Area, Alaska)* are still applicable and valid. Specifically, information in Section 4.12 of the LS 244 FEIS concluded that the potential effects of a VLOS on environmental, social, and economic resources ranged from minor to moderate for a few resources to major for most resources. Similarly, should a VLOS occur as a result of LS 258, all resources analyzed could be affected and impacts could range from minor to moderate for a few resources to major for most resources.

3.1.8 Oil Spill Risk Analysis

Oil spills are divided into two general activity categories and two general spill-size categories. These divisions reflect a difference in the ways information about the spills is derived and used. The two general activity categories considered in oil spill analysis are:

- Exploration and delineation; and
- Development, production, and decommissioning.

The two general spill-size categories considered in oil spill analysis are:

- Small spills, those less than less than (<) 1,000 bbl; and
- Large spills, those greater than or equal to (≥) 1,000 bbl.

A small spill would not be expected to persist on the water long enough for the model to follow its path in a trajectory analysis. Therefore, for small spills, BOEM estimates only the type of oil and the number and size of spill(s). No changes have been made to the small spill analysis in this SEIS to assess impacts from the high activity E&D Scenario.

For a large spill, a trajectory model is used to simulate the likelihood of one or more spills contacting resources (Ji and Smith, 2021) and results are synthesized in Appendix A of this SEIS. Oil Spill Risk Analysis (OSRA) for large spills are driven by three key inputs: 1) the national OCS large oil spill rate (ABS Consulting, Inc., 2016), 2) the resource volume of the high activity E&D Scenario for the given lease sale (Ji and Smith, 2021), and 3) hypothetical trajectories derived using model-simulated hindcast fields of winds, surface currents, and seasonal sea-ice concentration and movement (BOEM, 2016).

In this SEIS, there have been no changes to the input parameters for the large spill scenario. The national OCS spill rate remains in effect and the high activity case of the E&D Scenario allows for the production and transport of the full 192.3 MM bbl from any location within the underexplored basin of Cook Inlet. Additionally, the meteorological and oceanographic conditions captured in BOEM's Cook Inlet circulation model used to calculate spill trajectories is still representative of the variability found in the region. As a result, the OSRA model output described in the 2022 LS 258 FEIS is utilized in the effects analyses for Alternatives 7–9 described in Chapter 2.

While Alternatives 7, 8, and 9 reduce the sale area by 49 percent, 22.5 percent, and 20.9 percent respectively, reductions in sale area under each alternative is not equivalent to reductions in resource volume considered in the OSRA. BOEM still considers 192.3 MM bbl of production and transport in the large spill analysis to adequately capture both the mean number of large spills occurring and the combined probability of large spill occurrence and contact over the lifetime of the E&D Scenario. This will overestimate the impact of a spill for Alternatives 7, 8, and 9. Additionally, oil spill contact for these alternatives may take longer to reach resources due to the increased distances the oil would need to travel, providing increased opportunities to mitigate impacts through intervention and response as described in detail in BOEM, 2019.

3.2 Past, Present, and Reasonably Foreseeable Future Actions

Cumulative effects, as considered herein, are the incremental environmental impacts of the Proposed Action added to environmental impacts from past, present, and reasonably foreseeable future actions (PPRFFA), regardless of the agency (federal or non-federal) or person undertaking such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The cumulative effects assumptions are a description of past, present, and reasonably foreseeable future actions that are expected to have impacts that overlap spatially and temporally with impacts from the Proposed Action. Actions considered for analysis include:

- Past, present, and reasonably foreseeable future oil and gas actions that occurred in the past, ongoing actions for which infrastructure exists or is under construction, and future actions for which a formal proposal exists in or near the lease sale area.
- Past, present, and reasonably foreseeable future actions other than oil and gas actions in or near the lease sale area.

A search was conducted to determine if relevant new information related to past, present, and reasonably foreseeable future actions has become available since completion of the 2022 LS 258 FEIS. New information discovered included updated state oil and gas activities, six Cook Inlet OCS oil and gas lease sales directed to be conducted by the OBBBA, the Kenai Liquified Natural Gas Terminal, renewable energy activities, and marine transportation and ports. This information has been updated in Sections 3.2.1 to 3.2.3.

3.2.1 Oil and Gas Related Activities

OCS Oil and Gas Activities

Six (6) federal offshore oil and gas lease sales have been held in the Cook Inlet Planning Area. The first lease sale in the Cook Inlet Planning Area occurred in October 1977 (Sale CI), which resulted in 87 leases being issued. In September 1981, Sale 60 resulted in 13 leases being issued. A reoffering sale, Sale RS-2, was held in August 1982 but no bids were received. Sale 149, held in June 1997, resulted in two leases being issued. Lease Sale 191 (2004) was held but received no bids. Two other proposed lease sales (Sale 211 in 2009, and Sale 219 in 2011) were cancelled due to a lack of industry interest. The most recent lease sale was held in June 2017, Lease Sale 244, which resulted in 14 leases being issued to Hilcorp. In September 2024, Hilcorp relinquished 7 of those leases and retained the remaining 7 leases. Thirteen exploration wells have been drilled as a result of these lease sales with the last drilling activity in 1985 by Chevron, USA (Lease Sale 60). To date, no production has occurred on the Cook Inlet OCS. In 2019 and 2021, Hilcorp conducted geological and geophysical surveys – deep penetrating marine seismic surveys and geohazard surveys, respectively. It is anticipated that data from these surveys would be used to support Hilcorp's submission of an Exploration Plan.

On July 4, 2025, President Trump signed into law the OBBBA (Pub. L. No. 119-21). Included in this legislation is the requirement that BOEM conduct a minimum of six (6) oil and gas lease sales in the Cook Inlet Planning Area by March 2032. The OBBBA mandates that the first lease sale be held no later than March 15, 2026, with no fewer than 1 lease sale in the area in each of calendar years 2027 and 2028, and in each of calendar years 2030 through 2032.

BOEM acknowledges that oil and gas production from existing OCS leases have not yet contributed to cumulative effects in Cook Inlet and analyzing potential future effects from a past lease sale is difficult, if not impossible due to the lack of development activities. Industries that would support activities from the existing OCS oil and gas leases, such as fabrication, transportation, and other service providers, also support oil and gas development onshore and in State waters.

Actions considered for cumulative effects analysis include all activities (i.e., routine activities projected to occur and accidental events that could occur) from past, present, and future proposed Cook Inlet OCS oil and gas lease sales. This includes not only activities resulting from LS 258, but projected activity from Lease Sale 244 (for which neither exploration nor development drilling has begun to date), and activities resulting from the six future oil and gas lease sales required pursuant to the OBBBA. As detailed in the introduction to Chapter 4 to provide the public and decision-makers with a picture of potential post-lease activities and potential impacts that may occur as a result of a proposed lease sale (Proposed Action), BOEM develops an E&D Scenario. The E&D Scenario describes the post-lease oil and gas activities that could occur from a particular lease sale. It is possible that the Proposed Action of one or more of the six future OBBBA Cook Inlet lease sales may use an updated E&D Scenario with different timing, frequency, and/or duration of potential activities. For purposes of the current LS 258 SEIS Cumulative Effects analyses (in Sections 4.3-4.14), however, BOEM assumes that the maximum level of each post-OBBBA lease sale activity would be no more than that described in the LS 258 E&D Scenario.

Non-OCS Oil and Gas Activities

Oil and gas have been developed and produced in Cook Inlet state waters and onshore for several decades, beginning with the Swanson River, Kenai Peninsula (1958), and the Tyonek North Cook Inlet (1962) natural gas discoveries.

Offshore infrastructure was installed in the mid-1960s in Cook Inlet state waters and production has continued since that time. A liquefied natural gas (LNG) export plant was built in Nikiski in 1969 and began supplying natural gas to Japan under export license by the Department of Energy. Cook Inlet was considered a mature oil province that had reached peak oil production of more than 227,000 barrels per day (bpd) in 1970 and peak natural gas production in 1994. Following this period, Cook Inlet Basin's onshore and offshore oil production declined to 8,900 bpd. However, with the passage of the SOA's Cook Inlet Recovery Act in 2010 and the subsequent entry of Hilcorp into Alaska, Cook Inlet wells have been worked over and production levels have increased since 2011. An abbreviated listing of onshore and offshore past, present, and reasonably foreseeable Cook Inlet oil and gas discoveries and production is provided in Table 3-5.

Table 3-5: Cook Inlet Onshore and Offshore Oil and Gas Production

Cook Inlet Field / Unit Name	Discovery Year	Production Start	Oil and/or Gas Production	Past	Present	Reasonably Foreseeable Future Actions
Cosmopolitan Unit (Starichkof)	1967	2007	Oil & Gas	x	x	x
Kenai Unit	1961	1961	Gas	x	x	x
Cannery Loop Unit	1979	1988	Gas	x	x	x
Ninilchik Unit	1961	2001	Oil & Gas	x	x	x
Redoubt Shoal Unit	1968	2001	Oil	x	x	x
McArthur River Unit	1965	1967	Oil & Gas	x	x	x
West McArthur River Unit	1991	1994	Oil &Gas	x	x	x
Trading Bay Unit	1965	1967	Oil	x	x	x
North Trading Bay Unit	1965	1967	Oil	x		x
Middle Ground Shoal Unit	1962	1967	Oil	x		
North Middle Ground Shoal Unit	1964	1982	Gas	x		
Kitchen Lights Unit	2007	2015[1]	Oil &Gas	x	x	x
Granite Point Unit	1965	1967	Oil &Gas	x	x	x
North Cook Inlet Unit	1962	1970	Gas	x	x	x
Beluga River Unit	1962	1968	Gas	x		x

Source: ADNR, 2024 (ADOG, Activity Map, July 2024).

[1] ADNR, 2024.

Offshore infrastructure in Cook Inlet includes operational and “light-housed” (currently non-operational) platforms in state waters (Table 3-6). Although some platforms are not currently producing, they are likely to remain in place and in some instances could become operational again (Table 3-6). Other existing infrastructure includes subsea oil and gas pipelines, onshore terminal processing, and support facilities. As of 2019, there were approximately 126 kilometers (km) (80 mi) of subsea oil pipelines and 266 km (165 mi) of subsea gas pipelines in Cook Inlet (ADEC, 2019).

Table 3-6: Cook Inlet Offshore Oil and Gas Platforms

Cook Inlet Oil and Gas Field	Platform by Name	Oil and/or Gas Production	Year Installed	Cook Inlet Location	Platform Status
Redoubt Shoal Unit	Osprey	Oil	2000	mid-channel, west of Nikiski	In operation
Trading Bay Unit	King Salmon	Oil	1967	west side, adjacent to shore	In operation
	Dolly Varden	Oil & Gas	1967	west side, adjacent to shore	In operation
	Grayling	Oil & Gas	1967	west side, adjacent to shore	In operation
	Steelhead	Gas	1986	west side, adjacent to shore	In operation
	Monopod	Oil & Gas	1966	west side of channel	In operation
North Trading Bay Unit[1]	Spurr	none	1966	west side of channel	Decommissioned
	Spark	none	1968	west side of channel	Decommissioned
Middle Ground Shoal Unit[1]	“A”	Oil	1964	mid-channel	Decommissioned
	Baker	Oil	1965	mid-channel	Decommissioned
	Dillon	Oil	1966	mid-channel	Decommissioned
	“C”	Oil	1967	mid-channel	Decommissioned
Granite Point Unit	Bruce	Oil	1966	west side, adjacent to shore	In operation
	Anna	Oil & Gas	1966	west side, adjacent to shore	In operation
	Granite Point	Oil & Gas	1966	west side, adjacent to shore	In operation
North Cook Inlet Unit	Tyonek/Phillips A	Oil & Gas	1968	mid-channel	In operation
Kitchen Lights Unit	Julius R	Gas	2016	mid-channel	In operation
Drift River	Christy Lee	none	1965	west side	Decommission pending

Notes: Units listed are offshore in state of Alaska waters.

[1] Herz, 2024.

Source: BOEM, 2020. BOEM Report: “2019, Offshore Platforms Onshore Processing and Support Facilities, Cook Inlet Region, Alaska, Revised Nov 20, 2020.”

Historical Cook Inlet crude state oil production volumes in comparison with anticipated LS 258 production are illustrated on Figure 1 in Appendix B. Currently, Cook Inlet crude oil production is piped either to the Trading Bay Production Facility located on the west side of Cook Inlet, or to the Kenai Refinery in Nikiski. Crude oil produced outside Cook Inlet, including limited international crude, is delivered by truck and double-hulled tankers through Cook Inlet and pipelines to the refineries. Wholesale delivery occurs through terminals in Kenai, Anchorage, the Nikiski dock, and the Port of Alaska. Processed fuels are transported by pipeline to the Port of Alaska in Anchorage, the Anchorage International Airport, and for use in a network of fuel stations throughout Alaska. The Drift River Oil Terminal on the west side of Cook Inlet has been closed due to proximity to Mt. Redoubt, an active volcano. Drift River and the associated Christy Lee Loading Platform are scheduled to be decommissioned (Fletcher et al., 2021).

Volumes of historical Cook Inlet state gas production in comparison with anticipated LS 258 production are illustrated on Figure 2 in Appendix B. Currently, Cook Inlet produced gas is consumed by a variety of users in Alaska and natural gas processed liquids go to a storage facility in Kenai (CINGSA, 2016). Gas is transported via onshore distribution pipelines on both the east and west sides of Cook Inlet. Reasonably foreseeable future gas-related projects include the Alaska Stand-Alone Natural Gas Pipeline (ASAP) and the Alaska LNG Project. Each would involve the construction of a gas pipeline from the North Slope to southcentral Alaska and the transport of LNG out of state. The ASAP would terminate at Point Mackenzie in upper Cook Inlet where a new LNG plant would be constructed. Alaska LNG proposes to terminate the new gas line at an LNG plant in Nikiski for shipment out of Alaska. In addition, recent plans have been proposed for importing natural gas into Cook Inlet. The existing Kenai LNG Terminal, a former export facility in Nikiski, has been targeted for renovation as a natural gas import facility. Full scale import operations could begin as early as 2028, with initial LNG deliveries beginning in 2026.

Exploration and production in state waters and onshore (both state and federal lands) are occurring and are expected to continue throughout the 40-year lifespan of the E&D Scenario associated with LS 258. Not all exploration activities have led or will lead to resource development. Seismic surveys, exploration, and production are ongoing throughout Cook Inlet state waters and would be expected to continue throughout the 40-year lifespan of the E&D Scenario associated with LS 258.

Although large spills are highly unlikely, for purposes of analysis, BOEM has considered the effects of up to two additional large spills from sources other than those related to LS 258 post-lease activity (Appendix A, Table A4). These two spills are likely an overestimate of spills given the spill history in Cook Inlet. Over the past 55 years (1966–2020) approximately 16 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 and Campbell, 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 have occurred since the 1997 aviation fuel spill on JBER.

3.2.2 Renewable Energy Activities

GeoAlaska was awarded the South Augustine Island Noncompetitive Geothermal Prospecting Permit in June of 2022. The permit authorized geothermal exploration on 3,048 onshore acres for a 2-year term (ADNR, 2022). The plan of exploration was approved in June 2023 which included conducting a gravity and a magnetotellurics (MT) survey in summer 2023, creation of a subsurface model using the collected geophysical data, and drilling temperature gradient holes, dependent on favorable modeling results (ADNR, 2023). A second field season of exploration work on their prospecting permits was completed in the summer of 2024. The second field season included collecting additional MT data to refine the geothermal resource potential and depth of the magma chamber. In addition, the Alaska Department of Natural Resources (ADNR), Division of Oil and Gas (ADOG) received an additional application for geothermal exploration on the northern half of Augustine Island in the summer of 2024 (ADNR, 2024).

Ocean Renewable Power Company, Inc.

Ocean Renewable Power Company, Inc. (ORPC) submitted a draft pilot license application to the Federal Energy Regulatory Commission (FERC) in March 2025 to develop the East Foreland Tidal Energy Project, located in the waters of Cook Inlet, off East Foreland, Kenai Peninsula Borough, AK (FERC, 2025). ORPC plans to install tidal energy devices capable of producing up to 2 megawatts (MW) and proposes the following project works: 1) a Proteus Marine Renewables tidal device and associated anchoring system ; 2) two dedicated power and data (P&D) cables running from the tidal devices to respective shore stations; 3) four prefabricated standard shipping container shore stations; 4) transmission line; and 5) ancillary facilities. The proposed project would occur on a combination of State of Alaska submerged lands and private shoreline, and the unincorporated area of Nikiski, in the Kenai Peninsula Borough (KPB) (FERC, 2025).

3.2.3 Other Activities

Other activities that could contribute to cumulative environmental impacts include marine transportation, ports and terminals; mining projects; harvest activities; residential and community development; scientific research and survey activities; and military and homeland security activities.

Marine Transportation and Ports

Cook Inlet is a regional hub of marine transportation throughout the year and includes five deepwater ports (Anchorage, Port MacKenzie, Nikiski, Homer, and City of Seldovia), and several light-draft ports (e.g., Port Graham, Tyonek, and Williamsport). The Port of Alaska (Anchorage), the largest port in Alaska, is designated a U.S. Department of Defense National Strategic Port and provides services to approximately 90 percent of the population of Alaska, as well as fuel deliveries for the Ted Stevens International Airport in Anchorage (McDowell Group, 2020). Nikiski is the second largest port in Alaska by cargo tonnage (AAPA, 2018) and is the site of Alaska's largest refinery. Crude oil from the North Slope is transported by pipeline to Valdez then moved by tanker from the Valdez Marine Terminal to Nikiski for processing, along with crude oil from the Cook Inlet region (Fletcher et al., 2021). Refined gasoline, diesel fuel, jet fuel, and heating oil leave Nikiski by tanker or are transported to Anchorage and the Ted Stevens International Airport via subsea pipelines.

Most vessel traffic moves along north-south transit lines with deep draft vessels generally using the east side of Cook Inlet. Offshore supply vessels account for much of the commercial large vessel activity outside of the traditional north-south track lines, whereas commercial fishers and suppliers use cross-inlet traffic routes to reduce travel distances from Cook Inlet locales to the Bristol Bay region. Kachemak Bay is a frequent and preferred port of refuge for ships and tugs during bad weather and historically has the highest level of traffic activity in Cook Inlet. Fletcher et al. (2021) evaluated the changes in vessel traffic in Cook Inlet over the 10-year time frame of 2011–2020 using Automatic Identification System (AIS) data to characterize the vessel movements and estimate oil exposure associated with oil tankers, large cargo ships, oil field vessels, cruise ships and large ferries, and some tugs. Changes in traffic over the 10-year study have indicated that annual time spent in the Inlet fluctuates for all vessel types, but oil field and small cargo vessels fluctuate more than large cargo vessels. Crude oil tanker movements across the Inlet were eliminated after the Drift River Terminal closed in 2018 and tankers calling at the refinery in Nikiski have decreased from a 2013 high. At the same time, however, more product tankers have been calling at the Port of Alaska in 2019 and 2020, which is assumed to be a result of the closure of the North Pole refinery and an increased demand for jet fuel at Ted Stevens Anchorage International Airport. As of 2020, the number of foreign-flagged tankers entering the Inlet was almost equal to the number of U.S.-flagged tankers for the first time (Fletcher et al., 2021). Although many fishing vessels in Cook Inlet do not carry AIS, the available AIS data revealed that fishing vessels represented the largest number of operating vessels, followed by tankers (Fletcher et al., 2021).

Mining Projects

There are several mining claims and resources in southcentral Alaska that have been subject to mineral exploration activities. Exploration activities have been intermittent depending on the specific claim or resource. Four proposed mining projects are considered in the cumulative effects analysis: the Donlin Gold Mine Proposed Natural Gas Pipeline, the Diamond Point Rock Quarry, the Pebble Mine Project, and the Johnson Tract Proposal.

Donlin Gold Mine Proposed Natural Gas Pipeline

Donlin Gold is an undeveloped gold deposit located in western Alaska's Yukon-Kuskokwim region. Donlin Gold, LLC proposes to construct a 14-inch diameter steel pipeline to transport natural gas approximately 507 km (315 mi) from an existing 50.8-centimeter (cm) (20-inch (in)) pipeline tie-in near Beluga, Alaska to the proposed mine site power plant. Except for two above-ground fault crossings, the pipeline would be buried within an approximately 15.2-m (50-foot (ft)) right-of-way. The pipeline would be designed to deliver up to 73 million standard cubic feet per day of natural gas at a maximum allowable operating pressure of 1,480 pounds per square inch gauge for 30 years. Electrical power for the compressor station would be supplied by a 25-kilovolt transmission line running north from the Beluga Power Plant to the gas compressor station. The U.S. Army Corps of Engineers (USACE) released the Final EIS in April 2018 and, with the Bureau of Land Management (BLM), issued a Joint ROD. State and federal permitting activities are currently in progress.

Diamond Point Rock Quarry

Diamond Point, LLC has proposed to develop a granite quarry at Diamond Head near the convergence of Cottonwood and Iliamna bays on the western shore of Cook Inlet. The project involves modification of the shoreline to construct an access road, breakwater, barge landing, and solid fill dock. Coastal infrastructure includes discharging fill material into 11.42 ac below high tide line for staging equipment, stockpiling aggregate, and barge-loading facilities. Dredging would be required in Iliamna Bay. The 30–40 million cubic yards of hard rock would be a source for infrastructure projects in Anchorage, Kodiak, and the Alaska Peninsula.

Pebble Mine Project

Pebble Limited Partnership (PLP) is proposing to develop a large-scale copper, gold, and molybdenum deposit known as the Pebble Deposit. Located in the Bristol Bay watershed west of Cook Inlet, the proposed project includes an open-pit mine with associated infrastructure; the development of a port, dock, and year-round shore-based facilities located north of Dimond Point in Iliamna Bay on the west side of Cook Inlet; and a transportation corridor that includes a 264-km (164-mi), 30.5-cm (12-in) diameter gas pipeline from the Kenai Peninsula across Cook Inlet to the mine site. In February 2019, the USACE released the draft EIS for the Pebble Mine Project. A final EIS was issued in July 2020. The ROD was issued on November 20, 2020, and found that the mine was contrary to the public interest. The USACE's decision was appealed. The Pebble Mine project is currently on hold due to pending litigation but is included here as a pending future project.

Johnson Tract Proposal

The Johnson Tract Proposal is a poly-metallic project located near tidewater in Southcentral Alaska between Tuxedni and Chinitna bays (Brekken et al., 2024). The tract is currently being explored by HighGold Mining, Inc (HighGold) under a lease agreement with Cook Inlet Region, Inc. (CIRI), which has mineral and surface rights in the upper Johnson River watershed and adjacent drainages. HighGold has conducted seasonal exploration surface drilling programs from 2019 to 2023 with a focus on delineating the high-grade Johnson Tract ore deposit (JT Deposit) (Brekken et al., 2024). The Johnson Tract covers 20,942 ac of land and is composed of two blocks: 1) the South Tract totals 11,342 ac hosting the known JT Deposit, the existing airstrip, and camp; 2) the North Tract totals 9,600 ac and hosts several prospects. The Tracts are inholding in Lake Clark National Park and the property was conveyed to CIRI under the terms of the Alaskan Native Claims Settlement Act (ANCSA) and the Cook Inlet Land Exchange. The USDOI has issued a Decision Record addressing the conveyance of two easements, a transportation and a port easement, to provide for the transportation of minerals from the Johnson Tract (USDOI, 2025). JT Mining is entering the advanced exploration phase to assess the development and economic potential of the JT Deposit. Plans include advancing engineering, technical studies, and permitting in support of the construction of an underground exploration drift for infill drilling to both expand and upgrade the resource, expansion of the airstrip to accommodate aircraft that can carry large equipment, and construction of an access road to a barge landing at the coast that allows for direct shipping opportunity. The locations for the proposed port site and transportation corridor within Lake Clark National Park to access the JT are being evaluated (ADNR, 2025; https:\\www.dnr.alaska.gov/mlw/mining/large-mines/johnson-tract; accessed March 18, 2025).

Harvest Activities

Resource harvest activities, including subsistence, commercial, and sport fishing and hunting, have occurred and will continue to occur throughout lower Cook Inlet. Harvest levels (and therefore their potential to contribute to environmental cumulative effects) will continue to rise and fall and would be subject to regulations, co-management, or other decision-making.

Residential and Community Development

The estimated population of the KPB in 2020 was 61,350 (ADLWD, 2025). The Alaska Department of Labor and Workforce Development projects modest increases over the next two decades (ADLWD, 2022). A majority (86 percent) of the land in the KPB is federally or state owned and managed and is not generally available for community development. Borough, city, and private land ownership is concentrated primarily along major road corridors and the towns and cities that are located along the road system, except for Native corporation land holdings (KPB, 2019). Within the area available for development, residential land use dominates, interspersed with clusters and individual areas of commercial, industrial, gravel extraction, and agricultural use (KPB, 2019). The planning objectives identified in the *Kenai Peninsula Borough Comprehensive Plan* support future community development that follows these trends (KPB, 2019).

Scientific Research and Survey Activities

Scientific research and survey conducted by government, institutional, and private parties have the potential to disturb wildlife and interfere with subsistence and recreational activities. Animal mark and recapture studies and relocation efforts occur and have the potential to alter wildlife distributions (ADF&G, USFS, and USFWS, 2003; Olson, 2015). Activities conducted by aircraft and vessels typically have created the most potential for conflict with wildlife, but no substantial change in scientific aircraft or vessel activity is anticipated over the timescale of the lease sale.

Military/Homeland Security Activities

Joint Base Elmendorf-Richardson is located approximately 11 km (7 mi) northeast of downtown Anchorage in the upper Cook Inlet watershed. The 32,306-ha (74,641-ac) facility houses active-duty military personnel including Air Force, Army, Marine Corps, Navy, Army National Guard, Air National Guard, and Coast Guard. Although the various activities at JBER are land- or air-based, they could affect resources in Cook Inlet due to ongoing operations and historical disposal practices (e.g., sites such as Eagle River Flats contaminated by white phosphorus). There is no indication that the military presence at JBER will change in the foreseeable future, so BOEM has assumed JBER activities will continue at current levels.

Additional Considerations

Potential cumulative impacts were considered in the context of a changing climate. Climate change is important to the cumulative effects analysis because of the potential for the changing climate to influence the established climatic pattern of Cook Inlet. A changing climate could contribute to cumulative effects in many ways, including increased noise and disturbance due to increased shipping; increased severity of storms; increased glacial melting and riverine runoff; increased coastal erosion; drying of freshwater wetlands; decreases in ice cover with the potential for resultant changes in prey-species concentrations and distribution with related changes in species distributions; increased ocean acidity; range extension of species into Cook Inlet; changes in timing and magnitude of plankton blooms; changes in food web structure; changes in subsistence harvest practices; and changes in potential for community economic development and regional tourism activities. Evidence of warming in Alaska is wide-ranging and includes increases in average air and ocean temperatures, melting snow and ice, and sea level rise (IPCC, 2013, 2014). Data collected during the past 60 years indicate the state of Alaska has warmed more than twice as fast as the rest of the U.S., with average annual air temperature increasing by 1.7°C (3°F). Warming is expected to continue or accelerate (Chapin et al., 2014; IPCC, 2014; Stewart et al., 2013).

Cook Inlet is a dynamic marine environment where warming is interacting with other complex large-scale environmental processes. Ocean acidification, a decrease in marine pH levels resulting from climate change, is occurring in the North Pacific Ocean, including the Gulf of Alaska (Byrne et al., 2010). A notable marine ecosystem shift occurred in the Gulf of Alaska in the late 1970s, and more marine ecosystem shifts are predicted (Anderson and Piatt, 1999; Litzow, 2006). Warm water anomalies have become increasingly common and larger in scale (Frölicher and Laufkötter, 2018; Amaya et al., 2020; Song et al., 2023). “The Blob,” one of the largest marine heatwaves ever observed on Earth, occurred in 2014 to 2016 and stretched from the Gulf of Alaska to the coast of Baja California (Gentemann et al., 2017; Joh and Di Lorenzo, 2017). In the presence of the global warming trend, climate models project large increases in the frequency, intensity, duration, and spatial extent of warm temperature extremes, with the magnitude of the increase becoming progressively larger at higher warming levels (Capotondi et al., 2024). Marine heatwaves have been linked to the growth of diatoms and dinoflagellates that produce algal toxins, supporting predictions that harmful algal blooms will be increasingly common (Walsh et al., 2018; Wells et al., 2015; Gobler, 2020).

3.3 Regulatory and Administrative Framework

The OCS Oil and Gas Leasing Program is established by the OCSLA, and the implementing regulations promulgated by BOEM pursuant to its OCSLA authority. Oil and gas activities on the OCS must also comply with other federal, state, and local laws and regulations. Compliance with all applicable laws and regulations is assumed for all action alternatives considered in this SEIS. Based on the requirements in the applicable laws and regulations, mitigation can be implemented through binding and enforceable measures known as lease stipulations.

BOEM and BSEE also issue Notices to Lessees and Operators (NTLs), documents that provide clarification, description, or interpretation of a regulation or an OCS standard; provide guidelines on implementation of a special lease stipulation or regional requirement; provide a better understanding of the scope and meaning of a regulation by explaining BOEM's and BSEE's interpretation of a requirement; or transmit administration information. NTLs can be national or regional in scope and can be found on BOEM and BSEE's websites. Existing NTLs applicable to Cook Inlet apply to activities conducted pursuant to LS 258 and are considered part of the Proposed Action and each action alternative.

Additionally, BOEM and BSEE issue Information to Lessees and Operators (ITLs) for informational purposes. Some ITLs provide information about issues and concerns related to particular environmental or sociocultural resources. Others explain how lessees might plan their activities to meet BOEM or BSEE requirements or reduce potential impacts. Still other ITLs provide information about the requirements or mitigation required by other federal and state agencies. Existing ITLs applicable to Cook Inlet apply to activities conducted pursuant to LS 258 and are considered part of the Proposed Action and each action alternative.

Post-lease activities resulting from LS 258 will take place pursuant to the lease form and BOEM regulations governing Ancillary Activities, Exploration Plans (EP), and Development and Production Plans (DPP). Post-lease activities will also be covered by certain BSEE regulations and oversight, particularly regarding platform design and installation and oil spill response. BOEM may require additional post-lease mitigation as part of the environmental review and approval of Exploration and Development and Production Plans. Further mitigation may also be required by NMFS or U.S. Fish and Wildlife Service (USFWS) through the ESA Section 7 consultation process. "Take" of marine mammals that could occur incidental to post-lease activities is prohibited unless authorized by a Letter of Authorization or an Incidental Harassment Authorization under the Marine Mammal Protection Act (MMPA). These authorizations typically require extensive mitigation measures as described in Section 3.3.3. Mitigation requirements are also typically required by other regulatory agencies for buried pipelines constructed through wetlands on the Kenai Peninsula and for crossing beneath anadromous fish streams; the USACE, Alaska District, and the State of Alaska are expected to add time of year restrictions and require specific construction methods that would minimize impacts.

3.3.1 Compliance with Executive Order 14154

Executive Order (EO) 14154, Unleashing American Energy (Jan. 20, 2025), and a Presidential Memorandum, Ending Illegal Discrimination and Restoring Merit-Based Opportunity (Jan. 21, 2025), require the Department to strictly adhere to NEPA, 42 USC §§ 4321 et seq. Further, the previously mentioned Order and Memorandum repeal EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Feb. 11, 1994) and EO 14096, Revitalizing Our Nation's Commitment to Environmental Justice for All (Apr. 21, 2023). Because EOs 12898 and 14096 have been repealed, complying with such Orders is a legal impossibility. BOEM verifies that it has complied with the requirements of NEPA, including the Department's regulations and procedures implementing NEPA at 43 CFR Part 46 and Part 516 of the Departmental Manual, consistent with the President's January 2025 Order and Memorandum.

In the LS 258 FEIS, environmental justice considerations were included in the document. However, in compliance with EO 14154, the environmental justice analysis was not included in this SEIS (EO 14154). While environmental justice analysis is not included, BOEM continues to assess the environmental effects of the Proposed Action on Communities and Subsistence (Section 4.11).

EO 14154, Unleashing American Energy (Jan. 20, 2025), disbanded the Interagency Working Group (IWG) on the Social Cost of Greenhouse Gases and withdrew any guidance, instruction, recommendation, or document issued by the IWG, including the social cost of carbon protocol. As a result, the use of the social cost of greenhouse gas (GHG) was not included in this SEIS. However, the quantification of GHGs reasonably foreseeable, as a result of LS 258 and post-lease activities, is included in Section 4.3.8.

3.3.2 Lease Stipulations

The following proposed Lease Stipulations are considered part of the Proposed Action and would be expected to apply to all leases issued under Cook Inlet LS 258. BOEM has considered their mitigative effect, where appropriate, in the LS 258 FEIS and this SEIS.

Stipulation No. 1 – Protection of Fisheries

Exploration, development, and production operations must be conducted in a manner that minimizes or prevents conflicts with fishing communities and gear (including, but not limited to subsistence, sport, and commercial fishing). To minimize or prevent fishing activity conflicts, prior to submitting an EP or a DPP, the lessee/operator must review the planned exploration or development activities with directly affected fishing organizations, subsistence communities, and port authorities. This includes plans for on-lease surveys, offshore drilling unit mobilization and location, service vessel routes, and other vessel traffic.

The EP or DPP must include a summary of fishing activities near the proposed operations, an assessment of effects on fishing from the proposed activity, and measures to be taken by the lessee/operator to minimize or prevent conflicts. The assessment of effects and measures to minimize or prevent conflicts must be described under the environmental impact analysis, as required by 30 CFR 550.227 for EPs and 30 CFR 550.261 for DPPs.

Stipulation No. 2 – Protection of Biological Resources

If biological populations or habitats that may require additional protection are identified by BOEM in the leased area, the Regional Supervisor, Leasing and Plans (RSLP) may require the lessee/operator to conduct biological surveys to determine the extent and composition of such biological populations or habitats. The RSLP will provide written notification to the lessee/operator of the requirement to conduct such surveys. Based on any surveys that the RSLP required of the lessee/operator, or based on other information available to the RSLP regarding special biological resources, the RSLP may require the lessee/operator to: relocate the site of operations; establish to the satisfaction of the RSLP, on the basis of a site-specific survey, either that such operations will not have a significant adverse effect upon the resource identified or that a special biological resource does not exist; operate only during those periods of time, as established by the RSLP, 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.

If populations or habitats of biological significance are discovered during the conduct of any operations on the lease, the lessee/operator must immediately report such findings to the RSLP and make every reasonable effort to preserve the biological resource and protect it from damage. The RSLP will direct the lessee/operator with respect to the protection of the resource. The lessee/operator must submit all data obtained from biological surveys to the RSLP to include geospatial information in relation to the lessee’s/operator’s Proposed Action. The lessee/operator may take no action that might affect the biological populations or habitats surveyed until the RSLP provides written directions to the lessee/operator regarding permissible actions. The RSLP will provide a written response outlining permissible actions within 30 days.

Stipulation No. 3 – Orientation Program

An EP or DPP submitted under 30 CFR 550.211 or 30 CFR 550.241, respectively, must include a proposed orientation program for all personnel involved in the Proposed Action (including personnel of the lessee's/operator's agents, contractors, and subcontractors).

The program must be designed in sufficient detail to inform individuals working on the project of specific types of environmental, safety, social, and cultural concerns that relate to the area that could be affected by the operation or its personnel. The program must address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals, and provide guidance on how to avoid or minimize disturbance. The program must address Safety and Environmental Management System elements including, but not limited to: Stop Work Authority; Ultimate Work Authority; Employee Participation Program (Safety); and Reporting Unsafe Working Conditions. The program must be designed to increase the sensitivity and understanding of personnel to community values, customs, harvest practices, and way of life in areas where such personnel will be operating. The orientation program also must include information concerning avoidance of conflicts with subsistence, sport, and commercial fishing activities.

The program must be attended at least once a year by all personnel involved in on-site exploration or development and production activities (including personnel of the lessee's/operator's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in such activities of the lessee/operator and its agents, contractors, and subcontractors. The lessee/operator must maintain, for a minimum of 5 years, a record of the name(s) and date(s) of attendance of all employees that have attended the orientation program.

Stipulation No. 4 – Transportation of Hydrocarbons

Pipelines may be required for transporting produced hydrocarbons to shore if BOEM determines that: (a) pipeline rights-of-way can be determined and obtained; (b) laying such pipelines is technologically feasible and environmentally preferable; and (c) pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts.

BOEM may require that any pipeline used for transporting produced hydrocarbons to shore be placed in certain designated areas. In selecting the means of transportation, consideration will be given to recommendations of knowledgeable advisory groups within federal, state, and local governments, and industry.

This stipulation reflects the agency's considerations for transporting produced hydrocarbons in a safe, environmentally sound, and practicable way. This stipulation would help reduce risks to water quality, lower trophic level organisms, fish and fish migration, endangered species, marine mammals, and other resources from spills resulting from oil and gas transportation. In doing so, the stipulation would enhance environmental justice through the agency's determination of whether or not a pipeline is the preferred method of transportation.

3.3.3 Additional Requirements of NMFS and USFWS for Marine Mammals

NMFS and the USFWS have regulatory responsibilities for certain marine mammals under the ESA (for those marine mammals listed as threatened or endangered), and for all marine mammals under the MMPA. BOEM's obligation to conduct ESA consultations with NMFS and USFWS generally results in project-specific requirements which would be included as conditions of BOEM's approval. However, if warranted, operators may receive authorization for incidental take under the MMPA. Such authorizations may contain project-specific conditions in addition to the typical/standard measures summarized below that apply to all MMPA authorizations. BOEM's analyses of impacts on biological resources in this SEIS assume that these typical measures would be implemented.

General

- The operator shall comply with the National Oceanic and Atmospheric Administration's (NOAA's) most current Marine Mammal Oil Spill Response Guidelines.
- Protected species observers (PSOs) shall be used where appropriate to monitor marine mammal presence and take steps to avoid and minimize injury and disturbance.

Noise

- Activities shall be timed and located in a manner that reduces potential marine mammal disturbance.
- Attenuation zones, also termed "safety radii" or "exclusion radii," shall be established and monitored around noise-producing activities to identify, prevent, and reduce harassment and injury to marine mammals from noise.
- In poor visibility conditions, operational and monitoring adjustments shall be made to increase detection of marine mammals or reduce noise exposure; for example, noisy activities may be halted or postponed.
- When marine mammals are detected outside a vessel's safety or exclusion radius and are likely to enter the attenuation zone, the vessel's activities, speed, and/or direct course will be modified to exclude the animal(s) from that zone in a manner that does not compromise human safety.
- Seismic surveys, drilling, or pile-driving shall not begin if marine mammals are in exclusion zones.

Vessel Traffic

- Vessels shall not approach within 91 m (100 yards) of cetaceans or pinnipeds, or 100 m (109 yards) of sea otters, except if necessary to protect the health and safety of the crew.
- Vessels shall not approach within 500 m of harbor seal haulouts (Jansen et al., 2010).
- Vessels shall be operated at speeds necessary to ensure no physical contact with marine mammals occurs (including prop strikes at startup), and shall reduce speed to <5 knots when near marine mammals, or as weather conditions require, to reduce the potential for collisions.
- Vessels shall not be operated in such a way as to separate marine mammals from their group.
- Vessel operators shall not make multiple changes in direction when within 274 m (300 yards) of marine mammals.
- Vessels shall avoid multiple speed changes; however, vessels should slow down when within 274 m (300 yards) of marine mammals, especially during poor visibility.

Aircraft Traffic

- Aircraft shall operate at least 457 m (1,500 ft) above sea level, except during an emergency or to maintain safety.

- When weather conditions do not allow a 457-m flight altitude, aircraft may be operated at altitudes below 457 m.
- Helicopters shall not hover or circle above marine mammals and shall use prescribed transit corridors.

3.4 Mitigation Measures Proposed

Where appropriate, BOEM also identified mitigation measures which, if implemented through lease stipulations or other mechanisms, would further reduce potential impacts to various environmental resources. These additional mitigation measures are described below and in relevant sections of Chapter 4 to which they apply. BOEM may require additional mitigation as part of the environmental review and approval of proposed EPs and DPPs.

3.4.1 Birds

Habitat Impacts

To minimize impacts caused by terrestrial habitat alteration: Construction activities and infrastructure, such as pipelines, shall avoid important habitat areas, including estuarine and salt marshes and coastal Important Bird and Biodiversity Areas (IBAs).

Steps shall be taken to minimize destruction of active nests, eggs, and flightless chicks. These include conducting land clearing in winter prior to the arrival of spring migrants, avoiding land clearing between April 20 and July 15, staging mechanized equipment in winter to deter ground-nesting birds, and/or other measures that achieve the stated goal (USFWS, 2020).

Disturbance Impacts

Flushing

To minimize disturbance to colonial nesting birds, and to follow existing practice (FAA/AIM, 2019; Denny and Hobi, 2017), aircraft will maintain an altitude of at least 610 m (2,000 ft) when flying over seabird colonies.

Lighting

To minimize collision impacts to flying birds, including those caused by light attraction, a lighting plan should be developed in cooperation with BOEM, BSEE, and USFWS. The lighting plan would include details on design, installation, and day-to-day operation of lighting on production platforms and large vessels (e.g., marine seismic survey vessels which may be offshore overnight or longer) and incorporate the monitoring and adaptive management strategies listed below:

- Education on lighting attractions and bird collisions shall be provided to relevant contractor/staff.

Where safety allows, the plans shall incorporate the following:

- The number of exterior lights operating at “on” at any one time shall be minimized. Lessees will minimize the use of high-intensity work lights. Exterior lights will only be used as necessary to illuminate active, on-deck work areas during periods of darkness or inclement weather; otherwise, they will be turned off.
- Exterior lights shall be down shielded.

- Black-out curtains shall be used on exterior-facing windows.
- All avian mortalities and collisions (i.e., the presence of birds, dead or stranded, that are unable to depart on their own) shall be reported in a timely manner to BOEM and USFWS for use in potential adaptive management strategies. Records shall be kept and reported according to protocols developed in cooperation with BOEM, BSEE, and the USFWS, and the data shall be annually submitted in an electronic format to BOEM and USFWS.

The Plan shall also consider the following for production platforms:

- Green or blue exterior lights shall be used instead of white lights. Green and blue artificial lights have been shown to decrease the number of mortalities among nocturnally migrating birds.
- A strobe-based light-repellant system, similar to that used at the Northstar Unit, shall be designed and implemented for use on production platforms.
- Crane booms shall be lowered when not in use, rather than kept aloft and lighted.
- The height of gas flare booms shall be designed above 20 m (66 ft) (i.e., to include consideration of the mean flight altitude of vulnerable bird species). At-risk birds such as Steller’s eider are known to fly relatively low, at about 20 m (66 ft), during migration.
- Flare boom operating procedures shall minimize gas flaring on low visibility nights during the spring and fall passerine and waterbird migration seasons (approximately March 15 to May 30 and July 20 to October 15).
- An adaptive management component shall be included in the monitoring plan for avian mortalities and collisions. At a minimum, the plan shall include daily surveys and timely identification of any potential causal factors, record-keeping, and reporting to BOEM/BSEE/USFWS, i.e.:
  - Daily surveys of the platform for the presence of birds, stranded or dead, and the circumstances of their death. Surveys may be performed in conjunction with other work/surveys;
  - Records shall be kept according to protocols described above under lighting, and
  - Data shall be submitted to allow for timely potential alteration of lighting protocols (design or operation) that have been specifically indicated as causing increased strikes (where and as soon as feasible and safety allows); and
  - Surveys shall be conducted until decommissioning commences unless all parties (BOEM, BSEE, and USFWS) agree to a different timeline.

Vessel Traffic

To minimize impacts to nesting seabirds, vessels travelling greater than 5 knots shall not approach within 1 nautical mile (nmi) of all seabird colonies.

Aircraft Traffic

To minimize impacts to nesting seabirds, where safety allows: Aircraft shall avoid approaching within 1 nmi of any seabird colony April 15 through August 31.

3.4.2 Commercial Fishing

Prior to commencing an activity, lessees shall coordinate with commercial fishing groups to develop a mutually agreeable plan that minimizes space-use conflicts.

Chapter 4 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The potential impacts of a Cook Inlet oil and gas lease sale were analyzed in the 2022 LS 258 FEIS. This SEIS contains summaries of the previous analyses of the potential environmental impacts that could result under Alternatives 1 (Proposed Action), 2, 3A, 3B, 3C, 4A, 4B and 5 from an oil and gas lease sale in Cook Inlet. It also includes updates based on relevant new information available since the 2022 publication of the FEIS. Additionally, this SEIS addresses the deficiencies of the 2022 LS 258 FEIS described in the decision by the Court, by including the following: 1) analyses of three additional alternatives identified as Alternatives 7, 8, and 9; 2) revised and expanded analysis of the environmental consequences of vessel noise on beluga whales specifically; and 3) a revised and expanded cumulative impacts analysis for beluga whales. This chapter summarizes, updates, and incorporates by reference, relevant material from the 2022 LS 258 FEIS, and reexamines the environmental resources analyses based on new information available since its publication.

An OCS lease sale provides qualified bidders the opportunity to bid on OCS blocks to gain conditional rights to explore, develop, and produce oil and natural gas. Issuance of a lease does not authorize any exploration, development, or production activities. However, in order to provide the public and decision-makers with a picture of potential post-lease activities and potential impacts that may occur as a result of the proposed lease sale (Proposed Action), BOEM creates and analyzes an E&D Scenario. The E&D Scenario describes the types of post-lease oil and gas activities that could occur resulting from a lease sale and provides estimates on timing, frequency, and duration. The E&D Scenario (Appendix B) analyzed in this SEIS is the same one analyzed in the 2022 LS 258 FEIS.

The affected environment descriptions and impact analyses by resource are detailed in the 2022 LS 258 FEIS and are hereby incorporated by reference. Each resource-specific section summarizes the analysis presented in the 2022 LS 258 FEIS and if necessary, updates the affected environment likely to be affected by the post-lease activities described in the E&D Scenario. New information that has become available since completion of the 2022 LS 258 FEIS and is relevant to impact analyses is provided. Summaries of the potential impacts of the lease sale under each alternative described in the 2022 LS 258 FEIS are presented and/or reexamined in Sections 4.3–4.15 including detailed descriptions of potential impacts of Alternatives 7, 8, and 9. The analysis of the alternatives for each resource considers routine activities, accidental events, cumulative impact analysis, and new information available since publication of the 2022 LS 258 FEIS.

The cumulative analysis considers environmental and socioeconomic impacts that may result from the incremental impact of the Proposed Action when added to all past, present, and reasonably foreseeable future OCS and non-OCS actions (e.g., state oil and gas activities, commercial transportation and commercial fishing). Additionally, climate change is an on-going consideration in these impact analyses given its role in the changing subarctic ecosystem. The cumulative analysis focuses on activities that are reasonably foreseeable and that overlap geographically and temporally with the impacts of the Proposed Action.

This SEIS evaluates three new alternatives—Alternatives 7, 8, and 9—that exclude substantial portions of the lease sale area (49.0 percent, 22.5 percent, and 20.9 percent, respectively). Despite these exclusions, the overall level of activity described in the E&D Scenario remains the same and the estimated volume of oil that could be produced and transported in the OSRA of large spills remains the same. Because the probability of one or more large spills is directly tied to the volume of oil handled, the overall risk of spill occurrence is unchanged. The removal of lease blocks by the alternatives described above would result in increased distance from hypothetical spill locations considered in the original large spill analysis and provide more time for mitigation and response measures to be implemented (BOEM, 2019) before contacting resources, should any spill occur. The general trends in increased time to contact are discussed qualitatively in the effects analysis of this SEIS, but OSRA results from the FEIS were not recalculated by removing individual trajectories from excluded lease blocks.

The OSRA model (Ji and Smith, 2021) for the Proposed Action, summarized in Section 3.1.8 of this SEIS and described in detail in Appendix A, is utilized for Alternatives 7–9. The oil spill effects for Alternatives 7–9 are analyzed in the same manner as the large spill effects for the Proposed Action. Because of this, BOEM believes it is likely overestimating the effects on environmental resources resulting from potential contact with a large oil spill.

4.1 Exploration and Development Scenario

E&D scenarios are hypothetical views of future oil and gas activities based upon professional judgment of the geologic features within the area offered for lease coupled with an analysis of current exploration and production activities. E&D scenarios provide a plausible set of post-lease activities that may result from leasing. The LS 258 E&D Scenario is only one possible view of how the potential resources of the lease sale area could be developed. It provides a set of activities to frame BOEM’s environmental analyses and to inform decision-makers and the public of potential environmental effects of the Proposed Action (to hold a lease sale). The E&D Scenario considers a range of oil production between 0 and 192.3 MMbbl and a range of natural gas production between 229.5 and 301.9 billion cubic feet (Bcf). The high case assumes production of 192.3 MMbbl of oil and 301.9 Bcf of natural gas. The high case assumes one oil and one gas field are discovered and developed as a result of LS 258. Developing these discoveries is estimated to occur over a 40-year period, and is categorized into three phases: exploration, development and production, and decommissioning. The E&D Scenario can be found in Appendix B of this SEIS and Section 4.1 of the 2022 LS 258 FEIS. Additional information on the E&D Scenario is available on BOEM’s website at https://www.boem.gov/ak258/.

4.2 Impact Scale

The analyses in this chapter apply a scale to categorize the extent of potential impacts to specific resources. The scale considers the context and intensity of the impact based on four parameters: detectability, duration (i.e., short-term or long-lasting), spatial extent (i.e., localized or widespread), and magnitude (i.e., less than severe or severe, where the term “severe” refers to impacts with a clear, long-lasting change in the resource’s function in the ecosystem or cultural context).

Analysts used the best available information and their professional judgment to determine where a particular effect falls in the continuum on a relative scale from “negligible” to “major.” For biological resources, impacts were determined based on changes in the stock or population, rather than the individual level.

The impacts scale applied in this SEIS is as follows:

- Negligible: Little or no impact;
- Minor: Impacts are short-term and/or localized, and less than severe;
- Moderate: Impacts are long-lasting and widespread, and less than severe; and
- Major: Impacts are severe.

In applying this scale and the terms that describe impact categories (levels of effect), analysts considered the unique attributes and context of the resource being evaluated. For example, in considering impacts to biological resources, attributes such as the distribution, life history, and susceptibility of individuals and populations to impacts were considered. For impacts to subsistence activities, factors considered include the fundamental importance of these activities to cultural, individual and community health, and well-being. Based on these unique characteristics, impacts to subsistence activities are considered severe, and thus, major, if they would disrupt subsistence activities, make subsistence resources unavailable or undesirable for use, or only available in greatly reduced numbers for a substantial portion of a subsistence season for any community.

4.3 Air Quality

BOEM has reexamined the analysis for air quality presented in the 2022 LS 258 FEIS based on the new information presented in Section . The air quality geographic analysis area, its existing air quality description, and its climate assessment have not changed (see Sections 3.2.2.7 and 4.3 of the 2022 LS 258 FEIS; and BOEM, 2016). However, since the publication of the 2022 LS 258 FEIS, regional pollutant sources and emissions from non-OCS oil- and gas-related activities have changed, potentially influencing regional air quality due to past, present, and future reasonably foreseeable actions.

The assumptions and methodologies for estimating criteria and precursor emissions have not been modified. A description of air quality, along with the full analyses of the environmental consequences of the routine activities, accidental events, and reasonably foreseeable impacts associated with the Proposed Action is detailed in Section 4.3 of the 2022 LS 258 FEIS. Section 4.3.3 is a summary of air quality and impact analyses incorporated by reference from the 2022 LS 258 FEIS and Volume II of the 2016 LS 244 FEIS, Appendix C.

A review of new information concluded that no new information on air quality has been identified that would alter the previous impact conclusions. This new information serves to supplement air quality analysis, but the overall air quality impact conclusions in the 2022 LS 258 FEIS remain unchanged.

4.3.1 Summary of Affected Environment

A detailed description of air quality in the Cook Inlet area, located in Section 4.3.1 of the LS 258 FEIS, is incorporated by reference and summarized below. Air quality is determined by the concentration of measurable pollutants present in the ambient air within a region. To safeguard air quality, the EPA established the National Ambient Air Quality Standards (NAAQS). The NAAQS regulates six common criteria pollutants: sulfur dioxide (SO_2), nitrogen dioxide (NO_2), CO, ozone (O_3), particulate matter (PM; categorized by size PM_{10} and $PM_{2.5}$), and lead (Pb). There are two classifications of NAAQS: primary and secondary. Primary standards protect sensitive population groups (i.e., children, the elderly, and asthmatics), while secondary standards protect the public welfare, including visibility, and damage to animals, crops, vegetation, and buildings.

The State of Alaska regulates air quality over the land area surrounding the waters of Cook Inlet relative to a demarcated geographical area designated by the U.S. Environmental Protection Agency (EPA) as the Cook Inlet Intrastate Air Quality Control Region (AQCR), where AQCRs are defined under 42 USC 7407 (40 CFR 81.54 and ADEC 18 Alaska Administrative Code (AAC) 50.015, Table 2). The Cook Inlet AQCR includes all of the Municipality of Anchorage, the KPB, and the Matanuska-Susitna Borough. Thus, the EPA regulations applicable to the corresponding onshore area refer to the attainment status of the Cook Inlet AQCR and are also relevant to the lease sale area; attainment status, which is characterized as either attainment, nonattainment, or unclassifiable, is defined in Sec. 107 of the Clean Air Act (CAA) (42 USC 7407).

Areas that do not meet the NAAQS for one or more pollutant(s) are classified as nonattainment. Unclassifiable areas are treated as being in attainment. Maintenance areas are regions that were previously classified as nonattainment but have since demonstrated attainment of the NAAQS. The Cook Inlet Intrastate AQCR is largely considered to have pristine air quality (refer to Table 4-5 of the 2022 LS 258 FEIS), except for a portion of urban Anchorage and Eagle River.

The CAA also gives special air quality and visibility protection to national parks and wilderness areas larger than 6,000 and 5,000 acres, respectively, by allowing their designation as “Class I” areas. The Tuxedni Wilderness area within the Alaska Maritime National Wildlife Refuge is a 5,564.8-acre area located on Chisnik Island and Duck Island in Cook Inlet, adjacent to the lease sale area. It is the only Class I area in the region. Within the Cook Inlet AQCR, a portion of the Anchorage urban area located 160.9 km (100 mi) northeast of the lease sale area is designated a serious maintenance area for emissions of carbon monoxide (CO). In addition, 2.4 km (1.5 mi) northeast of Anchorage, the community of Eagle River is a moderate maintenance area for emissions of PM_{10} (EPA, 2015a and 2022; ADEC, 2016). No other nonattainment area or maintenance area for any other criteria pollutant is located within the Cook Inlet AQCR. Maintenance areas are those areas with a past violation of air quality standards that have been corrected, and which have since maintained the standard. These ‘maintenance areas’ remain under evaluation for 10 years. Background concentration of pollutants in the Cook Inlet OCS area and surrounding coastal area in comparison to the NAAQS and State of Alaska air quality standards can be found in Table 4-5 of the LS 258 FEIS. Currently, the air quality on the Kenai Peninsula meets, or is cleaner than the NAAQS.

4.3.2 New Information Available Since Publication of the 2022 LS 258 FEIS

Since the publication of the 2022 LS 258 FEIS, new information relevant to air quality in the Cook Inlet analysis area has become available from the EPA. The information provided below was assessed to determine its impact on the initial air quality analysis completed for the 2022 LS 258 FEIS.

To strengthen the nation’s NAAQS for fine particle pollution, the EPA revised the primary annual particulate matter equal to or less than 2.5 micrometers ($PM_{2.5}$) standard by lowering the level from 12.0 micrograms per cubic meter ($\mu g/m^3$) to 9.0 $\mu g/m^3$. The updated $PM_{2.5}$ standard was promulgated effective May 6, 2024 (89 FR 16202). As a result of this change, the Percentage of the Standard, as presented in this section (Table 4-1), would increase from 30.8 percent to 41.1 percent. This revision confirms that the Proposed Action remains compliant with the stricter annual $PM_{2.5}$ standards and would not result in a NAAQS exceedance.

On November 27, 2024, the EPA published the final rule (89 FR 95034) for the Guideline on Air Quality Models or “Guideline” (Appendix W to 40 CFR Part 51), which applies to federal, state, Tribal, and local regulatory use. The rule became effective January 28, 2025, with a one-year transition period ending November 29, 2025. The updated Guideline has been integrated into EPA’s regulations fulfilling the CAA Section 165(e)(3)(D) requirement for EPA to specify models to be used in the Prevention of Significant Deterioration (PSD) program. It outlines EPA-preferred air quality models, provides additional recommended techniques, and gives guidance for estimating ambient air pollutant concentrations (EPA, 2025). Most of the revisions focused on the enhancements to the American Meteorological Society/EPA Regulatory Model (AERMOD); however, the Guideline and the SOA still support the use of Offshore Coastal Dispersion (OCD) modeling in offshore situations where platform downwash and shoreline fumigation may occur (ADEC, 2018; EPA, 2017). The use of OCD Model 5 remains appropriate, considering the E&D Scenario and its ability to model for platform downwash and shoreline fumigation.

BOEM also reassessed the GHG emissions from Table 4-6 of the 2022 LS 258 FEIS. Table 4-1 below presents the original emissions estimates from LS 258 and the updated GHG assessment. The estimated emissions from criteria and precursor pollutants are expected to remain unchanged, as there are no modifications to the E&D Scenario.

Table 4-1: Reassessment of Estimated Greenhouse Gas Emissions from LS 258

Greenhouse Gases	Emissions LS 258 (short tons)[1]	Emissions LS 258 (short tons)[2]
N_2O	190	135
CH_4	69,427	2,001
CO_2	8,435,637	4,532,437
Total CO_2e	10,227,866	4,622,692

Notes: [1] Original GHG assessment from 2022 LS 258 FEIS. Carbon Dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O)
[2] Updated GHG assessment.
Source: Table 4-6, 2022 LS 258 FEIS

4.3.3 Environmental Consequences of the Proposed Action

Pollutant GHG types are considered in this air quality analysis due to their direct effects on human health from ambient concentrations of pollutant GHGs (EPA, 2009). Carbon-containing air pollutants, including CH_4, contribute to the formation of ground level O_3 (EPA, 2020). When estimating emissions, BOEM's models quantify the three main GHGs: CO_2, CH_4, and N_2O. Table 4-1 lists the previous and updated analysis for the GHGs anticipated directly from LS 258. This chapter focuses on the effects on air quality and not climate change. Greenhouse gases from the Proposed Action, and how they would contribute to future effects from climate change, are discussed in Appendix C of this SEIS.

Air emissions from OCS oil and gas development in the Cook Inlet could occur due to construction and operation activities associated with the Proposed Action. As described in Section 4.3.2 of the 2022 LS 258 FEIS, the combustion of diesel fuel, natural gas, and aviation fuel are the three primary contributors with the potential to impact air quality. The 2022 LS 258 FEIS incorporated by reference the modeling results from the OCD5 modeling study conducted for the 2016 LS 244 FEIS. The OCD5 model is an EPA preferred dispersion modeling tool designed to evaluate overwater plume transport, shoreline crossings, plume fumigation, and plume dispersion near offshore structures (e.g., downwash). OCD5 evaluated the worst-case air quality impacts on sensitive areas, including the Tuxedni Wilderness Area (Class I) and nearby inshore regions, from OCS oil and gas development. This assessment evaluated compliance with the NAAQS, the state AAQS, and the PSD program. Modeling results demonstrated the highest pollutant concentrations would occur over water and near the Oil and Gas (O&G) facility (e.g., an exploration rig or production platform) and rapidly decrease with distance (see Table C-1 and C-3, Appendix C-8, Volume II, 2016 LS 244 FEIS).

Refer to Section 4.3.2 of the 2022 LS 258 FEIS for estimated emissions and the highest predicted concentrations from exploration and production, detailed in Tables 4-6, 4-7, and 4-8. These estimates have not been updated in this SEIS but are assumed to still be valid as E&D scenarios are not anticipated to change. The analysis concluded that criteria air pollutant emissions from offshore exploration and production in attainment areas are unlikely to result in exceedances of NAAQS (note: if modeling indicates a potential exceedance of the PSD Class I increments near a Class I or Class II area, operators may need to obtain an EPA PSD permit and submit their air quality analysis to the USFWS and/or National Park Service for regulatory review).

BOEM applied the modeling results from LS 244 to LS 258, given that both lease areas are in the same planning area, anticipate the same types of pollutants with respect to the NAAQS, and are both located near the Tuxedni Wilderness Area. Further information regarding the air quality modeling study is provided in Sections 4.3.2 and 4.3.5 of 2022 LS 258 FEIS; and Appendix C of the 2016 LS 244 FEIS, Volume II.

Oil spills, spill drills, and spill cleanup activities, whether accidental or routine, can impact air quality. Impacts will vary based on the size, location, duration of spill(s) or drills, and the meteorological conditions. Detailed discussions on the effects of spills, spill drills, and spill response activities on air quality are provided in Table ES-2 of the Executive Summary in the 2022 LS 258 FEIS; and Section A-3.1 in Appendix A. Impacts from post-lease activities conducted as a result of the proposed action, including accidental small spills, and spill drills, would be minor, but could have minor to moderate impacts on air quality when impacts from a large spill are considered.

4.3.4 Environmental Consequences of Alternatives 3A, 3B, 3C, 4A, 4B and 5

The exclusion of 10 and 7 blocks under Alternatives 3A and 4A, respectively, would not result in changes to the estimated emissions and is not expected to cause significant differences in overall air quality. Air quality under Alternatives 3A, 3B, 3C, 4A, 4B, and 5 are anticipated to be similar to those of the Proposed Action. Overall, air quality impacts under Alternatives 3–5 are expected to be short-term and minor and are unlikely to result in a NAAQS exceedance. Refer to Sections 2.3–2.5, and 4.3.2.2 of the 2022 LS 258 FEIS.

4.3.5 Environmental Consequences of Alternative 7–9

BOEM reevaluated the air quality analysis presented in the 2022 LS 258 FEIS using the original estimated emissions to compare against Alternatives 7, 8, and 9 to determine the extent of air quality impacts expected under each Alternative. The E&D Scenario used for this analysis remains unchanged from the 2022 LS 258 FEIS. Alternatives 7, 8, and 9 reduce lease areas by 49 percent, 22.5 percent, and 20.9 percent, respectively. However, current emission sources (e.g., stationary and mobile) in and around the Cook Inlet Intrastate AQCR do not produce levels of emissions that cause exceedances or violations of the NAAQS. This is because air quality effects would not be additive due to rapid dispersion and diffusion with the surrounding clean air (BOEM, 2022). In conclusion, the air quality impacts from Alternatives 7, 8, and 9 are expected to be comparable to those of the Proposed Action. These post-lease related emissions would occur over the anticipated maximum 40-year lifespan of these operations.

4.3.6 Cumulative Effects

The inclusion of incremental actions from LS 258 activities, as described in the E&D Scenario, combined with a changing climate and other reasonably foreseeable actions – such as oil and gas operations, onshore and near-shore renewable energy development, large spills, increased vessel and aircraft traffic, national security activities, regional recreation and tourism – could impact air quality. Updated reasonably foreseeable past, present, and future actions are found in Section 3.2 of this SEIS.

Emissions from past actions are expected to have dispersed throughout the atmosphere and are not anticipated to contribute to cumulative air quality impacts. Present and reasonably foreseeable future actions represent potential onshore or near-shore sources of air emissions, including both stationary and mobile sources, such as industrial facilities, vessels, and vehicles. As stated in the 2022 LS 258 FEIS, emission sources in and around the area are not anticipated to cause any exceedances or violations of NAAQS.

The updated PPRFFA (Section 3.2) includes actions associated with the six future OBBBA lease sales in Cook Inlet. While activities could occur concurrently, they are unlikely to take place in the same vicinity. Lease blocks are approximately ~14.5 km (9 square miles (mi^2)) in size, and operators typically do not lease blocks adjacent to other operators (BOEM, 2022). Therefore, it is unlikely that two independent exploration or production operations would occur close enough to generate a combined or synergistic air quality effect. Furthermore, because these sources are not expected to emit within the same area, their emissions plumes would likely disperse before interacting, reducing the potential for elevated pollutant concentrations. As a result, emissions produced from E&D activities for LS 244, LS 258, and the 6 future OBBBA lease sales are not projected to have synergistic or additive air quality effects with ongoing or planned onshore or near shore activities (BOEM, 2016, 2022).

A large oil spill could result in minor to moderate impacts on air quality. The extent of these impacts would depend on various factors, including the time of the year, the type of activity, and/or the size of the spill. While an increase in air quality impacts could occur under these conditions, they are expected to be short-term.

Climate change can also affect air quality by increasing ambient air temperatures and altering atmospheric circulation patterns. Changes to global circulation may result in localized changes in rainfall distribution, resulting in wetter than normal conditions in some areas and drier conditions in others, which can influence pollutant dispersion and concentration. Higher water vapor content (due to higher temperatures) is expected to decrease ozone background concentrations. The distribution and movement of particulate matter (including black carbon) are complex and uncertain within a changing climate (BOEM, 2022). Although black carbon makes up a small portion of $PM^{2.5}$, it is a climate forcing pollutant. Post-lease activities conducted as a result of LS 258, as described in the E&D Scenario, may have an additive effect when considering the ongoing impacts of climate change.

Overall, past, present, and future reasonably foreseeable actions are expected to result in minor to moderate air quality impacts and are not anticipated to violate the NAAQS. Cumulative effects for the Proposed Action and Alternatives 1–5 are discussed in Section 4.3.4 of the 2022 LS 258 FEIS; and in Section C-9, Appendix C, of the 2016 LS 244 FEIS.

Similar to the Proposed Action and Alternatives 1–5, Alternatives 7, 8, and 9 are not projected to be cumulative when combined with ongoing or planned onshore or nearshore activities due to the rapid dispersion and diffusion with the surrounding air. Air quality impacts under Alternatives 7, 8, and 9 are expected to be similar to that of the Proposed Action and Alternatives 1–5. Alternatives 7, 8, and 9 are expected to support the SOA in maintaining compliance with the NAAQS.

4.3.7 Conclusion

BOEM has reexamined the impact conclusions for air quality presented in the 2022 LS 258 FEIS. The regulatory and maintenance statuses of the Cook Inlet Intrastate AQCR (EPA, 2025) have remained unchanged since the publication of the 2022 LS 258 FEIS. No new information was discovered that would alter the impact conclusions for air quality presented in the 2022 LS 258 FEIS, and the analysis and assessment of potential impacts still apply for LS 258. The post-lease activities that may result from LS 258, as described in the E&D Scenario, and including small spills and spill drills (e.g., the Proposed Action) are expected to result in minor impacts on air quality and are unlikely to result in a NAAQS exceedance. The level of impacts to air quality in the lease sale area from Alternatives 3A, 3B, 3C, 4A, 4B, and 5 would be essentially the same as the Proposed Action – short-term and minor. Additionally, a lease sale under Alternatives 7, 8, or 9 would be expected to have the same level of impacts as the Proposed Action – short-term and minor. The impacts of past, present, and reasonably foreseeable future actions, when combined with effects of the Proposed Action, would be minor. Overall, impacts on air quality will be short-term and localized, generally minor. The impacts of a large spill and spill response on air quality, when combined with impacts from the Proposed Action, would be short-term and minor to moderate.

4.3.8 Life Cycle Greenhouse Gas Emissions

BOEM has updated its analysis of life cycle GHG emissions since publication of the 2022 LS 258 FEIS. The most recent model and data updates are found in the publication of the 2024–2029 National OCS Oil and Gas Program. The updated analysis for this SEIS includes a newly developed quantitative estimate of the Proposed Action's impact on foreign oil production and the related upstream GHG emissions. The results of this analysis are included in Appendix C.

The analysis for this SEIS considers the impacts from the Proposed Action. Importantly, while the location of the forecasted activities could shift under any of the action alternatives, the ranges of overall production and activity levels do not change, as discussed in Chapter 3 and Chapter 4 Therefore, the modelled GHG emissions are applicable to any action alternative.

This chapter provides an overview of BOEM's life cycle GHG emission estimates. The full analysis is included in Appendix C. "Life cycle" refers to emissions from all activities related to the upstream (exploration, development, and production), midstream (storage, refining, and transportation), and downstream (consumption) of a resource. Given the global nature of energy, in particular oil, BOEM includes both domestic and foreign GHG emissions in the analysis to the extent possible to capture both the emissions associated with OCS production as well as the resulting emissions associated with the impact that OCS production has on other domestic energy production and foreign oil production. The quantitative GHG emissions analysis can be categorized into two components: (1) the full life cycle GHG emissions estimates of domestically produced or consumed energy; and (2) the GHG emissions estimates of foreign oil production (upstream) and consumption (downstream). The potential general effects from climate-related factors to the environment are discussed in the specific resource sections later in this chapter.

BOEM's GHG analysis considers a No Action Alternative in which there is no new OCS leasing. Because there is no new leasing in the No Action Alternative, there are no associated GHG emissions assigned to the No Action Alternative, as emissions from energy sources that are part of the energy market baseline (i.e. the level and sources of energy present in the absence of the Proposed Action) are considered the baseline level of emissions (see Appendix C for more detail). GHG emissions associated with OCS oil and gas production from existing leases would still occur in the absence of the Proposed Action, but because these emissions would occur regardless of future leasing decisions, they are not quantified separately. Rather, they are treated as part of the modeling baseline along with all other sources of energy not directly stemming from a new OCS lease sale. To the extent existing leases' production or other energy sources are displaced by the Proposed Action's production, BOEM accounts for the emissions reductions within its estimate of the total Proposed Action emissions. Total Proposed Action emissions are those associated with OCS exploration, development, and production from a lease sale under the Proposed Action after accounting for those emissions displaced from substitute energy sources which are not produced or consumed under the Proposed Action.

The total Proposed Action GHG emissions are the emissions from new OCS oil and natural gas activity and production as described in the analyzed E&D scenarios (Appendix B). This also includes the reduction in GHG emissions based on displaced substitute energy sources, such as coal, biofuel, renewables, and onshore or imported oil and natural gas, displaced by the modeled OCS oil and gas production under the Proposed Action. When considering the full life cycle of energy produced or consumed domestically, BOEM's analysis indicates that the Proposed Action GHG emissions estimates are higher than those of displaced energy substitutes, and small changes in modeling assumptions could lead to different results. The total Proposed Action emissions are estimated at 5.4 million metric tons CO_2 equivalents (CO_2e) above the No Action Alternative GHG modeling baseline (Appendix C).

BOEM's analysis also considers GHG emission estimates resulting from a change in foreign oil production and consumption. If the Proposed Action is selected, BOEM estimates foreign oil consumption would increase by 43.3 MMbbl over the period of Proposed Action production described in the high activity level E&D Scenario. This is due to the decrease in prices caused by an increase in supply from anticipated OCS oil and natural gas production under the Proposed Action resulting in an increase in consumption.

Table 4-1 shows the estimates of life cycle GHG emissions from OCS oil and natural gas anticipated from new leases under the Proposed Action and those of domestically consumed or produced energy that would be displaced by the anticipated OCS oil and natural gas. Table 4-2 also shows the change in GHG emissions associated with foreign oil production (upstream) and consumption (downstream) estimated to occur due to a decrease in oil prices under the Proposed Action. While BOEM provides estimates of GHG emissions resulting from a shift in foreign oil production and consumption, BOEM is not able to quantify the change in the global full life cycle GHG emissions resulting from the Proposed Action. BOEM provides a qualitative discussion of the unquantified components of global GHG emissions, i.e., those resulting from foreign oil's midstream and the full life cycle of foreign displaced non-oil energy substitutes (Appendix C).

Table 4-2 shows that BOEM estimates about 4.2 million metric tons of CO_2e would be emitted from upstream OCS oil- and gas-related activities for the Proposed Action at the high activity level. However, because of the OCS production, other energy sources would not be produced (i.e., displaced). These displaced sources would have generated 9.9 million metric tons of CO_2e upstream emissions. The displaced energy substitutes, primarily oil imports and domestic onshore oil and gas, have higher upstream GHG emissions per barrel of oil equivalent than OCS oil and gas. This leads to estimated reductions in total Proposed Action emissions for the domestic upstream.

Table 4-2: Life Cycle GHG Emissions of the Proposed Action in Thousands of Metric Tons CO_2e

Activity Level	Source	Domestic Upstream	Domestic Mid- & Downstream	Domestic Total	Foreign Oil Upstream	Foreign Oil Downstream
High	OCS Oil & Gas Emissions	4,194	80,455	84,649	2,153	16,437
High	Displaced Energy Emissions	-9,901	-69,330	-79,232	**	**
High	Total Proposed Action Emissions*	-5,708	11,125	5,418	2,153	16,437

Notes: Values rounded to nearest 1,000 metric tons.
For ease of comparison, BOEM provides combined totals of all three GHG emissions in CO_2 equivalents (CO_2e). Methane (CH_4) and nitrous oxide (N_2O) are converted to CO_2e using EPA current Global Warming Potentials (40 CFR Part 98) .
* The Total Proposed Action Emissions are the emissions associated with the OCS oil and gas plus the reductions associated with displaced energy substitutes. These emissions represent total GHG emissions attributable to the Proposed Action, i.e., row 1 plus row 2 (for each activity level).
** BOEM is unable to quantitatively estimate energy substitutes in foreign markets. Thus, there are no estimates of displaced energy substitutes within the columns for the foreign GHG emissions estimates.

For the midstream and downstream, the Proposed Action high-activity level emissions are estimated at 84.6 million metric tons of CO_2e. However, the emissions reductions from the displacement of energy substitutes are estimated at 79.2 million metric tons of CO_2e. This results in total Proposed Action midstream and downstream GHG emissions of 5.4 million metric tons of CO_2e. The Proposed Action mid- and downstream GHG emissions estimates are larger than those of the displaced substitutes. This increase is due to slightly higher energy consumption and fuel switching towards oil and natural gas influenced by lower oil and natural gas prices as a result of the anticipated OCS oil and natural gas production from new leases under the Proposed Action.

In total, the life cycle analysis of domestically produced or consumed energy shows that selection of the Proposed Action results in a small increase (less than 7 percent relative to displaced emissions) in emissions from those under the No Action Alternative.

Appendix C provides context for the domestic life cycle GHG emissions analysis by comparing Total Proposed Action Emissions for the high activity level to various annual state emissions. As shown in Table 9 in Appendix C, the 37 years of estimated OCS oil and gas activity associated with the Proposed Action (i.e., a single proposed OCS oil and gas lease sale) are estimated to generate a similar volume of GHG emissions as 21 months of the average monthly emissions generated in Alaska during 2022.

The domestic analysis indicates that the Proposed Action emissions are higher than those resulting from the displaced substitutes. When considering the impact of changes in foreign oil production and consumption, the Proposed Action represents an even greater increase in estimated global GHG emissions relative to those of the domestic analysis. BOEM quantitatively estimates the change in foreign oil's upstream and downstream GHG emissions as a result of lower global oil prices under the Proposed Action. Table 4-2 shows BOEM's estimates of the increase in foreign oil upstream GHG emissions under the Proposed Action as well as the increase in GHG emissions from foreign oil consumption. Foreign oil production decreases under the Proposed Action. However, BOEM's domestic analysis accounts for a reduced upstream (production) GHG emissions from a decrease in oil imports consumed domestically. From a global perspective and to avoid double counting, BOEM adjusts the foreign oil upstream GHG emissions. See Appendix C for a more detailed discussion of these adjustments. BOEM qualitatively considers shifts in the broader foreign energy market that are currently unable to be quantified. Like the impact on foreign oil's downstream, the foreign oil midstream would likely see an increase in GHG emissions. While foreign energy markets would see a decrease in GHG emissions due to increased oil consumption displacing substitute fossil fuel sources, (e.g., natural gas and coal), that decrease would not mitigate the quantified increase in foreign oil's upstream and downstream emissions.

After estimating GHG emissions, BOEM then places the estimated volumes of the GHG emissions attributable to the Proposed Action into context with a discussion of their potential impacts on the environment and resources we depend on to support our economy and lifestyle.

In conclusion, global GHG emissions would increase under the Proposed Action. BOEM is not providing a combined quantitative estimate of domestic and foreign emissions because BOEM's foreign GHG analysis is not quantified to the same extent as the domestic GHG analysis. However, as explained in Appendix C, were BOEM able to quantify the missing components of the foreign GHG analysis, such estimates would not be expected to change BOEM's conclusions about the relative impact differences between the Proposed Action and alternatives. Therefore, BOEM is relying on qualitative assessments to fill quantitative gaps where possible. BOEM's combined quantitative and qualitative GHG analyses represent the best available and scientifically credible approach for evaluating and comparing emissions under the Proposed Action and the No Action Alternative. BOEM has used the reliable scientific information available to date and reasonably accepted scientific methodologies to extrapolate from existing information. The incomplete or unavailable information above, while relevant, would not likely change the impact conclusions reached in this analysis and is not essential to a reasoned choice among alternatives.

4.4 Water Quality

BOEM has reexamined the water quality analysis presented in the 2022 LS 258 EIS based on the new information presented in Section 4.4.2. While this new information documents the potential impacts on water quality and the ecological health of the marine system due to the photoxidation of hydrocarbon compounds, the impact conclusion for water quality as presented in the 2022 LS 258 FEIS, and as incorporated herein by reference, remains unchanged. A description of water quality resources, along with the full analyses of the environmental consequences of the routine activities, accidental events, and cumulative impacts associated with the Proposed Action are presented in Section 4.4 of the 2022 LS 258 FEIS. The updated analysis associated with the Proposed Action is found below in Section 4.4.3. Analysis of the environmental impacts resulting from Alternatives 3A, 3B,3C,4A, 4B, and 5, and Alternatives 7–9 are found in Section 4.4.5. The updated cumulative effects analysis is below in Section 4.4.6.

4.4.1 Summary of Affected Environment

A detailed description of water quality resources, located in Section 4.4 of the 2022 LS 258 FEIS, is incorporated herein by reference and summarized as follows. Cook Inlet is a complex estuary receiving freshwater discharge from numerous rivers and streams, and marine connections with Shelikof Strait and the Gulf of Alaska. Many of the streams flowing into Cook Inlet are glacially fed and contain high concentrations of suspended particulate matter (Segar, 1995). The quality of water in the Cook Inlet Planning Area meets criteria for the protection of marine life according to Section 403 of the Clean Water Act (CWA). Hydrocarbon concentrations in Cook Inlet sediments are comparable to values reported for background hydrocarbons in Alaska offshore coastal waters; therefore, oil and gas production in upper Cook Inlet does not appear to be a source of petroleum contaminants (MMS, 2001). Previous studies have found no indication of heavy metal pollution in lower Cook Inlet, but some evidence of elevated mercury (Hg) in suspended sediment, most likely linked to riverine inputs, may originate naturally or from past mining and other anthropogenic activities (Kinnetic Laboratories, 2010; Segar, 1995).

4.4.2 New Information Available since Publication of the 2022 LS 258 FEIS

Relevant new scientific material on the understanding of Cook Inlet water quality has become available since the publication of the 2022 LS 258 FEIS. This new information documents the potential impacts to Cook Inlet water quality and the ecological health of the marine system due to the solubility, bioavailability, and induced toxicity resulting from the photooxidation of hydrocarbon compounds. This information advances BOEM’s understanding of the potential impacts to the Cook Inlet aquatic environment, and although this new information informs this updated analysis, it does not change the current levels of, or effect on, water quality impairment in Cook Inlet; therefore, the conclusions presented in the 2022 LS 258 FEIS remain unchanged.

Tomco et al. (2023a) investigated the chemical fate and toxicity of photooxidized Cook Inlet crude oil. Hydrocarbon oxidation products (HOPs) are crude oil degradation by-products that are formed from weathering processes in the environment. Readily water soluble and more bioavailable when compared to parent oil, HOPs pose a potential biological threat due to the solubility and toxicity of the resulting compounds. Production of these degradation intermediates via photooxidation occurs when solar radiation, particularly ultraviolet (UV) light, initiates a series of reactions resulting in more water-soluble oxidized products. The potential toxicological effects of HOPs are of concern in Cook Inlet, particularly in the event of a summer crude oil spill where sunlight for 16 hours per day may result in significant photo-enhanced toxicity (Tomco et al., 2023b).

Dissolution and photooxidation of hydrocarbon compounds following an oil spill is a process that poses risks to the ecological health of a marine system. Tomco et al. (2023b), Harsha et al. (2024, 2023), and Redman et al. (2024) all examined the transport, fate, and toxicological significance of HOPs in Cook Inlet. Analytical techniques outlined by Harsha et al. (2023) identified the production of napthenic acids and oxygenated polycyclic aromatic hydrocarbons (oxyPAHs) in laboratory simulated oil spills using Cook Inlet crude oil and diesel. Harsha et al. (2024) examined the chemical complexity and toxicity contribution of the readily available water-soluble fraction of crude oil and dissolved HOPs on Pacific herring embryos, focusing on photomodification induced toxicity and biological mechanisms.

Highlighting the diversity of the complex mixture resulting from the photooxidation of crude oil and the limitations of targeted analysis for adequately monitoring HOPs in the environment, Redman et al. (2024) identified 251 HOPs using a non-target analytical approach. Whisenhant et al., (2022) furthers the investigation into HOPS by examining the unique short-wavelength feature associated with photo-oxidized refined fuel (including heating oil, diesel, Jet-A, kerosene, and gasoline) that are not present in photolytically decomposed crude oil.

4.4.3 Environmental Consequences of the Proposed Action

Post-lease activities conducted as a result from LS 258 which disturb the seafloor and generate a resuspension of sediment, or discharge directly to the water, could impact water quality through introduction of suspended solids, turbidity, and other pollutants. Turbidity, and its associated total suspended solids (TSS) in the water column, would be temporarily and locally increased from seafloor disturbance activities decreasing over time as suspended solids settle to the ocean floor. Elevated TSS levels from temporary seafloor disturbance activities are highly unlikely to exceed ambient TSS levels that naturally occur from riverine and stream inputs draining into Cook Inlet (Saupe et al., 2005). Drill cuttings and fluids discharged into the marine environment disperse in the water column increasing turbidity, accumulate on the seafloor potentially smothering benthic organisms, elevate concentration of some trace metals, and alter sediment characteristics (NRC, 1983, 2003, 2005). Increased temperature and salinity in drilling fluid discharges could cause localized and temporary impacts to water quality. BOEM expects that all discharges from lease activities associated with LS 258 will comply with permit limits set forth by the EPA National Pollutant Discharge Elimination System (NPDES) program.

In accordance with the CWA § 402, an EPA NPDES permit must be obtained for all oil and gas operational discharges (including vessel discharges), during exploration, production, and decommissioning. Aside from exploration cuttings and fluids, discharges such as bilge water, ballast water, fire control system test water, cooling water, sanitary and domestic wastes, and deck drainage could contain a variety of nutrients, trace metals, and other pollutants. While these pollutants have the potential to impact water quality near the point of discharge, these discharges are expected to represent only small pollutant loadings when properly designed and functioning equipment is used, and little to no impacts would be expected. Production and development rock cuttings would not be discharged, but are assumed to be reused, reinjected, or barged to shore for onshore disposal (see Section 4.1.2 for E&D Scenario in 2022 LS 258 FEIS; production and development assumptions); subsequently, no impacts to the marine environment would result from these specific discharges.

Effects of spills, spill drills, and spill response activities on water quality are described in Section A-3.3 of Appendix A. Most accidental spills would be small, localized, and have relatively temporary and inconsequential impacts on water quality. A large oil spill would impact water quality in the area of the release and if the spill occurred under broken ice, it might have long-lasting, albeit localized, impacts. Long-term impacts could result should the spill reach the shoreline affecting estuarine and riverine waters causing long-term persistence of hydrocarbon contamination in marine or shoreline sediments.

Additionally, recent efforts by Tomco et al. (2023a, b), Harsha et al. (2023, 2024), and Redman et al. (2024) (see Section 4.4.2) further demonstrate the potential impact on water quality and the ecological health of the marine system due to the solubility, bioavailability, and induced toxicity resulting from the photooxidation of hydrocarbon compounds. Exposure to sunlight adds oxygen to crude oil, changing the oil's chemical and physical properties and producing an entire range of highly water-soluble bioavailable compounds (Tomco et al., 2023b). Readily transportable through water movements, these highly mobile HOPs are capable of traveling vast distances ahead of any signs of a visible oil spill front. Identifying the presence of these complex compounds in the aquatic environment resulting from a large oil spill would necessitate the employment of a variety of analytical techniques to appropriately document and monitor the fate and transport of these HOPs. And although this new information does not change the overall impact conclusion for water quality (see Section 4.4.7), it does, however, advance the understanding of the potential long-term impacts to water quality and the coastal ecosystems resulting from a large oil spill.

4.4.4 Environmental Consequences of the Alternatives 3A, 3B, 3C, 4A, 4B, and 5

Potential impacts on water quality under all action alternatives would not differ substantially from those described for the Proposed Action (Section 4.4.2, 2022 LS258 FEIS) or as updated in Section 4.4.3. These alternatives would not change the total level of activity considered in the E&D Scenario, and none of the restrictions identified in these alternatives would be expected to change the likelihood or severity of impacts on water quality. Consequently, impacts of these alternatives on water quality would be the same as those for the Proposed Action – minor over the life of the E&D Scenario, accidental small spills, and spill drills.

4.4.5 Environmental Consequences of Alternatives 7–9

A lease sale under Alternatives 7, 8, or 9 would have similar impacts to water quality as those described and analyzed for the Proposed Action in the 2022 LS 258 FEIS (Section 4.4.2) and as updated in Section 4.4.3. Activities as described in the E&D Scenario that disturb the seafloor, generate a resuspension of sediment, or discharge directly to the water could impact water quality through introduction of suspended solids, turbidity, and other pollutants. Such activities include drilling of exploration, delineation, production, and service wells; anchoring; installing and removing nodes, cables, and sensors; trenching activities for subsea/shoreline pipelines; preparation of the seabed for exploration and/or production platforms; and pipeline decommissioning.

For Alternatives 7, 8, and 9, the overall activity level as described in the LS 258 E&D Scenario (Section 4.1, 2022 LS 258 FEIS) would remain the same; however, a reduction in the lease blocks offered for lease is considered. Alternative 7 (the Northern Area Exclusion) would reduce the lease sale area offered for lease by 49 percent. Alternatives 8 and 9 would reduce the lease sale areas offered for lease by 22.5 and 20.9 percent, respectively. The reduction in the number of lease blocks proposed in Alternatives 7, 8, and 9 lessens the overall lease sale area, but does not modify the type nor duration of the anticipated E&D activities. For all excluded blocks in Alternatives 7–9, there would be a complete lack of any temporary and short-term elevated levels of TSS, seafloor disturbances, and NPDES permitted discharges. Due to the highly influential and invariant tidal range driving water circulation throughout the greater Cook Inlet area, any differences in water quality across the areas represented by Alternatives 7–9 would only be measurable at a very small, localized scale. Therefore, because the post-lease activities as described in the E&D Scenario remain unchanged, the potential impacts to water quality as identified in the 2022 LS 258 FEIS also remain unchanged. Overall, impacts of these alternatives on water quality would be minor over the life of the E&D Scenario, including accidental small spills, and spill drills. The addition of a large oil spill and any ensuing spill response would increase the overall impact on water quality to moderate because the effects could be long-lasting and widespread.

4.4.6 Cumulative Effects

While many cumulative impacts are reasonably foreseeable, the addition of the Proposed Action to the past, present, and reasonably foreseeable future actions (Section 3.2 is not expected to generate widespread or persistent impacts to Cook Inlet water quality. The potential impacts of the Proposed Action would likely comprise small, incremental contributions to the overall cumulative effects, which are limited to localized areas and times. The updated PPRFFA scenario (Section 3.2) includes actions associated with the six OBBBA lease sales. The Proposed Action's small, incremental contribution over its 40-year duration may overlap in time and space with the increased incremental discharges associated with the six OBBBA's potential drilling and vessel activities temporarily impacting water quality by increases in TSS, turbidity, pollutants, and hydrocarbon spills. The incremental contribution of the Proposed Action to the overall cumulative effects would be less prominent as post-lease activities from previous lease sales and the succeeding lease sales come into effect.

Primarily due to climate change, cumulative impacts to water quality are likely to be major, although the incrementally additive impact of the Proposed Action, in the context of these past, present, and reasonably foreseeable actions, ranges from negligible to minor. When considering the long-lasting, widespread impacts resulting from a large oil spill, moderate cumulative effects could result.

While contributors to cumulative impacts, i.e., climate change or mining activities, would overlap with impacts associated with the E&D Scenario, the Proposed Action would not contribute any discernible additive or synergistic effects to the overall cumulative effects. Additionally, while new information regarding the effects of a warming ocean and future heatwaves was identified since the publication of the 2022 LS 258 FEIS (Section 4.4.4, Cumulative Effects), the 2022 LS 258 FEIS already accounted for changes to the environmental baseline when analyzing the cumulative impacts of the Proposed Action.

4.4.7 Conclusion

BOEM has reexamined the analysis for water quality presented in the 2022 LS 258 FEIS. While no new information was discovered that would alter the impact conclusion for water quality presented in that document (Section 4.4.2, 2022 LS 258 FEIS), the new information analyzed above in Section 4.4.2 presents an updated analysis of the potential long-term impacts from HOPs associated with a large oil spill. The analysis and assessment of potential impacts as discussed in Section 4.4.4, 2022 LS 258 FEIS still applies.

A lease sale under Alternatives 7, 8, or 9 would have similar impacts to those described for the Proposed Action. In all three alternatives, the overall level of activity as described in the LS 258 E&D Scenario (Appendix B) would remain the same. The reduction in the number of lease blocks proposed in Alternatives 7, 8, and 9 only changes the locations in the lease sale area where these activities could occur. Therefore, given the same level of potential E&D activity, the different spatial configurations of Alternatives 7, 8, and 9 do not change the expected level of minor effects to water quality. These minor impacts would not result in any long-lasting change to water quality, nor its function in the Cook Inlet ecosystem.

4.5 Coastal and Estuarine Habitats

BOEM has reexamined the coastal and estuarine habitats analysis presented in the 2022 LS 258 EIS based on new information presented below. While the new information documents the increased value of the ecological functions of kelp and kelp canopies in the coastal habitat of Cook Inlet, the impact conclusion for coastal and estuarine habitats as presented in the 2022 LS 258 FEIS, and as incorporated herein by reference, remains unchanged.

A description of coastal and estuarine habitats, along with the full analyses of the environmental consequences of the routine activities, accidental events, and cumulative impacts associated with the Proposed Action are presented in Section 4.5 of the 2022 LS 258 FEIS. The updated environmental impacts associated with the Proposed Action are found below in Section 4.5.3. Analysis of the environmental impacts resulting from Alternatives 3A, 3B,3C, 4A, 4B, and 5, and Alternatives 7–9 are found in Sections 4.5.4 and 4.5.5, respectively. The updated cumulative effects analysis is below in Section 4.5.6.

4.5.1 Summary of Affected Environment

A detailed description of coastal and estuarine resources, located in Section 4.5 of the 2022 LS 258 FEIS, is incorporated herein by reference and summarized as follows. Cook Inlet is a subarctic estuarine system approximately 350 km (218 mi) from north to south, and 200 km (124 mi) at its widest extent from east to west. Four major bays branch off Cook Inlet: Kamishak Bay, Kachemak Bay, and Turnagain and Knik arms (Renner et al., 2017). The Inlet's waters are affected by numerous land-locked glaciers feeding streams and four major rivers (the Kenai, Knik, Matanuska, and Susitna) and constitutes the largest riverine drainage into the Gulf of Alaska (Benke and Cushing, 2010; Brabets et al., 2009).

Cook Inlet encompasses a wide range of coastal wetland habitats including along-shore and across-shore areas from the high to the low intertidal zones. Large rock platforms are found throughout Kamishak Bay, while steep rock shorelines are more common along the eastern shorelines of lower Cook Inlet. Many shorelines of upper and central Cook Inlet support extensive salt marsh habitats. Much of Cook Inlet is bordered by extensive intertidal mud and sand flats that grade into equally extensive vegetated tidal and supratidal wetlands. Supratidal, intertidal, and subtidal wetland communities are an important conduit of energy, nutrients, and pollutants between terrestrial and marine environments, and provide resources for subsistence, sport, and commercial harvest. They also are important for recreational activities such as wildlife and nature viewing.

4.5.2 New Information Available Since Publication of the 2022 LS 258 FEIS

New information documents the increased value on the role of kelp and kelp canopies on ecological functions, food production, socioeconomic factors and cultural values, and reduction of current velocities in the Cook Inlet region. Recently kelp, and more notably canopy kelps, have been examined for their role in providing coastal resilience benefits in Alaska (Paxton and Freedman, 2024). Hondolero and Edwards (2017) conducted an in-situ study in Kachemak Bay, showing that two different types of kelp forests, those dominated by *Nereocystis leutkeana* and those with *Eularia fisulosa*, both reduced current velocity. Although when compared to prevailing currents in Kachemak Bay, the reductions in current velocity were minor (Paxton and Freedman, 2024), the role of kelp in providing coastal protection is, nonetheless, an area of current interest.

Coastal resilience includes a diverse range of topics including ecological functions, food production, socioeconomic factors and cultural values, and reduction of current velocities. Beyond providing habitat for a range of species from spider crabs, Pacific sand lance, Pacific octopus, marbled murrelet nurseries, kelp wrack also provides habitat and is a food source for terrestrial organisms. Kelp contributes to food production through primary and secondary pathways by direct harvest of wild kelp and harvesting kelp as part of mariculture, respectively. The socioeconomic and cultural values attributed to kelp is evidenced by traditional and cultural harvests conducted by present day Alaska Natives (Paxton and Freedman, 2024).

4.5.3 Environmental Consequences of the Proposed Action

Post-lease activities conducted as a result of LS 258 could impact deepwater habitats, estuarine, coastal, and freshwater wetlands. As discussed previously in the context of water quality, an increase in TSS and pollutants would be expected from drilling exploration and delineation wells; installation and removal of nodes, cables, sensors, production platforms, and pipelines; vessel anchoring, and vessel and other operational discharges. Construction of the onshore pipeline and associated landfall tie-in described within the E&D Scenario, while conducted within an established pipeline right-of-way and tying into existing infrastructure, would directly impact coastal estuarine and terrestrial wetland habitat by physical disturbance resulting from land clearing and trenching activities. Activities conducted in the nearshore in proximity to kelp communities could potentially impact established kelp and kelp canopies and any associated coastal resilience contributions. The degree to which any kelp and/or kelp canopies, any of the associated coastal resilience contributions could be impacted would depend on the proximity of the action to the kelp and kelp canopies.

Effects of spills, spill drills, and spill response activities on coastal and estuarine habitats are described in Section A-3.4 of Appendix A. Most small, accidental spills of crude oil would have localized and relatively slight impacts. Heavy oiling of shorelines, substrate, and emergent vegetation resulting from a large crude oil spill would be damaging and cause long-term impacts to coastal and estuarine habitats. Spills during the winter would cause far less impact to vegetated wetlands than spills that occur during the active summer growing season. Diesel or refined product spills of any size would damage or be lethal to exposed vegetation on contact. Spill response activities could cause impact by damaging vegetation and/or spreading oil contamination further into shoreline sediments. A gas release would be expected to volatilize quickly and not result in ignition and burning of vegetation.

4.5.4 Environmental Consequences of the Alternatives 3A, 3B, 3C, 4A, 4B, and 5

Potential impacts on coastal and estuarine habitats under all action alternatives would not differ substantially from those described in the 2022 LS 258 FEIS (Section 4.5.2), or as updated in Section 4.5.3. Coastal and estuarine habitats are transitional habitats located between deepwater and upland habitats and are more influenced by their association with land than the marine systems. These alternatives would not change the total level of activity under the E&D Scenario, and none of the restrictions identified in these alternatives would be expected to change the likelihood or severity of impacts on coastal and estuarine wetlands. Consequently, impacts of these alternatives on coastal and estuarine habitats would be the same as those for the Proposed Action — minor for E&D Scenario activities, accidental small spills, and spill drills. The addition of a large oil spill and associated spill response could increase the impact to coastal and estuarine habitats to major, depending upon the location and timing of the spill.

4.5.5 Environmental Consequences of Alternatives 7–9

A lease sale under Alternative 7, 8, or 9 would have similar impacts to coastal and estuarine habitats as those described and analyzed for the Proposed Action (Section 4.5.3) and in the 2022 LS 258 FEIS (Section 4.5.2). Post-lease activities conducted as described in the E&D Scenario could impact deepwater habitats, estuarine, coastal, and freshwater wetlands by an increase in TSS and pollutants from drilling exploration and delineation wells; installation and removal of nodes, cables, sensors, production platforms, and pipelines; vessel anchoring, and vessel and other operational discharges. Construction of the onshore pipeline and associated landfall tie-in described within the E&D Scenario, while conducted within an established pipeline right-of-way and tying into existing infrastructure, would directly impact coastal estuarine and terrestrial wetland habitat by physical disturbance resulting from land clearing and trenching activities. Activities conducted in the nearshore in proximity to kelp communities could potentially impact established kelp and kelp canopies and any associated coastal resilience contributions.

For Alternatives 7, 8, and 9, the overall level of activity as described in the LS 258 E&D Scenario (Section 4.1, 2022 LS 258 FEIS) would remain the same, however a reduction in the blocks offered for lease is considered. Alternative 7 would reduce the lease sale area offered for lease by 49 percent. Alternatives 8 and 9 would reduce the lease sale areas offered for lease by 22.5 and 20.9 percent, respectively. The reduction in the number of lease blocks proposed in Alternatives 7, 8, and 9 lessens the overall lease sale area but does not modify the type nor duration of the anticipated E&D activities.

Within the excluded blocks of Alternatives 7–9, there would be a complete lack of E&D activities and their associated temporary and short-term impacts of elevated levels of TSS, seafloor disturbances, and NPDES permitted discharges. The coastal and deepwater habitats of, and adjacent to, the excluded blocks in Alternatives 7–9 along both the western and eastern coastlines of Cook Inlet, including any estuarine habitats, tidal mud flats, eelgrass beds and salt marshes (particularly those associated with Tuxedni and Chinitna bays), would be spatially buffered from any short term and localized impacts associated with leasing activities from the E&D Scenario. Essential coastal, estuarine, and deepwater ecological functions, such as supporting fish and benthic organisms, birds and mammals would likely not be interrupted by the potential temporary and short-term localized impacts of E&D activities. However, because post-lease activities as described in the E&D Scenario remain unchanged, there still exists the potential for impacts to coastal and freshwater wetlands from landfall and pipeline construction during development to occur. Potential impacts to coastal and estuarine habitats in non-excluded lease blocks as identified in the 2022 LS 258 FEIS would remain unchanged. Overall, impacts to coastal and estuarine habitats resulting from activities associated with the E&D on Alternatives 7–9 would be minor. These minor impacts would not result in any long-lasting detrimental effects on the overall ecological functions, species abundance, or composition of marine or freshwater wetlands or plant communities of Cook Inlet, and most wetland habitat would be expected to recover following decommissioning. The addition of a large oil spill and spill response could increase the impact to coastal and estuarine habitats to major, depending upon the location and timing.

4.5.6 Cumulative Effects

While many cumulative impacts are foreseeable, the addition of the Proposed Action to the PPRFFA (Section 3.2) is not expected to generate widespread or persistent impacts to the coastal and estuarine habitats of Cook Inlet. The potential impacts of the Proposed Action would likely comprise small, incremental contributions (limited to localized areas and times) to the overall cumulative effects. The updated PPRFFA scenario (Section 3.2) includes actions associated with the six OBBBA lease sales. The Proposed Action's small, incremental contribution over its 40-year duration may overlap in time and space with physical disturbance to deepwater, estuarine, and freshwater habitats resulting from post-lease activities association with the six OBBBAs. The incremental contribution of the Proposed Action to the overall cumulative effects would be less prominent as post-lease activities from previous lease sales and the succeeding lease sales come into effect. Where contributors to cumulative impacts, i.e., climate change or vessel traffic, overlap with impacts associated with the E&D Scenario, the Proposed Action would not contribute any discernible additive or synergistic effects to the overall cumulative effects. Overall, the cumulative impact to estuarine and coastal habitats resulting from past, present, and reasonably foreseeable future actions and a changing climate, including the incremental contribution from the LS 258, as described in the E&D Scenario, would range from minor to moderate, however when including the impacts from large oil spills the impact to coastal and estuarine habitats could increase to major.

4.5.7 Conclusion

BOEM has reexamined the analysis for coastal and estuarine habitats presented in the 2022 LS 258 FEIS. While no new information was discovered that would alter the impact conclusion for coastal and estuarine habitats presented in that document, the new information summarized above in Section 4.5.2 substantiates the increased ecological value of kelp and kelp canopies for coastal resilience in Cook Inlet. The analysis and assessment of potential impacts as discussed in Section 4.5.2, 2022 LS 258 FEIS still applies.

A lease sale under Alternative 7, 8, or 9 would have similar impacts to those described for the Proposed Action. However, the exclusion of lease blocks proposed in Alternatives 7, 8, and 9 is likely to lessen potential impacts to coastal, estuarine, and deepwater habitats specifically in, and adjacent to, the excluded lease blocks. This slight shift of lesser potential impacts is not so great as to reduce the overall impact level of minor, because for all three alternatives, the overall level of activity as described in the LS 258 E&D Scenario (Appendix B) would remain the same.

Given the same level of potential E&D activity in Alternatives 7–9, the expected level of effects to coastal and estuarine habitats, as stated in the 2022 LS 258 FEIS, remains the same. These minor impacts would not result in any long-lasting detrimental effects on the overall ecological functions, species abundance, or composition of marine and freshwater wetlands or plant communities of Cook Inlet.

4.6 Fish and Invertebrates

A description of fish and invertebrate resources, along with the full analyses of the environmental consequences of the routine activities, accidental events, and cumulative impacts associated with the Proposed Action are presented in Section 4.6 of the 2022 LS 258 FEIS. Relevant new information that has become available since the 2022 FEIS is presented in Section 4.6.2. Resource descriptions and impact analyses are incorporated by reference from the 2022 LS 258 FEIS for the Proposed Action and Alternatives 3A, 3B, 3C, 4A, 4B and 5, and are summarized below in Sections 4.6.3 and 4.6.4, respectively. Environmental consequences of Alternatives 7, 8, and 9 are described in Section 4.6.5, and updates to the Cumulative Effects and Conclusions analyses are found in Sections 4.6.6 and 4.6.7 respectively of this document. BOEM has reexamined the analysis for fish and invertebrates presented in the 2022 LS 258 FEIS based on the new information presented in Section 4.6.2. No new information was discovered that would alter the impact conclusion for fish and invertebrates presented in the 2022 LS 258 FEIS.

4.6.1 Summary of Affected Environment

Cook Inlet is home to many species and communities of fish and invertebrates in habitats ranging from the intertidal zone to the open ocean. Broadly, pelagic species groups are associated with the water column and include very small plankton (phytoplankton, zooplankton, ichthyoplankton, and nekton), to larger fishes and invertebrates. Benthic communities include marine vegetation, fish, and invertebrates that live on or in the seafloor. Individual population sizes for fish and invertebrates can vary throughout Cook Inlet geographically and over time. Cook Inlet is a highly productive marine ecosystem largely driven by spring and summer phytoplankton blooms. The extreme tides present in Cook Inlet forces a high amount of sediment mixing that affects nutrient availability throughout the year. Seasonal increases in sunlight coupled with nutrient rich waters trigger phytoplankton production and subsequent zooplankton production which enhances the base of the entire Cook Inlet food web.

Community structures for invertebrates and fish can be highly malleable in response to alterations in nutrient availability, temperature shifts, introduction of new species, and changes to habitat, among other factors. Intertidal and shallow subtidal invertebrate community composition also depends on the sediment types present in an area. Plankton are a critical food source for upper trophic levels, while fish and other invertebrates serve as both predators for lower trophic animals and prey for other fish, birds, and mammals. Forage fish, including herring, smelt, eulachon, sand lance, and capelin, provide an energy-rich link between zooplankton and upper-level predators that is vital in the regional food web. Changes in forage fish ecology have been linked to changes in predator populations, and fluctuations in community structure may have far-reaching impacts on the overall food web.

Benthic and pelagic fish occupy a wide variety of habitats and depths throughout Cook Inlet year-round, though seasonal migrations or aggregations are common. Cook Inlet, along with the freshwater streams that flow into it, is a migratory corridor and early life rearing area for all five species of Pacific salmon. Sockeye salmon support one of the most important commercial fisheries on the Pacific coast of North

America and are increasingly sought after in recreational fisheries. Many species of fish and invertebrates found in Cook Inlet are harvested for subsistence, personal, or commercial use, while other non-harvested prey species help support a healthy ecosystem structure.

4.6.2 New Information Available Since Publication of the 2022 LS 258 FEIS

New information was discovered about Cook Inlet fish and invertebrates after a search of relevant literature and is summarized below. Resource information was examined to assess its relevance to the Proposed Action. The new information expands BOEM's knowledge base with regard to food webs and marine heatwaves, but did not contradict the information or analysis presented in the 2022 LS 258 FEIS. The inclusion of this new information does not change the overall conclusions presented in the 2022 LS 258 FEIS.

Marine heatwaves are expected to continue and intensify in the future, and as a result, additional regime shifts, altered prey communities, and impacts to upper levels of the food web may become more likely (Starko et al., 2025; Pecuchet et al., 2025; Hauri et al., 2024). At the time of the 2022 LS 258 FEIS publication, research into the crash of forage fish populations and a mass seabird mortality event in relation to a well-documented marine heatwave in the Gulf of Alaska was ongoing. Since the 2022 FEIS publication, more of that research has been made available, showing the strong connection between forage fish populations and upper trophic levels (see Section 4.7 of this SEIS for more detailed discussion on new information about impacts on birds). One paper from Robinson et al. (2024) found the effects of the recent marine heatwave to be more pronounced for birds that rely on pelagic prey than for birds that rely on benthic prey due to the decreased impact of the heatwave on different prey communities. Conte et al. (2024) examined interannual variability in planktonic communities based on a long-term hind-cast model and found that nutrient availability is a main driver of planktonic production and that there can be carryover effects from year to year.

4.6.3 Environmental Consequences of the Proposed Action

Post-lease activities conducted as a result of LS 258, as described in the E&D Scenario, which could cause impacts to invertebrates and fish, include seismic surveys, platform installation, drilling, presence of structures, pipeline trenching, and vessel traffic. Some impacts, such as presence of platforms and the associated lighting and water intake structures would be long-term but would generally be limited to the immediate vicinity of the structure or activity. Other impacts, such as noise from vessels, drilling, or seismic surveys would be short-term or transitory and would not have lasting effects. While impacts may be acute for individuals present in the immediate area of an activity, changes to the overall population dynamics are not expected. Accidental events such as oil spills and spill cleanup activities can impact fish and invertebrates. Most accidental spills are relatively small (<1,000 bbl) and would be localized and limited in area and duration, but a large spill (>1,000 bbl) could be widespread and longer lasting. For more information on the effects of spills, spill drills, and spill response activities on fish and invertebrates, refer to Appendix A, Section A-3.5.

The 2022 LS 258 FEIS found that impacts from noise, habitat alteration, disturbance, accidental small oil spills, and spill drills associated with the Proposed Action on fish and invertebrates in Cook Inlet would be short-term, localized to the area of activity, and unlikely to change overall population structures or the resource's function in the ecosystem.

4.6.4 Environmental Consequences of Alternatives 3A, 3B, 3C, 4A, 4B and 5

Both Alternatives 3 and 4 excluded lease blocks (3A and 4A), imposed seasonal restrictions on seismic surveys on specific lease blocks (3B and 3C), or prohibited discharge of drilling cuttings or fluids and any seafloor disturbance (4B), which could reduce some adverse impacts of noise and disturbance in those specific areas. Similarly, Alternative 5 imposed a seasonal restriction on seismic surveys, which could prevent some adverse impacts on migratory and resident fish and invertebrate communities in the mitigated area. The analysis of alternatives in the 2022 LS 258 FEIS found that the overall level of impact from activities described in the E&D Scenario would not change if any of these alternatives were implemented. The expected impacts to fish and invertebrates described for the Proposed Action would still occur for the Alternative scenarios. Thus, selection of Alternatives 3A, 3B, 4A, 4B, and/or 5 would not result in a change of impact designation when compared to the Proposed action.

4.6.5 Environmental Consequences of Alternatives 7–9

Alternative 7, 8, or 9 would have impacts similar to those of the Proposed Action. These impacts include seafloor disturbance, habitat alteration, water quality impacts from drilling and other operational discharges and water intake structures, noise, presence of structures, and disturbance from accidental spills and spill response activities. Analysis of Alternatives 7, 8, and 9 did not identify any activities in the new alternatives that are likely to produce additional or new impacts to fish and invertebrates that were not analyzed in the original LS 258 EIS.

In all three alternatives, the overall level of activity described in the E&D Scenario (Appendix B) will stay the same; the only change would be in the geographic areas where these activities could take place. Alternative 7 would reduce the geographic area offered for lease by 49 percent, while Alternatives 8 and 9 would reduce the geographic areas offered for lease by 22.5 and 20.9 percent, respectively. The areas excluded under Alternatives 7, 8, and 9 do not overlap with any Habitat Areas of Particular Concern (HAPC) but are located in areas identified as Essential Fish Habitat (EFH). The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires federal agencies to consult with NMFS on activities that could adversely affect EFH. NOAA defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” Removal of lease blocks identified in these alternatives would lessen the anticipated impacts to EFH and benthic fish and invertebrate communities present in those specific areas and to the animals that prey upon benthic species. Thus, the proposed new alternatives would likely decrease the effects of the action in the areas removed from leasing.

The expected effects on fish and invertebrate communities described for the Proposed Action in the 2022 LS 258 FEIS also apply to Alternatives 7, 8, and 9 because the overall level of activity described in the E&D Scenario would not change if some or all of the new Alternatives were implemented. The expected impacts to fish and invertebrates described for the Proposed Action in the 2022 LS 258 FEIS would still occur under the new Alternative scenarios because the new alternatives do not affect the duration or types of anticipated activities, only the geographic locations in which the activities occur. No additional area or habitat types are expected to be impacted under the new alternatives. Thus, no change of impact designation from what was identified in the 2022 LS 258 FEIS is warranted for these alternatives. Overall, impacts will be short-term and localized, and generally minor, although they can become moderate in the event of a large spill and the subsequent response.

4.6.6 Cumulative Effects

While many cumulative impacts are foreseeable, the addition of the Proposed Action to the past, present, and reasonably foreseeable future actions (Section 3.2) is not expected to have widespread or persistent impacts on the health or community structure of fish and invertebrates living in Cook Inlet. The potential impacts of the Proposed Action would likely comprise small, incremental contributions to the overall cumulative effects. Although cumulative impacts to fish and invertebrates may be major—primarily due to factors such as climate change—the incrementally additive impact of the Proposed Action, in the context of these past, present, and reasonably foreseeable actions, is negligible to minor. The updated PPRFFA scenario (Section 3.2) includes actions associated with the six OBBBA lease sales. The Proposed Action's small, incremental contribution over its 40-year duration may overlap in time and space with impacts on fish and invertebrate communities and habitat resulting from post-lease activities associated with the six lease sales. The incremental contribution of the Proposed Action to the overall cumulative effects would be less prominent as post-lease activities from previous lease sales and the succeeding lease sales come into effect. While sources of cumulative impacts, e.g., climate change or presence of structures, would overlap with impacts associated with the E&D Scenario, the Proposed Action would not contribute any discernible additive or synergistic effects to the overall cumulative effects. The effects of a warming ocean and future heatwaves were analyzed in the 2022 LS 258 FEIS, and new research published since then does not present information that would change the conclusion from the FEIS.

4.6.7 Conclusion

BOEM has reexamined the analysis for fish and invertebrates presented in the 2022 LS 258 FEIS. No new information was discovered that would alter the overall impact conclusion for fish and invertebrates presented in that document, and the analysis and assessment of potential impacts described for LS 258 still apply under the new alternatives presented here. Alternatives 3A, 3B, 3C, 4A, 4B, or 5 would have impacts similar to those of the Proposed Action. Similarly, impacts from Alternatives 7, 8, or 9 would be similar to those in the Proposed Action. In all three alternatives, the overall level of activity described in the E&D Scenario (Appendix B) would stay the same; the only change will be in the geographic areas where these activities could take place. Therefore, given the same level of activity, the different spatial configurations of Alternatives 7, 8, and 9 do not change the expected level of effects to fish and invertebrates.

4.7 Birds

BOEM has reexamined and updated the bird analysis from the 2022 LS 258 FEIS. New information on birds and effects to birds in lower Cook Inlet is summarized in Section 4.7.2 and incorporated into revised impact analyses in Sections 4.7.3 through 4.7.6. These updates reveal increased vulnerability of more bird populations, which may result in more populations incurring a moderate level of impact than previously estimated. However, the overall impact level from routine activities and accidental events under the Proposed Action remains the same as described in the 2022 LS 258 FEIS (Section 4.7.2.5): a range of minor to moderate. Section 4.7.4 updates the environmental consequences for Alternatives 3–5 and Section 4.7.5 analyzes effects from new Alternatives 7–9. Section 4.7.6 provides an updated PPRFFA analysis, and Section 4.7.7 summarizes the updated conclusions.

4.7.1 Summary of Affected Environment

The detailed description of bird resources found in Section 4.7.1 of the 2022 LS 258 FEIS is incorporated herein by reference and summarized as follows. Almost 250 species of marine birds, landbirds, raptors, and other birds use lower Cook Inlet habitats year-round or seasonally. Many breed in summer in coastal areas and seabird colonies, overwinter in open waters or sheltered coasts, or migrate through the region in spring and fall. Besides dense seabird colonies, lower Cook Inlet supports large aggregations that gather for the post-breeding molt and spring and fall migration. It supports year-round concentrations of bald eagles and provides molting and wintering habitat for ESA-listed Steller's eider. Several birds, like the Kenai song sparrow, breeding Tule white-fronted goose, and wintering Pribilof Island rock sandpiper[3] are

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[3] Pribilof Island rock sandpiper is the nominate subspecies (*Calidris ptilocnemis ptilocnemis*) of the four recognized subspecies of rock sandpiper.

endemic to the region. At the time of publication of the 2022 LS 258 FEIS, at least 23 Important Bird Areas (IBAs) had been designated in nearshore waters, coastal habitats, or offshore habitats of Cook Inlet.

4.7.2 New Information Available Since Publication of 2022 LS 258 FEIS

New information is available on the status of many Cook Inlet birds and habitats, including updated effects of the 2015–2016 Pacific Marine Heatwave (PMH) on marine birds, and the variability and constraints of bird migration strategies. New information is then presented relevant to potential effects to birds from post-lease activities as a result of LS 258. This section ends with new information relevant to cumulative effects on birds in Cook Inlet.

Affected Environment

Seabirds. Recent studies (Arimitsu et al., 2023; Renner et al., 2024) show substantial declines in most common seabird populations, including common murre, tufted puffin, shearwater species, pigeon guillemot, and Kittlitz's and marbled murrelets. The 2015–2016 PMH mass mortality of millions of Gulf of Alaska (GOA) murres, with no sign of population recovery to date, was caused by change in availability of forage fish and the murres' low flexibility in foraging strategies (Jones et al., 2024; Renner et al., 2024; Sauve et al., 2023). Tufted puffins are also markedly declining across the GOA, but also showing winter distributional shifts, attributed to its more flexible diet than that of fish-eating murres (Cushing et al., 2024; Pearson et al., 2023; Schaefer et al., 2022). Pronounced reproductive impacts have persisted post-PMH for fish-eating birds including common murre and black-legged kittiwake (Arimitsu et al., 2023; Marsteller et al., 2024; Schoen et al., 2024).

Waterfowl. The Tule goose, endemic to Cook Inlet, has been found to be a genetically distinct subspecies and therefore considered vulnerable due to relative isolation and limited population (Wilson et al., 2022). New tracking of Pacific greater white-fronted, Tule, and lesser snow geese across GOA waters and with frequent nocturnal stopovers at sea, increases understanding of Cook Inlet's importance to migration and reveals variability in flight altitudes according to wind conditions (Weiser et al., 2024). Sea duck surveys observed Steller's eiders beyond their typical wintering range, and potential future shifts in molting areas have been predicted (Maliguine, 2024; Robinson et al., 2024).

Shorebirds. New surveys and tracking data confirm the importance of Cook Inlet to a variety of shorebird populations and uses, including wintering rock sandpiper, summering black oystercatcher, partial migration of oystercatchers (some of which remain as year-round residents), and south-bound migration of short-billed dowitcher populations (Robinson et al., 2024; Rankin, 2023; Bathrick et al., 2024, respectively). Studies of the significantly declining lesser yellowlegs confirmed its extreme long-distance migration, demonstrated its breeding site fidelity to Cook Inlet, and importance of Cook Inlet as not only breeding site but migratory stopover (Christie et al., 2023; McDuffie et al., 2022). Shorebird populations are declining broadly, with 26 of 28 species showing negative trends, including many that migrate over lower Cook Inlet like Hudsonian godwit, short-billed dowitcher, dunlin and lesser yellowlegs (McDuffie et al., 2022; Smith et al., 2023b; Wilde et al., 2022).

Landbirds. Bald eagle reproductive success declined post-PMH (Schmidt et al., 2024), and raptors and common raven have experienced the heaviest impacts among non-aquatic wild birds from avian influenza (Ramey, 2024). Alaska has lost over 147 million landbirds since 1993, with the steepest losses in boreal forest species and aerial insectivores, large numbers of which nocturnally migrate in flocks across Cook Inlet (Michel et al., 2024; Michel, 2024).

Migration Strategies. Recent studies (Kuletz et al., 2024a and references therein; Whelan et al., 2022) demonstrate the flexibility as well as constraints in migration routes, timing, and stopovers. Strategies range from acquiring sufficient energy prior to departure to fuel a non-stop flight, to stopping and foraging during travel (Evans and Bearhop, 2022). Route, stopovers, duration, and arrival and departure times can vary between years, seasons, wind or prey conditions, species, and individuals (Bathrick et al., 2024; Saalfeld et al., 2024; Woehler and Hobday, 2024). Nocturnal passerine migration remains poorly understood, though seasonal migration timing shifts have been documented in 86 percent of the 21 species studied (Scurr et al., 2024).

IBAs and Habitats. New data supports the value of Cook Inlet IBAs and other bird habitats. Long-term hotspots for seabirds like Kittlitz's murrelet and tufted puffin have been identified within *Kachemak Bay IBA* (IBA #21 on Figure 4-1), (Arimitsu et al., 2023). Lower Cook Inlet is newly identified as a hotspot for southbound red phalarope and wintering tufted puffin (Saalfeld et al., 2024; Schaeffer et al., 2022). Migration stopovers for black turnstone and breeding hotspots for rapidly declining landbirds overlap with several IBAs (Taylor et al., 2022; Weiser, 2024). The number of recognized IBAs in Cook Inlet has increased from 23 to 39 (BOEM, 2024). BOEM has prepared an updated IBA map and table from Audubon Alaska information showing the 39 Cook Inlet IBAs, (BOEM, 2024; Audubon Alaska, 2014) (Figure 4-1).

Effects

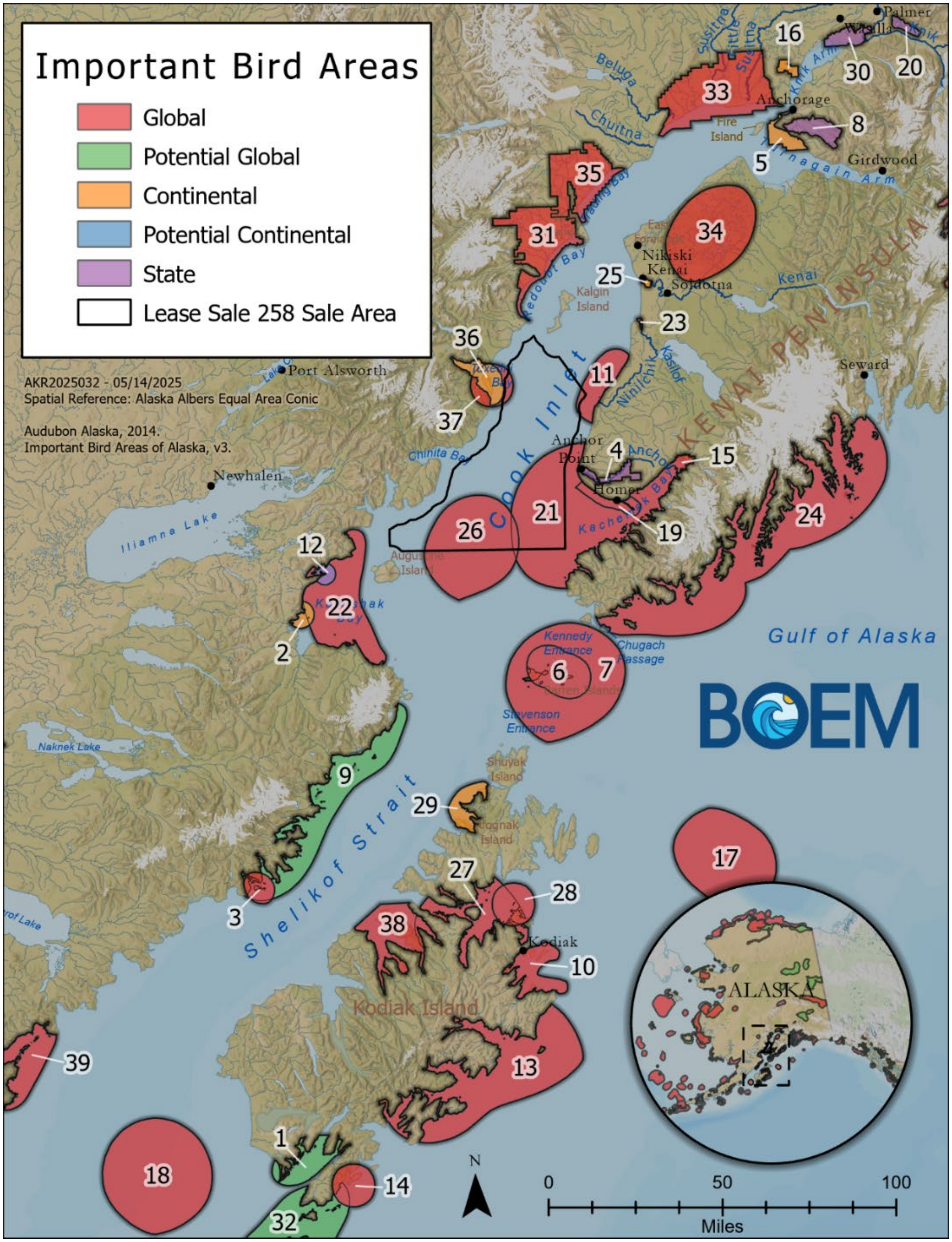
Noise. New information on noise impacts suggests that underwater noise could disrupt foraging of long-tailed duck, surf scoter and common eider that may rely on acoustic cues (McGrew et al., 2022; Lillis et al., 2016).

Disturbance. Offshore lighting is increasingly understood to pose collision risks to nocturnal migrants (Brust and Hüppop, 2022; Labunski et al., 2024). Updated guidance documents (USFWS, 2023a, 2024a) continue to recommend bird-conscious lighting strategies consistent with mitigation BOEM proposed in the 2022 LS 258 FEIS. Research on lighting mitigation strategies is ongoing, and Gulka et al. (2025) and Zeidler et al. (2022) discuss additional strategies like lighting deterrent systems, compensatory mitigation, and real-time monitoring systems accompanying vessel self-monitoring and response readiness.

Oil Spills. New information on dispersants suggests that dispersants alone (not just in combination with oil) can damage seabird feathers, reducing buoyancy and insulation (Fritt-Rasmussen et al., 2023). Gilmour et al.'s (2023) review includes how response efforts can compound physical effects of oil, and scale of impact is influenced by species-specific movements and bird life stage and abundance in the impacted area.

Cumulative Impacts. New information available on cumulative effects to Alaska's migratory birds includes updates on HPAI having widespread effects on many bird types (Ramey, 2024; Ramey et al., 2022; Hill et al., 2022); high mercury burdens at seabird colonies (Calvert et al., 2024); ingestion of plastics having widespread and potentially long-term effects on surface-feeding seabirds (Charlton-Howard et al., 2023; Fackelmann et al., 2023; Gilmour et al., 2023); and beak deformities caused by avian keratin disorder first identified in Alaska and affecting individuals of many species (Gerik et al., 2023).

Recent studies and reviews have contributed to understanding climate change-related impacts which are expected to be numerous, complex and wide-ranging for birds (Marsteller at al., 2024; Woehler and Hobday, 2024). Ultimately, lower populations for many species are expected from increases in such effects as mass mortality events (for marine birds (Jones et al., 2024; Kuletz et al., 2024b; Smith et al., 2023a and references therein) and breeding failures (Olin et al., 2024; Oswald and Arnold, 2024; Sauve et al., 2023). Other expected effects include shifts in distributions and community compositions (Cushing et al., 2024; Jones et al., 2024; Taylor et al., 2022) and migration strategies across the GOA (Weiser et al., 2024; Puleo, 2024; Lagasse and Breed, 2024).



Notes: See Table 4-3 for key to map figures
Based on Audubon Alaska data from http://databasin.org/datasets/f9e442345fb54ae28cf72f249d2c23a9.

Figure 4-1: Important Bird Areas in the Cook Inlet Area

Table 4-3: Important Bird Areas (IBAs) in the Cook Inlet Area

Map Number	Site Name	Priority	Type
1	Alitak Bay	Potential Global	Coastal
2	Amakdedulia Cove Colony	Continental	Colony
3	Amalik Bay Colonies	Global	Colony
4	Anchor River	State	Interior
5	Anchorage Coastal	Continental	Coastal
6	Barren Islands Colonies	Global	Colony
7	Barren Islands Marine	Global	Marine
8	Campbell Creek	State	Interior
9	Cape Douglas to Amalik Bay	Potential Global	Coastal
10	Chiniak Bay	Global	Coastal
11	Clam Gulch	Global	Coastal
12	Contact Point Colony	State	Colony
13	Eastern Kodiak Island Marine	Global	Marine
14	Flat Island Colony	Global	Colony
15	Fox River Flats	Global	Coastal
16	Goose Bay	Continental	Coastal
17	Gulf of Alaska Shelf 151W58N	Global	Marine
18	Gulf of Alaska Shelf 155W57N	Global	Marine
19	Homer Spit	Global	Coastal
20	Jim Creek Basin	State	Interior
21	Kachemak Bay	Global	Marine
22	Kamishak Bay	Global	Coastal
23	Kasilof River Flats	Global	Coastal
24	Kenai Fjords	Global	Marine
25	Kenai River Flats	Continental	Coastal
26	Lower Cook Inlet 153W59N	Global	Marine
27	Marmot Bay	Global	Marine
28	Marmot Bay Colonies	Global	Colony
29	Northwest Afognak Island	Continental	Coastal
30	Palmer Hay Flats	State	Coastal
31	Redoubt Bay	Global	Coastal
32	Sitkinak Strait	Potential Global	Coastal
33	Susitna Flats	Global	Coastal
34	Swanson Lakes	Global	Interior
35	Trading Bay	Global	Coastal
36	Tuxedni Bay	Continental	Coastal
37	Tuxedni Island Colony	Global	Colony
38	Uganik Bay & Viekoda Bay	Global	Coastal
39	Wide Bay	Global	Coastal

Notes: Numbers and names of IBAs correspond to the map in Figure 4-1.
“Priority” refers to conservation priority as determined by BirdLife International and Audubon (see: https://www.birds.cornell.edu/landtrust/important-bird-areas/)

The ability of birds to successfully alter migration strategy in response to a changing environment can be constrained by many factors such as destination, weather, limited genetic diversity, and physiological condition (Christie et al., 2023; Robertson et al., 2024; Wilson et al., 2022). Arctic and Alaska-breeding birds face particular constraints, e.g., short summers and strong fidelity to breeding sites that are size limited or rapidly changing, etc. (Kuletz et al., 2024a; Smith et al., 2023a; Woehler and Hobday, 2024).

Resilience to impacts vary with species and life history strategies. Generalist foragers and wide-ranging seabirds with lower energy requirements may be buffered from effects of lower prey availability (Cushing et al., 2024; Jones et al., 2024). Significant variability in interannual at-sea counts and migratory timing and routing suggest that red phalarope (unlike many other pelagic species) has the capacity to be resilient to changes in prey availability (Saalfeld et al., 2024). Localized areas of climate refugia could help some marine and terrestrial birds adapt to changing conditions. However, long and short distance migrants, and birds occupying high elevation habitats or with narrow climate niches like boreal chickadee may lack sufficient area of climate refugia by the end of the century compared to other resident birds (van Oordt et al., 2024).

4.7.3 Environmental Consequences of the Proposed Action

BOEM has reexamined and updated the impact analysis for birds in the 2022 LS 258 FEIS. The detailed descriptions of environmental consequences in section 4.7.2 of the 2022 LS 258 FEIS are incorporated herein by reference. Each of the following impact sections begins with a brief summary of the incorporated description and follows with updated analysis and consequences based on the new information. Post-lease activities conducted as a result of LS 258, as described in the E&D Scenario, which could cause impacts to birds include seismic surveys, anchoring of drilling units and vessels, platform and pipeline installation, discharge of drill cuttings, and the operation of platforms, vessels, aircraft and vehicles.

Noise

Post-lease activities such as seismic surveys may cause short-term displacement of birds due to noise. New research suggests sea ducks may rely on underwater hearing for foraging, which could be affected by noise (McGrew et al., 2022; Lillis et al., 2016). However, since sea ducks typically forage in nearshore areas—away from most offshore post-lease activities, this new information does not change the 2022 LS 258 FEIS conclusion: noise impacts are expected to be typically limited to near vessels that are continually moving toward new areas and therefore localized and brief.

Habitat Alteration

Post-lease activities that could affect birds by altering their marine or terrestrial habitats include construction, vessel anchoring, and trenching. These activities could decrease marine foraging success by increasing water column turbidity or covering benthic prey, or on land could displace or kill active nests. Declining trends evident in significant numbers of migratory bird populations have been presented in new information in Section 4.7.2, as has the recognition of additional Cook Inlet IBAs and other important bird habitat areas. However, most expected marine bird habitat alteration effects associated with the E&D Scenario would continue to be related to prey availability and therefore of a similar impact level to that of invertebrate and fish prey resources (Section 4.6), i.e., only affecting a limited number of individuals for a brief time in localized places. Most terrestrial habitat alteration effects including nest destruction would expect to be mitigated by siting and timing guidance. Therefore, impacts to birds that could arise from both marine and terrestrial habitat altering activities associated with the E&D Scenario are not expected to change from typically short-term and localized, as in the 2022 LS 258 FEIS conclusion.

Disturbance

Post-lease activities described in the E&D Scenario that could produce disturbance impacts (up to and including mortality) include platform, vessel, aircraft, and vehicle operations. Attraction and disorientation caused by the bright lighting of vessels, MODUs, production platforms, and gas flaring from the latter, can cause chronic collisions each spring and/or autumn of birds migrating together in large flocks from widespread breeding populations. Traffic operations described in the E&D Scenario could also disturb large dense flocks while foraging, molting or nesting, although mass flushing leading to nesting colony failure is expected to be avoided with mitigation that requires vessels and aircraft to observe a buffer area around seabird colonies.

New information suggests that more Cook Inlet migratory bird populations than the few recognized in 2022 LS 258 FEIS are vulnerable or declining (Section 4.7.2) and would therefore be more likely to experience long-term or widespread impacts from disturbance. New information related to disturbance effects also suggests that the scale of nocturnal migration movement, and therefore attraction and collision risk, is larger and may affect more bird populations than previously understood. Neither the new information on declining trends and vulnerabilities nor new information on collision risks change the finding in the 2022 LS 258 FEIS that birds will experience a range of disturbance effects from short-term and localized to potentially long-term and widespread, depending on population. The number of potential bird strikes would be somewhat mitigated if the lighting recommendations in the 2022 LS 258 FEIS (Section 4.7.2.3) and this SEIS, and the new USFWS guidance documents, were applied, but collisions would still occur and there would still be a range of levels of disturbance impacts. The only new difference is that more populations would be expected to be subject to long-term and widespread impacts than estimated in the 2022 LS 258 FEIS.

Oil Spills

As detailed in Section 3.1.1, most spills would be small and localized. Effects of spills, spill drills, and spill response activities on birds are described in Section A-3.5 of Appendix A and summarized and incorporated here-in by reference. A large spill could have long-term and widespread impacts on birds, especially if it occurs near concentrations of marine birds or coastal habitats. Such events may foul critical staging, nesting, or migratory areas and require habitat remediation. Vulnerable or endemic populations—such as the wintering Pribilof Island rock sandpiper—could experience severe, population-level effects.

Spill drills are short-term and localized, with minimal impact. Spill response activities may cause temporary displacement but could result in longer-term effects if conducted during sensitive periods like nesting or migration. In rare cases, a gas explosion could cause localized mortality among birds.

New information suggests that more Cook Inlet migratory bird populations than the few recognized in 2022 LS 258 FEIS are vulnerable or declining and could therefore experience long-term or widespread impacts from contact with a large spill and/or associated response activities. The new information on oil spill impacts on birds is consistent with analyses in 2022 LS 258 FEIS and Appendix A. The conclusion therefore remains that effects from a large spill would be a range according to species and populations, from minor when little immediate contact with birds or important habitat is involved, to long-term and widespread with potentially severe population-level impacts if a large spill contacted small or otherwise vulnerable populations. Spill responses would also have an impact range from short-term and localized displacement to long-term in cases where large concentrations of birds are present or nesting.

Overall Impact Level Conclusion for the Proposed Action

Because of the wide variety of birds and their habits in lower Cook Inlet, a range of impacts are expected from E&D Scenario activities. Most birds would experience short-term and localized, i.e., minor, effects from routine operations, small spills, and spill drills. The 2022 LS 258 FEIS (Sections 4.7.2.5 and 4.7.3) concluded that a few vulnerable or declining populations could face long-term or widespread, therefore moderate impacts from vessel activity, habitat alteration, and lighting or flaring.

New information confirms that birds would incur a range of levels of impact, but that the declining status and vulnerability to risks of more bird populations than previously recognized means that more may now fall into the moderate impact category. Similarly, when a large spill and response efforts are considered alongside E&D activities, more populations than previously estimated would be expected to incur a moderate or even major impact. However, the overall conclusion remains a range of minor to major impacts, depending on population, season, and location.

4.7.4 Environmental Consequences of Alternatives 3A, 3B, 3C, 4A, 4B and 5

Section 4.7.3 of the 2022 LS 258 FEIS (incorporated by reference) analyzed potential impacts to birds under Alternatives 3A, 3B, 3C, 4A, 4B, and 5. With new information on bird vulnerability, the overall impact level remains a range of minor to moderate, consistent with the Proposed Action. However, more birds are now considered at risk of moderate impacts due to increased recognition of declining and vulnerable species. Each alternative would reduce certain effects of the Proposed Action on individual birds but not to a population level extent or enough to reduce the risk of a moderate level of impact to vulnerable populations. When large spill and response effects are added to the effects of E&D Scenario activities, the consequences for some species may increase, but the overall impact level for each alternative would remain a range of minor to major, as previously concluded.

4.7.5 Environmental Consequences of Alternatives 7–9

Alternatives 7, 8, and 9 would result in similar types of impacts on birds as the Proposed Action, including noise, habitat alteration, collision risk, disturbance from traffic, and potential water quality degradation from spills. These effects are consistent with those analyzed in the 2022 LS 258 FEIS. While subpopulations or numbers of individuals affected would vary somewhat, the overall impact level for each alternative would be the same as that of the Proposed Action, a range from minor to moderate.

Alternative 7, though 49 percent smaller in area than the Proposed Action, would concentrate activities in bird-rich habitats, including the *Lower Cook Inlet 59°N 153°W IBA* (IBA #26), *Outer Kachemak Bay IBA* (IBA #21), and areas used by ESA-listed Steller's eider. This concentration could increase the number of birds and populations experiencing moderate impacts. While it may reduce effects to some post-breeding waterfowl and shorebirds in *Tuxedni Bay* and *Tuxedni Island Colony IBAs* (IBA #36 and #37), it could still affect foraging seabirds from those areas. Overall, Alternative 7 would be expected to result in more individual impacts and potentially more bird populations facing long-term, or moderate, impacts, although it would still be within the same overall impact level as the Proposed Action: a range from minor to moderate. When considering the addition of a large spill and response, the impact level would be a range of moderate to major, the same as that of the Proposed Action.

Alternative 8 would be expected to reduce effects to *Tuxedni Bay* and *Tuxedni Island Colony IBAs* and to birds foraging in outer Chinitna Bay and do this without concentrating all activities into a much smaller and more bird-rich area. The areas excluded under Alternative 8 are not among the highest marine bird seasonal density areas of the lease sale area. While it excludes some breeding areas for black-legged kittiwake and horned puffin, the overall impact level would be the same as that of the Proposed Action, a range of minor to moderate, and moderate to major when including a large spill and spill response.

Alternative 9 would have minimal differences from the effects of the Proposed Action. The excluded area is small, with limited overlap with IBAs or breeding colonies. It may offer slight additional protection to wintering Steller's eider and waterfowl near Ninilchik and Anchor Point, though vessel traffic could still cause disturbance. The overall impact level remains a range of minor to moderate, and moderate to major when considering the effects of a large spill and spill response.

4.7.6 Cumulative Effects

A cumulative effects analysis for birds was presented in Section 4.7.4 of the 2022 LS 258 FEIS and is updated here with new information from Section 4.7.2 and the revised PPRFFA (Section 3.2). Birds in lower Cook Inlet are affected by multiple PPRFFAs, including energy development, vessel traffic, mining, fishing, community development, and military activity. Climate change remains the most widespread and long-term stressor. Cumulative effects include habitat loss, disturbance, light attraction and collision risk, and reduced fitness from contaminants and oil spills. Most birds experience only one type of effect, so impacts are typically not additive—except for climate change, which potentially affects most birds.

Migrating birds face ongoing collision risks from existing infrastructure, including platforms and the Fire Island wind farm in Cook Inlet State waters north of the proposed sale area. The construction of up to six LS 258 platforms would significantly increase light attraction and collision risk in lower Cook Inlet's currently dark and featureless OCS waters. The updated PPRFFAs (Section 3.2) now includes six near-future OBBBA lease sales. With the installation of lighted platforms in the lower Cook Inlet OCS from past and future lease sales, the cumulative risk of light attraction and collision hazards would be expected to increase throughout the 40 years of the Proposed Action. Conversely, the incremental addition of the LS 258-related effects would, over time, be less persistent to total cumulative risk as the amount of lighted infrastructure grows. Large oil spills and response activities could cause long-term and widespread impacts to birds, their habitats and prey (Appendix A), especially if they occur at breeding or stopover sites where birds from many areas congregate. Additional spills from other sources (Section 3.2.1) could further increase cumulative impacts. Climate change and ecosystem regime shifts are anticipated to have the most significant long-term effects, particularly on breeding and vulnerable species. New data confirm that more populations are declining or at risk than previously estimated, increasing the likelihood of major cumulative impacts.

Overall, the cumulative impact level from PPRFFAs, climate change, and LS 258 post-lease activities remains a range from moderate to major, consistent with Section 4.7.4 of the 2022 LS 258 FEIS. While LS 258 may contribute significantly to offshore collision risk, its relative incremental impact will diminish as additional offshore infrastructure and associated vessels are deployed.

4.7.7 Conclusion

BOEM has reexamined the 2022 LS 258 FEIS bird impact analysis. The new information does not change the overall impact level conclusions found in Sections 4.7.2.5 and 4.7.3. However, substantial new information describing the declining status and vulnerability of more bird populations of many types indicates that more bird populations would be expected to incur a moderate level of impact than previously estimated. The overall impact level for birds from the Proposed Action, including associated small spills and spill drills, remains, however, a range of minor to moderate. Alternatives 3A, 3B, 3C, 4A, 4B, and 5 would result in the same overall impact level, a range of minor to moderate, as the Proposed Action. Similarly, Alternatives 7, 8, and 9 would also have the same overall impact level. When considering the potential effects of a large spill and associated response efforts added to E&D Scenario activities, more bird populations than previously estimated may experience moderate or even major impacts. The overall conclusion remains a range from minor to major, depending on populations, season, and location.

4.8 Marine Mammals

BOEM has reexamined the analysis of potential impacts to marine mammals presented in the 2022 LS 258 FEIS. Section 4.8 of that document provided a description of marine mammal resources and an analysis of the environmental consequences of routine activities and accidental events that are likely to be associated with the Proposed Action. It also provided an analysis of the environmental consequences of the Proposed Action together with past, present, and reasonably foreseeable future actions. The analysis presented here incorporates by reference and summarizes Section 4.8 of the 2022 LS 258 FEIS and includes new information that has become available since publication of the FEIS to update the previous analysis and address the deficiencies that were identified by the Court (see Section 1.1 for a summary of the Court's findings).

Sections 4.8.1 through 4.8.3 of this document summarize the affected environment, introduce new information available since publication of the 2022 LS 258 FEIS, and add to the analysis of impacts of the Proposed Action on marine mammals presented in the 2022 LS 258 FEIS by further analyzing impacts of vessel noise on beluga whales. Section 4.8.4 summarizes and updates the analysis of environmental consequences of the Alternatives. The analysis of alternatives considers impacts on marine mammals collectively, and also provides analyses specifically focused on beluga whales. Section 4.8.5 updates and expands the cumulative effects analysis to consider cumulative impacts to beluga whales separately from other marine mammals. Section 4.8.6 provides conclusions regarding the scale of impacts to marine mammals and belugas. The new information and additional analyses serve to supplement and expand the conclusions in the 2022 LS 258 FEIS, but no new information was discovered that alters the previous impact conclusions for marine mammals generally and beluga whales specifically. The impacts of post-lease activities associated with the E&D Scenario, accidental small spills, and spill drills would be negligible to minor for marine mammals and minor for belugas, primarily resulting from anthropogenic noise and vessel traffic. With the addition of a large spill, the impact level would be minor to moderate for marine mammals collectively, with minor impacts for most marine mammal populations, including beluga whales.

4.8.1 Summary of Affected Environment

The Cook Inlet Planning Area provides habitat for the following marine mammals: beluga, killer, fin, gray, humpback, and minke whales; Dall’s and harbor porpoises; Pacific white-sided dolphins; harbor seals; Steller sea lions; and sea otters. Uncommon or rare marine mammal visitors to waters around Kodiak and the Barren Islands include northern fur seals, elephant seals, along with beaked, blue, sei, sperm, and north Pacific right whales.

Cook Inlet beluga whales are mostly found in upper Cook Inlet. In summer (May-September) they concentrate in the northern part of upper Cook Inlet, especially Knik and Turnagain arms; the Beluga, Susitna, and Little Susitna river deltas, and Chickaloon Bay, which constitute core areas of important habitat. During spawning runs of anadromous fishes, belugas congregate near the mouths of larger streams to feed, particularly on salmon and smelt (Quakenbush et al., 2015; Saupe et al., 2014). Less is known about their distribution in winter (October–April), but existing data suggests they mostly remain in upper Cook Inlet, with occasional visitations to a few nearshore areas of lower Cook Inlet.

Cook Inlet beluga whales were listed as endangered under the ESA in 2008 after the population declined in the 1990s (73 FR 62919, October 22, 2008). Two areas (Area 1 and Area 2) in Cook Inlet were designated as critical habitats (76 FR 20180, April 11, 2011). Area 1 includes the locations of concentrated use in upper Cook Inlet where belugas may be found year-round. Area 2 includes nearshore areas of seasonal use in central and lower Cook Inlet where belugas are more dispersed including the Kenai Peninsula nearshore areas, Trading Bay, and Tuxedni Bay. Area 2 also includes historically important areas where belugas are sometimes found, including Kachemak Bay and along the western coast of Cook Inlet between Chinitna Bay and Kamishak Bay. These areas may play a role in the beluga population’s recovery. The population numbers have remained less than about 400 individuals since 2004 despite protections under the ESA and MMPA with no indication of recovery.

Two types of orcas or killer whales regularly occur in Cook Inlet. They are the resident killer whales (Eastern North Pacific Alaska Resident Stock) and the Bigg’s (Eastern North Pacific, Gulf of Alaska, Aleutian Islands, and Bering Sea Transient Stock) killer whales. Resident killer whales preferentially eat salmonids (particularly Chinooks), sablefish, herring, halibut, cod, and other large fishes. Bigg’s (transient) killer whales hunt and consume other marine mammals such as belugas, baleen whales, sea otters, porpoises, harbor seals, and Steller sea lions.

Three species of dolphins and porpoises occur in Cook Inlet. Dall's porpoises have been documented in Cook Inlet during all months of the year. Harbor porpoises are common in Cook Inlet in ice-free waters. Pacific white-sided dolphins are also present in Cook Inlet year-round. These species feed on squid and a variety of small schooling fishes.

Cook Inlet is visited regularly by four species of baleen whales. Fin whales have important feeding areas near the Barren and Semidi islands in lower Cook Inlet in summer. Migrating gray whales visit Cook Inlet during spring and fall. Humpbacks whales feed regularly in Cook Inlet during the summer. Minke whales have been observed off Cape Starichkof and Anchor Point year-round, but most probably leave Cook Inlet by October. Fin whales and two stocks of humpback whales (the Western North Pacific DPS and Mexico DPS) are listed as endangered (35 FR 12222, July 30, 1970; 81 FR 62260, September 8, 2016, respectively).

Harbor seals, Steller sea lions, and sea otters are residents in Cook Inlet. The Cook Inlet/Shelikof stock of harbor seals is distributed throughout Cook Inlet in the summer and from lower Cook Inlet through Shelikof Strait to Unimak Pass during winter. The Central Gulf of Alaska DPS of the western stock of Steller sea lions occupies lower Cook Inlet. The entire stock is listed as endangered under the ESA (62 FR 24345, May 5, 1997). A few rookeries and haulouts occur in the southernmost coastal areas of Cook Inlet, and there are many haulouts and rookeries along the coast of Shelikof Strait, Kodiak, and the Kenai Peninsula. The critical habitat designation for the Central Gulf of Alaska DPS of Steller sea lions includes the Shelikof Strait foraging area and a 37-km (20-nmi) buffer around all major haulouts and rookeries (58 FR 45269, August 27, 1993), as amended in 59 FR 30715, June 15, 1994). Two stocks of northern sea otters live year-round in Cook Inlet. The threatened southwest Alaska DPS (listed in 70 FR 46366, August 9, 2005) occupies shallow coastal waters of western Cook Inlet while the non-ESA listed southcentral stock occupies the eastern coast. Critical habitat for the southwest Alaska Stock was designated in 2009 (74 FR 51988, October 8, 2009).

4.8.2 New Information Available Since Publication of the 2022 LS 258 FEIS

New information was collected from scientific literature, survey results, marine mammal researchers, professional conference presentations, and other sources. All information was examined for reliability and relevance to the Proposed Action. New information was available that supports the analysis of environmental consequences of the Proposed Action previously described in the 2022 LS 258 FEIS. All such new information is not described in detail, as it did not change any of the impact conclusions presented in the 2022 LS 258 FEIS. Instead, this section highlights new information that is relevant to the environmental consequences of Alternatives 7–9, and the analysis of vessel impacts to beluga whales. It includes new marine mammal survey data as well as data on Cook Inlet beluga whale distribution, acoustics, and population demographics. Additional new information is presented in the Environmental Consequences of Alternatives in Section 4.8.4, and Cumulative Effects analyses in Section 4.8.5.

All Marine Mammals

Since publication of the 2022 LS 258 FEIS, the Alaska marine mammal stock assessment reports have been revised. These reports provide population estimates and information on the marine mammal stocks of Alaska. In the Cook Inlet Planning Area, new abundance estimates were calculated for killer whales, Humpback whales, Western DPS Steller sea lions, and northern sea otters, and Cook Inlet beluga whales (Table 4-4).

The current minimum population estimate of the Eastern North Pacific Alaska resident stock of killer whales has decreased from 2,347 to 1,920 (Muto et al., 2020; Young et al., 2024). However, the total count of individuals in the Prince William Sound/Kenai Fjord/Kodiak region (which includes those in the

Cook Inlet Planning Area) was 751 for the period 2005 to 2012 and 784 for the period 2005–2019, suggesting increases in pod sizes. However, count data alone does not provide a reliable estimate of abundance. At present, reliable data on trends for the entire Alaska resident stock of killer whales are unavailable and counts are likely conservative since scientists continue to observe new whales.

Humpback whale population estimates have been updated. The minimum estimate of population size of the Central North Pacific/Hawaiian stock of the Humpback whale is estimated at 7,265 total. The portion of the total stock that migrates to the Gulf of Alaska is estimated to be 2,129 (Young et al. 2024). These estimates have been revised from 7,891 and 2,222 respectively (Muto et al., 2020). Declines are attributed to disruption of lower trophic level prey by the 2014–2016 MHW in the Gulf of Alaska (Arimitsu et al., 2021). The Western North Pacific stock of the Humpback whale was estimated to contain a minimum of 865 individuals (Muto et al., 2020) and is now estimated at 1,007 whales (Young et al., 2024). The portion of the stock that visits summer feeding areas in the U.S. is 75 whales. Population trend information is not available. The Mexico/North Pacific stock of the humpback whale was previously estimated to contain a minimum of 766 individuals, but estimates are from 2004–2006 data and are no longer considered valid for population estimation. No current estimate is available.

Table 4-4: Marine Mammals Occurring in Cook Inlet, Alaska

Common Name	Status ESA (MMPA)	Seasonal Presence in Cook Inlet	Minimum Abundance Estimate
Toothed Whales			
Beluga Whale (Cook Inlet Stock[1])	Endangered (Depleted)	Year round	331[a]
Resident Killer Whale (Eastern North Pacific Alaska Resident Stock)	N/A (Not Depleted)	Year round in ice-free waters.	1,920[b]
Biggs Killer Whale (Eastern North Pacific, Gulf of Alaska, Aleutian Islands, and Bering Sea Transient Stock)	N/A (Not Depleted)	Year round in ice-free waters.	587[b]
Dall's Porpoise (Alaska Stock)	N/A (Not Depleted)	Year round	13,110[b]
Harbor Porpoise (Gulf of Alaska Stock)	N/A (Not Depleted)	Year round in lower inlet. Ice-free season in upper inlet.	26,064 from 1996 survey. No current estimate[b]
Pacific White-sided Dolphin	N/A (Not Depleted)	Year round in lower inlet.	26,880 from 1990 survey. No current estimate[b]
Baleen Whales			
Fin Whale (Northeast Pacific Stock)	Endangered (Depleted)	Spring, Summer, and Fall in lower inlet.	2,554 from 2013 survey. No current estimate exists[b]
Gray Whale (Eastern Pacific Stock)	N/A (Not Depleted)	Spring and Fall in lower inlet.	25,849[c]
Humpback Whale (Central North Pacific/Hawaii Stock)	N/A (not Depleted)	Spring, Summer, and Fall in lower inlet.	7,265 entire stock; 2,129 Gulf of Alaska[b]
Humpback Whale (Mexico/North Pacific stock)	Endangered (Depleted)	Spring, Summer, and Fall in lower inlet.	766 from 2004-2006 data. No current estimate[b]
Humpback Whale (Western North Pacific Stock)	Endangered (Depleted)	Spring, Summer, and Fall in lower inlet.	1,007[b]
Minke Whale	N/A (Not Depleted)	Spring, Summer, and Fall in lower inlet.	1,233 from a 2006 survey. No current estimate[b]
Pinnipeds			
Harbor Seal (Cook Inlet/Shelikof Strait Stock)	N/A (Not Depleted)	Year round in lower inlet. Ice-free season in upper inlet. Many move to Shelikof Strait during winter.	26,907[b]
Steller Sea Lion (Western DPS)	Endangered (Depleted)	Year round in lower inlet. Ice-free season in upper inlet.	73,211 (Entire Stock) 49,837 Stock in U.S. waters[b]
Sea Otters			

Common Name	Status ESA (MMPA)	Seasonal Presence in Cook Inlet	Minimum Abundance Estimate
Northern Sea Otter Southcentral Alaska Stock	N/A (Not Depleted)	Year round	19,854 for entire stock. 9,152 for eastern Cook Inlet[d]
Northern Sea Otter Southwest Alaska Stock	Threatened (Depleted)	Year round	41,666 for entire stock. 26,378 for Kodiak/ Kamishak/Alaska Peninsula[d]

Sources: [a] Goetz, et al., 2023.
[b] data compiled by and presented in Young et al., 2024.
[c] data compiled by and presented in Carretta et al., 2024.
[d] data compiled by and presented in USFWS, 2023c.
Notes: [1] Under the Marine Mammal Protection Act (MMPA) of 1972, "stock" is defined as a group of marine mammals of the same species that inhabit a specific geographic area and exhibit common characteristics. This definition is used to manage marine mammal populations within a species.

The best model-estimated count of the Western U.S. stock of the Steller sea lion has been updated to 49,837 sea lions in U.S. waters (Young et al., 2024). This is a decrease from the previous estimate of 52,932 (Muto et al., 2021). Within the stock, Steller sea lions in various regions show different trends. Steller sea lions in the Cook Inlet Planning Area belong to the Central Gulf of Alaska portion of the stock and show a positive population growth trend of 2.3 percent per year. Trends are generally flat or declining west of Samalga Pass in the central and western Aleutian Islands.

Estimates for sea otters have also been updated. The southwest Alaska stock of northern sea otters is estimated to contain a minimum of 41,666 individuals, down from 45,064 presented in the 2014 stock assessment (USFWS, 2023b; 2014). This includes 26,378 sea otters in the Kodiak, Kamishak, and Alaska Peninsula region, of which an estimated 10,737 are in western lower Cook Inlet (Garlich-Miller et al., 2018). Otter abundance in the southcentral stock is estimated at 19,854, an increase from 14,661 (USFWS, 2023c; Muto et al., 2020), with 9,152 in eastern lower Cook Inlet. The population trends are highly variable by region but appear to be stable or slightly increasing in lower Cook Inlet.

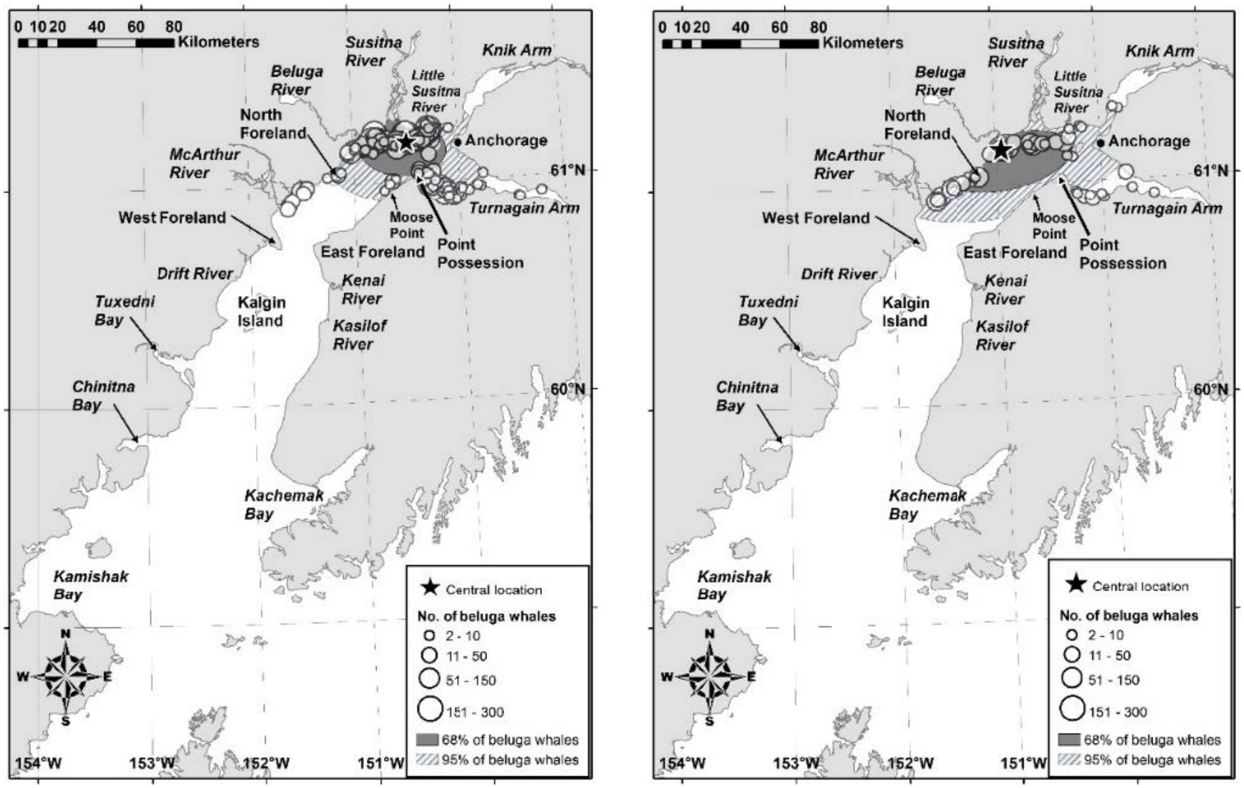
Understanding the distribution, abundance, and trends of marine species is crucial for assessing the potential impacts of the Proposed Action and Alternatives . These factors influence the likelihood of exposure to LS 258 activities in Cook Inlet. While there may be increases in local populations of Steller sea lions, sea otters, and beluga whales (see Section 4.8.1.2, 2022 LS 258 FEIS), the reported growth in their numbers is not large enough to appreciably increase the probability that marine mammals would be exposed to LS 258 oil- and gas-related activities.

Cook Inlet Beluga Whales

New information was collected on the distribution, acoustics, and population demographics of the Cook Inlet beluga whale that is relevant to the evaluation of effects of vessel noise on belugas. Relevant information is highlighted here but see the below subsection *Analysis of Effects of Vessel Noise on Cook Inlet Belugas* for the full evaluation.

The best estimate of abundance for Cook Inlet beluga whales is 331 individuals. (Goetz et al., 2023). This is an increase from the previous minimum estimate of 267 (Shelden and Wade, 2019) and is based on a weighted average of data from the three most recent reliable beluga whale aerial surveys conducted by NMFS in 2016, 2018, and 2022 (Goetz et al., 2023). Survey results since 2018 suggest that the population may be starting to increase, if only slightly. However, after the 2016 survey, a major revision was made to the methods used to estimate group sizes from the survey. A new Bayesian methodology replaced the estimation process used in the past (Boyd et al., 2019). Since the most recent abundance estimates include only 3 years of survey data and a change in analysis techniques, it is too early to draw any conclusions regarding the population trend; additional data is needed to confirm a population increase.

On December 6, 2024, BOEM staff met with biologists from NMFS in order to share new information about Cook Inlet beluga whale distribution (Seymour and Gill, 2024). NMFS indicated that in recent years, more belugas have been seen outside of the core habitat in upper Cook Inlet, but this may be due to increased monitoring efforts rather than changes in distribution. Goetz et al. (2023) mapped areas occupied by belugas in Cook Inlet from repeated systematic aerial surveys conducted by ADF&G in the 1970s, and in later years by NMFS. Mapping showed that the distribution contracted during and after population declines in the 1990s, reaching a minimum geographic distribution in 2009–2018. Since then, NMFS aerial surveys in 2021 and 2022 found belugas in a slightly larger area (Figure 4-2).



Notes: Distribution of belugas around each central location (star symbol) for each period was calculated at 1 and 2 standard deviations (capturing 68% and 95% of the whales; shaded regions).

Source: Goetz et al. (2023).

Figure 4-2: Areas Occupied by Belugas in Cook Inlet, Alaska, During Systematic Aerial Surveys in 2009–2018 (L) and 2021–2022 (R)

A recent Passive Acoustic Monitoring (PAM) survey conducted in 2021-2022 detected the presence of belugas in Chinitna River and Tuxedni Bay in winter (Castellote et al., 2024), and National Park Service aircraft spotted a pod of about 30 belugas swimming into Chinitna Bay in the first week of February 2025 (NPS, 2025). NMFS aerial surveys detected the presence of belugas in and around Tuxedni Bay in spring 2018–2021 (NOAA and NMFS, 2022). These recent sightings suggest that use in this area could have increased since the range contraction of the beluga whale in the late 1990s and 2000s documented by Shelden (2011), and belugas may be returning to historically occupied habitats known from tagging data, aerial surveys, and other observations (Shelden et al., 2015). Alternately, recent increases in monitoring may be revealing areas of recurrent seasonal use that were not consistently detected by previous monitoring techniques.

NMFS reported that sightings of belugas in the Kenai River have become more regular in recent years (Seymour and Gill, 2024). This is corroborated by the Alaska Beluga Monitoring Program, which has data indicating belugas use this area in winter and spring (ABMP, 2025). Belugas were historically seen in and around the Kenai and Kasilof rivers during summer aerial surveys in the late 1970s and early 1980s. Dutton et al. (2012) reported that sightings declined during the 1980s and 1990s, but small groups could sometimes be seen in the lower Kenai River in the 2000s. McGuire et al. (2023) reported that sightings of belugas near the Kenai River were rare until 2007 but occurred yearly between 2008 and 2021 (with the exception of 2016). In recent years, sightings in and near the Kenai and Kasilof rivers have been typical in the spring and fall (Ovitz, 2019; Castellote et al., 2020). It is unknown if these spring and fall observations represent a seasonal shift in distribution or are due to increased monitoring efforts outside the summer season. Acoustic detections indicate that belugas can also be present in the Kenai River during winter (Castellote et al., 2016; Castellote et al., 2020). Belugas appear to avoid the Kenai River from April to the end of August, presumably due to high levels of “anthropogenic” noise (noise from human activities) related to commercial, personal use and sport fishing (Kumar et al., 2024).

Reports of incidental sightings of belugas in other areas of lower Cook Inlet have increased since 2011 as dedicated outreach and monitoring efforts were expanded beyond the NMFS aerial surveys (McGuire et al., 2014; McGuire et al., 2017). Between 1993 and 1995, very few belugas (less than three percent of all annual sightings) were found south of East Foreland and West Foreland (Rugh et al., 2000). In subsequent years, 1996–2011, hardly any were seen in the lower inlet during NMFS aerial surveys (one sighting in Tuxedni Bay in 1997, two in Kachemak Bay in 2001, and one in 2012 in Trading Bay) (Shelden et al., 2015; Shelden and Wade, 2019). The Cook Inlet Beluga Whale Photo-ID Project (McGuire et al., 2023) reports incidental sighting of belugas around Kalgin Island, near Redoubt Bay, and as far south as Kachemak Bay in October in lower Cook Inlet. Very few recent sightings have been documented south of Anchor Point, and the use of the deeper waters in the central current of lower Cook Inlet by belugas has not been observed.

As the understanding of beluga whale distribution evolves, it becomes increasingly important to investigate how environmental factors, such as vessel noise, impact their communication and behavior. New information from Brewer et al. (2023) provided the first description of the Cook Inlet beluga whale vocal repertoire and evaluated the potential for commercial ship noise to “mask” or cover the sound used for most call types. This analysis indicated that, in the Susitna River area, which is in the core of the beluga whale critical habitat and within 2,000 m of the Port of Alaska commercial shipping lanes, beluga communication could be impacted during each commercial ship passage, with all seven of the most common call types being partially or fully masked during this type of noise disturbance.

Song et al. (2023) investigated the echolocation signals of Bristol Bay beluga whales and discovered these belugas emitted high-frequency broadband clicks with high amplitude source levels even in extremely shallow waters, despite potential strong reverberation and acoustic clutter. Belugas can modify the acoustic properties of their clicks and communication signals and have been reported to utilize higher frequency signals in response to increased background noise (Au et al., 1985; Vergara et al., 2025). Although not focused on Cook Inlet belugas, this study provides the first evidence from wild belugas in natural shallow-water habitats like those of Cook Inlet, suggesting that they may have developed unique adaptations for navigating acoustically challenging environments.

Understanding the population demographics of belugas is essential for assessing their overall health and future survival. While distribution information illustrates how belugas might be exposed to the Proposed Action, acoustic information provides a baseline on how belugas may respond, and demographics provide insights into how exposure and response could affect survival rates and reproduction. These factors are crucial for predicting changes that could impact individual whales and potentially the population.

McHuron et al. (2023) developed a new model to assess how variations in prey availability and anthropogenic disturbances impact the survival and reproductive success of pregnant Cook Inlet belugas.

Results indicated that foraging activity peaked during summer, leading to increased blubber reserves critical for survival in winter when prey is scarce. Decreased prey availability from late spring to early fall was predicted to negatively affect the population's survival and birth rate, but intermittent human disturbances were predicted to have only minor effects if abundant prey was available.

Another new demographic model was provided by Warlick et al. (2024), who used data from 2004 to 2018 to create an integrated population model for Cook Inlet beluga whales. They examined how prey availability and ocean conditions impacted the whales' survival and reproduction rates, and they conducted a population viability analysis to predict extinction risk under different scenarios. The results indicated that while breeding females and young calves had relatively high survival rates, reproduction rates were low, and survival rates among non-breeding whales were low. The analysis suggested the population should likely continue to decline, with a 17–32 percent chance of extinction in the next 150 years (Warlick et al., 2024). This study indicates that even small changes in reproduction or survival could have population-level effects

4.8.3 Environmental Consequences of the Proposed Action

This section provides an impact analysis for marine mammals as a group and a separate detailed analysis of the effects of vessel noise on Cook Inlet belugas. Section 4.8.2 of the 2022 LS 258 FEIS is incorporated by reference. Each subsection provides a summary of the primary sources of impact from post-lease activities, together with any updated analysis of consequences based on new information. Additional background information on underwater noise and marine mammal hearing is provided for context.

Habitat Alteration

LS 258 post-lease activities would have temporary or permanent effects on marine mammal habitat through drilling operations and permanent platform and pipeline installations that cause physical seafloor disturbance and water quality changes from increased turbidity and operational discharges. Impacts would be localized to activity sites, though water quality changes would spread to larger areas. Changes to benthic habitats would directly impact bottom-dwelling invertebrates like clams, crabs, sea urchins, and mussels that feed sea otters, pinnipeds and gray whales, while water column alterations would affect fish, squid, and zooplankton that feed whales, porpoises, and pinnipeds. Several factors would limit habitat alteration from LS 258 activities. Cook Inlet's strong currents and tides would quickly disperse suspended materials, reducing concentrated effects. Drill cuttings and fluids would be reused or reinjected rather than discharged into Cook Inlet. NPDES permits would regulate operational discharges. Since marine mammals forage across large areas of Cook Inlet and the Gulf of Alaska, localized habitat changes from LS 258 would not significantly affect overall food availability or harm marine mammal populations.

Disturbance and Collision

Vessels and aircraft activities would result in non-acoustic impacts. Aircraft generate disturbances from airborne noise and visual cues like shadowing, which could be perceived as predation threats, while vessel impacts are linked to visual presence and movement. Behavioral responses are highly variable and range from no observable reaction to diving, changing speed or direction, approaching to investigate, or fleeing. Vessel strikes are possible, but several factors reduce collision risks. Fast-moving vessels pose greater risks than the large, slow-moving vessels used during most post-lease activities. Collision risk is limited by the generally low vessel traffic levels from LS 258 activities. Vessels will avoid most critical habitat areas, which mainly occur outside the OCS. BOEM's standard mitigation measures require vessels to avoid marine mammals and haulouts and to reduce speed in their presence. Overall, vessel and aircraft activities are expected to cause only minor disturbances to marine mammals in Cook Inlet.

Oil Spills

Effects of spills, spill drills, and spill response activities on marine mammals are described in Appendix A, which synthesized the OSRA conducted by Ji and Smith (2021). The OSRA indicates a 19 percent chance of one or more large spills (3,800 barrels) occurring over 32 years of oil and gas production, with an 81 percent chance of no large spills (Ji and Smith, 2021). Small spills would not affect marine mammal populations due to their limited volume and localized nature, causing only temporary effects on individuals. Large spills could affect marine mammals through hydrocarbon exposure causing skin and eye lesions, respiratory problems, organ damage from contaminated prey, and habitat degradation through contamination in food webs and sediment persistence (Helm et al., 2015; Peterson et al., 2003). Spill drills are short-term activities prior to a spill that involve vessels and personnel that could cause minor disturbances and temporary behavioral effects, but these are unlikely to cause any lasting effects to marine mammals. Spill response activities after a spill may disturb marine mammals but are designed to yield net benefits by removing oil from the environment.

Effects of large oil spills on Cook Inlet beluga whales are concerning due to their small population size. However, oil spill risk is minimal due to low probability of a spill contacting critical habitat. Critical Habitat Area 1, the area of core important habitat in upper Cook Inlet used intensively for breeding and calving, lies completely outside the lease sale area. Only a small portion of Critical Habitat Area 2 overlaps with the lease sale area, representing just 10 OCS lease blocks or approximately 0.85 percent of total designated beluga critical habitat. This overlap area consists of fall and winter feeding areas where belugas occur in much lower densities compared to the core habitat areas in upper Cook Inlet. Since belugas are absent from the lower Cook Inlet lease sale area for much of the year, temporal overlap between whale presence and potential spill exposure is substantially reduced. The OSRA estimated that currents and tidal flow generate the highest spill contact risks in lower Cook Inlet, particularly around Augustine Island, lower Cook Inlet, and areas near the Kenai Peninsula, while most areas in upper Cook Inlet have relatively low contact probabilities. The combined risk of a spill both occurring and contacting beluga whale core habitat in upper Cook Inlet is less than 1 percent (Ji and Smith, 2021). The greatest chance of a spill reaching any area used by belugas would be in lower Cook Inlet near Iniskin and Iliamna bays south of Chinitna Bay, where belugas are rarely seen. This geographic distribution creates an overall low risk profile associated with a minor impact level despite the population's inherent vulnerability.

Sea otters are particularly vulnerable to oil spills due to their distribution in Cook Inlet and their dependence on fur for insulation. Oil contamination of their fur could lead to hypothermia and death by compromising their insulation. Grooming would likely result in oil ingestion. They could also face long-term health risks from hydrocarbon contaminants in the benthic organisms they consume. These vulnerabilities are heightened because sea otters occupy coastal areas of lower Cook Inlet where spill contact risks are higher than elsewhere. The highest combined probability of a large spill both occurring and contacting areas used by sea otters was estimated to be 10 percent (Ji and Smith, 2021). A major oil spill event could compromise habitat value for feeding, resting, and reproduction, requiring a decade or more for population recovery (Ballachey et al. 2014; Monson et al. 2000; Garshelis and Johnson, 2013). The relatively large population size of sea otters in Cook Inlet (~20,000 from Garlich-Miller et al., 2018) provides some resilience against population-level effects, but sizeable numbers of individuals could experience reduced survival or reproduction, potentially resulting in moderate impacts to the population.

Harbor seals could be affected by oil spills in both marine areas and on haulouts. The Cook Inlet harbor seal population appears stable with about 27,000 individuals. Ji and Smith (2021) estimated the combined probability of a spill occurring and contacting harbor seal resource areas in lower Cook Inlet at 6–13 percent. Harbor seals are vulnerable to contamination when hauling out on beaches and rocks, particularly during the April–May pupping season. Potential impacts include inhaling and ingesting oil, feeding on contaminated food sources such as fish and crustaceans, displacement from important resting and breeding areas, and eye and respiratory irritation. The harbor seal population would likely recover from a large spill within a few years, though some individuals could experience long-term health effects.

Steller sea lions in Cook Inlet belong to the western population, which is listed as threatened under the ESA. They use lower Cook Inlet areas where spill contact probabilities are higher than elsewhere, but critical habitat areas lie to the south and outside of the Lease Sale Area, with no overlap. The rookeries and haulouts in southern Cook Inlet have up to a 6 percent combined probability of both a spill occurring and making contact (Ji and Smith, 2021). Individual Steller sea lions could face significant impacts as they do not seem to avoid oil. Steller sea lions were observed swimming in or near oil slicks during the Exxon Valdez oil spill and high levels of PAHs were found in dead Steller sea lions after that event (Calkins et al., 1994).

Large baleen whales (fin, humpback, gray, and minke whales) visit Cook Inlet seasonally, mainly from spring through fall, and occupy lower Cook Inlet where spill contact probabilities are higher. Their seasonal presence also coincides with the higher risk of spills in summer. Overall combined probabilities were up to 6 percent and were similar to those for other species in lower Cook Inlet (Ji and Smith, 2021). Their large body size means potential for high levels of oil exposure through filter-feeding on large amounts of contaminated prey. Potential impacts also include baleen fouling, inhalation of volatile hydrocarbons, and temporary displacement from feeding areas. Historical observations suggest large whales swim through oil slicks without immediate obvious effects (Geraci and St. Aubin, 1990), but long-term health impacts could occur. Population-level effects would likely be minimal due to their wide-ranging nature and low densities in Cook Inlet.

Smaller marine mammals (killer whales, Dall's porpoises, harbor porpoises, and Pacific white-sided dolphins) are present year-round in Cook Inlet. Their fast-moving and wide-ranging behavior may help reduce exposure during a large spill, though social pod structure could result in multiple animals being affected simultaneously. Their fish-eating diet could expose them to contaminated prey. These species would likely experience the lowest overall impacts due to their mobility, but the combined probability of a spill occurring and contacting areas used by these species would be similar to that of larger cetaceans, as estimated by Ji and Smith (2021).

The likelihood of a large oil spill affecting Cook Inlet marine mammals is relatively low, but the consequences could affect some populations. Sea otters face the highest vulnerability from a large spill due to their dependence on fur for insulation, resulting in a moderate impact level. Cook Inlet beluga whales are at risk due to the small population size, but geographic and temporal factors substantially reduce the risk of exposure to a large spill, yielding a minor overall impact level. Whales are at relatively low risk, while other species with less mobility face a somewhat higher risk. The OSRA model used for this analysis does not account for spill preparedness, prevention, response, cleanup, or containment measures and therefore may overestimate the actual chance of a large spill contacting marine mammal habitat (Ji and Smith, 2021).

Noise

Underwater Noise and Marine Mammal Hearing

This section has three parts. The first part provides background information important for understanding the effects of noise on marine mammals. The second part summarizes and updates the evaluation of consequences of noise on marine mammals presented in Section 4.8.2.1 of the 2022 LS 258 FEIS. The third part analyzes the effects of vessel noise on Cook Inlet beluga whales.

The Importance of Sound to Marine Mammals

Marine mammals are highly dependent on acoustic cues as a primary means of communicating and assessing their environment. Sound travels faster and farther in water (~1,500 m/s) than it does in air (~350 m/s), making this a reliable mode of information transfer across large distances and in dark environments where visual cues are limited. Sound plays an essential role in critical activities like breeding, navigating, avoiding predators, foraging and maintaining social structure. Marine mammals glean information from a range of acoustic signals, including ambient sounds produced on reefs, the low-frequency rumble associated with approaching storms, and the vocalizations of other marine fauna. Additionally, toothed whales utilize echolocation clicks to navigate their surroundings and locate prey (Madsen and Surlykke 2013).

Functional Hearing Groups

Marine mammal species have been classified into functional hearing groups based on similar anatomical auditory structures and frequency-specific hearing sensitivity obtained from hearing tests on a subset of species (Finneran, 2015; NMFS, 2018; Southall et al., 2019). Species for which empirical measurements have not been made are grouped with similar species for categorization. This concept of marine mammal functional hearing groups was first described by Southall et al. (2007). After a few updates based on newer studies, science and regulations now recognize several functional hearing groups (Southall et al. 2019; NMFS, 2024a). The relevant functional hearing groups are provided in Table 4-5. NMFS has regulatory authority over the protection of cetaceans and pinnipeds species that occur in and near Cook Inlet. The USFWS oversees the protection of sea, manatees, otters and some other marine carnivores (i.e., polar bears, and walruses).

Since the last publication summarizing the best available information on marine mammal functional hearing groups (Southall et al. 2019), a formative study on hearing in baleen whales was conducted. In a bay off Norway, auditory brainstem response tests were performed on two adolescent minke whales (Houser et al. 2024). The upper limit of their hearing range was determined to be between 45–90 kHz, substantially higher than previously thought. As this study was conducted while the NMFS technical guidance was being updated, this information did not inform the 2024 technical guidance (cited herein as NMFS, 2024a).

To determine whether a particular sound source is audible to a marine mammal, the frequency of the sound source is compared with the species' hearing range. If an activity generates sound at frequencies that are within the species' hearing range and exceeds a minimum sound level at the animal's location, then that sound is audible. Sounds at frequencies outside of the hearing range are inaudible but still possess the ability to inflict injury if they are above certain thresholds based on the hearing group.

Table 4-5: Marine Mammal Hearing Groups and Underwater Hearing Ranges

Hearing Group	Generalized Hearing Range*
Low-frequency Cetaceans (Gray, Humpback, Fin, Minke, Right Whales)	7 Hz to 36 kHz
High-frequency Cetaceans (Belugas, Killer Whales, Pacific White-sided Dolphin)	150 Hz to 160 kHz
Very High-frequency Cetaceans (harbor porpoises, Dall's porpoise)	200 Hz to 165 kHz
Phocid Pinnipeds (Harbor Seals)	40 Hz to 90 kHz
Otariid Pinnipeds (Steller Sea Lions, California Sea Lions, Northern Fur Seals)	60 Hz to 68 kHz
Sea otters	125 Hz to 38 kHz**

Notes: Hz = hertz kHz = kilohertz

* Represents the generalized hearing range for each group as a composite (i.e., all species within the group). Individual species' hearing ranges may not be as broad. Generalized hearing ranges were chosen based on the ~65

dB threshold from composite audiograms or previous analysis and/or data in NMFS, 2024a; Southall et al., 2007; and Southall et al., 2019.

** Generalized hearing ranges for sea otters are from Ghoul and Reichmuth, 2014.

Potential Impacts of Underwater Sound on Marine Mammals

The importance of sound to marine mammals means there is potential for adverse effects from unwanted sounds, such as anthropogenic noise. Depending on the level of exposure, the context, and the type of sound, potential impacts of underwater sound on marine mammals may include non-auditory injury, auditory injury (e.g., permanent hearing loss), temporary hearing loss, behavioral changes, acoustic masking, or increases in physiological stress (OSPAR, 2009). Each of these impacts is discussed below.

Non-auditory Injury: Non-auditory physiological injury is possible for very intense sounds or blasts, such as explosions. This kind of impact is only possible during detonation of explosives in decommissioning or in rare cases, from occurrence of unexploded ordnances. Although many marine mammals can adapt to large changes in pressure, such as in a deep foraging dive, the shock waves produced by explosives expose the animal to rapid and great changes in pressure, which in turn causes a rapid expansion of air-filled cavities (e.g., the lungs) that cannot be compensated for. This causes tears, breaks, or hemorrhaging in the surrounding tissue or bone. The extent and severity to which such injuries occur depends on several factors including the size of these air-filled cavities, ambient pressure, how close an animal is to the blast, and the size of the blast (U.S. Navy, 2017). In extreme cases, this can lead to severe lung damage which can directly kill the animal; a less severe lung injury may indirectly lead to death due to an increased vulnerability to predation or the inability to complete foraging dives.

Auditory Injury and Temporary Hearing Loss: An animal's auditory sensitivity to a sound depends on the spectral, temporal, and amplitude characteristics of the sound (Richardson et al., 1995). When exposed to sounds of significant duration and amplitude (typically within close range of a source), marine mammals may experience noise-induced threshold shifts and auditory injury (**AUD INJ**). Threshold shift is a shift in the ability to hear, and auditory injury is a physical injury to any part of the hearing system. Permanent Threshold Shift (**PTS**) is an irreversible loss of hearing due to hair cell loss or other structural damage to auditory tissues (Henderson et al. 2008; Saunders et al. 1985). Temporary Threshold Shift (**TTS**) is a relatively short-term (e.g., within several hours or days), reversible loss of hearing following noise exposure (Finneran, 2015; Southall et al., 2007), often resulting from hair cell fatigue (Saunders et al., 1985; Yost, 2000). While experiencing TTS, the hearing threshold rises, meaning that a sound must be louder to be detected. Prolonged or repeated exposure to sounds at levels that are sufficient to induce TTS without adequate recovery time can lead to auditory injury including PTS (Finneran, 2015; Southall et al., 2007). Research suggests that some odontocete species may have mechanisms to selectively reduce their hearing sensitivity when provided with a precursory cue that an intense sound is just about to arrive, which may help to protect themselves from auditory injury or TTS (Nachtigall and Supin, 2013).

Behavioral Impacts: When exposed to underwater sound, marine mammals may show varying levels of behavioral disturbance ranging from no observable response to overt behavioral changes. They may flee from an area to avoid the noise source, change their vocal activity, stop or change foraging behaviors, or change their typical dive or social behavior, among other responses (NRC, 2003). The implications of behavioral disturbance can range from the temporary displacement of an individual to reduction in fitness related to decreased foraging success, which could have long-term consequences on a population. Studies have shown that noise level alone often fails to reliably predict behavioral responses because several contextual factors play a role in whether and how an animal responds (DeRuiter et al., 2013; Ellison et al., 2012; Gomez et al., 2016; Richardson et al., 1995; Southall et al., 2007). Some of these factors include:

- Context of the exposure – e.g., behavioral state of the animal, habitat characteristics,

- The biological relevance of the signal – e.g., whether the signal is audible, whether the signal sounds like a predator,
- The life stage of the animal – e.g., juvenile, mother and calf,
- Prior experience of the animal – e.g., is it a novel sound source,
- Sound properties – e.g., duration of sound exposure, sound pressure level, sound type, mobility/directionality of the source, and
- Physical properties of the medium that may affect how the sound propagates – e.g., bathymetry, temperature, salinity.

It is also possible that marine mammals may become habituated (show a reduced response) or sensitized (show an increased response) when repeatedly exposed to sounds (Bejder et al., 2009; Nisbet, 2000). Tolerance is defined as '*the intensity of disturbance that an individual tolerates without responding in a defined way*' (Nisbet, 2000). Over the course of the habituation process, individual tolerance levels increase, whereas tolerance levels conversely decrease as individuals become sensitized to specific stimuli (Bejder et al., 2009; Nisbet, 2000). Variability exists across species and among individuals, thereby resulting in variable thresholds of disturbance (see Gomez et al., 2016 for a review; Richardson et al., 1995). Because of these many factors, behavioral impacts are challenging to both predict and measure, and this remains an active field of study in marine mammal bioacoustics.

Auditory Masking: Acoustic masking occurs when a sound signal that is of importance to a marine mammal (e.g., communication calls, echolocation, and environmental sound cues) is rendered undetectable due to the low signal-to-noise ratio in a frequency band relevant to a marine mammal's hearing range. In other words, masking occurs when a noise source overlaps in time, space, and frequency with a signal of interest and obscures an animal's ability to hear it (Clark et al., 2009; Richardson et al., 1995). Auditory masking may occur over larger spatial scales than noise-induced threshold shift or behavioral disturbance. Masking can reduce an individual's "communication space," (the range at which it can effectively transmit and receive acoustic cues from conspecifics) or "listening space" (the range at which it can detect relevant acoustic cues from the environment). A growing body of research is focused on the risk of masking from anthropogenic sources, the ecological significance of masking, and what anti-masking strategies may be used by marine mammals (Branstetter and Sills, 2022; Clark et al., 2009; Holt et al., 2009; Scheifele et al., 2005; Serrano and Terhune, 2001; Turnbull and Terhune, 1993). This understanding is essential to fully address masking in regulation or mitigation approaches (Erbe et al. 2016). In the interim, most assessments only consider the overlap in frequency between the sound source and the hearing range of marine mammals.

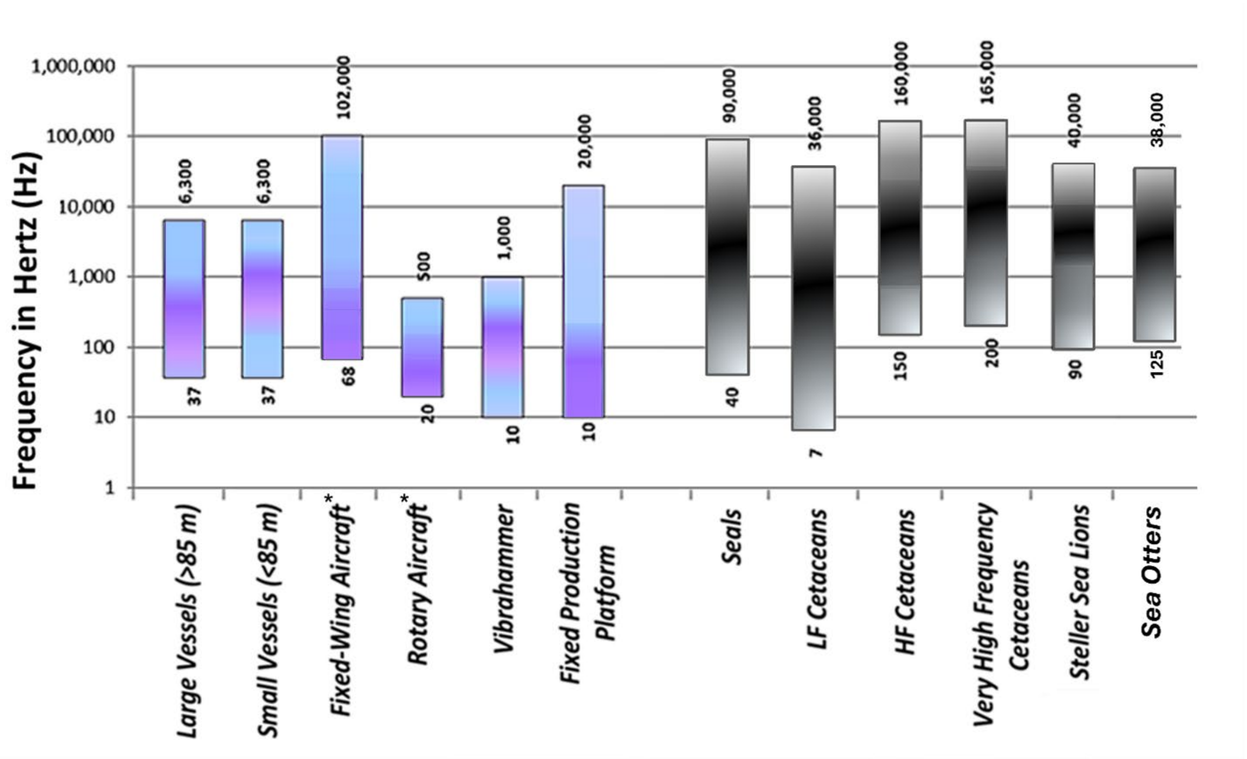
Physiological stress: The presence of anthropogenic noise, even at low levels, can increase physiological stress in marine mammals (Kight and Swaddle, 2011; Wright et al., 2007a). For example, various hormone levels may change in response to stress (including cortisol, reproductive hormones, thyroid hormones, among others; Watt et al., 2021), animals may exhibit increased respiration rates, an increase or decrease in heart rate (Williams et al., 2022), or changes in other bodily functions. With prolonged stress from noise, these physiological changes may be tied to lower reproductive rates or decreased fertility, compromised immune function (Rolland et al., 2012), or disrupted metabolic regulation, leading to accelerated aging or slowed growth. It can be difficult to observe or sample these responses in wild animals. Several methods have emerged that allow for reliable measurements in marine mammals (Hunt et al., 2014) and may include sampling through blood, saliva, blubber, feces, urine, or the blow produced by a whale, or tagging animals with heart rate monitors (Rolland et al., 2005). The impact of physiological stress on an individual or population can be exacerbated by factors such as the age, condition of the animal (e.g., illness, injury, or stress during a critical life-stage such as reproduction), or vulnerability from other stressors (e.g., food scarcity, habitat loss).

The effects of anthropogenic sound on marine life have been studied for more than half a century. In that time, it has become clear that this is a complex subject with many interacting factors and extreme variability in response from one sound source to another and from species to species. Even within species, individuals may have markedly different responses to a similar exposure. But some general trends have emerged from this body of work. First, the louder and more impulsive the received sound is, the higher the likelihood of an adverse physiological effect, such as auditory injury or TTS. Impulsive sounds have a quick onset, short duration, high peak levels, and rapid decline, and differ from continuous noise, which is steadier, with sustained energy levels over time. Auditory injury or TTS generally occur at relatively close distances to a source, in comparison to behavioral effects, masking, or increases in stress, which can occur wherever the sound can be heard. Secondly, the hearing sensitivity of an animal plays a major role in whether it is affected by a sound or not, and there is a wide range of hearing sensitivities among marine mammal species.

Many human activities (including activities associated with LS 258) generate sounds which span a wide range of frequencies (i.e., broadband) that partially or entirely overlap marine mammal hearing ranges. Figure 4-3 shows several examples of broadband sound-producing activities alongside the proposed hearing ranges of marine mammal groups. Note that the figure shows the typical range of frequencies from activities and depicts the dominant frequencies that contain the most energy. The dominant energy within a range of frequencies is where a sound source produces its strongest or most concentrated acoustic energy. For example, Figure 4-3 reported sounds from large vessels spanned a frequency range from 37 Hz to 6.3 kHz and sounds below 1 kHz contained the most energy. Activities that generate high amplitude sounds have the greatest potential for adverse effects on marine mammals when the dominant frequencies produced by the activities overlap with the hearing range of the animal.

Beluga whales are included in the high-frequency cetacean hearing group and hear across a wide range of frequencies. Research on captive belugas and wild belugas from Cook Inlet and Bristol Bay has shown belugas can hear across a broad range from <1 kHz-150 kHz, with particularly sensitive hearing between 45–80 kHz (Mooney et al., 2020; Castellote et al., 2014; Awbrey et al., 1988). Communication sounds occur in the frequency range of 200 Hz to 144 kHz (Vergara et al., 2021). Belugas have earned the nickname "canaries of the sea" due to their wide repertoire of communication calls including whistles, pulsed calls, and combination tonal-pulsed calls (e.g., Garland et al., 2015). Echolocation signals are produced with peak energy between 40-160 kHz (Au et al. 1985, 1987; Zahn et al., 2021; Song et al., 2023). These biosonar clicks are used for navigation and hunting in the extremely murky, significant tides and currents of Cook Inlet, where visual cues are limited.

Beluga whales are thought to have sensitive hearing compared to other toothed whales (Houser and Finneran, 2006; Houser et al., 2018). Castellote et al. (2014) reported that belugas could detect sound levels as low as 50 dB when those sounds were within their frequency range of greatest hearing sensitivity (45–80 kHz). Belugas have a reduced hearing sensitivity to low frequency sounds compared to higher frequencies. Sounds below 100 Hz are audible to beluga whales when noise is in excess of around 120 dB (Awbrey et al., 1988). In contrast, fin whales, which belong to the low-frequency cetacean hearing group, are believed to have the greatest sensitivity between 1–10 kHz and can hear in the 7–36 kHz frequency band.



Notes: Darker regions show the dominant frequencies produced by sources and the frequencies of greatest sensitivity for marine mammal groups.

* Aircraft frequencies were measured underwater, directly below overflights.

** Vertical rectangles show the typical range of frequencies from activities, but darker bands within rectangles depict the dominant frequencies that contain the most energy.

Sources: Greene et al., 2008; Blackwell and Green, 2003; Greene and Moore, 1995; NMFS, 2024a; Ghoul and Reichmuth, 2014.

Figure 4-3: Comparison of the Frequency Ranges of Underwater Sounds Generated by Activities Associated with Lease Sale 258 with the Generalized Frequency Ranges Audible to Marine Mammal Hearing Groups

Units of Measurement

Sound can be quantified and characterized based on a number of physical parameters. A complete description of the units can be found in ISO (2017). Some of the major parameters and their measurement units (in parentheses) are:

Acoustic pressure (*pascal, Pa*): The values used to describe the acoustic (or sound) pressure are peak pressure, peak-to-peak pressure and root-mean-square (rms) pressure deviation. The peak sound pressure is defined as the maximum absolute sound pressure deviation within a defined time period and is considered an instantaneous value. The peak-to-peak pressure is the range of pressure change from the most negative to the most positive pressure amplitude of a signal. Whereas the rms sound pressure represents a time-averaged pressure and is calculated as the square root of the mean (average) of the time-varying sound pressure squared over a given period. The peak level (L_{pk}), peak-to-peak level (L_{pk-pk}), and sound pressure level (L_{rms} or SPL) are computed by multiplying the logarithm of the ratio of the peak or rms pressures to a reference pressure (1 μPa in water) by a factor of 20 and are reported in decibels, see Sound Levels.

Sound exposure (*pascal-squared second, or Pa^2-s*): Sound exposure is proportional to the acoustic energy of a sound. It is the time-integrated squared sound pressure over a stated period or acoustic event. Unlike sound pressure, which provides an instantaneous or time-averaged value of acoustic pressure, sound exposure is cumulative over a period of time.

Sound Levels: There is an extremely wide dynamic range of values when measuring acoustic pressure in pascals, so it is customary to use a logarithmic scale to compress the range of values. Aside from the ease it creates for comparing a wide range of values, animals (including humans) perceive sound on a logarithmic scale. These logarithmic acoustic quantities are known as sound levels and are expressed in decibels (**dB**), which is the logarithm of the ratio of the measurement in question to a fixed reference value. Underwater acoustic sound pressure levels are referenced to a pressure of 1 μPa. Note: airborne sound pressure levels have a different reference pressure: 20 μPa.

The sound pressure and exposure metrics previously described also can be expressed as levels, and are commonly used in this way:

- root-mean-square sound pressure level (L_{rms} or SPL, in dB re 1 μPa)
- peak pressure level (L_{pk}, in dB re 1 μPa)
- peak-to-peak pressure level (L_{pk-pk}, in dB re 1 μPa)
- sound exposure level (SEL, in dB re 1 $\mu Pa^2 s$)

Note: There are a few commonly used time periods used for SEL, including a 24-hour period (used in the U.S. for the regulation of noise impacts to marine mammals (SEL_{24})), or the duration of a single event, such as a single pile driving strike or an airgun pulse, called the single strike SEL (SEL_{ss}). A sound exposure for some other period, such as the entire installation of a pile, may be written without a subscript (SEL), but to be meaningful, should always denote the duration of the event.

Introduction to Noise Thresholds for Impact Assessment

NMFS has developed a threshold-based framework for determining when underwater noise exposure can cause adverse effects to marine mammals. The NMFS framework is useful for determining which sound sources associated with LS 258 may generate noise levels capable of causing adverse effects to marine mammals and predicting the possible type and severity of effects. Full details of the framework are described in NMFS (2024a). In Cook Inlet, NMFS has regulatory jurisdiction over cetaceans, dolphins, porpoises, seals, and sea lions and USFWS has jurisdiction over sea otters. USFWS has also adopted a similar framework.

The MMPA and ESA are the two statutes that are most relevant when considering potential harm from anthropogenic noise on marine mammals. The MMPA prohibits the “take” of marine mammals, defined as the harassment, hunting, capturing, killing, or an attempt of any of those actions on a marine mammal. This act requires that an incidental take authorization be obtained from the NMFS for the incidental take of marine mammals as a result of anthropogenic activities. MMPA regulators divide the effects on marine mammals that could result in a take into Level A and Level B, defined for non-military activities as follows:

Level A: Any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild.

Level B: Any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing a disruption of behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering, but that does not have the potential to injure a marine mammal or marine mammal stock in the wild (16 USC 1362).

With respect to anthropogenic sounds, NMFS publishes acoustic thresholds, otherwise known as "Acoustic Guidance," to delineate the sound levels at which potential takes could occur. Level A takes exclusively involve auditory injuries, whereas Level B takes include behavioral effects as well as TTS. The current regulatory framework used by NMFS for evaluating an acoustic take of a marine mammal involves assessing whether the animal's received sound level exceeds a given threshold. For Level A, this threshold differs by functional hearing group, but for Level B, the same threshold is used across all marine mammals.

Thresholds for Auditory Injury

The current NMFS (2024a) injury (Level A) thresholds consist of dual criteria of peak sound pressure level (peak SPL; L_{pk}) and 24 hour-cumulative sound exposure level (SEL; L_E) thresholds (Table 4-6). These criteria, along with information about source levels and sound propagation, are used to predict the potential distance from a sound source within which injury may occur. Whichever criterion results in the largest distance is generally used, to be most conservative. The SEL thresholds are frequency-weighted, which means that the thresholds account for the frequency-specific hearing sensitivity of the functional hearing group, de-emphasizing the frequencies at which the animal is less sensitive. The frequency weighting functions are described in detail in Accomando et al. (2024).

The NMFS criteria also identifies thresholds for impulsive and continuous noise. At close distances to impulsive sounds, physiological effects to an animal are likely, including TTS and auditory injury, which includes but is not limited to PTS. Impulsive sounds associated with oil and gas development include seismic airguns, explosions, sparkers, and boomers. Auditory injury and TTS are also possible after exposure to non-impulsive sounds if the amplitude is high and the duration of sound exposure is long enough. This classification of sound types, therefore, provides a conservative framework upon which to predict potential adverse hearing impacts to marine mammals.

NMFS predicts that beluga whales (and others in the High Frequency Cetacean group) can experience acoustic injury from impulsive sources like seismic surveys due to either a peak sound pressure level exceeding 230 dB or from a cumulative sound exposure level that exceeds 193 dB within 24 hours. Belugas would experience injury from non-impulsive noise like vessel engine noise if the cumulative SEL exceeds 201 dB in a 24-hour period (Table 4-6).

Table 4-6 Acoustic Injury Thresholds for Marine Mammal Hearing Groups

Hearing Group	PTS Onset Acoustic Thresholds (received noise levels)		
	Peak SPL (L_{pk}) Impulsive	SEL_{24h} (L_E) Impulsive	SEL_{24h} (L_E) Non-Impulsive
Low Frequency Cetaceans	222 dB	183 dB	197 dB
High Frequency Cetaceans	230 dB	193 dB	201 dB
Very High Frequency Cetaceans	202 dB	159 dB	181 dB
Phocid Pinnipeds (Seals)	223 dB	183 dB	195 dB
Otariid Pinnipeds (Sea lions)	230 dB	185 dB	199 dB
Sea Otters	232 dB	203 dB	219 dB

Note: Peak sound pressure (L_{pk}) has a reference value of 1 µPa, and cumulative sound pressure level (L_E) has a reference value of 1 μPa^2-s. The thresholds incorporate auditory weighting functions specific to each marine mammal group. The accumulation period for cumulative sound exposure thresholds is 24 hours. Values for northern sea otters are from Southall et al. (2019) and are adopted by USFWS (e.g., 90 FR 19496, May 8, 2025, all others are from NMFS (2024a).

NMFS predicts that beluga whales (and others in the High Frequency Cetacean group) could experience acoustic injury from impulsive sources like seismic surveys due to either a peak sound pressure level exceeding 230 dB or from a cumulative sound exposure level that exceeds 193 dB within 24 hours. Belugas would experience injury from non-impulsive noise like vessel engine noise if the cumulative SEL exceeds 201 dB in a 24-hour period (Table 4-6).

Thresholds for Behavioral Disturbance

For behavioral effects of anthropogenic sound on marine mammals, NMFS classifies sound sources as either intermittent or continuous (NMFS, 2024a). Continuous noise is produced by activities such as drilling, vessel traffic or vibratory pile-driving, which produce a steady flow of sound over time. Impulsive noise consists of intermittent bursts or pulses of sound. Sources of impulse noise include echosounders, sub-bottom profilers, airguns and impact pile-driving. It is important to recognize that these delineations are not always practical in application, as a continuous yet moving sound source (such as a vessel passing over a fixed receiver) could be considered intermittent from the perspective of the receiver under certain conditions.

NMFS currently uses a threshold for behavioral disturbance (Level B) of 160 dB re 1 µPa SPL for non-explosive impulsive sounds (e.g., airguns and impact pile-driving) and intermittent sound sources (e.g., scientific and non-tactical sonar), and 120 dB re 1 µPa SPL for continuous sounds (e.g., vibratory pile-driving, drilling, etc.) (NMFS, 2019). This is an "unweighted" criterion that is applicable for all marine mammal species. USFWS has set a threshold for take by Level B harassment for sea otters at 160 dB of received underwater sound for both impulsive and non-impulsive sound sources (e.g., 90 FR 19496, May 8, 2025). Unlike with SEL-based thresholds, the accumulation of acoustic energy over time is not relevant for this criterion—meaning that a Level B take can occur even if an animal experiences a received SPL of 160 dB re 1 µPa very briefly in one instance. Level B harassment is generally treated as a binary step function (i.e., no effect if noise is less than the threshold, always an effect at the threshold or higher),

While there are numerous factors that determine whether an individual is affected by a sound, resulting in substantial variability even in similar exposure scenarios (e.g., Ellison et al., 2012; Southall et al., 2007), the Level B criterion was adopted based on the available data and the practical need to use a metric-based threshold that is both predictable and measurable for most activities. Several lines of evidence provide the basis for Level B thresholds. Southall et al. (2007, 2019) reviewed studies of behavioral responses among marine mammals and found considerable variability among taxa but determined that exposures below 120 dB generally do not appear to induce strong behavioral responses. Behavioral effects, including avoidance, become more likely in the range between 120 to 160 dB, and most marine mammals show some, albeit variable, responses to sound between 140 to 180 dB. Southall et al. (2007) also connected the onset of behavioral disturbance with noise levels that are likely to cause TTS. The onset of TTS occurs at noise levels that are often similar to levels at which marine mammals show indications of behavioral harassment (e.g., Schlundt et al., 2000; Mooney et al., 2009). TTS of a sufficient degree can result in reduced opportunities to detect important signals (conspecific communication, predators, prey) and may result in disruptions in behavior patterns that would not otherwise occur. The Level B criterion do account for how the context in which a sound is received affects the nature and extent of responses to a stimulus and may overestimate the likelihood of behavioral responses.

Sound Source Levels, Attenuation, and Impact Zones

Activities associated with LS 258 would generate sounds of various levels. Table 4-7 shows example underwater sound levels measured from a variety of sources—including activities in the Proposed Action. Many of these activities are within the frequency hearing ranges of marine mammals and could exceed the NMFS and USFWS thresholds, which indicates that exposure may result in injury or behavioral disturbances. Seismic surveys and impact pile driving are the activities most likely to generate underwater noise levels capable of causing acoustic injury. Vessel noise is concerning because although it is not among the loudest sources, it would be the most frequent and widespread underwater noise source anticipated to result from LS 258 activities. Section 4.8.2 of the 2022 LS 258 FEIS presents an evaluation of effects of noise from pile driving, seismic surveys, drilling operations, platform and pipeline construction, and other actions, while the effects of vessel noise are evaluated in this document.

Table 4-7: Underwater Sound Measurements from a Variety of Sources, Including Oil and Gas-related Activities

Source	Broadband Sound Pressure Level (dB) Underwater[1]	Source
Underwater Earthquake	144 dB	Richardson et al, 1995
Underwater Volcano	192+ dB	DOSITS, 2025
Offshore Oil Platforms	97-119 dB at 0.3-19 kilometers	Blackwell and Greene, 2003
Drilling (from Bottom-grounded Platforms)	119-127 dB; up to 124 dB at 1km	Richardson et al., 1995; Blackwell et al., 2004 (respectively)
Small Vessels (crew boat)	156 dB	Richardson et al., 1995
Small Vessel (fishing boat)	151 dB	Richardson et al., 1995
Small Vessels (trawler)	158 dB	Richardson et al., 1995
Tugs	145-200 dB	Bassett et al., 2012; Roberts Bank, 2014; Richardson et al., 1995
Tug Leo (docking Katie II gravel barge)	149 dB at 100 m	Blackwell and Greene, 2003
Tug (towing a Barge)	165-174 dB	Bassett et al. 2012
Tug (towing Jack-up Rig)	185 dB	NMFS, 2022
Large Commercial Vessels	169-190 dB	Richardson et al., 1995
Emerald Bulker (Cargo-bulk carrier)	134 dB at 540 m	Blackwell and Greene, 2003
Northern Lights (Cargo-freight Ship)	126 dB at 114 m	Blackwell and Greene, 2003
Cargo Vessel	172-198 dB	Richardson et al., 1995
Supply Vessel	181 dB	Richardson et al., 1995
General Vessel Noise	145-175 dB	Richardson et al., 1995; Blackwell and Greene, 2003; Ireland and Bisson, 2016
Avon Rubber Boat (full speed)	142 dB at 8.5 m	Blackwell and Greene, 2003
Underwater recording directly below a military jet on approach for landing	122-134 dB at 10 m depth (aircraft altitude unspecified)	Blackwell and Greene, 2003
Dredging	167-185 dB	Richardson et al., 1995
Seismic Surveys (2D/3D) with Large Airgun Array (>12 airguns)	232-265 dB 185-217 dB at 100 meters	Richardson et al., 1995; Austin and Warner 2013; 81 FR 47239; Center for Marine Acoustics, 2023
Seismic Surveys with Small Airgun Arrays (≤12 airguns)	193-265 dB	Richardson et al., 1995; Center for Marine Acoustics, 2023
Seismic Surveys using Small to Large Single Airguns	191-232 dB	Richardson et al., 1995; Center for Marine Acoustics, 2023
Geohazard Surveys	210-220 dB	Manufacturer Specs.
Pingers	192 dB	Manufacturer Specs
Drilling (from an Exploratory Drilling Rig)	137 dB	Marine Acoustics, Inc., 2011
Dredging	~155 dB	Richardson et al., 1995
Pile driving (Vibratory Sheet Pile Driving)	160-175 dB at 10 meters	Illingworth and Rodkin, 2014
Side-scan Sonar	220-230 dB	Richardson et al., 1995
Sub-bottom Profilers	200-230 dB	Richardson et al., 1995

Note: [1] As measured at one meter from the source unless otherwise specified.

Vessels produce dominant noise at low frequencies with maximum energy between 10 Hz to 1 kHz and maximum sound levels that range between approximately 160 to 220 dB when measured at 1 m from the source (NRC, 2003). Typical SPLs generated by vessels range from 140 dB re 1 µPa·m for smaller fishing vessels to greater than 195 dB re 1 µPa·m for fast-moving supertankers (NRC, 2003). Large commercial ships generate peak SPLs at frequencies between 10 and 50 Hz, and much of the remaining acoustic energy drops off above 1 kHz (Greene and Moore, 1995). Most small boat engines typically generate sound levels around 150 to 180 dB re 1 µPa·m in the mid-frequency range (1–5 kHz) (Erbe, 2002; Kipple & Gabriele, 2003, 2004). For example, small craft equipped with outboard motors (14 to 18 feet long with 25 to 40 horsepower) operating at speeds of 10 to 20 knots have maximum source levels around 160 dB re 1 µPa·m, peaking at 5 kHz (Kipple & Gabriele, 2003). Generally, larger vessels produce louder sounds, and increased speed correlates with greater noise emissions.

As sound travels away from its source, the sound level decreases (“attenuates”) due to absorption, reflection, and refraction. Mathematical models have been developed for predicting the distance from the source at which sound levels drop below injury and behavioral disturbance thresholds (e.g., NMFS, 2020). For instance, inside the predicted “injury zone,” noise levels will exceed injury thresholds. Beyond this zone, sound levels will remain audible, but exposure is not expected to cause injury. Activities like seismic surveys and pile driving generate injury zones that typically extend outward from source to a radius ranging from a few hundred meters to several thousand meters. Behavioral disturbance zones may extend several kilometers from the source. Mitigation measures from ESA consultations and MMPA authorizations typically require monitoring of these attenuation zones. Observers must watch all "safety radii" (the behavioral disturbance zones) to detect when marine mammals show signs of harassment. Work must be stopped if a marine mammal enters any "exclusion radii" (injury zones).

Most of the vessels used in LS 258 post-lease activities would be supply and transportation vessels that mostly generate low-frequency noise. During 2001, underwater sound measurements from vessels in transit were recorded in Cook Inlet. One of the source levels reported was 150 dB re 1 µPa·m (Blackwell and Green, 2003). Service, crew, and support vessels associated with oil and gas activities typically produce source levels around 155 to 180 dB re 1 µPa·m (Greene and Moore, 1995; Table 4-10). Further, Jiménez-Arranz et al. (2020) summarized acoustic characteristics for vessels and reported that source levels from ‘medium’ vessels (26–100 m in length) are typically 165–175 dB re 1 µPa·m. NMFS has estimated the radii of behavioral disturbance zones from support vessels with source levels between 171–176 dB to extend to 2,154 m (7,067 ft) from the vessel (NMFS, 2024b,c).

Summary of Noise Impacts to Marine Mammals from LS 258

Underwater noise from LS 258 post-lease activities would primarily consist of temporary behavioral responses rather than physical injury. The two activities with the greatest potential to affect marine mammals are seismic surveys and pile-driving operations. Seismic surveys using airguns would produce the most significant noise impacts, generating impulsive, low-frequency sounds up to 237 dB re 1 µPa at the source. These surveys would create a behavioral disturbance zone extending 9.5 kilometers from the source, with potential injury zones typically limited to a few hundred meters from airgun arrays. Pile-driving during platform installation would generate noise intense enough to potentially injure marine mammals at close range, though sound levels drop considerably within short distances and typically do not extend beyond one kilometer from the source. Marine mammals generally avoid the noisiest areas until activities cease.

Other noise sources, including drilling, vessel traffic, and aircraft operations, would produce less intense sounds that could cause temporary behavioral responses such as avoidance, heightened alertness, and changes in diving activity, but would not reach levels sufficient to cause acoustic injury. Anthropogenic noise can mask important biological sounds that marine mammals use for communication, navigation, foraging, and predator avoidance. These effects would be short-term and localized, and marine mammals would be able to move away from high-level sound to areas with less disturbance.

Mitigation measures, including employing PSOs, ramp-up and shut-down procedures, and operational restrictions, would minimize the risk of injury. The analysis concludes seismic surveys and pile-driving could cause acoustic injury; however, such impacts are unlikely due to natural avoidance behaviors and required mitigation measures, with no population-level effects anticipated.

Analysis of Effects of Vessel Noise on Cook Inlet Belugas

Behavioral Effects

All populations of belugas rely on sound for navigation, communication, feeding, and predator avoidance. Based on captive research it is known that beluga whales hear best at relatively high frequencies, in the 10-100 kHz range, which is above the range of most industrial activities (Norman, 2011). Marine mammals, including beluga whales, respond to vessel noise with various behavioral changes including temporary displacement (e.g., Richardson et al., 1995; Finley et al., 1990). Belugas sometimes appear to tolerate vessels, but at other times, they flee, dive, separate from their groups, or change direction when vessels approach (Blane and Jaakson, 1994). Documented beluga behavioral responses to vessels range from no observable response to extreme sensitivity (Richardson et al., 1995; Blackwell and Greene, 2003; Finley et al., 1990; Martin et al., 2023). Blackwell and Greene (2003) observed the lowest anthropogenic and “natural” ambient underwater sounds levels in upper Cook Inlet are located at two locations heavily frequented by beluga whales, the mouth of the Susitna River and east Knik Arm near Birchwood. Background noise in lower Cook Inlet, particularly along the western edges of Cook Inlet south of Trading Bay should be lower since those areas receive less vessel traffic and remain largely undeveloped.

Belugas may interpret vessel noise as a threat. Noise from outboard motors, small boats, tugs, barges, seismic air guns, and drilling have been documented to evoke an avoidance or startle response (i.e., fleeing) at varying “received levels” (the level of noise received at the location of the beluga) (e.g., Blevins, 2015; Finley et al., 1990; Fraker, 1977, 1978; Stewart et al., 1983; Martin et al., 2023). Halliday et al. (2019) found beluga vocalizations in the Mackenzie River estuary decreased when ships traveled within 5 km. This reduction was either caused by belugas decreasing their calling rates or fleeing the area in response to the ship; the latter is supported from observations by Inuvialuit observers (Halliday et al., 2019). Furthermore, disruption of beluga behavior was observed within 50 km from transiting tankers, cargo haulers, tugs, and research vessels (Martin et al., 2023).

Martin et al. (2023) documented increases in belugas' swim speed with decreases in distance from vessels for a variety of ship types at distances up to 79 km away, in an area that sees infrequent vessel traffic. The findings in Martin et al. (2023) corroborate previous studies showing that belugas in the Arctic often react to vessels far beyond the whales' visual range, implying that the whales are reacting to the vessels' underwater sound stimuli. However, Martin, et al. (2023) did suggest belugas can at least partially habituate to vessel traffic, citing the responses of belugas in the Gulf of St. Lawrence as an example. Richardson, et al. (1990) hypothesized that reaction distances of belugas are larger when anthropogenic noise contains frequencies greater than 1 kHz due to their sensitive high-frequency hearing. Cosens and Dueck (1993) confirmed the presence of higher frequency (5 kHz band) components in the noise signal from the icebreaker ship studied by Finley, et al. (1990), and Erbe and Farmer (2000) and Schack and Haapaniemi (2017) provided further evidence that belugas should be able to detect such sounds at large distances (35–78 km and 43–79 km, respectively). Behavioral effects were also observed within 50 km of tankers, cargo haulers, tugs, and research vessels. Notably, belugas tend to be more tolerant of stationary, steady noise sources compared to dynamic sources like approaching vessels (Fraker, 1977, 1978; Stewart et al., 1983).

It must be noted that noise levels for icebreakers and other vessels in the Arctic should propagate differently than the noise from tugboats, barges and service vessels in the shallow Cook Inlet basin, due to very different oceanographic differences between the two areas. Furthermore, the U.S. has but one icebreaker and that vessel operates almost exclusively in the Arctic, not in Cook Inlet, so values recorded for icebreakers do not necessarily reflect those of the other, less noisy vessels that operate in Cook Inlet. Blackwell and Greene (2003) also noted beluga whales near the Port of Anchorage did not overtly appear to be harassed by the sounds of tugboats and barges, though it wasn’t determined if they were tolerating the sounds in order to continue feeding or if the efficiency of their feeding was reduced (Norman, 2011).

A beluga’s response to vessel noise may be influenced by various factors, including location, prior experience, behavioral state at the time of the encounter, the vessel’s noise characteristics, and the individual’s physical condition. A beluga’s behavioral state before and during exposure to vessel noise plays a role in their responses. For example, Fraker (1978) and Stewart, et al. (1983) found belugas in the Mackenzie River estuary and Nushagak Bay, Alaska, showed no reaction to nearby ships or underwater drilling sound playbacks when they were feeding. Blane and Jaakson (1994) documented avoidance behavior in St. Lawrence belugas to vessels, noting avoidance behavior intensified as the number of vessels increased. Belugas avoided vessels by prolonging surfacing intervals, increasing dive periods, increasing their swim speed, and by grouping tightly together (Blane and Jaakson, 1994). However, feeding and traveling animals were less likely to exhibit changes in behavior than animals engaged in “milling” or resting. The practice of subsistence hunting from small vessels may contribute to a heightened sensitivity to vessel noise in some beluga populations (Burns and Seaman, 1986; Huntington, 2000; Stanek, 1996).

Beluga whales in Arctic waters seem to be more sensitive to ship noise than those in subarctic areas (e.g., Finley et al., 1990; Halliday et al., 2020; Martin et al., 2023). This difference may occur because Arctic belugas encounter much less human-made noise compared to non-Arctic populations (PAME, 2019). For example, in the subarctic St. Lawrence River, where vessel traffic is prevalent, belugas were observed to be more tolerant of vessels than in areas with less activity (Lesage, et al., 1999). Blackwell and Greene (2003) observed that beluga whales in Cook Inlet “did not seem bothered” when travelling slowly within a few meters of the hull and stern of a moored cargo-freight ship. They speculated that in areas where belugas are subjected to increased vessel traffic, they may habituate and become more tolerant of the vessels. Even in Arctic environments, some belugas have shown increased tolerance to vessel noise with continued exposure. Finley et al., (1990) documented belugas that initially fled from icebreaker noise later returned to the area despite ongoing noise at higher levels.

While it is possible that beluga whales in Cook Inlet are less sensitive to vessel disturbance than Arctic belugas, they have nonetheless been observed displaying startle responses and avoiding vessel activities, like other populations. For example, HDR Inc. (2015) reported that three belugas in Twentymile River were startled by a small motorboat. One whale surfaced quickly and then dove, while the group rapidly fled the Twentymile River and headed into Turnagain Arm. Belugas in Cook Inlet tend to be cautious even around idling or stationary boats, likely due to their past experiences with subsistence hunting from small vessels (Blevins, 2015).

Behavioral responses to vessel noise reflect underlying physiological stress. When exposed to loud sounds, stress hormones can be released into the bloodstream (ONR, 2009; Romano et al., 2004). These hormones affect multiple body systems including respiratory, cardiac, metabolic, immune, and reproductive functions (Wright et al., 2007a, 2007b). Most observable behavioral reactions stem from these underlying stress responses, meaning that visible behaviors like avoidance swimming and abandonment of feeding areas are external signs of internal physiological stress (Gordon et al., 2004; Tyack, 2008). Chronic stress responses can lead to serious health consequences including increased susceptibility to disease and reproductive problems (Romano et al., 2004). Tolerance of a disturbance or lack of an observable response does not always reflect the true physiological cost to the animal or represent true habituation (e.g., Nisbet, 2000; Bejder et al., 2009). Some marine mammals may continue normal activities like feeding or socializing while internally experiencing elevated stress.

Behavioral response to vessel noise can have energetic costs. The potential energetic effects of the startle responses of Cook Inlet beluga whales to disturbances were modeled by John et al. (2024). This study measured resting metabolic rates and swimming costs, finding that high-speed swimming significantly decreases the whales' ability to stay submerged for long periods. This forces belugas into costly anaerobic activity that requires longer recovery times, increasing their overall energy expenditure (John et al., 2024). Repeated or prolonged fleeing from vessels would reduce energy stores used for essential life activities like foraging, reproduction, and growth.

Repeated vessel disturbances in Cook Inlet may be causing Cook Inlet belugas to abandon important feeding areas. Kumar et al. (2024) discovered that belugas completely avoided the Kenai River from April through late August, even though large numbers of salmon—their preferred food—were available during this period. Hundreds of fishing boats were active in the Kenai River area during these months. The belugas only returned after the legal fishing season ended and most of the boats had left the area (Kumar et al., 2024). Belugas may be accommodating for the loss of this feeding area by using alternative foraging sites (Kumar et al., 2024).

Under certain circumstances, behavioral responses to vessels may be capable of causing impacts at the population level. Warlick et al. (2024) identified positive correlations between prey abundance and Cook Inlet beluga fecundity and calf survival. McHuron et al. (2023) predicted that belugas can cope with intermittent behavioral disturbances if prey are abundant during summer and early fall and above critical thresholds in winter. These studies suggest population-level risks are linked to prey. Risks arise from increased disturbances during prey shortages or chronic disturbances that interrupt feeding in key areas. Kumar et al. (2024) showed vessel activities can interrupt feeding by documenting absence of belugas in the Kenai River during the peak fishing season. The geographic range contraction documented by Rugh et al. (2010) and Shelden et al. (2015) has concentrated Cook Inlet belugas in areas with high human activity near Anchorage, increasing the possibility that vessel activities in Cook Inlet overlap key feeding areas. These conditions make behavioral disturbance from vessel noise a concern for the Cook Inlet beluga population.

The potential consequences of behavioral disturbance to belugas from LS 258 activities were considered in light of the research described above, which demonstrates that vessel noise can elicit behavioral and physiological responses in Cook Inlet belugas and may be particularly impactful when these disturbances displace whales from important feeding areas or occur during periods of prey scarcity. LS 258 activities may expose individual Cook Inlet beluga whales to vessel noise at levels that exceed NMFS's thresholds for behavioral response. However, the risk of exposure to vessel noise is reduced by the geographic locations where vessels would be used and the seasonal nature of LS 258 activities.

Vessels would be the primary form of marine transportation for post-lease activities associated with LS 258. The number and types of vessels are described in the E&D Scenario (Appendix B). Over the 40-year life of the project, LS 258 could increase vessel traffic in lower Cook Inlet by 5 vessel trips per week during exploration, 7–42 trips per week during peak development, production, and decommissioning phases, and two per week during normal production operations (approximately 1 vessel per day overall). Vessels would be used for geophysical, geohazard and geotechnical surveys (including seismic surveys), construction of pipelines and platforms, towing drilling rigs, support during well drilling, maintenance, crew and supply transport, decommissioning, spill drills, and spill response. Most vessel traffic would occur between ports in Homer, Kenai, or Nikiski, and the leased blocks on the OCS.

Most vessel traffic associated with LS 258 would occur during summer when Cook Inlet belugas reside in upper Cook Inlet (Goetz et al. (2023), over 30 mi (48 km) north of the lease sale area. For example, exploration activities, including seismic surveys, and activities supporting peak development, including pipeline installations, production, and decommissioning, would all occur during summer and early fall (see Table 1 in Appendix B). Belugas concentrate in upper Cook Inlet around the Susitna River Delta, Knik Arm, Turnagain Arm, Chickaloon Bay, and near Fire Island during the ice-free season (Shelden et al., 2015; Castellote et al., 2016; McGuire et al., 2020). In winter, some belugas range further south in and near the Kenai, Tuxedni, and the Chinitna rivers (McGuire et al., 2020, Castellote et al., 2020; 2024). During winter, belugas in lower Cook Inlet may encounter activities associated with LS 258 near drill sites or in vessel transit corridors.

The only vessel transit corridor expected to be used by both LS 258 vessels and belugas would be located at the Kenai River, where port facilities occur. Although LS 258 vessels are most active in summer and most likely to use Nikiski or Homer, where port facilities are better developed, the facilities at Kenai could be used for some purposes during winter. LS 258 vessel traffic near Kenai would constitute a small fraction of the existing traffic using this area and would not change overall vessel traffic patterns or create a novel stimulus to belugas (Fletcher et al., 2021). Ships travelling between offshore oil and gas sites and ports use the same routes regularly and travel at steady, predictable speeds. This consistent travel pattern reduces the likelihood that vessel noise would cause startle responses from individuals.

Cook Inlet belugas typically occur in shallow coastal waters and are most commonly found in areas ranging from just a few hundred yards (m) to 2–3 mi (3.2–4.8 km) from shore (Shelden et al., 2015). The 258 lease sale area lies in the OCS and is located at ≥4.8 km (3 mi) from shore, meaning OCS vessel noise at or above the 120 dB disturbance threshold should not overlap the areas used by belugas, except perhaps near Tuxedni or Chinitna bay, where the western boundary of the lease sale area is nearest to areas known or suspected to be used by belugas in winter. Tuxedni and Chinitna bays are not in the OCS and LS 258 vessel traffic would not travel through these areas. For these reasons the effects of vessel noise would be limited to sounds propagating from the OCS into beluga habitat.

Most vessel traffic associated with LS 258 would be from transport vessels, supply vessels, and other support vessels. Vessel noise from LS 258 activities should not reach Tuxedni or Chinitna bay at sound levels above the behavioral disturbance threshold. Source levels for typical supply or transport vessel are expected to range from 160 to 180 dB re 1 µPa·m (Jiménez-Arranz et al., 2020; Table 35 in the Biological Opinion on BOEM Gulf of America Oil and Gas Program, 2025). NMFS (2024b, c) concluded support vessels with source levels up to 176 dB would generate a 2,154-m (7,067-ft) behavioral disturbance zone. Although beluga whales are unlikely to occur on the OCS due to the distance from shore, it is possible that belugas could travel through the OCS while heading to wintering grounds. Belugas could detect the typical vessel sounds from LS 258 activities and may respond by avoiding them. Belugas should be able to avoid elevated noise extending from a vessel without needing to travel long distances or abandon the area completely, thereby avoiding high energetic costs and interruptions of important behaviors like feeding. Further, beluga behavioral responses are anticipated to be temporary (e.g., Blane and Jaakson, 1994). For these reasons, behavioral responses to most vessel activities are expected to have negligible effects on belugas.

Towing, anchor handling, and dynamic positioning activities would generate higher noise levels. These activities have a low likelihood of affecting belugas because of the spatial and temporal separation between the lease sale area and Cook Inlet beluga whale habitat. These activities would mostly occur during summer and would not occur near beluga summering habitat areas. However, if these activities happen outside of summer, or early fall, or if belugas are present in Tuxedni or Chinitna bays during summer, these noises could cause disturbances. For example, NMFS (2022) approved the work of Hilcorp (2022) in which Hilcorp modelled the sound source levels and distances to behavioral disturbance thresholds from tugs towing a drill rig in Cook Inlet. The highest expected level of noise was predicted to produce a behavioral disturbance zone extending outward to a radius of 3,850 m from the tugs (Hilcorp, 2022). Although this analysis was specific to Hilcorp's work, these activities are very similar to tug activities included in the Proposed Action. This indicates tugs towing a rig for LS 258 in Cook Inlet could also cause behavioral disturbances ~2.4 mi (3,850 m) from the tugboats. A beluga swimming 1 km seaward from the mouth of Tuxedni or Chinitna Bay could possibly be within 3,850 m of vessel operations on the western edge of the OCS. Individual belugas exposed to high amplitude vessel activities like tugs towing rigs, anchor handling, or dynamic positioning may engage in avoidance behavior, exhibit short-term vigilance, or experience stress responses.

Disturbances from LS 258 would cause, at most, minor effects to belugas because disturbances would be infrequent, intermittent and would occur outside of known important feeding areas. Behavioral disturbance due to LS 258 vessel noise is generally unlikely due to the distances between beluga habitat and project activities and the anticipated timing of vessel work. The increase in vessel traffic from LS 258 would represent a relatively small contribution to existing traffic in Cook Inlet, with overall levels remaining well below (Fletcher et al., 2021) those at the Port of Anchorage, the Kenai River or Homer. Vessel noise consists primarily of low-frequency sounds which occur below the most sensitive portion of beluga whale hearing range (e.g., Mooney et al., 2020; Castelotte et al., 2014), further reducing potential impacts. Noise exposure would be short-term, typically occurring over parts of several days, and would not significantly disrupt important behavior such as feeding, breeding, or resting. BOEM vessel traffic mitigation measures require minimum standoff distances and speed reductions in the presence of marine mammals. Based on the implementation of mitigation measures, the relatively low level of vessel work, and the very low occurrence of beluga whales near the project area at any given time, behavioral disturbance from vessel noise would be temporary and have no long-term population-level consequences.

Masking

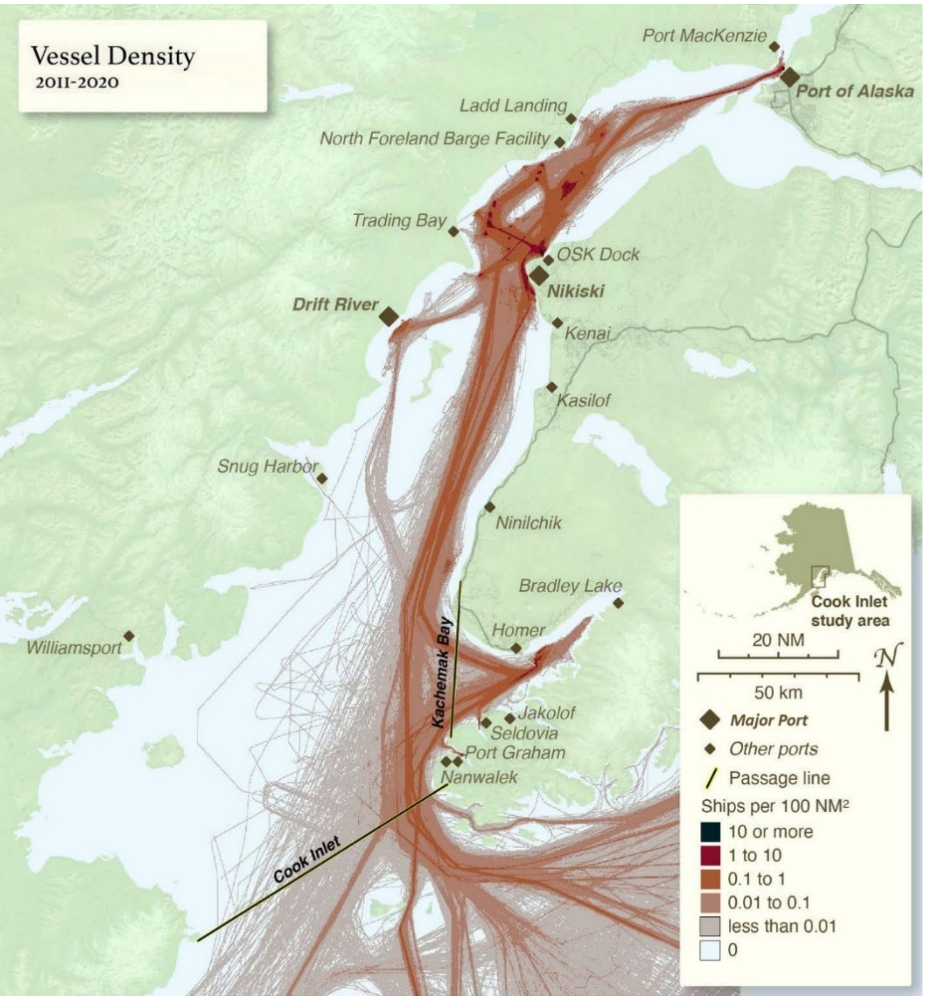
Acoustic masking occurs when a sound interferes with an individual's ability to detect and discriminate against another sound. Under certain conditions vessel noise can acoustically mask the ability of marine mammals to hear biologically important sounds. Most of the noise from vessels occurs at frequencies below the most sensitive hearing range of the beluga whale; however, belugas use lower frequencies for many of their communication calls. Lesage et al. (1999) reported that vessel noise induced changes in beluga calling rates, with a tendency to emit calls repetitively, an increase in call duration, and an upward shift in the frequency range used to vocalize. Lesage et al. (1999) noted that there was considerable overlap between the noise generated by the ferry and outboard engines recorded in their study and the normal frequency range used by belugas to communicate. Newer research shows that vessel noise also masks higher frequency sounds up to 30 kHz (Veirs et al., 2016), which includes frequencies that are especially relevant for odontocete hearing sensitivity (e.g., Aguilar de Soto et al., 2006; Arveson & Vendittis, 2000; Götz et al., 2009; Vergara et al., 2021). Brewer et al. (2023) examined the vocal repertoire of Cook Inlet belugas and the seven most common call types were then used to investigate masking by commercial ship noise. Results indicated that these call types were partially masked by distant ship noise and completely masked by close ship noise in the frequency range of 0–12 kHz (Brewer et al., 2023). Furthermore, Gervaise et al. (2012) indicated that vessel noise in the Saguenay–St. Lawrence Marine Park greatly interferes with the communication and echolocation sounds of beluga whales. Gervaise et al. (2012) reported that due to vessel noise, beluga potential communication range was reduced to less than 30 percent of its expected range under natural noise conditions for half of the study period, and communication range was reduced to less than 15 percent for one quarter of the study period, with little dependence on call frequency. In addition, Vergara et al. (2021) found that vessel noise in the St. Lawrence Estuary led to a 57 percent and 53 percent reduction in communication range for beluga adults and sub-adults, respectively, and a median range of 170 m for newborn calves.

Belugas can adjust their calls to suit their specific environment. Booy et al. (2024) found differences in parameters of contact calls across four beluga populations throughout Canada, which demonstrate belugas' ability to modify their vocalizations. This acoustic plasticity may help belugas adapt to different environments. Studies suggest that belugas use their acoustic abilities to reduce masking effects from both natural and anthropogenic noise sources. Song et al. (2023) found that belugas in Bristol Bay use high-frequency clicks for echolocation. A variety of modifications in beluga vocalizations have been reported in the presence of vessel noise (e.g., Lesage et al., 1999; Scheifele et al., 2005; Gervaise et al., 2012; Vergara et al., 2025).

In the St. Lawrence Estuary, belugas exposed to vessel traffic produce louder calls (Scheifele et al., 2005). A recent study by Vergara et al. (2025) discovered that belugas in the St. Lawrence region use ultrasonic calls consistently in the presence of vessel noise while other call types decreased—these high frequency sounds may help them communicate with less interference from boat noise. Researchers also found belugas responded differently to large ferries than to smaller boats, sometimes calling less, altering their vocal patterns, and repeating certain calls (Lesage et al., 1999), which may help to alleviate masking.

Cook Inlet has high levels of ambient noise from natural sources. In general, ambient and background noise levels within Cook Inlet are assumed to be less than 120 dB during calm conditions but may exceed 120 dB during environmental events such as high winds and peak tidal fluctuations (Blackwell and Greene, 2003). High levels of natural ambient noise may reduce the ability for an animal to detect and respond to some sources of anthropogenic noise. High levels of ambient noise may also moderate behavioral responses resulting from anthropogenic noise exposures if animals are accustomed to altering vocalizations or adopting other coping strategies.

In Cook Inlet, acoustic masking by commercial vessel noise in shipping lanes is a concern for belugas (Castellote et al., 2018). Roughly 411 commercial ships use the main shipping lanes annually, with an average of 8 ships coming and going per week (Fletcher et al., 2021). Commercial vessels include tankers, cargo vessels, passenger ships, and vessels used by government and industry. Large vessel traffic in Cook Inlet is moderate or low when compared to other North American west coast ports and waterways in California, and Washington (Notteboom et al., 2022). Commercial vessels are characterized by sources with dominant frequencies between 6 and 500 Hz and source levels between 160 and 200 dB re 1 µPa·m (McKenna et al., 2013; Richardson, 1995). Along the western margin of lower Cook Inlet, commercial vessel traffic mainly consisted of fishing, survey and small cargo vessels, while along the eastern margin of Cook Inlet, most transits were made between the southern end of the Kenai Peninsula and Anchorage with a relatively large amount of activity in Trading Bay by small cargo vessels, oilfield cargo vessels, tugs, fishing vessels and survey vessels (Figure 4-4; Fletcher et al., 2021).



Source: Fletcher et al., 2021.

Figure 4-4: **Vessel Shipping Lanes Illustrated from Tracking of Cargo Vessels, Ferries, Cruise Ships, and Tugboats**

Although the dominant broadband sound from large vessels occurs below the most sensitive portions of beluga whale hearing (e.g., Blackwell and Greene, 2003; Mooney et al., 2020; Castellote et al., 2014), the total range of sound produced by vessels includes frequencies that overlap the hearing and communication ranges of belugas. Therefore, there is concern that large vessel noise in Cook Inlet masks sounds used by belugas. Brewer et al. (2023) deployed bottom-mounted passive acoustic recorders to monitor belugas and vessel noise in core habitat areas. The study documented call types used by the Cook Inlet beluga whale population and compared frequencies of common vocalizations to the frequencies produced by vessel traffic in Cook Inlet. Brewer et al. (2023) reported that all of the most commonly used call types in the Cook Inlet beluga vocal repertoire were partially masked by distant commercial ship noise and completely masked by close commercial ship noise in the frequency range up to 12 kHz. Brewer et al. (2023) predicted that calls of belugas in the Susitna River Delta, an area of core habitat, could be completely masked by vessels closest to this site during transit along the designated shipping lanes. Further, Eickmeier and Vallarta (2023) also looked at the sounds produced by commercial vessels in Cook Inlet and their potential to interfere with beluga communication, navigation, and foraging. They demonstrated that the communication sounds of Cook Inlet belugas can be completely masked by the noise from a containership positioned 5 km away, and echolocation signals could be partially masked at distances up to 2.5 km (Eickmeier and Vallarta, 2023).

Masking by fishing vessels and small boats is also a concern for belugas. The acoustic signatures of small vessels often contain higher frequency components. Beluga hearing is more sensitive at higher frequencies, meaning that sounds produced by smaller vessels may have more overlap with beluga hearing and communication range than larger vessels (Castellote et al., 2014; Veirs et al., 2016). However, small vessels typically produce lower SPLs compared to large vessels (e.g., around 140 dB at 1 m for small fishing vessels compared to 195 dB at 1 m or greater for large vessels) (NRC, 2003). Castellote et al. (2018) analyzed 8,756 hours of acoustic recordings from different locations and months in Cook Inlet and found small vessel noise to be short duration and low in density. As such, acoustic disturbance from small vessels may affect belugas in fewer areas and less frequently than from large vessels. An exception is the mouth of the Kenai River where multiple outboard motors are used concurrently for long periods each day in spring and summer during the fishing season (ADF&G, 2025a,b).

The biological importance of masking from vessel noise to belugas in Cook Inlet remains uncertain. While the high levels of commercial vessel traffic near core habitat areas place belugas at risk, Cook Inlet's naturally high ambient noise levels and belugas' ability to modify their vocalizations may help to alleviate vessel noise impacts.

The potential for LS 258 activities to mask sounds used by Cook Inlet beluga whales is lower due to several factors including the comparatively low level of vessel operations, naturally high levels of ambient noise, seasonal timing restrictions, and geographic separation. LS 258 is expected to generate a relatively modest increase in vessel traffic, as described in the E&D Scenario (Appendix B). Over the 40-year project life, activities would increase vessel traffic in lower Cook Inlet by approximately one vessel per day. During the exploration phase, approximately five vessel trips per week are anticipated, with higher activity levels during potential development phases. This represents a relatively small addition to the existing acoustic environment (Table 4, Appendix B). Vessel types associated with LS 258 include support vessels for seismic surveys, supply boats for drilling operations, tugboats, crew transfer vessels, and cargo barges for equipment transport.

Vessels working on LS 258 activities would have greater spatial separation from belugas than many other vessels in Cook Inlet. The LS 258 lease sale area is located in lower Cook Inlet, and the majority of vessel traffic associated with LS 258 would occur during summer months when Cook Inlet belugas are concentrated in upper Cook Inlet, creating substantial geographic separation. Additionally, most vessel activities would occur on the OCS where belugas are infrequently observed compared to coastal areas. Even if vessel noise exposure occurred, individual vessels would ensonify a particular location for a short period of time. In conclusion, masking effects are expected to be temporary, with anticipated localized effects on beluga behavior and no anticipated long-term effect on survival or fitness.

Acoustic Injury

Direct experiments of acoustic injury to marine mammals are relatively limited due to ethical considerations and legal requirements that prevent exposing marine mammals to harmful sound levels. One case of accidental PTS has been reported in a captive harbor seal resulting from what was intended to be a study of induced TTS (Reichmuth et al., 2019). Most available data come from anecdotal reports, accidental events, or modeling results (Todd et al., 1996; Danil and St. Leger, 2011). The clearest evidence of acoustic injury comes from mass stranding events associated with military sonar operations and seismic survey noise (e.g., U.S. Navy, 2013; Cox et al., 2006). Normal vessel transiting operations occur at lower sound levels than typical Navy sonar or seismic surveys. Auditory injury from vessel noise is not expected to occur and would be difficult to document in the wild.

Some vessel activities from LS 258 can produce noise exceeding NMFS auditory injury acoustic thresholds; however, beluga exposure to noise levels above the injury thresholds are highly unlikely as they are expected to extend only short distances from the vessels. NMFS (2017a) evaluated activities of LS 244, which were nearly identical to those of LS 258, and found the loudest vessel activities would likely be towing, anchor handling, and dynamic positioning. The highest SPL was expected to be 195 dB at the source from anchor handling noise. NMFS used this sound level to evaluate the likelihood of acoustic injury. The analysis concluded that while acoustic injury could theoretically occur, the likelihood of it occurring is extremely remote. This conclusion was based on several factors: model results showed that for the high-frequency cetacean hearing group the area where sound levels could exceed the injury thresholds was small, within meters of the source; beluga whales are unlikely to intentionally approach a source within such a short distance or remain close enough for long enough to accumulate harmful levels of sound energy; and application of mitigation measures would ensure noise zones would be clear of belugas before operations began. NMFS (2017a) also determined that noise from regular vessel transit activities (which would constitute the majority of vessel work for LS 258) would not exceed minimum acoustic thresholds for injury.

NMFS (2022) also concluded that vessel activities would not cause acoustic injury associated with tugs towing drill rigs in Cook Inlet in 2021. Hilcorp (2022) modeled the likelihood of acoustic injury from three tugs towing a jack-up rig in Cook Inlet. Modelling parameters are fully described in NMFS (2022). Modelling was performed for stationary and mobile sources. A source level of 185 dB was used as a representative source level for three tugs operating at 50 percent power output based on sound source verification (SSV) tests of tugs pulling a jack-up rig (Lawrence et al., 2022, as cited in NMFS, 2022). This value is approximately five dB higher than source levels reported for tugs under load (Bassett et al., 2012; Austin and Warner, 2013; and Roberts Bank, 2014) and is therefore a conservative estimate for impact assessments. Modelling results for stationary activities put the distance from the source to the Level A injury threshold at 78 m for the high frequency hearing group (NMFS, 2022). For mobile sources, the average distance to Level A thresholds was calculated to be zero. Because belugas can leave the area well before reaching the sound exposure level required to cause acoustic injury, NMFS determined no vessel actions would result in acoustic injury (NMFS, 2022).

Factors that reduce the likelihood of injury are those that also reduce the likelihood of behavioral responses. Ships in transit will travel in a consistent and predictable direction and speed, essentially providing acoustic warning of their arrival long before arriving at a given location. Animals are unlikely to approach a loud stationary vessel, so highly energetic startle responses from belugas are not expected. No acoustic injury is expected, and belugas exposed to high-dB noise would most likely show behavioral disturbances such as deflecting away from noise source and avoiding the area. These behaviors are expected to be brief and unlikely to significantly disrupt normal behavior patterns like feeding, breeding, and sheltering. Although some behavioral disturbances to a few individuals could occur, these responses would not have lasting effects on the Cook Inlet beluga whale population.

BOEM requires the risk of exposure to be reduced or avoided wherever possible to protect marine mammals. A description of required mitigation is included in Section 3.4. Mitigation measures include reducing in-water noise levels or proximity of the activity to marine mammals. Additional mitigation measures are developed through interagency consultations with NMFS and USFWS to further protect ESA-listed marine mammals. ESA consultations generally require PSOs to monitor areas near activities that may produce high-dB sound. PSOs observe the injury zone to ensure no marine mammals are present prior to beginning sound-producing work and stop work if marine mammals enter the injury zone during sound production. Vessel activities generating high-dB noise are required to gradually ramp up sound levels to prevent sudden exposure without warning. Consequently, no acoustic injuries to belugas are expected to result from LS 258 vessel activities.

Effects to Cook Inlet Beluga Whale Habitat

Chronic or recurrent vessel noise can impact the habitat for belugas. For instance, the St. Lawrence Estuary population faces habitat degradation from intense vessel traffic, which includes an average of 7,500 commercial, 13,000 whale-watching, and 9,000 recreational boat trips per year (Parks Canada, 2018). In a recent study the median communication range for belugas was affected with ranges for adult and sub-adult calls dropping by 57 percent and 53 percent respectively in the presence of vessel noise. Likewise, newborn call ranges dropped to 170 meters under the same conditions (Vergara et al., 2021). These first estimates of the communication range of belugas suggests the quiet calls of newborns may be masked by anthropogenic noise, interfering with mother–calf communications (Vergara et al., 2021). Despite these challenges, the critical habitat remains relatively stable and supports essential calving and calf-rearing functions (DFO Canada, 2016; Parks Canada, 2018). In Alaska, Kumar et al. (2024) provided evidence of habitat impacts. Cook Inlet beluga whales avoid the Kenai River when there are high levels of anthropogenic noise from fishing-related vessel activity, despite the high density of salmon present in the river.

Activities related to LS 258 are unlikely to affect Cook Inlet beluga whale habitat (see Figure 2-5 of the 2022 Lease Sale 258 FEIS showing the critical habitat). It is unlikely that vessels would enter the narrow strip of critical habitat along the western edge of Cook Inlet during post-lease activities since those areas are off lease and far from any ports. Most vessel activities would not generate sounds capable of disturbing belugas within the critical habitat. The few that might—like tugboats positioning drilling rigs—would be short-term activities and would have no long-term impact on habitat. Beluga whales have not abandoned waters near the Port of Anchorage where vessel traffic and noise levels are much higher than what is expected from LS 258.

Vessels departing and returning to port in Homer might transit habitat for beluga whales in Kachemak Bay. The port of Homer lies at the northern periphery of Kachemak Bay and can port up to 1,500 boats, making the presence of a few project vessels inconsequential to beluga whales. Additionally, the area is rarely used by belugas. Historically, Alaska Natives described calving areas as including the northern side of Kachemak Bay in April and May (Huntington, 2000). Prior to the population declines, belugas were regularly sighted at the Homer Spit and the head of Kachemak Bay, appearing during spring and fall of some years in groups of 10–20 individuals (Speckman and Piatt, 2000). However, since 1993, the NMFS aerial summer surveys have recorded only two belugas in Kachemak Bay (in 2001) (Shelden and Wade, 2019). There have been anecdotal sightings of belugas in Kachemak Bay reported from other sources in 2001, 2003, 2006, 2007, 2015, and 2018. In 2021, a group of 2 or 3 belugas was seen in Kachemak Bay, but these were the first ones reported since 2018 (Seymour, 2023). The low numbers of belugas in this area of habitat suggests routine vessel noise from transits in and out of Homer would affect very few belugas, would not affect the population, and would not change the availability or quality of habitat.

Conclusions regarding impacts to belugas from post-lease vessel noise, including behavioral effects, masking, acoustic injury, and habitat changes, are based on seasonal, geographic, and noise-related factors, as well as BOEM mitigation measures. BOEM requires vessels to avoid approaching belugas and reduce speed in their presence. Given the low likelihood of exposure to disruptive noise levels, short duration of spatial overlap, and low beluga densities in the lease sale area, effects from vessel sound, including routine vessel activities and periodic high-dB activities like dynamic positioning and tug towing, are expected to be minor and affect only a few belugas. Consequences to the Cook Inlet beluga population from all post-lease activities described by the E&D Scenario, including small spills and spill drills, will be minor. With the possible addition of a large spill, the effects would increase but would remain minor due to limited potential spill of this size to affect belugas in Cook Inlet (see Section 4.8.2.4 of the 2022 LS 258 FEIS).

Overall Impact Level Conclusion for the Proposed Action

Because of the variety of marine mammals and their habits in Cook Inlet, a range of impact levels is expected from LS 258 activities, accidental small spills, and spill drills described in the E&D Scenario. Most post-lease activities would cause no more than short-term and localized disturbances and would have a negligible impact on marine mammal populations. The 2022 LS 258 FEIS (Section 4.8.3) concluded that a few populations, including beluga whales, could potentially experience minor impacts from E&D Scenario activities (including vessel operations, habitat alterations, and collision risk). New information describes the status and distribution of the marine mammal populations that use Cook Inlet. The new information does not change the 2022 LS 258 FEIS conclusions. An overall impact range of negligible to minor across all species is still appropriate. When considering the effects of a large spill and related response efforts added to the activities described in the E&D Scenario, marine mammals would be expected to experience a minor to moderate impact level. A large spill would increase the potential consequences to beluga whales, but because belugas are uncommon in OCS waters and primarily occupy areas of upper Cook Inlet where oil spill risks are reduced compared to lower Cook Inlet, belugas would experience a minor level of impacts from LS 258 post-lease activities.

4.8.4 Environmental Consequences of Alternatives

This section describes how alternatives affect marine mammals collectively and Cook Inlet beluga whales specifically. It summarizes original alternatives from the 2022 LS 258 FEIS, evaluates new alternatives, and compares impacts. This section provides additional detail compared to other resource analyses (such as air quality or economics) because the new alternatives (Alternatives 7–9) offer specific benefits to marine mammals. While the 2022 FEIS only analyzed marine mammal effects collectively, this SEIS also provides separate analysis for Cook Inlet beluga whales because: (1) the alternatives produce different impact levels for belugas; (2) the Court directed specific analyses for belugas, and although BOEM was not directed to conduct a beluga-specific analysis of alternatives, doing so aligns with the Court's other directions; and (3) the Court directed BOEM to evaluate alternatives that result in meaningful differences in impacts. A separate analysis for belugas ensures that impact differences produced by the new alternatives are not obscured by collective evaluation with all marine mammals. The possible effects of the alternatives are summarized as impact level determinations. The four-tier impact scale (negligible, minor, moderate, major) is designed to capture broad patterns of environmental consequence. Each category encompasses a range of effect intensities. Alternatives providing meaningful conservation benefits may still fall within the same broad category, particularly when baseline impacts are already low due to existing mitigation measures. Detailed assessments are in the sections that follow.

Environmental Consequences of Alternatives 3A, 3B, 3C, 4A, 4B, and 5

Potential impacts on marine mammals under alternatives 3A, 3B, 3C, 4A, 4B, and 5 are described in Section 4.8.3 of the 2022 LS 258 FEIS and are summarized and incorporated here by reference. These alternatives provide protection for beluga whales and marine mammals by excluding small numbers of lease blocks, applying timing restrictions for certain activities, and prohibiting discharges and seafloor disturbance in certain areas.

Alternative 3A – Beluga Whale Critical Habitat Exclusion would exclude 10 OCS blocks within the lease sale area that overlap with beluga whale critical habitat, which would prevent most of the adverse effects of oil and gas development in the critical habitat area. This provides the strongest protection for beluga whale critical habitat among alternatives 3A, 3B, 3C, 4A, 4B, and 5, but provides limited benefits for other marine mammals.

Alternative 3B – Beluga Whale Critical Habitat Mitigation would reduce the risk of noise impacts on beluga whales by prohibiting seismic surveys and exploratory drilling in critical habitat from November 1 to April 30 when beluga whales are most likely to be present. This alternative is less effective than 3A at preventing impacts within critical habitat since exploration activities could still occur during summer and fall months.

Alternative 3C – Beluga Whale Northern Feeding Areas Mitigation precludes seismic activities on all available OCS blocks from November 1 through April 1. Alternative 3C also restricts on-lease seismic surveys within 16.1 km (10 mi) of major anadromous streams when beluga whales are following food resources (July 1–September 30). These timing restrictions would lower the likelihood of vessel collisions, acoustic injuries, or disturbances from noise during winter when beluga whales are most likely to be in or near the lease sale area and during the summer when belugas are intensively feeding near river mouths. These restrictions will provide greatest benefit to belugas, but will also reduce the risk of noise impacts to Steller sea lions, harbor seals, and sea otters. However, benefits to marine mammals other than belugas are limited because they would not be protected from impacts outside of the mitigated areas or months.

Alternative 4A – Northern Sea Otter Critical Habitat Exclusion would reduce the risk of impacts on sea otters by excluding seven OCS blocks that overlap northern sea otter critical habitat. Alternative 4A would also provide protection for some Cook Inlet beluga whale critical habitat off the western shoreline of Cook Inlet south of Kalgin Island near Tuxedni Bay. Alternative 4A would provide more protection for sea otters compared to the Proposed Action or Alternative 4B.

Alternative 4B – Northern Sea Otter Critical Habitat Mitigation would reduce impacts on northern sea otter foraging areas by prohibiting discharges and seafloor disturbance in and near northern sea otter critical habitat, but other oil and gas activities could still occur, e.g., seismic surveys, with required mitigation. Both Alternatives 4A and 4B would provide fewer protective benefits than other alternatives due to the comparatively small areas of exclusion and mitigation and the relatively few otters that use these areas.

Alternative 5 – Gillnet Fishery Mitigation: Under Alternative 5, seismic operations would not be permitted between mid-June to mid-August to prevent conflicts with gillnet fishing. Seismic restrictions may also prevent some adverse impacts on migratory and resident fish. Impacts on marine mammals from acoustic noise would be reduced during this period. Harbor seals in the mitigation area would benefit from this timing restriction; they use haulouts to give birth in June and molt in August. Alternative 5 would provide a greater level of protection than 3A, 3B, 3C, 4A, or 4B and a similar level of potential reduction in impacts as Alternatives 7 and 9 for harbor seals. Beluga whales may indirectly benefit through protection of their fish prey, but this alternative provides little direct protection for the beluga whales themselves.

Under Alternatives 3–5, potential impacts to marine mammals and beluga whales would not differ substantially from those described for the Proposed Action. No additional types of effects were identified that are not already analyzed in the 2022 LS 258 FEIS. Alternatives 3A, 3B, 3C, 4A, 4B, and 5 would reduce potential impacts to beluga whales and marine mammals compared to the Proposed Action. Although these effects would be lessened, the impact level for belugas would remain minor for routine activities, both with and without the addition of a large spill. The overall impact level for marine mammals collectively would remain the same as the Proposed Action: negligible to minor for routine activities, including small spills, and spill drills, and minor to moderate when including a large spill.

Environmental Consequences of Alternatives 7, 8, and 9

Alternative 7 – Northern Area Exclusion

Alternative 7 would reduce the geographic area of the Cook Inlet Planning Area offered for lease by 49 percent. Adopting Alternative 7 would not change the overall level of post-lease activity associated with LS 258, but it would shift activities southward below the approximate latitude of Anchor Point. Alternative 7 would protect marine mammals found within the excluded blocks from most of the effects of noise and from permanent habitat disturbance or alteration. However, shifting the post-lease activities southward would increase the potential impacts to those marine mammals that occupy the southern end of the lease sale area by reducing the distance between those animals and lease-related noise, habitat impacts and possible oil spills. Some activities, like vessel traffic, could extend into the excluded blocks; no vessel access restrictions are proposed.

Alternative 7 would establish a large protective buffer around areas that beluga whales use, including regions officially designated as critical habitat. This exclusion zone would create spatial separation between belugas and activities associated with LS 258 that generate underwater noise, alter habitat, and contribute to the risk of oil spills. The protection varies by season based on beluga behavior patterns. During winter months (September 1 to May 15), when Castellote et al. (2024) identified Tuxedni Bay and the Tuxedni River as important winter foraging locations, the exclusion zone would provide greater spatial separation and reduce exposure to various stressors. During summer months of the open-water season (June–October), belugas tend to avoid lower Cook Inlet and concentrate in and near large river systems in upper Cook Inlet, particularly the Susitna River. Since most of LS 258's high-noise activities would occur during summer, including seismic surveys, pipeline installations, construction, and decommissioning (see Table 4-5, Table 4-6, and Table 4-7), there is already a low probability of exposure to post-lease activities. Alternative 7 would further reduce this low risk by increasing distances between belugas and vessels working at drill sites thereby reducing collision risks and noise disturbance (collision risk is discussed in the 2022 LS 258 FEIS, Section 4.8.2). However, vessels traveling to or from a lease would not be restricted by an exclusion, so belugas could still be exposed to some vessel noise from vessel transit activities.

Alternative 7 would provide no additional protection for most of the northern sea otters in Cook Inlet. Large populations of northern sea otters are found in Kachemak and Kamishak bays, south of the exclusion blocks. Alternative 7 could focus post-lease activities in areas closer to these population centers, increasing possible disturbances, collision risk, and habitat impacts. While most otters in Cook Inlet (those in Kachemak and Kamishak bays) would experience increased exposure to post-lease activities, the relatively fewer otters outside these areas, including those using coastal areas of the Kenai Peninsula north of Kachemak Bay and those living north of Kamishak Bay, could benefit from a shifting of activities southward. Alternative 7 would also exclude several lease blocks north of Kamishak Bay that contain sea otter critical habitat (see Figure 2-6). Alternative 7 would therefore provide some protection for northern sea otters along the Kenai coast and in the excluded blocks of designated critical habitat by reducing the level of exposure to underwater noise, risk of collision, disturbance, and habitat impacts.

Many, but not all, harbor seals would experience seasonal benefits associated with Alternative 7. Harbor seals favor coastal areas in spring and summer, and shift to areas outside of Cook Inlet in fall and winter (Boveng et al., 2012). Harbor seals use haulouts along the coastlines of Cook Inlet both inside of and outside of the excluded blocks of Alternative 7 (Boveng et al., 2011). Haulouts are concentrated in Tuxedni, Chinitna, Iniskin, and Iliamna bays, and on Kalgin Island and the small islands nearby. Alternative 7 would increase the distance between post-lease activities and haulouts in and near Tuxedni and Chinitna bays, and near Kalgin Island, thereby reducing potential disturbances from underwater noise, effects of habitat alteration, and on-lease vessel activities. However, harbor seals using haulouts in

Iniskin and Iliamna bays would not experience these benefits since Alternative 7 would shift post-lease activities into areas closer to them, increasing the likelihood of potential effects on these animals.

Alternative 7 would have little effect on most baleen whales, orcas, Steller sea lions, porpoises, and dolphins. Most of these animals occur in the southern portion of lower Cook Inlet and would not benefit from exclusion of post-lease activities in the northern portion of the lease sale area. While individuals from these species may travel into and use the excluded blocks of Alternative 7, they are transient occupants, using areas of Cook Inlet both within and outside the excluded blocks as needed. The benefits of excluding post-lease activities would last only while an individual is in the exclusion and would not reduce the overall frequency, intensity, or duration of exposure to post-lease activities in Cook Inlet. Harbor porpoises may experience some greater benefit compared to other species as many sightings have been documented within the excluded blocks and near Chinitna and Tuxedni bays (Rugh et al*.,* 2005; Shelden et al., 2014). All species could be affected by post-lease activities outside of the exclusion area.

Under Alternative 7, the total amount of post-lease activity would be similar to that described for the Proposed Action. For beluga whales and many harbor seals in Cook Inlet, the effects of Alternative 7 would be less than those described for the Proposed Action and Alternatives 3A, 3B, 3C, 4A, 4B and 5 because these species use coastal areas adjacent to the excluded blocks. Activities would occur further from habitat areas used by these species, and animals would have a lower level of exposure to noise, vessel traffic, and habitat impacts. Additionally, restricting post-lease activities to areas south of Anchor Point would mean that accidental spills would most likely originate farther from the areas known to be used by belugas and many (but not all) harbor seals. Oil spilled in the southern portion of the lease area would take longer to reach northern portions of Cook Inlet and these northern areas could experience oil spill effects later than other areas. The delay could allow for additional clean-up and mitigation in response to the spill and ultimately result in fewer impacts within excluded areas.

Compared to the Proposed Action, Alternative 7 would reduce impacts to both marine mammals overall and beluga whales specifically. Alternative 7 would reduce impacts to marine mammals as a whole, but the decrease would not be sufficient to reduce the overall impact level because of the limited benefits for some species (e.g., sea otters, Steller's sea lions) and because marine mammals remain unprotected from impacts outside the exclusion. The impact level for marine mammals as a group would be negligible to minor (without a large spill) or minor to moderate (with a large spill). Alternative 7 would reduce the impact level for beluga whales from minor to negligible by creating a large protective buffer around critical habitat and other occupied areas that provides substantial spatial separation between belugas and noise, habitat disturbance, and oil spill risks. If a large spill is included, the impact level associated with Alternative 7 could rise to minor.

Alternative 8 – The Tuxedni Bay/Chinitna Bay Buffer Exclusion

Under this alternative, lease sale blocks that overlap a 10-mile buffer from the mouths of Tuxedni Bay or Chinitna Bay would be excluded from the lease sale. This alternative reduces the lease sale area by 22.5 percent and provides broad spatial separation between belugas and LS 258 activities by creating distance between work on the OCS and areas known or suspected to contain important habitat for Cook Inlet beluga whales. Belugas have repeatedly been documented using Tuxedni Bay, mainly in winter, and it is the southernmost area known to be occupied seasonally and used for foraging by a sizeable number of belugas (Castellote et al., 2020; 2024). Chinitna Bay has less documented evidence of use but is suspected to be important for wintering belugas. Belugas have been recorded within Chinitna River using Passive Acoustic Monitoring (PAM) in winter (Castellote et al., 2024) and have recently been seen in Chinitna Bay in anecdotal sightings (NPS, 2025). BOEM staff met with NMFS beluga whale biologists Verena Gill and Jill Seymour on December 6, 2024, who reported that belugas may use Chinitna Bay more frequently than documented in previous aerial surveys and scientific literature (Seymour and Gill, 2024).

The exclusion of lease blocks within a 10-mile coastal buffer provides substantial spatial separation between lease sale activities and adjacent coastal areas occupied by belugas, reducing (but not eliminating) vessel collision risk and potential for disturbance. This buffer offers meaningful protection because belugas generally stay near the coast in Cook Inlet (often within 3.2–4.8 km or 2–3 mi) from shore) and rarely use the deeper waters in the central current (Shelden et al., 2015). The exclusion of lease blocks within a 10-mile buffer allows sound from on-lease seismic surveys to attenuate to low levels before reaching areas occupied by belugas. Seismic surveys can generate very high levels of underwater sound (up to 265 dB; Table 4-7). Exposure can cause acoustic injury at close range—usually considered within 500 m, but sometimes up to 1,500 m (BOEM and BSEE, 2023)—and can interrupt important behaviors at farther distances (NMFS, 2024a). For example, in 2019, NMFS established 7,330-m (4.5-mi) around seismic survey vessels for monitoring possible behavioral disturbances of marine mammals during surveys in Cook Inlet (84 FR 12330, April 1, 2019). Under similar circumstances, the coastal buffer described under this alternative would mean that a beluga in Tuxedni or Chinitna Bay could be swimming 5.5 miles from shore and would still be outside the zone of behavioral disturbance generated by seismic work conducted on a lease.

Alternative 8 would provide protective benefits to some harbor seals and harbor porpoises. Harbor seal haulouts are located adjacent to the excluded blocks and are used for pupping and molting (Boveng et al., 2011). In a recent investigation, harbor porpoises were frequently detected in and near Chinitna and Tuxedni bays (Rugh et al*.*, 2005). Benefits to these species would be similar to those expected for belugas. The spatial buffer would reduce the likelihood of noise disturbances along much of the western coast of lower Cook Inlet and would make habitat impacts unlikely near Chinitna and Tuxedni bays.

Alternative 8 would exclude several lease blocks containing northern sea otter critical habitat, reducing noise impacts and protecting the habitat from disturbance. However, this alternative would benefit relatively few sea otters since most Cook Inlet otters live in Kamishak and Kachemak bays, far from the Tuxedni and Chinitna bay exclusion areas. Few sea otters have been documented in the critical habitat within Alternative 8's exclusion blocks (Garlich-Miller et al., 2018), limiting the direct population benefits of this alternative.

Most baleen whales, orcas, Steller sea lions, and dolphins occur mainly in the southern portion of lower Cook Inlet and use the Chinitna and Tuxedni areas intermittently. The main benefit of excluding post-lease activities from these areas would be a reduced risk of disturbance near Tuxedni and Chinitna bays. However, this benefit would apply only while an individual is in the excluded area and overall, Alternative 8 would not reduce these animals' levels of exposure to post-lease activities in Cook Inlet.

The impacts on marine mammals from Alternative 8 would be slightly greater than those described for Alternatives 3C, 7, and 9, but slightly less than described for the Proposed Action and Alternatives 3A, 3B, 4A, 4B, and 5. These differences are primarily due to the greater protection for Cook Inlet beluga habitat and the protection provided to harbor seal haulouts. Some northern sea otters and harbor porpoises could also receive benefits. Protective benefits for each of these species arise from greater spatial separation between post-lease activities and habitat areas. The greater distance reduces the intensity of LS 258-related sound exposure, risk of vessel collision, and likelihood of habitat effects.

Alternative 8 would result in impacts to marine mammals that are slightly less than the Proposed Action due to greater protection for Cook Inlet beluga habitat and harbor seal haulouts, together with some benefits to northern sea otters and harbor porpoises. These protective benefits arise from greater spatial separation between post-lease activities and habitat areas, which reduces sound exposure intensity, vessel collision risk, and likelihood of habitat effects, but benefits would not be sufficient to change the impact level for marine mammals collectively compared to the Proposed Action, resulting in negligible to minor impacts for routine activities and minor to moderate impacts with the addition of a large oil spill.

Alternative 8 would reduce the impact level for Cook Inlet beluga whales from minor to negligible. The reduced impact level results from 10-mile buffers around Tuxedni and Chinitna Bays that create substantial spatial separation from lease activities, allow seismic sounds to attenuate to low levels before reaching beluga habitat, and ensure most whales remain outside behavioral disturbance zones. In the event of a large spill, impact levels could increase to minor for belugas.

Alternative 9 – Northern Feeding Areas 5-Mile Exclusion

Alternative 9 excludes lease blocks that overlap a five-mile buffer from the coastline of Kalgin Island and Cook Inlet north of an east/west line crossing Cook Inlet from Anchor Point to the west side of Cook Inlet south of Chinitna Bay. This alternative reduces the Lease Sale Area by 21 percent and provides a protective buffer between on-lease activities and the mouths of anadromous streams. Beluga whales feed on anadromous fish in the estuaries and river mouths of Cook Inlet, and they travel along nearshore coastal areas between rivers, avoiding the swift and deep waters of the middle of Cook Inlet. This alternative excludes from leasing the coastal areas north of the approximate latitude of Anchor Point, which have been modelled as important habitat in the peer-reviewed literature or have had recurrent observations of belugas (McHuron et al., 2023; Goetz et al., 2012). Although the coastal areas south of Tuxedni Bay and along the western Kenai peninsula are not known to be used frequently, they may serve as important movement corridors or have greater use than is currently documented (Seymour and Gill, 2024). NMFS identified a five-mile distance around high- and medium-flow anadromous waters as an important feature of critical habitat for the Cook Inlet beluga whale (76 FR 20180, April 11, 2011). This alternative provides a buffer along these areas while allowing leasing in the deeper waters of the central channel and in areas south of Anchor Point where documented beluga sightings are rare.

The Northern Feeding Areas 5-Mile Exclusion reduces potential impacts to Cook Inlet belugas, sea otters, and harbor seals by providing spatial separation between lease activities and the coastal habitat and nearshore haulouts occupied by these species. The increased distance between on-lease activities and coastal habitat reduces the potential impacts to marine mammals from noise disturbance, habitat alteration, and vessel activities. This alternative also excludes from leasing several lease blocks in northern sea otter and beluga whale critical habitat, which lessens the likelihood of post-lease impacts to these critical habitats.

Alternative 9 protects more Cook Inlet beluga whale critical habitat than Alternatives 4A, 4B, 5 and 8, but less than Alternatives 3A, 3B, 3C and 7. Alternative 9 protects more northern sea otter critical habitat than Alternatives 4A or 4B by creating a buffer between disturbances from oil and gas activities and northern sea otter critical habitat outside of the lease sale area. For harbor seals, Alternative 9 would provide a similar level of protection to Alternatives 3A, 3B, 3C and less protection than Alternatives 7 and 8. Other marine mammals would be affected in the same manner as described for the Proposed Action (see Section 4.8.2 of 2022 LS 258 FEIS). For these reasons, impacts on marine mammals would be less than for Alternatives 4A, 4B, and 5, but more than Alternative 7.

Alternative 9 would result in negligible to minor impacts for marine mammals collectively (excluding a large spill). While effects would be reduced compared to the Proposed Action due to protective buffers around coastal habitat, the reduction would not change the overall impact level. While Cook Inlet beluga whales, northern sea otters, and harbor seals benefit from spatial separation between lease activities and their critical areas, other marine mammals would experience similar impacts as the Proposed Action since they use areas both within and outside the excluded blocks. Including a large oil spill, Alternative 9 would result in the same impact level as the Proposed Action: a minor to moderate level of effects. Alternative 9 would reduce the impact level of the Proposed Action from minor to negligible for Cook Inlet beluga whales by creating a 5-mile buffer around coastal areas north of Anchor Point that protects critical feeding habitat near anadromous stream mouths and nearshore travel corridors. This exclusion provides spatial separation between lease activities and the coastal areas where belugas concentrate to feed and travel, reducing potential impacts from underwater noise, habitat alteration, and vessel activities while protecting beluga whale critical habitat from direct lease-related disturbances. Including large spills, the impact level would be minor.

Comparison and Conclusions

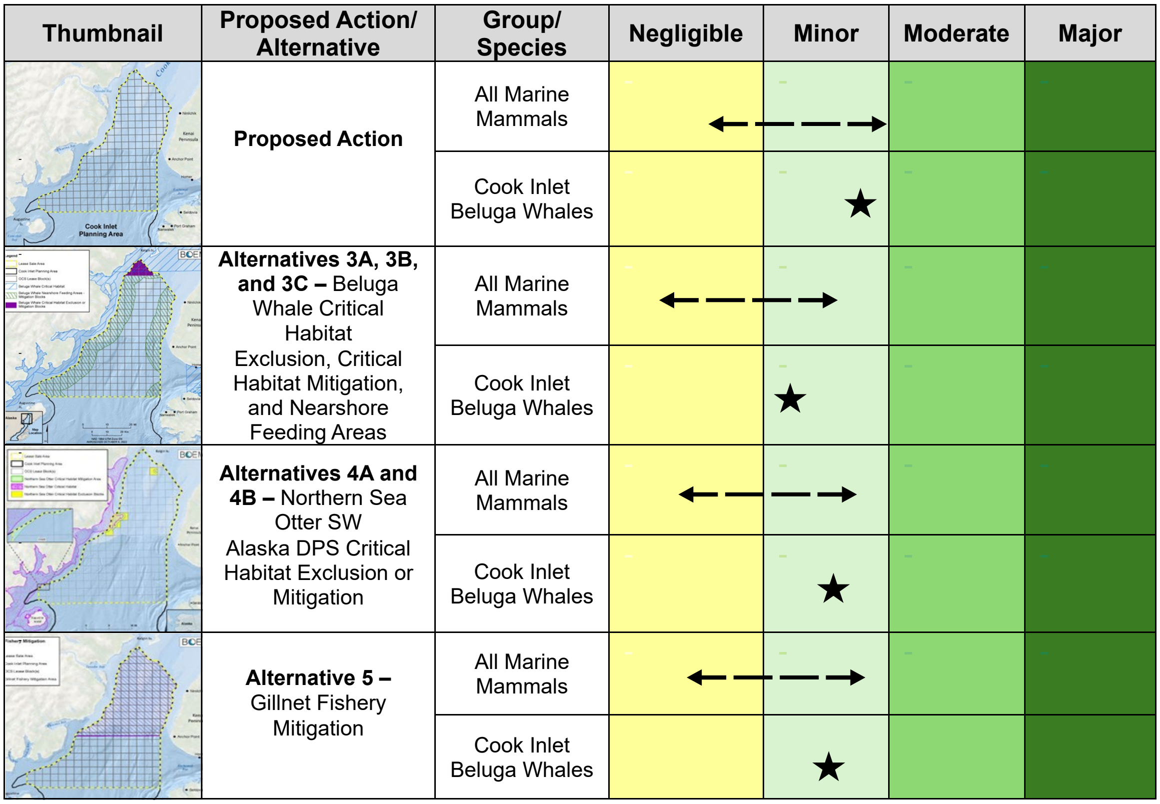
The level of impact of the Proposed Action on all marine mammals, including belugas, would be categorized as negligible to minor, while impacts to belugas alone would be minor. With the addition of a large spill, the level of effect would be categorized as minor to moderate for marine mammals, and minor for beluga whales and most other marine mammal populations, except sea otters. As described in the 2022 LS 258 FEIS Section 4.8.2, exposure of sea otters to oil can cause immediate fouling of the fur, hypothermia, and death, resulting in a moderate level of impacts.

Alternatives 3–5 all result in the same impact level as the Proposed Action for marine mammals, ranging from negligible to minor for routine activities and minor to moderate when including a large oil spill. Alternatives 7–9 also maintain the same overall impact levels for marine mammals collectively, although they provide enhanced protections for some species through spatial buffers and exclusion zones. Among the Proposed Action and Alternatives 3–5 and 7–9, there are differences in effects, although when evaluated for marine mammals as a group, the differences are not enough to change the overall impact level. Alternatives 3–5 provide modest benefits through small exclusions (7–10 blocks) and timing restrictions, reducing impacts for belugas, harbor seals, Steller sea lions, and some northern sea otters. Alternatives 7–9 provide greater protective benefits, creating large spatial exclusions of 21–49 percent of the lease sale area that further reduce impacts for the same species. Each alternative has beneficial effects, but no alternative except Alternative 2—the No Action Alternative—avoids impacting all marine mammals.

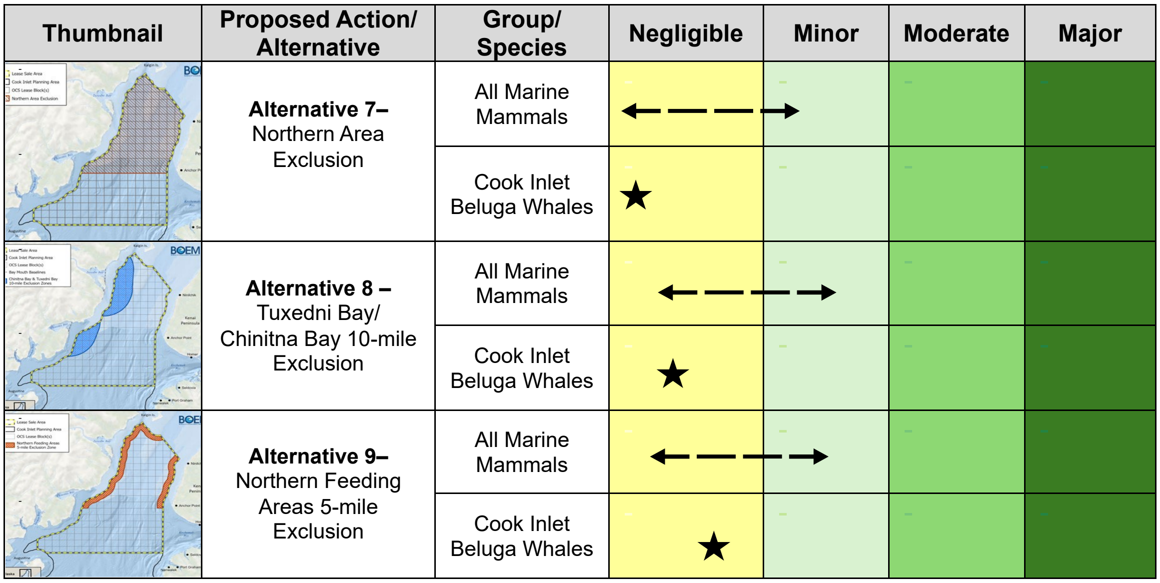
Several reasons explain why alternatives with protective benefits that reduce the possible impacts do not reduce the overall impact level for marine mammals as a whole. First, alternatives do not change the type or duration of reasonably foreseeable actions or oil spill likelihood; they only change geographic areas where actions may occur. The same amount of development could occur in a smaller area and result in a spill of similar size. Most marine mammals travel widely and could be impacted when they travel outside the excluded or mitigated blocks. Second, the extent to which impacts can be reduced from an already-low level is limited. Mitigation measures described in Section 3.4 reduce potential impacts of all alternatives and the Proposed Action. Additional mitigation measures are required for ESA and MMPA compliance, and BOEM may require additional mitigation for EP or DPP approval. Collectively, these factors minimize potential impacts to marine mammals, resulting in negligible to minor impacts. Alternatives meant to further reduce already-low impact levels can only produce incrementally smaller likelihood of impacts rather than change the impact level determination. Third, the impact scale represents the range of effects across marine mammal species. When impacts are evaluated collectively, species-specific benefits can be obscured by the range of responses across all marine mammals. Alternatives 7–9 provide protective buffers for belugas, but the overall impact level for marine mammals collectively remains the same because other species do not experience the same level of benefit. For instance, Alternative 7 could focus post-lease activities closer to sea otter population centers, increasing disturbances, collision risk, and habitat impacts. The collective assessment methodology weighs each species equally, resulting in the same overall 'negligible to minor' range despite the substantial beluga-specific benefits.

Differences in the impact levels among alternatives become apparent when belugas are considered separately. Alternatives 3–5 would reduce potential impacts to beluga whales compared to the Proposed Action through critical habitat exclusions and timing restrictions. These measures result in a lower level of potential impacts compared to the Proposed Action, though both remain categorized as ‘minor’. Potential impacts increase when a large spill is included in the analysis, but the impact level would remain in the minor category because a large spill has a low likelihood of reaching core areas of beluga habitat. Alternatives 7–9, when compared to the Proposed Action, would reduce the impact level from minor to negligible for routine activities and from moderate to minor when including a large spill. The impact level is reduced because Alternatives 7–9 create large spatial exclusions ranging from 21 to 49 percent of the lease sale area, including up to 117 lease blocks in key locations for beluga protection, whereas Alternatives 3–5 rely on smaller exclusions of 7–10 blocks and timing restrictions. These larger exclusions create physical separation between belugas and lease activities, which reduces collision and oil spill risks and allows seismic sound to attenuate before reaching beluga habitat, helping ensure whales remain outside behavioral disturbance zones.

Figure 4-5 summarizes the differences among the Proposed Action and alternatives in effects to beluga whales and marine mammals collectively. It provides a visual comparison that illustrates within-category variations in impact intensity even when the overall impact level classifications remain the same. The four columns represent the four impact categories (negligible, minor, moderate, and major). The impact level of each alternative is indicated by the placement of a graphic feature within the column or category. For marine mammals, the figure uses arrow bars to show how impact levels span the impact categories. The placement of the arrows represents the range of expected impacts among all marine mammal species. Arrows ranging farther to the right indicate alternatives with greater potential impacts while arrows to the left indicate fewer impacts. For belugas, stars indicate the impact level for the Proposed Action and each alternative. Placement of the star toward the right of the column indicates greater potential impacts, and placement to the left means fewer or less intense impacts within each category. The figure demonstrates the reduction in impacts from Alternatives 7–9 for marine mammals as a group compared to the Proposed Action and Alternatives 3–5 despite the lack of change in impact level. It also demonstrates the reduction in impact level for beluga whales from Alternatives 7–9.



Thumbnail	Proposed Action/ Alternative	Group/ Species	Negligible	Minor	Moderate	Major
	Proposed Action	All Marine Mammals	← —	— — →		
		Cook Inlet Beluga Whales		★		
	Alternatives 3A, 3B, and 3C – Beluga Whale Critical Habitat Exclusion, Critical Habitat Mitigation, and Nearshore Feeding Areas	All Marine Mammals	← — —	— →		
		Cook Inlet Beluga Whales		★		
	Alternatives 4A and 4B – Northern Sea Otter SW Alaska DPS Critical Habitat Exclusion or Mitigation	All Marine Mammals	← —	— — →		
		Cook Inlet Beluga Whales		★		
	Alternative 5 – Gillnet Fishery Mitigation	All Marine Mammals	← —	— — →		
		Cook Inlet Beluga Whales		★		



Thumbnail	Proposed Action/ Alternative	Group/ Species	Negligible	Minor	Moderate	Major
	Alternative 7– Northern Area Exclusion	All Marine Mammals	←———	→		
		Cook Inlet Beluga Whales	★			
	Alternative 8 – Tuxedni Bay/ Chinitna Bay 10-mile Exclusion	All Marine Mammals	←———	——→		
		Cook Inlet Beluga Whales	★			
	Alternative 9– Northern Feeding Areas 5-mile Exclusion	All Marine Mammals	←———	——→		
		Cook Inlet Beluga Whales	★			

Figure 4-5: Visual Comparison of Impact Levels for Marine Mammals and Cook Inlet Beluga Whales across LS 258 Proposed Action and Alternatives

Note: The Proposed Action is described in the E&D Scenario (2022 FEIS Section 4.1) and includes small spills **(no large spill; see** 2022 FEIS Section 3.1.1). Additional description is provided in the text immediately preceding the figure.

4.8.5 Cumulative Effects

Section 4.8.4 of the 2022 LS 258 FEIS presents an analysis of cumulative effects of the Proposed Action together with other past, present, and reasonably foreseeable future actions on marine mammals in Cook Inlet. Updated actions are presented in Section 3.2 of this SEIS. This section examines cumulative effects in light of new information available since publication of the 2022 Lease Sale 258 FEIS. New information is discussed in Section 4.8.2 and in the following sections, where relevant. A detailed assessment of impacts to Cook Inlet beluga whales apart from other marine mammals is also included.

Cumulative Impacts on Marine Mammals

Recent federal legislation mandated six additional lease sales in the Cook Inlet Planning Area over 7 years, potentially increasing cumulative impacts from oil and gas activities on marine mammals. Oil and gas operations in Cook Inlet have and will continue to affect marine mammals in three main ways. First, underwater noises can harm or disturb marine animals. Seismic surveys and pile driving create sounds that are potentially injurious to nearby marine mammals, while drilling, construction, and vessel traffic produce disruptive noise causing behavioral changes. Second, operations have altered marine mammal habitat through building ports, offshore platforms, and underwater pipelines, and drilling activities have released materials like drilling muds into waters. These habitat changes currently affect only a small portion of total marine mammal habitat in Cook Inlet, and some disturbed areas naturally recover over time. Third, human presence from workers, vessels, aircraft, and equipment causes marine mammals to avoid areas, potentially displacing them from preferred habitats during construction and maintenance. While current effects are generally localized and temporary, future oil and gas activity levels will determine cumulative effects over the life of the Proposed Action.

Recent plans have been proposed for importing liquified natural gas into Cook Inlet. The existing Kenai LNG Terminal, a former export facility in Nikiski, has been targeted for renovation as a natural gas import facility. Large-scale reconstruction is not expected for this facility, but LNG imports would increase vessel traffic through Cook Inlet. Additional vessels would add to the existing risk of oil spills and release of hazardous materials, although safety features required for LNG transport would reduce the spill risk relative to other types of vessels. In the case of an accidental LNG release, threats to marine mammals in the immediate area would arise from the rapid phase transition from a liquid to a gas as LNG is exposed to ambient temperatures. Vaporized LNG can create a gas cloud that displaces oxygen and causes asphyxiation. LNG vapor is highly flammable, and if released in sufficient quantities and ignited, the resulting explosion or fire can cause injuries or loss of life. Effects on marine mammals are highly unlikely due to the extremely rapid dispersion and localized impacts of LNG, which would require the animal to be present in the immediate area during an LNG release. LNG release accidents are rare and marine mammals in Cook Inlet are not so common as to make the simultaneous occurrence of both in the same area more than a remote possibility (e.g., Vanem et al., 2008, regarding LNG accidents; Goetz et al., 2023; Esslinger et al., 2021; Boveng et al., 2011, regarding marine mammal densities).

Renewable energy development has recently become reasonably foreseeable in Cook Inlet. Tidal energy development near East Foreland and geothermal development of Augustine Island could introduce novel stressors and contribute to existing stressors affecting marine mammals. The East Foreland pilot project is a proposed hydrokinetic tidal energy development that would generate electricity using submerged turbines that rotate in response to tidal currents. The main concerns are disturbance, habitat impacts, and possible collisions with turbines or cables. Disturbance effects could arise from both the physical presence of and noise from the installation and maintenance of the turbines. Habitat impacts could occur if tidal flow changes or Electromagnetic Field (EMF) emissions alter the movement patterns and distribution of marine mammals and their prey. An EMF forms around any electrical conductor when current flows through it. Underwater cables used for power transmission and data communication generate these fields as electrical current moves through the conductors. EMF from submerged cables have localized effects to electrosensitive species. In Cook Inlet, several submerged power and data cables have already been installed. The size and scale of the possible impacts from EMFs are unknown and very little research has yet been completed to understand the potential effects. However, some research has indicated that EMF emissions do not pose a substantial risk to marine mammals (Copping et al., 2020).

Tidal turbines operate in areas with extremely powerful currents, and collision between marine mammals and turbine blades is a concern due to placement in natural movement corridors, attraction to these devices, or inability to avoid the turbines. There are no operational turbine projects along the U.S. Pacific coast, and no information is available to indicate whether marine mammals in Cook Inlet would be at risk of collisions. Studies from Scotland have shown that seals and porpoises can avoid turbines, responding at distances from less than 150 m to 2 km from the turbines (Gillespie et al., 2021; Montabaranom et al., 2025; Onoufriou et al., 2021). Garavelli et al. (2024) evaluated available data and found tidal energy poses very low collision risks, but the uncertain population impacts of even rare events (injury or death) require targeted research. The initiation of East Foreland tidal as a pilot project would allow research and monitoring during an experimental stage when effects may be smaller and more localized than would be expected from a full-scale tidal energy facility.

Geothermal development of Augustine Island is in early exploration. The scope of development is yet unknown but could include onshore construction of geothermal wells, well pads, pipelines, a power plant, roads, personnel housing, transportation, and maintenance facilities. Exploration has thus far focused on onshore areas. Marine impacts are likely to be related to the installation of a subsea power cable and the vessel and aircraft transportation necessary to access the Island. There may be local habitat degradation due to shoreline construction of docking facilities. Effects on marine mammals would include disturbance or displacement by vessels and aircraft. Marine mammal habitat may be affected by noise and changes in water quality or food availability. Sea otters are known to use areas near Augustine Island and may be affected more than other species. Geothermal development would contribute to the cumulative impacts of other past, present, and reasonably foreseeable future actions involving vessel and aircraft transportation and construction along the Cook Inlet coastline. Shoreline development is described in Section 4.8.4 of the 2022 Lease Sale 258 FEIS.

Mining has occurred along Cook Inlet's coastlines for decades, creating localized habitat impacts for marine mammals that will likely persist and potentially intensify with continued extraction in the future. The Johnson Tract poly-metallic mine is a project between Tuxedni and Chinitna bays that, if approved, could affect marine mammals due to project-related coastline development, vessel and aircraft traffic, and changes to water quality. Marine mammals that use the area, including Cook Inlet beluga whales and harbor seals, would be exposed to additional underwater noise and disturbance, habitat alteration, a possible increase in risk of strikes, and/or hazardous material spills from vessel traffic and operation of a marine ore terminal.

Commercial shipping is the largest contributor of underwater anthropogenic noise in Cook Inlet (Castellote et al., 2018). Vessel traffic associated with an LNG import facility, renewable energy projects, and the Johnson Tract mine would add to ongoing vessel operations and contribute to underwater noise, risk of collisions, and risk of spills from vessels in Cook Inlet. Collectively these can cause disturbance and displacement, habitat alteration, and changes in food resources available to marine mammals. Vessel traffic from these sources would add a small increase in the risk of collisions, although marine mammals can often avoid slow-moving commercial and industrial vessels.

New information suggests that increased shipping across the world is contributing to cumulative impacts on whales. Nisi et al. (2024) published distribution models for four globally ranging species and combined more than 35 billion positions from 176,000 ships to produce a global estimate of whale-ship collision risk. They found that shipping occurs across 92 percent of whale ranges, and less than 7 percent of risk hotspots contain management strategies to reduce collisions. In Cook Inlet, changes in traffic between 2011–2020 have not indicated significant trends in the amount of vessel traffic, but fluctuations in vessel types were apparent; increases were noted in the number of foreign-flagged tankers and the time spent by tankers in Cook Inlet (Fletcher et al., 2021). The development of mitigation measures for reducing collision risk has been supported by recent research. Redfern et al. (2024) found a 10-knot speed restriction would reduce vessel collision risk with right whales, humpback, fin, and sei whales. Turgeon et al. (2025) found that the use of AIS on vessels improved operator compliance with mandatory speed reduction zones in St. Lawrence Estuary beluga habitat. Klosner (2022) described how the use of PAM enabled ships to avoid collisions with vocalizing sperm whales.

As explained in Section 4.8.4 of the 2022 LS 258 FEIS, climate-related changes will have the most widespread and long-term contribution of impacts on many marine mammal species in comparison to other past, present, and reasonably foreseeable future actions. Climate-related impacts include increased water temperatures, changes in species distribution, increased ocean acidification, changes in sea ice, and changes in human actions that influence marine mammals.

New information has described how species that use Cook Inlet may respond to climate change. For instance, Moore et al. (2022) documented changes in gray whale distribution related to climate-influenced changes in prey variability and ocean dynamics. Escajeda (2023) noted changes in the timing of migration of fin whales linked to warmer ocean temperatures. New information also described the effects of marine heatwaves on marine mammals. A “marine heatwave” is a prolonged period of unusually warm sea surface temperatures in a particular ocean region. The frequency and duration of MHWs have been increasing with ocean warming due to climate change. These were first detected in the Pacific Ocean in 2013 and have since become increasingly common and larger in scale (Song et al., 2023). Marine heatwaves have been linked to Unusual Mortality Events or reduced survival among humpbacks, Steller sea lions, grey whales, and ice seals (Boveng et al., 2020; Moore et al., 2022; Cheeseman et al., 2024; Hastings et al., 2023; Gulland et al., 2022).

Changes in long-term population trends among humpback whales of the North Pacific were linked to a 2014–2016 marine heatwave (Cheeseman et al., 2024). Prior to 2014, North Pacific humpback whale populations were increasing as whales recovered from commercial whaling. After the 2014–2016 period, there was a notable decline in local abundance of humpback whales in the latitudes affected by the heatwave. Reductions in prey biomass occurred during the heatwaves and the decreases in prey were associated with fewer calves, a prevalence of underfed and emaciated whales, increased strandings, and the absence of individual whales known to use the affected areas. On the breeding grounds, there were significant declines among both adults and calves of the year (Frankel et al., 2022). Summer feeding populations in the Gulf of Alaska, which include those using Cook Inlet, have since shown signs of recent recovery (Moran et al., 2025). However, recoveries may be short-lived if severe MHWs occur in the future, as predicted by Barkhordarian et al. (2022).

After the 2014–2016 MHW, fish-eating killer whales in coastal Prince William Sound and the Kenai Fjords National Park and Preserve experienced acute impacts on survival and prolonged disruption of reproductive schedules. Durban et al. (2025) provided evidence suggesting impacts on reproductive health are likely to persist due to smaller adult sizes attained by females that were growing during the heatwave. Female killer whales with smaller body sizes have less nutrients and energy stores to support pregnancies and lactation. In other whale species this has been correlated with reduced lifetime reproductive success. Despite exposure to past, present, and reasonably foreseeable future actions and environmental conditions in Cook Inlet, fin whales, Steller sea lions, sea otters, and some populations of killer whales are thought to be stable or increasing. Cook Inlet beluga whales have shown long-term declines, and trends are currently uncertain.

Cumulative Impacts on Cook Inlet Beluga Whales

This section provides an analysis of impacts to Cook Inlet beluga whales from the Proposed Action together with past, present, and reasonably foreseeable future actions described in Section 3.2. This analysis responds to the Court's determination that BOEM should have considered the cumulative impacts on Cook Inlet beluga whales separately from other marine mammals. While most marine mammal populations have shown resiliency from past stressors, Cook Inlet belugas have failed to recover from population declines.

Oil and Gas

Cook Inlet beluga whales have coexisted with oil and gas operations since the 1960s, and most oil and gas development in Cook Inlet is in Cook Inlet beluga whale critical habitat. Exploration has taken place on the OCS, but all oil and gas production in Cook Inlet to date currently occurs in State of Alaska waters. Cumulative effects from oil and gas-related activities include PPRFFAs in State waters as well as future actions in the offshore waters of the OCS. Future offshore work may result from existing leases that Hilcorp acquired in 2017’s Lease Sale 244, the current Proposed Action, and additional future lease sales. Federal law (the OBBBA) mandates six oil and gas lease sales in the Cook Inlet Planning Area by March 2032. Additional lease sales are possible afterward. Oil and gas actions may impact beluga whales by introducing noise into the environment, disturbing whales with the presence of people and vessels, altering habitat, and accidentally injuring or killing individual whales.

Oil and gas work can and will continue to generate noise levels above NMFS thresholds for behavioral disturbance during well drilling, pipeline placement, in-water construction, and some vessel activities. These operations can also cause non-acoustic disturbances. Sources of non-acoustic disturbance include the presence of workers, vessels, aircraft, and equipment. The effects of these actions are often difficult to identify because noise-related stressors are not easily separated from visual or other sensory stimuli, but the response of the animal is likely to be similar. Disturbance to Cook Inlet beluga whales can trigger various behavioral responses, ranging from mild stress reactions to more severe impacts such as feeding disruption and abandonment of important habitat areas. The effects are generally short in duration, and belugas typically return to normal activities after the source of disturbance ceases.

Noise levels exceeding NMFS's injury thresholds have been generated by activities like seismic surveys, pile driving, and towing a rig with multiple tugs are among the oil and gas activities that can produce. (e.g., NMFS, 2017b; 89 FR 60164, July 24, 2024; 89 FR 51102, June 14, 2024). Exposure at close range or over a prolonged period could compromise a beluga's ability to hear or communicate, as described in Section 4.8.2 under Subsection *Underwater Noise and Marine Mammal Hearing*. The risk of these impacts would rise if oil and gas development increases in Cook Inlet; however, oil and gas operators are expected to seek authorizations for actions that could cause injuries from NMFS, and operators are required by those authorizations to conduct mitigation efforts to reduce effects on individuals and prevent impacts on the population (e.g., BOEM and BSEE, 2023).

NMFS reviews noise-producing oil and gas work in Cook Inlet for the amount and severity of disturbance and issues authorizations for incidental take of marine mammals under the MMPA, and for listed species under the ESA. For instance, NMFS issued an authorization for take incidental to construction of a marine terminal and pipeline for the Alaska LNG Project (85 FR 59291, September 21, 2020). Harvest, Alaska LLC received authorization for take related to pipeline installation (83 FR 8437, February 27, 2018). NMFS authorized incidental take from seismic surveys in Cook Inlet, including Hilcorp G&G surveys (84 FR 37442, July 31, 2019). NMFS authorized incidental take by Furie for rig towing with tugs and installation of conductor piles with an impact hammer (89 FR 51102, June 14, 2024) and by Hilcorp for drilling operations and rig-towing with tugs (87 FR 62364, October 14, 2022; 89 FR 60164, July 24, 2024). The additive effects of past actions that NMFS has authorized for incidental take have been identified as a concern to the Cook Inlet beluga whale population (Migura and Bollini, 2021; CBD et al., 2022). However, issuing incidental take authorizations is not expected to cause impacts to the population because NMFS may authorize takes for an action only if it would have a negligible effect on the population and affect no more than a small number of marine mammals. Most of the harassment allowed by these authorizations is from research operations. Take from oil and gas actions constitute only a small portion of the total incidental take authorized for belugas, and these authorizations provide a means of applying mitigation measures that would not otherwise be required.

Oil and gas operations have affected beluga whale habitat and will continue to do so in the future. Impacts are often temporary, such as noise, but they can also cause permanent habitat loss by physically changing the marine environment or creating chronic noise or ongoing disturbances. Cook Inlet has offshore platforms, submerged pipelines, and various oil and gas shoreline facilities, and although some disturbed habitat (i.e., pipeline routes and sediment deposition areas) will recover over time, some local areas will remain unavailable for use by belugas (e.g., space occupied by platforms). To date, only a very small fraction of available habitat has been permanently altered. Oil and gas activities can also lead to habitat degradation caused by contaminants. Discharges of wastewater, produced waters, drilling muds, cuttings, and tailings may contain toxic metals, organic and inorganic components, and naturally occurring radioactive materials (Kharaka and Dorsey, 2005). However, wastewater discharges to Cook Inlet are permitted by the State of Alaska and must comply with water quality standards in 18 AAC 70 (see Section 4.4 for more information).

Accidental oil and gas releases have occurred in Cook Inlet, not connected to OCS exploration or development, and they are likely to occur in the future (Robertson and Campbell, 2020). The cumulative effects scenario developed for this analysis (Section 3.2) forecasts two accidental large oil spills from activities not related to LS 258 over the 40-year duration of LS 258 (see Appendix A). Contact with spilled oil can cause elevated stress and physiological reactions to inhalation or ingestion of hydrocarbon toxins. Oil contamination can kill or contaminate fish and invertebrates eaten by beluga whales. An oil spill could have acute effects on a small number of belugas from immediate exposure to spilled oil or could result in longer-lasting chronic or latent effects to beluga health or from impacts to food resources. The existence of spill response infrastructure, protocols, and active spill response measures has and will continue to help minimize effects from large oil spills on beluga whales.

The original listing decision for the Cook Inlet beluga whale identified oil and gas as a contributor to habitat modification, which is identified as one of the threats affecting belugas (73 FR 62919, October 22, 2008). The Recovery Plan for the Cook Inlet Beluga Whale identified stressors related to oil and gas operations as factors contributing to cumulative impacts affecting belugas, but oil and gas development was not identified as an inherent threat by NMFS (2016). The cumulative effects of oil and gas work in Cook Inlet will depend on the industry's future activity levels in the region.

Renewable Energy

Reasonably foreseeable renewable energy projects which may contribute to cumulative effects to beluga whales in Cook Inlet include tidal and geothermal projects. Beluga whales are extremely rare in Kamishak Bay near Augustine Island where geothermal energy development is being considered (e.g., Shelden et al. 2015; Goetz et al., 2023). Disturbance in other areas could result from the addition of project-related vessel traffic between Augustine Island and port sites. Beluga whale habitat could be temporarily altered by seafloor disturbance during power cable installation. Tidal energy development near East Foreland would have similar effects from seafloor disturbance and vessel traffic, but belugas could also be exposed to risk of collision with turbine structures or cables, noise generated by the turbine, and loss of habitat in the immediate vicinity. The likelihood and severity of impacts to belugas are unknown, but baseline monitoring to establish beluga use patterns has been conducted (ORPC Alaska, 2014) and continued monitoring would enable comparisons after turbines are installed.

Marine Transportation, Ports, and Terminals (Vessel Traffic)

Marine vessel traffic is and will continue to be present in Cook Inlet throughout the year. Vessels include containerships, bulk cargo freighters, tankers, commercial and sport-fishing vessels, tugboats and recreational vessels. Vessel traffic is considered a threat to the recovery of the Cook Inlet beluga whale population due to the potential for vessel noise to interfere with feeding and communication, and the risk of vessel strikes (NMFS, 2016). Vessel traffic in Cook Inlet is the loudest source of regularly occurring man-made noise in Cook Inlet (Castellote et al., 2016; 2018). Even though seismic surveys and pile driving can generate much higher levels of noise than vessels, these are infrequent, shore-duration activities.

The underwater noise generated by vessels has the potential to result in behavioral harassment and masking. Researchers recently modelled masking by vessel noise in Cook Inlet and found that acoustic signals of belugas can be fully masked by ship noise at short range and partially masked by distant ship noise. These studies indicate that anthropogenic sound associated with Cook Inlet’s shipping channels likely masks some beluga whale communication and echolocation sounds (Eickmeier and Vallarta, 2023; Brewer et al., 2023). Most of the masking by vessel transits in shipping lanes is projected to be of short duration because transits by large vessels occur at a relatively low level. Daily vessel transits by large ships (300 gross tons or more) average only 1.3 per day (Nuka Research, 2015) or about 8 ships per week (Fletcher et al., 2021). Although Cook Inlet noise sources and their signal characteristics have been documented in (e.g., Fletcher et al., 2021), a comprehensive survey of the cumulative impacts of vessel noise on Cook Inlet belugas has not been conducted.

Various commercial and recreational fishing vessels operate throughout Cook Inlet, with some areas of intensive salmon and herring fishing. Smaller boats that travel at high speed and frequently change directions may displace belugas or pose a threat of vessel strike, particularly near river mouths where belugas often congregate to feed on fish runs. Fourteen percent of Cook Inlet beluga whales in a photo-ID catalog had external injuries and marks suggestive of vessel strikes (McGuire et al., 2021). Ship strikes from large vessels are expected to pose less of a threat to belugas due to these ships' slower speeds and straight-line movements. Vessel activities have negative consequences for Cook Inlet beluga whales where boats cause collisions or displace belugas from sensitive feeding or calving habitats. For instance, Kumar et al. (2024) concluded that Cook Inlet beluga whales avoid the Kenai River when there are high levels of vessel noise from fishing boats from April to the end of August, despite the high density of salmon in the river during this time. Vessel activity will continue to affect belugas, but targeted mitigation may be developed to protect sensitive areas.

The cumulative effects of vessel noise on Cook Inlet beluga whales are not clearly known, but they are likely to continue and may have adverse effects on the population. Changes in vessel traffic patterns are likely to reflect general economic trends and specific projects in Cook Inlet. Because most development projects have a marine shipping component, the influence of vessel traffic on belugas will change with the rate of development. Between 2015 and 2025, population and economic growth projections indicated only moderate increases to vessel traffic on the order of 1.5 to 2.5 percent annually (Nuka Research, 2015). Uncertainties arise not only from changing vessel traffic patterns, but also from lack of information about the quantity of vessel noise disturbance belugas can tolerate. McHuron et al. (2023) addressed this question by modelling the effects of Cook Inlet beluga whales' behavioral decisions in a landscape with intermittent disturbances such as those caused by anthropogenic activities. They found that intermittent disturbances that resulted in lost foraging opportunities had little impact on body condition or vital rates so long as prey were abundant during the summer and early fall. NMFS has identified vessel noise, particularly in upper Cook Inlet, together with other anthropogenic sound, as a high-level concern for the recovery of Cook Inlet beluga whales (NMFS, 2016; Young et al., 2024). Vessel noise was identified as the top priority for noise mitigation actions to benefit Cook Inlet belugas (Castellote et al., 2018).

Mining

Several proposed mining projects may affect Cook Inlet belugas, including Pebble Mine, Donlin Gold, Diamond Point rock quarry, and the Johnson Tract mine (see Sections 3.2 of this document and the 2022 LS 258 FEIS). Donlin Gold would require construction of a gas pipeline tie-in on Cook Inlet's coast. Port sites for Pebble Mine, Diamond Point quarry, and the Johnson Tract mine would facilitate transportation of ore for offsite processing. Port site and pipeline development would introduce high levels of noise during construction. Port sites would generate lower levels of chronic noise during operations. Shipping of ore would add a considerable amount of vessel traffic to Cook Inlet. Mining could contribute to the cumulative effects to Cook Inlet beluga whales from possible heavy metal pollution.

The Johnson Tract mine has greater potential to contribute to cumulative effects than Pebble Mine or Diamond Point quarry due to the proposed location. The Johnson Tract mine's transportation plan has identified Tuxedni Bay as a possible port site. NOAA and NMFS (2022) documented belugas in Tuxedni Bay during aerial surveys conducted in spring (March–April) and fall (September–December) of 2018–2021. Castellote et al. (2024) documented the use of Tuxedni Bay by belugas between September and April and characterized the area as important winter habitat for belugas due to low levels of anthropogenic noise in the area. If vessels or port facilities cause belugas to avoid Tuxedni Bay, the whales could expend more energy to find alternate habitat during this critical time of year.

Mining could also affect Cook Inlet beluga whales through risks of pollution. The watersheds of the Diamond Point quarry and Johnson Tract mine drain into Cook Inlet and could release contaminants directly into Cook Inlet beluga whale habitat. Pebble Mine would transport ore through Cook Inlet and could contribute contaminants from dust or stormwater drainage along the marine transport corridor and at the port site. Discharges and runoff from mining areas may contain metal compounds, organic substances, and acids and alkalis used in ore extraction and processing (Shul'kin et al., 2015). Mining operations can also alter surface and groundwater temperatures, flow rates, and nutrient or oxygen levels, which may decrease or contaminate prey fish populations and negatively alter habitat (Norman et al., 2015). There is particular concern with copper, cadmium, selenium, arsenic, mercury, lead, and zinc in the aquatic environment because of their potential toxicity to fish (Scannell, 2009; EPA, 1987; Baldwin et al., 2003; Kumari et al., 2017; Jewett and Duffy, 2007; Paul et al., 2014). Cook Inlet belugas could be affected by mining through bioaccumulation of contaminants from food resources near port sites and at the outflows of affected watersheds or through reductions in food resources at these locations.

Tuxedni Bay is of particular concern for mining impacts because belugas rarely occur near other proposed mining sites. Cook Inlet beluga whales feed heavily on salmon during summer runs in upper Cook Inlet, but salmon are not likely to contribute high contaminant loads from mining in Cook Inlet, as most of their body mass is acquired during growth in the open ocean. However, in winter, the species being eaten in Tuxedni Bay are unknown and the relative importance of winter feeding to Cook Inlet beluga whales' energetics and survival is also unknown. Thus, the probability of exposure to mine-related contaminants or loss of food resources from Cook Inlet mining cannot be predicted from the available information. Cumulative impacts of contamination from mining, together with other sources of pollution, remain a concern for the Cook Inlet beluga whale.

Fisheries Harvest

Fishing is a major industry in Alaska and poses risks to Cook Inlet beluga whales from prey competition, harassment, ship strikes, and entanglement in fishing gear. Salmon are the primary prey for Cook Inlet beluga whales and recent declines in harvest may indicate concerns for food availability for belugas. The 2012–2021 average annual commercial salmon fishery harvest was 2.5 million fish, and the 2022 harvest of 1.4 million was 44 percent less than the 10-year average. The 2022 upper Cook Inlet commercial harvest compared to the 2012–2021 average was down 34 percent for chum, 43 percent for sockeye, 44 percent for coho, 58 percent for Chinook, and 72 percent for pink salmon (Lipka and Stumpf, 2024). It is unknown whether these results show a short-term fluctuation or are an indicator of a lasting ecosystem shift and downward trend which could affect belugas.

Bernard (2025) evaluated annual Cook Inlet beluga whale survival rates in relation to salmon abundance and found that beluga survival appears to have declined between 2005 and 2017, coinciding with a period of decreased biomass in both Chinook and sockeye salmon runs. The correlation of survival rates with the biomass of salmon suggests that beluga survival may depend upon the size of salmon runs. Norman, et al. (2020) found a correlation between beluga whale reproductive success and salmon abundance in the Deshka River. However, Cook Inlet belugas also feed heavily on eulachon, and a lack of data on eulachon abundance and beluga whale prey selectivity introduces uncertainty into the linkages between belugas and their prey (Bechtol, 2025). It remains unknown whether and to what extent salmon and eulachon may be less available to belugas due to competition with fisheries harvest. The Cook Inlet Beluga Whale Recovery Team considers reduction in availability of prey due to fishing to be a moderate threat to the population (NMFS, 2016).

Historically, Cook Inlet beluga whale mortality and serious injury have occurred in the Cook Inlet salmon set gillnet and drift gillnet fisheries, but no recent mortalities involving fisheries have been confirmed (Young et al., 2024). Between 2005 and 2017, McGuire et al. (2021) documented from a long-term photo-ID dataset 14 instances of potential entanglement scars on Cook Inlet belugas. Of those indicating entanglement, 11 observations suggested entanglement with monofilament line, netting, or other rope or line. Three were confirmed scars from a net injury, a heavy braided line, and a gillnet. Fishing gear is the most common type of debris involved in entanglements but is not the only type. One live entangled beluga was reported in McGuire et al. (2021) and again observed in 2024 that appeared to be caught within a tire or culvert liner, the source of which is unknown. No intervention occurred, and the animal disappeared after the 2024 sighting.

Subsistence Harvest and Illegal Shooting

Alaska Natives legally hunted Cook Inlet belugas prior to and after passage of the MMPA in 1972 (Mahoney and Shelden, 2000). The hunt removed 20 percent of the population in 1996, which was high enough to account for population decline from 1994 through 1998 (Hobbs et al., 2000). Alaska Natives restricted harvest in 1999 after declines became apparent. Although harvest limits were set at one or two belugas per year between 2000 and 2006, no whale hunting has taken place since 2005. Subsistence harvest by Alaska Natives is not now contributing to cumulative impacts on Cook Inlet beluga whales.

Illegal shooting and harassment may be affecting the Cook Inlet beluga population. McGuire et al. (2021) conducted a photo-ID analysis of approximately 400 individuals, both living and deceased, and found four possible bullet wounds. These wounds may also have been caused by a killer whale bite or an interaction with a vessel, but McGuire et al. (2021) noted that shell casings have been found at beluga whale viewing stations. One photo showed an arrow shaft protruding from a recent wound. They concluded that belugas experience illegal harassment and injury that is not associated with subsistence harvest (McGuire et al., 2021). Since 2006, the NMFS Office of Law Enforcement has investigated credible reports of apparent fresh gunshot injuries to Cook Inlet belugas, indicating that poaching and/or intentional harassment may occur (NMFS, 2016). The scale of the problem is unknown. Illegal poaching and shooting, together with other sources of illegal take, is considered a threat of medium magnitude to the recovery of Cook Inlet beluga whales (NMFS, 2016).

Residential and Community Development

Coastal development in Cook Inlet has resulted in localized areas of habitat loss and increases in vessel traffic, noise, and pollution and will continue into the future. Potential projects within the Cook Inlet area include the following: mining projects; renewable energy projects (geothermal and tidal energy development); roadway construction; dredging; oil or gas work; laying of electrical, communication, or fluid lines; and construction and maintenance of docks, bridges, breakwaters and port structures. Coastal development causes loss of habitat beneath the footprint of permanent structures and can alter the habitat by affecting local water circulation patterns. Permanent structures such as docks, platforms, or bridges can change the availability of prey. However, because permanent structures may repel some prey species but attract others, the net effect of structures on beluga whale habitat remains unknown.

The primary range of Cook Inlet beluga whales is in upper Cook Inlet where additional coastal development is likely. Land use patterns, bathymetry, and extreme tidal ranges make some areas of Cook Inlet unsuitable for development. Even though the majority of Cook Inlet is undeveloped, Cook Inlet beluga whales may still experience noise, vessel traffic, and pollution from coastal development. Restriction of migratory and movement corridors is an important concern where development could prevent belugas from using travel corridors to access critical feeding areas (Kendall and Cornick, 2015). There is limited understanding of how the Cook Inlet beluga whale population might be affected by various development projects due to the uncertainty of future development and lack of understanding of how belugas will respond. NMFS has designated the loss or degradation of habitat as a medium-level concern for the recovery of Cook Inlet belugas (NMFS, 2016; Young et al., 2024).

Pollution

Human activities and development in urban areas around Cook Inlet contribute contaminants to Cook Inlet. Contaminants are a concern because at high levels, certain contaminants can suppress immune function, disrupt hormone and reproductive systems, impair neurological processes, and interfere with normal metabolism, collectively compromising health of affected individuals. Contaminants enter Cook Inlet beluga habitat from spills, stormwater runoff from residential, industrial, and military areas, offshore oil and gas operations, dredging, municipal wastewater, and marine vessel discharges.

Researchers have collected contaminant data from Cook Inlet belugas. Burek-Huntington et al. (2022a) conducted a retrospective analysis of subsistence-harvested Cook Inlet beluga whale blubber and liver samples from 1989 to 2005. Contaminant analysis included several persistent organic pollutants (POPs), per- and polyfluoroalkyl substances (PFAS), and total mercury. Concentrations of POPs had significantly increased between 1995 to 2005. Overall, levels were higher in Cook Inlet belugas than Arctic beluga populations, which may be due to proximity to Anchorage and industrial areas. Poirier et al. (2019) tested for polycyclic aromatic hydrocarbons (PAHs) among beluga populations and found significantly higher levels in St. Lawrence Estuary and Cook Inlet beluga whale samples compared to those from Arctic and captive belugas; however, the authors note that the sample size was too small to provide robust analysis. Becker et al. (2000) tested POPs from various populations and found that levels were substantially lower for both Cook Inlet beluga whales and Arctic belugas than for whales from St. Lawrence Estuary.

Environmental sampling conducted by EPA provided information about potential sources of contaminants. Seven fish species, eight invertebrates, and three plant species in Cook Inlet were tested for concentrations of 161 chemicals (EPA, 2003). There were detections of mercury, organochlorine pesticides, and polychlorinated biphenyls (PCBs). Approximately one-half of the 104 PAHs were detected in fish, invertebrate, and plant samples. This suggests bioaccumulation from food resources is a possible source of contaminants in Cook Inlet beluga whales.

There is little information available to determine what effects contaminants have had on the health of Cook Inlet beluga whales or how these effects may change in the future. Burek-Huntington et al. (2022a,b) provided a retrospective analysis of samples collected from subsistence-harvested Cook Inlet belugas from 1989 to 2005 and suggested a relationship between contaminant exposure and congenital abnormalities found in two beluga whale calves. They found some indications that pollutants such as flame retardants have increased over time, but it was unclear if levels were sufficient to affect fetal development. They concluded that their findings did not explain the current lack of recovery of the population and additional research is needed on the causes of congenital abnormalities in Cook Inlet beluga whales.

While the Recovery Plan for Cook Inlet beluga whales identified pollution as a threat, it notes that available information indicates that the magnitude of the pollution threat to Cook Inlet beluga whales appears low. Evidence cited for this conclusion includes relatively low contaminant loads among Cook Inlet beluga whales compared to other beluga populations and chemical analyses of water and dredging sediments from Cook Inlet showing contamination below management levels, and sometimes below detection limits (NMFS, 2016).

Scientific Research

Scientific research on belugas in Cook Inlet is ongoing and is needed to understand the distribution, abundance, and factors limiting recovery of this population. Previous research has included line-transect surveys, behavioral observations, photo-identification, attachment of scientific instruments (tagging), blood and tissue sampling, and live capture for health assessments. Current projects include the Cook

Inlet Beluga Whale Photo-ID Project, which identifies individual whales to provide information about movement patterns, habitat use, survivorship, reproduction, and population size (McGuire et al., 2023). The Alaska Beluga Monitoring Program is a multi-agency effort to conduct visual observations of Cook Inlet beluga whales and collect location data (ABMP, 2025). Many important aspects of Cook Inlet beluga whale biology will continue to be the subject of ongoing research in the future. The NMFS Marine Mammal Laboratory is planning biennial photogrammetry drone surveys to estimate abundance. Studies on distribution and prey base using PAM and eDNA sampling are also being planned.

Scientific research on Cook Inlet beluga whales is expected to have only minimal effects on the species, depending on specific research methodology. For instance, the acoustic research currently conducted on beluga whales uses hydrophones and has no impact on the animals. However, some research efforts, particularly those requiring physical contact, have impacted individual belugas. Burek-Huntington et al. (2022c) investigated wounds from prior tagging in dead stranded belugas from Cook Inlet and Bristol Bay. One animal had normal wound healing 12 years after tagging. Another had a systemic *Staphylococcus sp.* infection, including of the tag wound, 12.8 years after tagging. The third died four months after tagging, possibly from a killer whale attack, but also had an infection of the tag wound, which had spread to a lymph node. This work demonstrates the risks of attaching tags for research. The vast majority of present-day research uses remote, non-invasive methods such as photo-identification and aerial and vessel surveys that result in only a minor degree of disturbance. Nonetheless, these studies demonstrate that scientific research contributes to cumulative effects and must be done with care to avoid adverse consequences.

Military and Homeland Security

Military practices occur adjacent to Cook Inlet at JBER, and, together with other past, present, and reasonably foreseeable future actions, contribute to cumulative levels of contaminants and noise affecting Cook Inlet beluga whales. Legacy contamination from elemental white phosphorus (from smoke-producing devices) has been faulted for unusually high mortality rates of migrating waterfowl at JBER. Remediation efforts have been conducted, but ongoing contamination continues to be a concern for marine species in downstream areas. High levels of airborne noise arise from indirect live-fire weapons training at the Eagle River Flats Impact Area and from aircraft overflights above Cook Inlet. Risks to belugas are limited because in-water military exercises are not conducted in Cook Inlet and transference of airborne noise into the water column occurs only very near the source. Blevins (2015) conducted interviews to collect local knowledge regarding beluga whale reactions to noise. One participant reported continued use of an area near JBER by Cook Inlet beluga whale mothers and calves despite military activity. In sum, it is not known whether to what degree military actions have affected belugas, but possible effects will continue with future military actions.

Additional Considerations

Reasonably foreseeable effects of climate change may contribute to cumulative impacts to beluga whales in Cook Inlet. Climate change is affecting Cook Inlet and Alaska in a number of ways that may alter the physical and ecological environment on which Cook Inlet beluga whales rely. Cook Inlet is shifting towards increasingly longer ice-free seasons at a rate consistent with other parts of the state. Average annual temperatures in Alaska are expected to rise by an additional 2°F to 4°F by 2050 and 4°F to 6°F by 2100 (Chapin et al., 2014). Average annual precipitation in the Cook Inlet region is anticipated to increase three to four percent over the 40-year span of LS 258 activities. Most of the increased precipitation in Cook Inlet is predicted to occur in winter months (November through January) and in May. These increases would be balanced in part by drier weather in June (USACE, 2018). Changes in precipitation and timing of breakup (spring melt) could affect belugas by altering freshwater habitat for their main prey, salmon and eulachon.

The greatest climate change risk to Cook Inlet belugas may be potential changes in salmon and eulachon freshwater habitat. Temperature and hydrology influence several critical life stages of salmonids in their freshwater habitats, and during periods of rapid climate change, can have significant effects on fish populations (Bryant, 2009). For example, rapid glacial melting could increase silt deposition, potentially altering salmon spawning habitat. Alternately, glacial retreat may be creating new salmon habitat (Pitman et al., 2021). Climate-driven changes in rainfall, freshwater runoff, stream temperature, and water column stability could have widespread effects on seasonal streamflow within the Cook Inlet drainage basin, affecting prey abundance for belugas in unpredictable ways.

Changes to the marine and coastal ecosystems occurring as a result of global climate change are associated with shifts in temperature, oxygen content, and pH levels (Doney et al., 2012). Such changes in the marine environment alter growth, survival, and reproduction of marine species, influencing abundance and distribution (e.g., Tillman and Siemann, 2011; Doney et al., 2012; Sydeman et al., 2015). Norman et al. (2015) predicted that changes in prey distribution, composition, and productivity will present foraging challenges for Cook Inlet beluga whales, requiring them to expend greater effort or resort to lower quality prey. Belugas may also encounter a greater number of novel or unusual competitors. For instance, O'Brien et al. (2013) predicted that sharks in Cook Inlet may increase due to climate change.

Loss of winter sea ice could result in changes in Cook Inlet beluga whale seasonal distribution and habitat use. Beluga whale distribution in winter is strongly influenced by sea ice formation (Goetz et al., 2012). Richardson et al. (1991) reported beluga whales in the Arctic often travel along the ice pack and feed on prey beneath it. Despite the presence of sometimes very dense sea ice, some belugas remain in upper Cook Inlet during winter (Shelden et al., 2015; Castellote et al., 2020). Less ice could result in increased vessel or construction activities during an extended open-water season and an associated increase in noise, pollution, and risk of ship strike. Changes in sea ice concentration may also have a direct effect on ocean noise pollution. As levels of carbon dioxide rise, ocean waters are becoming more acidic, which reduces concentrations of seawater salts that attenuate sound, allowing lower frequency sound to carry farther (Reeder and Chiu, 2010).

Current climate trends are favorable for the growth of Harmful Algal Blooms (HABs) and the spread of pathogens. Lefebvre et al. (2022) reported evidence of HAB toxins (e.g., domoic acid and saxitoxin) in Alaskan waters at levels high enough to be accumulated by and detected in marine mammals. No evidence has yet been found indicating a specific HAB threat to Cook Inlet beluga whales. In testing by Burek-Huntington et al. (2015), very low levels of domoic acid were found in two of 17 Cook Inlet beluga whales, and saxitoxin was present just above the detection limit in one out of 15 whales. Climate change is rapidly altering the global movement of pathogens, bringing diseases to new areas. Guimarães et al. (2007) demonstrated this vulnerability by modeling the dynamics of infectious disease spread through an isolated group of killer whales in the Pacific Northwest, showing how small populations like Cook Inlet beluga whales are especially susceptible to population-wide disease outbreaks.

NMFS's current marine mammal stock assessments identify climate change as a threat to all marine mammal stocks occurring in Alaska, including the Cook Inlet beluga whale (Young et al., 2024). Gulland et al. (2022) reviewed the likely effects of climate change on marine mammals in the U.S. and found that effects on demography and health are uncertain. For some species, indirect effects of climate change may introduce new stressors or exacerbate existing problems. For Cook Inlet beluga whales, the effects of climate change will likely create several challenges, especially through impacts to salmon, their primary prey. Warmer ocean temperatures and changes in stream hydrology may present challenges in the freshwater and marine ecosystems and could cause salmon declines. While the degree of impact and the consequences for the population are unknown, climate change will contribute to the cumulative effects influencing Cook Inlet beluga whales.

Cumulative Impacts Conclusions

The combination of oil and gas actions, renewable energy development, mining operations, and increased vessel traffic creates cumulative impacts affecting marine mammals throughout Cook Inlet. These activities introduce underwater noise, habitat disturbance, and collision risks. Climate change represents the most widespread and long-term contributor to cumulative impacts, with rising ocean temperatures, marine heatwaves, and ecosystem changes already affecting humpback whales, Steller sea lions, and grey whales. While some species may be more resilient due to larger ranges or feeding flexibility, others face heightened vulnerability due to restricted distributions or specialized habitat requirements. The overlapping temporal and spatial occurrence of reasonably foreseeable future actions and climate change means that marine mammals face additive and potentially synergistic effects of human activities and environmental changes.

The cumulative effects of multiple stressors are collectively considered a high-ranked threat to the recovery of the Cook Inlet beluga whale (NMFS, 2016). The small population size places the population at risk from catastrophic events (e.g., natural disasters, spills, mass strandings) and stochastic influences, but risk of inbreeding and loss of genetic diversity have been evaluated and were not thought to be inhibiting recovery (Hobbs et al., 2006). While the ultimate causes preventing recovery are not known, low reproductive rates and poor survival among non-breeders are thought to be proximate causes (Jacobson et al., 2020; Himes Boor et al., 2022). Population declines may have caused a loss of the transfer of cultural knowledge and social cohesion among Cook Inlet beluga whales, both of which are important to feeding and accessing important habitat at crucial times (e.g., O’Corry-Crowe et al., 2018). Risks from catastrophic events, cumulative effects, and noise currently pose the highest level of direct threat to recovery of Cook Inlet beluga whales, followed by disease, habitat degradation, reduction in prey, unauthorized take, pollution, and predation (NOAA and NMFS, 2022). Multiple interacting stressors make developing effective strategies for mitigating cumulative impacts especially difficult.

This section updated the 2022 LS 258 FEIS analysis of cumulative impacts to marine mammals and evaluated the cumulative impacts to beluga whales. New information and additional past, present, and reasonably foreseeable future actions did not change the impact level conclusions for marine mammals as a whole. When the effects from the post-lease activities described in the E&D Scenario are combined with past, present, and reasonably foreseeable future actions, cumulative impacts on marine mammals would be minor to moderate. Including cumulative impacts from climate change, the impact level could range from moderate to major for marine mammals over the lifespan of the E&D Scenario, depending on the extent and severity of environmental changes. For beluga whales, the Proposed Action together with past, present, and reasonably foreseeable future actions could yield cumulative impacts at a moderate impact level. Adding impacts from climate change could result in an impact level of major for belugas over the lifespan of the E&D Scenario, depending on the extent and severity of climate-related effects. This conclusion stems from the small population size of beluga whales, which makes them particularly vulnerable to environmental risks and uncertain future conditions.

4.8.6 Conclusions

Marine mammals in Cook Inlet would experience mostly non-injurious, short-term disturbances from activities following LS 258. Activities could include oil and gas exploration, development, production and decommissioning work described in the E&D Scenario, along with small accidental spills, spill drills, and spill response efforts. Most of the anticipated impacts to marine mammals would result from anthropogenic noise and vessel traffic. Activities would mainly cause temporary changes in animal behavior and physiological effects. These effects are expected to be minor and temporary with no long-term consequences for survival or fitness. Some noise sources, including seismic surveys and pile driving, could cause acoustic injury to marine mammals. Effects would be lessened by required mitigation measures. Most activities would not cause physical harm, except in the unlikely event of a vessel collision or large oil spill that could kill some marine mammals.

Cook Inlet beluga whales would be exposed to vessel noise from LS 258 activities. Individual belugas would mainly experience brief behavioral responses such as avoidance swimming or displacement. These effects would be short-term and localized. The risk of impacts is reduced by the geographic separation between the lease sale area and primary beluga habitat, the seasonal timing of most vessel activities during summer when belugas are concentrated in upper Cook Inlet, and the implementation of required mitigation measures. Most vessel activities would produce sound levels that are lower than those of existing commercial traffic in Cook Inlet, and the relatively modest increase in vessel traffic would not substantially change the existing acoustic environment. Although some masking of beluga vocalizations may occur, the whales' demonstrated ability to adjust their communication patterns may provide some protection against these effects. The potential for acoustic injury is extremely low due to the short distances over which harmful sound levels extend and the whales' ability to avoid approaching vessels. With implementation of mitigation measures, effects of vessel noise associated with LS 258 are expected to be minor and to affect only a few belugas.

Cumulative impacts from reasonably foreseeable future actions are a risk to recovery of Cook Inlet beluga whales due to multiple, overlapping stressors occurring year-round throughout their range. Climate change poses the most widespread and long-term risks through potential ecosystem changes affecting prey availability and habitat conditions. The small population size makes belugas particularly vulnerable to catastrophic events and stochastic influences, and poor survival and low reproductive rates and are likely limiting recovery. The uncertainty regarding future cumulative effects and difficulty in effectively mitigating multiple simultaneous threats compounds the challenges facing this species. Impacts associated with the E&D Scenario would represent a small incremental contribution to overall cumulative impacts affecting both marine mammals collectively and beluga whales specifically.

Table 4-8 summarizes the potential impact levels of the Proposed Action, Alternatives, and cumulative effects on marine mammals and beluga whales. Alternatives 7, 8, and 9 reduce impact levels from minor to negligible for beluga whales whereas other scenarios do not change the impact levels. These conclusions consider the original findings of the 2022 LS 258 FEIS as well as new information related to the affected area, the environmental consequences of the Proposed Action, the numbers and types of marine mammals in the area, and the mechanisms by which marine mammals may be affected. No new information was found that altered the original conclusions presented in the 2022 LS 258 FEIS.

Table 4-8: Summary of Impact Level Conclusions for Marine Mammals and Cook Inlet Beluga Whales

Impact Level[6]	All Marine Mammals				Beluga Whales			
Scenario	**Negligible**	**Minor**	**Moderate**	**Major**	**Negligible**	**Minor**	**Moderate**	**Major**
Proposed Action with no large spill[1]	⬅	➡				★		
Proposed Action with a large spill from LS 258[2]		⬅	➡			★		
Alternatives 3–5 with no large spill from LS 258[3]	⬅	➡				★		
Alternatives 3–5 with a large spill from LS 258[2,3]		⬅	➡			★		
Alternatives 7–9 with no large spill from LS 258[4]	⬅	➡			★			
Alternatives 7–9 with a large spill from LS 258[2,4]		⬅	➡			★		
Proposed Action and Cumulative Effects including up to two large spills from sources other than LS 258[5]		⬅	➡				★	
Proposed Action and Cumulative Effects including up to two large spills from sources other than LS 258 and climate change[5]			⬅	➡				★

Notes: Arrows show the lower range (←) and upper range (→) of impact level expected for the Proposed Action, the Alternatives, and cumulative impacts on marine mammals as a collective group. Stars (★) show the impact levels for Cook Inlet beluga whales. Alternative 6 is a compilation of other alternatives and is not analyzed separately.

[1] Post-LS 258 activities are described in the E&D Scenario (Appendix B) and small spills (Section 3.1.1).

[2] Large spill scenario is described in Section 3.1.4.

[3] Alternatives 3-5 are described in Sections 2.3-2.5

[4] Alternatives 7–9 are described in Sections 2.7-2.9

[5] Cumulative effects are described in 2022 LS 258 FEIS Section 3.2 and Section 3.2 of this SEIS. Large spills from sources other than LS 258 are described in Appendix A.

[6] Impact Scale described in Section 4.2.

4.9 Terrestrial Mammals

A description of terrestrial mammal resources, along with the full analyses of the environmental consequences of the routine activities, accidental events, and cumulative impacts associated with the Proposed Action are presented in Section 4.9 of the 2022 LS 258 FEIS. Sections 4.9.1 and 4.9.2 below are summaries of the affected environment and relevant new information, respectively, since publication of the 2022 LS 258 FEIS. Sections 4.9.3 and 4.9.4 provide a summary of the environmental consequences of the Proposed Action and alternatives 3A, 3B, 3C, 4A, 4B, and 5, respectively. Sections 4.9.5 and 4.9.6 describe the environmental consequences of Alternatives 7, 8, and 9 and updates the cumulative effects, respectively. Section 4.9.7 summarizes the impact conclusions for all sections.

4.9.1 Summary of Affected Environment

A detailed description of terrestrial mammal resources is found in Section 4.9.1 of the 2022 LS 258 FEIS and is summarized below. Approximately 43 species of terrestrial mammals are known to occur in the lower Cook Inlet area. None of these species are currently listed as threatened or endangered, and most populations at the species level are considered stable (IUCN, 2015). Among the terrestrial mammals in the region, brown bear, black bear, caribou, and moose are most likely to be affected by post-lease activities.

4.9.2 New Information Available Since Publication of the 2022 LS 258 FEIS

A search for new information for terrestrial mammals was made of all relevant literature available through various printed and internet sources. Recent ADF&G species management reports and research articles were examined to assess its relevance to the Proposed Action. No new information that indicates additional effects, interactions, locations, or population-level impacts were discovered; therefore, the conclusions presented in the 2022 LS 258 FEIS remain unchanged.

4.9.3 Environmental Consequences of the Proposed Action

Post-lease activities conducted as a result of LS 258 that could cause impacts to terrestrial mammals include noise from air traffic, terrestrial habitat alteration from construction of onshore pipelines and facilities, and disturbance from increased vehicle traffic associated with the hauling of equipment, supplies, and waste. Most project impacts would be geographically distant from terrestrial habitats, occurring largely offshore in the lease sale area. Impacts from noise, habitat alteration, disturbance, and oil spill response activities would have short-term and localized effects. Impacts on terrestrial mammals from a large spill are also expected to be minor due to the low potential for adverse impacts from oiling of individuals or habitats.

4.9.4 Environmental Consequences of Alternatives 3A, 3B, 3C, 4A, 4B, and 5

Potential impacts on terrestrial mammals under all the Alternatives 3A, 3B, 3C, 4A, 4B and 5 would not differ substantially from those described for the Proposed Action. These alternatives would not change the total level of post-lease activity expected to result from LS 258, as described in the E&D Scenario. The alternatives address specific resources in Cook Inlet, including the beluga whale, northern sea otter, and gillnet fishery. Thus, none of the restrictions identified in these alternatives would be expected to change the likelihood or severity of impacts on terrestrial mammals. Overall, impacts of all these alternatives on terrestrial mammals would be essentially the same as those for the Proposed Action – minor for E&D Scenario activities, accidental small spills, and spill drills. Impacts on terrestrial mammals remain minor when a large spill is considered.

4.9.5 Environmental Consequences of Alternatives 7–9

A lease sale under Alternative 7, 8, or 9 would have impacts similar to those of the Proposed Action. These impacts include noise, habitat alteration, disturbance from onshore support activities, and disturbance from oil spill response activities. No new impacts have been identified that are not already addressed in the 2022 LS 258 FEIS.

In all three alternatives, the overall level of activity described in the E&D Scenario (Section 4.1, 2022 LS 258 FEIS) will stay the same; the only change will be in the geographic areas where these activities could take place. Alternative 7 would reduce the geographic area offered for lease by 49 percent. Alternatives 8 and 9 would reduce the geographic areas offered for lease by 22.5 and 20.9 percent, respectively.

The exclusion of activities in the geographic areas that are bounded by Alternatives 7, 8, and 9 would not reduce impacts to terrestrial mammals due to the geographic distance of terrestrial mammal populations and habitats. These alternatives would not change the total level of post-lease activity as described in the E&D Scenario. Thus, none of the exclusions identified in these alternatives would be expected to change the likelihood or severity of impacts on terrestrial mammals.

The expected effects on terrestrial mammals described for the Proposed Action in the 2022 LS 258 FEIS also apply to Alternatives 7, 8, and 9. This is because the alternatives do not change the type or duration of the anticipated E&D activities; they only change the geographic areas where those activities occur. Therefore, the impact conclusions provided in the 2022 LS 258 FEIS remain unchanged. Overall, impacts will be short-term and localized, generally minor. Impacts on terrestrial mammals remain minor when a large spill is considered.

4.9.6 Cumulative Effects

While many cumulative impacts are foreseeable, the addition of the Proposed Action to past, present, and reasonably foreseeable future actions (Section 3.2) is not expected to have widespread or persistent impacts on terrestrial mammal populations in the Cook Inlet region. The potential impacts of the Proposed Action would likely comprise small, incremental contributions to the overall cumulative effects. Most impacts from activities considered in the E&D Scenario would occur on the OCS and in offshore waters, remaining geographically separate from terrestrial mammals and their habitat, and would not produce long-term disturbances or population-level effects. The updated PPRFFA scenario (Section 3.2) includes actions associated with the six OBBBA lease sales. The Proposed Action's small, incremental contribution over its 40-year duration may overlap in time and space with physical disturbance to terrestrial habitats resulting from post-lease activities association with the six OBBBAs. The incremental contribution of the Proposed Action to the overall cumulative effects would be less prominent as post-lease activities from previous lease sales and the succeeding lease sales come into effect. While some sources of cumulative impacts, e.g., climate change or mining operations, would overlap with onshore impacts associated with the E&D Scenario, the Proposed Action would not contribute any discernible additive or synergistic effects to the overall cumulative effects. The overall cumulative impact on terrestrial mammals and habitats resulting from past, present, and reasonably foreseeable future actions and a changing climate, including the incremental contribution from LS 258, as described in the E&D Scenario, would range from negligible to minor. when including the impacts from a large oil spill the impacts on terrestrial mammals and habitats would remain minor.

4.9.7 Conclusion

BOEM has reexamined the impact conclusions for terrestrial mammals presented in the 2022 LS 258 FEIS. No new information was discovered that would alter the impact conclusions for terrestrial mammals presented in the 2022 LS 258 FEIS (Sections 4.9.2, 4.9.3, and 4.9.4), and the analysis and assessment of potential impacts still apply for LS 258. Post-lease activities that may result from LS 258, as described in the E&D Scenario (i.e., the Proposed Action) are expected to result in minor impacts on terrestrial mammals. The level of impacts to terrestrial mammals in the lease sale area from Alternatives 3A, 3B, 3C, 4A, 4B, or 5 would be the same as the Proposed Action – short-term and minor. Additionally, a lease sale under Alternative 7, 8, or 9 would be expected to have the same level of impacts as the Proposed Action – short-term and minor. The impacts of past, present and reasonably foreseeable future actions, when combined with effects of the Proposed Action, would be negligible to minor. The impacts of a large spill and spill response to resource, when combined with impacts from the Proposed Action, would remain minor.

4.10 Recreation, Tourism, and Sport Fishing

A description of recreation, tourism, and sport fishing (RTSF) resources, along with the full analyses of the environmental consequences of the routine activities, accidental events, and cumulative impacts associated with the Proposed Action, are presented in Section 4.10 of the 2022 LS 258 FEIS. Section 4.10.2 below is a summary of relevant new information since publication of the 2022 LS 258 FEIS. Sections 4.10.3 and 4.10.4 provide a summary of the environmental consequences of the Proposed Action and alternatives 3A, 3B, 3C, 4A, 4B, and 5, respectively. Sections 4.10.5 and 4.10.6 describe the environmental consequences of Alternatives 7, 8, and 9 and updates the cumulative effects analysis, respectively. Section 4.10.7 summarizes the impact conclusions for all sections.

4.10.1 Summary of Affected Environment

A detailed description of RTSF resources is found in section 4.10.1 of the 2022 LS 258 FEIS and is summarized below. Recreation, tourism, and sport fishing are important components of economic activity in Cook Inlet and the three are closely linked. Opportunities to participate in outdoor recreation are an essential element in the quality of life for residents of Alaska (Brooks and Haynes, 2001). Furthermore, tourism is one of the driving forces behind Alaska's economy (BLM, 2006), and recreation is the key component of tourism that attracts in-state and out-of-state tourists to Cook Inlet. The saltwater sport fishery in Cook Inlet, freshwater sport fishery on the Kenai Peninsula, and clamming are an important part of the total economy. Sport fisheries also are an important part of recreation and tourism experiences of the area.

4.10.2 New Information Available Since Publication of the 2022 LS 258 FEIS

A search for new information for RTSF was made of all relevant literature available through various printed and internet sources. The new resource information was examined to assess its relevance to the Proposed Action. No new or relevant information that changed the type or levels of impact was discovered; therefore, the conclusions presented in the 2022 LS 258 FEIS remain unchanged.

4.10.3 Environmental Consequences of the Proposed Action

Post-lease activities conducted as a result of LS 258 that could cause impacts to RTSF include noise from air traffic, seismic surveys, platform installation, and drilling. Impacts would vary by the size, duration, and the location of the activity. Disturbance from vessels could cause space-use conflicts with waterborne recreational activities such as recreational marine sport fishing, and waterborne wildlife viewing and sightseeing. Space-use conflicts could arise from vessels engaged in operations such as seismic surveys or other support activities, or the presence of platforms. Most impacts resulting from the E&D Scenario would overlap with areas used for recreational, tourism and sport fishing activities. In the instances when they coincide, the duration of effects would be short lived. Impacts from noise and disturbance would be minor for post-lease activities, accidental small spills and spill drills, and moderate with the addition of a large spill.

4.10.4 Environmental Consequences of Alternatives 3A, 3B, 3C, 4A, 4B, and 5

Potential impacts on RTSF under all the action alternatives would not differ substantially from those described for the Proposed Action. These alternatives would not change the total level of post-lease activity as described in the E&D Scenario. These alternatives are directed at reducing impacts to certain important resources in Cook Inlet, and thus none of the restrictions identified in the alternatives would be expected to alter the likelihood or severity of effects on RTSF identified for the Proposed Action. Impacts of these alternatives would be essentially the same as those for the Proposed Action – minor for post-lease activities, accidental small spills and spill drills, and moderate with the addition of a large spill.

4.10.5 Environmental Consequences of Alternatives 7–9

A lease sale under Alternative 7, 8, or 9 would have impacts similar to those of the Proposed Action. These impacts include noise (from air traffic, seismic surveys, and platform installation) and disturbance from space-use conflicts. No new impacts have been identified that are not already noted in the 2022 LS 258 FEIS.

In all three alternatives, the overall level of activity described in the E&D Scenario (Section 4.1, 2022 LS 258 FEIS) would remain the same; the only change would be in the geographic areas where these activities could take place. Alternative 7 would reduce the geographic area offered for lease by 49 percent. Alternatives 8 and 9 would reduce the geographic areas offered for lease by 22.5 and 20.9 percent, respectively.

The impacts from most activities would be limited to the areas leased under these alternatives. The exclusion of activities in the geographic areas bounded by Alternatives 7, 8, and 9 would reduce impacts to RTSF in those areas by avoiding space-use conflicts; however, vessel and aircraft traffic could still occur in those areas if vessels and aircraft needed to pass through to access other leased blocks. By removing certain lease blocks for each alternative, the expected impacts on RTSF in those areas would be reduced.

The expected effects on RTSF described for the Proposed Action in the 2022 LS 258 FEIS also apply to Alternatives 7, 8, and 9. This is because the alternatives do not change the type or duration of the anticipated E&D activities; they only change the geographic areas where those activities could occur. Space-use conflicts from platform installations would be eliminated completely from the excluded blocks. Therefore, the impact conclusions provided in the 2022 LS 258 FEIS remain unchanged. Overall, impacts would be short-term and localized, generally minor, although they can become moderate in the event of a major spill and the subsequent response.

4.10.6 Cumulative Effects

While many cumulative impacts are foreseeable, the addition of the Proposed Action to the past, present, and reasonably foreseeable future actions (Section 3.2 is not expected to have widespread or persistent impacts on RTSF in Cook Inlet. The potential impacts of the Proposed Action would likely comprise small, incremental contributions to the overall cumulative effects. Past, present, and reasonably foreseeable future actions that could affect RTSF include oil and gas operations, large oil spills, and other non-oil and gas activities to include marine transportation, ports and terminals, and commercial fishing. The potential impacts to RTSF from these activities would primarily come from space-use conflicts. The updated PPRFFA scenario (Section 3.2) includes actions associated with the six OBBBA lease sales. The Proposed Action’s small, incremental contribution over its 40-year duration may overlap in time and space in the form of space-use conflicts resulting from post-lease activities associated with the six OBBBAs. The incremental contribution of the Proposed Action to the overall cumulative effects would be less prominent as post-lease activities from previous lease sales and the succeeding lease sales come into effect. Climate change is another source of cumulative impact on RTSF in lower Cook Inlet. While sources of cumulative impacts, e.g., climate change or vessel traffic, would overlap with impacts associated with the E&D Scenario, the Proposed Action would not contribute any discernible additive or synergistic effects to the overall cumulative effects. Overall, the cumulative impacts to RTSF resulting from past, present, and reasonably foreseeable future actions, including the incremental contribution of post-lease activities that may result from LS 258, would be minor.

4.10.7 Conclusion

BOEM has reexamined the impact conclusions for RTSF presented in the 2022 LS 258 FEIS. No new information was discovered that would alter the impact conclusions for RTSF presented in the 2022 LS 258 FEIS (Sections 4.10.2, 4.10.3, and 4.10.4). Therefore, the analysis and assessment of potential impacts still apply for LS 258. Post-lease activities that may result from LS 258, as described in the E&D Scenario (i.e., the Proposed Action) are expected to result in minor impacts on RTSF due to space-use conflicts. The level of impacts to RTSF in the lease sale area from Alternatives 3A, 3B, 3C, 4A, 4B, or 5 would be the same as the Proposed Action – short-term and minor. Additionally, a lease sale under Alternative 7, 8, or 9 would be expected to have the same level of impacts as the Proposed Action – short-term and minor. The impacts of past, present and reasonably foreseeable future actions, when combined with effects of the Proposed Action, would be minor. The impacts of a Proposed Action to RTSF, when combined with impacts from a large spill and response, would be moderate.

4.11 Communities and Subsistence

BOEM has reexamined the analysis for communities and subsistence presented in the 2022 LS 258 FEIS based on the new information presented in Section 4.11.2, below. No new information was discovered that would alter the overall impact conclusion for communities and subsistence presented in the 2022 LS 258 FEIS; however, recently published information expands BOEM's knowledge related to subsistence harvest and uses in the Cook Inlet region. A description of communities and subsistence, along with the full analyses of the environmental consequences of the routine activities, accidental events, and cumulative impacts associated with the Proposed Action are presented in Section 4.11 of the 2022 LS 258 FEIS. Sections 4.11.3 and 4.11.4, below, provide a summary of the impact analyses for the Proposed Action and Alternatives 3–5 that is incorporated by reference from the 2022 LS 258 FEIS. Sections 4.11.5 and 4.11.6 describe the environmental consequences of Alternatives 7, 8, and 9 and update the cumulative effects analysis, respectively.

4.11.1 Summary of Affected Environment

The affected environment description for communities and subsistence is detailed in the 2022 LS 258 FEIS, Section 4.11.1 and is hereby incorporated by reference. Communities on the Kenai Peninsula include small cities and towns that are connected by the road system, and several smaller, non-road-connected villages. The majority of residents of the KPB do not live within incorporated cities but in one of the established unincorporated communities along the road system; these communities are an important element of the southern Kenai Peninsula. Tourism and recreation, oil and gas, government, and commercial fishing are important economic sectors in the southern Kenai Peninsula, and the community character and identity of the region is intertwined with connections to the natural environment. Subsistence hunting, fishing, and trapping occur year-round throughout the entire Cook Inlet area on land, in rivers, and in coastal waters. Subsistence resources include salmon and other fish, big game, small game and furbearers, marine mammals, birds and eggs, marine invertebrates, and plants and berries. The importance of subsistence is reflected in the following: high levels of participation; high harvest levels which produce a large portion of the local food supply; extensive sharing of subsistence harvests through kinship and other networks; and large investments of time and money in subsistence equipment, supplies, and activities.

4.11.2 New Information Available Since Publication of the 2022 LS 258 FEIS

New information was discovered for subsistence activities and harvest patterns. Resource information was examined to assess its relevance to the Proposed Action. The new information expands BOEM's knowledge base with regards to subsistence activities and patterns in the Cook Inlet region but does not change the overall conclusions presented in the 2022 LS 258 FEIS.

The ADF&G Division of Subsistence compiles data from a range of research efforts and conducts studies to gather information on aspects of subsistence uses in Alaska, including in the Cook Inlet region. The 2022 LS 258 FEIS utilized information from the ADF&G Division of Subsistence, which has published a number of Cook Inlet-relevant studies since the 2022 LS 258 FEIS. ADF&G released annual reports on subsistence and personal use salmon fisheries in Alaska for years 2019 and 2020 (Brown et al., 2022, 2023). The reports document continued salmon harvest in the Cook Inlet region, both through the subsistence permit system and through personal use permits in Upper and Lower Cook Inlet. The reports note declines in harvest in certain management areas and permit systems for one or both years, but overall reflect the continued importance of salmon in the Cook Inlet region.

ADG&G provides additional details on subsistence salmon harvest patterns in Nanwalek and Port Graham (Woodard et al., 2023). For the years 2016 and 2017, salmon remained a key food source for both communities. Salmon harvest locations were almost exclusively in nearshore areas along the coast and in bays. The primary harvest method in both communities was rod-and-reel, followed by subsistence setnet fishing, troll gear, and removal from commercial catches, with variability in fishing method for different salmon species. The study, along with long-term harvest data and other recent publications (e.g., Keating et al., 2020), contributes further evidence to an increasing trend in both communities toward concentrated salmon harvest among a small number of fishers. For both study years, an estimated 71 percent of Nanwalek's salmon harvest was harvested by 21 to 26 percent of the community's households, and in Port Graham, approximately 69 percent of the salmon was harvested by 10 to 18 percent of the community's households. Large gaps between the harvest estimates based on household surveys and those reported through the subsistence salmon permit system were noted, implying challenges in using permit return data to estimate subsistence harvest amounts.

ADF&G updated subsistence harvest information for Pacific halibut in Alaska, including the Cook Inlet and Gulf of Alaska region (Brown and Koster, 2025). Subsistence halibut harvesters in Cook Inlet harvested 20,474 pounds of halibut in 2022, accounting for 5 percent of the state total and ranking Cook Inlet the sixth-largest geographic subarea of halibut harvest in the state. Communities in Kodiak harvested a total of just over 81,000 pounds of halibut, among the top five geographic subareas in the state. While the study documented declines in halibut harvest over time, halibut remains an important subsistence resource in Cook Inlet and the surrounding areas.

A study on the harvest of waterfowl and sandhill cranes and eggs throughout Alaska, based on analysis of ADF&G subsistence data, indicates waterfowl and sandhill cranes are targeted in the Gulf of Alaska-Cook Inlet region in the fall and winter (Naves and Schamber, 2024). Geese and ducks represent the majority of bird and egg harvest in the Gulf of Alaska-Cook Inlet region, but the region had relatively low bird and egg harvest compared to other regions of Alaska.

4.11.3 Environmental Consequences of the Proposed Action

The impact analysis for communities and subsistence is detailed in the 2022 LS 258 FEIS, Section 4.11.2 and is hereby incorporated by reference. Post-lease activities reasonably foreseeable as a result of LS 258 would have impacts on communities in the Cook Inlet region through effects on subsistence activities and harvest patterns. Potential impacts to subsistence would primarily occur through changes in the availability of subsistence resources to harvesters and from space-use conflicts. Impacts on communities would also occur through changes in the economy of the region (Section 4.12); impacts to commercial fishing (Section 4.13); and impacts on recreation, tourism, and sport fishing (Section 4.10) — all of which are important aspects of the economic and social fabric of many Kenai Peninsula communities.

Activities that could impact the availability of resources to subsistence harvesters include noise, seafloor disturbance, and operational discharges resulting in changes in the quantity, quality, or distribution of biological resources. Noise impacts are expected to be short-term and localized within individual subsistence harvest seasons, but the potential for impacts would persist throughout the lifespan of activities. Temporary and localized impacts from seafloor disturbance and construction around pipeline landfall location(s) may occur during construction. Operational discharges could occur over the life of activities, and subsistence harvests could be disrupted by harvesters' self-imposed restrictions on resources considered to be tainted by discharges.

Space-use conflicts can result from activities that overlap in time and space with subsistence activities that would prevent or limit harvesters' access to subsistence use areas and resources. Activities that could cause space-use conflicts include vessel, vehicle, and aircraft operations; and construction, operation, and maintenance of platforms and onshore pipelines. The recently published information described in Section 4.11.2 documents most subsistence salmon harvest by the communities of Port Graham and Nanwalek occurs in bays and nearshore areas (Woodard et al., 2023), rather than in the lease sale area. This new information supports the assessment that overlap between post-lease activities and key subsistence harvest activities would be limited. Over the course of the timespan for all potential E&D related activities, individual occurrences of space-use conflicts between vessels or aircraft and subsistence activities would be short-term and localized. Construction and the ongoing presence of offshore platforms and onshore pipelines may result in space-use conflicts with some subsistence users. The Alaska Conflict Management Plan lease stipulation (Stipulation 9) is intended to minimize potential impacts to subsistence and other cultural activities of Alaska Native communities. The stipulation requires lessees/operators to consult with Alaska Native communities in the lease sale area to identify potential conflicts between planned oil and gas activities and subsistence or other cultural activities. Lease Stipulation 9 also requires Lessees/operators to submit a Conflict Management Plan (CMP) documenting consultation with participating communities to determine best practices to prevent unreasonable conflicts with subsistence or other cultural activities, and outline specific mitigation measures the Lessee/operator will implement.

A large oil spill and associated spill response could substantially disrupt subsistence harvests and commercial fishing for one or more seasons, resulting in major impacts to subsistence activities and harvest patterns. Impacts of a large oil spill could extend beyond Cook Inlet communities to Kodiak Island and Alaska Peninsula communities. For more information on the effects of spills, spill drills, and spill response activities on sociocultural systems, subsistence, and community health, refer to Appendix A, Sections A-3.10, A-3.11, and A-3.12.

4.11.4 Environmental Consequences of Alternatives 3A, 3B, 3C, 4A, 4B, and 5

The overall level of impacts to communities and subsistence in the KPB and Cook Inlet area from Alternatives 3A, 3B, 3C, 4A, 4B, and 5 would be the same as the Proposed Action, because these alternatives would not change the total level of post-lease activity expected to result from LS 258, as described in the E&D Scenario. Under these alternatives, impacts would be mostly short-term and minor but could be potentially major when adding the effects of a large spill and spill response. While none of the alternatives are expected to alter the overall impact conclusion compared to the Proposed Action, two of the alternatives could help somewhat reduce impacts on communities and subsistence. Limiting seismic surveys and decreasing noise disturbances from platforms near major anadromous fish streams under Alternative 3C, Beluga Whale Northern Feeding Areas Mitigation, would decrease noise impacts for a large part of the year. This would benefit salmon species and subsistence and personal use salmon fisheries, potentially reducing impacts on communities and subsistence. Additionally, Alternative 5, Gillnet Fishery Mitigation, could reduce impacts in communities where commercial fishing is an important subsistence, economic, social, and cultural activity.

4.11.5 Environmental Consequences of Alternatives 7–9

A lease sale under Alternative 7, 8, or 9 would have impacts on communities and subsistence similar to those of the Proposed Action. These impacts include space-use conflicts and changes in the availability of subsistence resources to harvesters from vessel, vehicle, and aircraft operations; construction, operation, and maintenance of platforms and pipelines; noise; and operational discharges. No new impacts have been identified that are not already noted in the 2022 LS 258 FEIS.

In all three alternatives, the overall level of activity described in the E&D Scenario (Section 4.1, 2022 LS 258 FEIS) would remain the same; the only change would be in the geographic areas where these activities could take place. Alternative 7 would reduce the geographic area offered for lease by 49 percent. Alternatives 8 and 9 would reduce the geographic areas offered for lease by 22.5 and 20.9 percent, respectively.

Alternative 7, the Northern Area Exclusion, would result in fewer lease-related activities (e.g. vessel traffic) in the excluded lease blocks. The excluded area overlaps with some documented subsistence harvest areas (Jones and Kostick, 2016), and exclusion of this area from leasing would potentially have a minor reduction in impacts on subsistence harvest in those areas. Alternatives 5 and 7 overlap nearly identical geographic areas but differ because Alternative 5 provides seasonal restrictions where Alternative 7 excludes the same lease blocks. As a result, excluding blocks under Alternative 7 could also reduce impacts in communities where commercial fishing is an important subsistence, economic, social, and cultural activity. The area excluded under Alternative 8 has minimal overlap with documented subsistence harvest areas (Jones and Kostick, 2016) and is not expected to result in a change in impacts to subsistence and communities. Parts of the area excluded under Alternative 9 overlap with some documented subsistence harvest areas, and Alternative 9 may help slightly reduce impacts on subsistence fishing in the excluded lease blocks. Most documented marine subsistence harvest locations for the communities of Nanwalek and Port Graham occur nearshore in the southern portion of the lease sale area that is not within the areas excluded under Alternatives 7, 8, and 9 (Jones and Kostick, 2016; Woodard et al., 2023), and the difference in impacts between the alternatives and the Proposed Action for those communities would likely be minimal.

Under Alternatives 7, 8, and 9, space use conflicts could still occur if vessels and aircraft pass through excluded areas to access leased blocks. Lease Stipulation 9, the Alaska Conflict Management Plan, would help avoid impacts of space use conflicts on subsistence harvest and other cultural activities for Alaska Native communities. Alternatives 7, 8, or 9 could result in an avoidance of impacts to species harvested for subsistence, thereby increasing the availability of subsistence resources compared to the Proposed Action. Alternative 8 is not expected to result in a change in impacts to subsistence and communities. While minor reductions in impacts to communities and subsistence may be realized through Alternatives 7 or 9, the overall level of impacts would remain short-term and/or localized, similar to the impact level described for the Proposed Action.

4.11.6 Cumulative Effects

While many cumulative impacts are foreseeable, the addition of the Proposed Action to the past, present, and reasonably foreseeable future actions (Section 3.2) is not expected to have widespread or persistent impacts on communities' subsistence harvest patterns or activities, or the availability of subsistence resources in the Cook Inlet area. The overall cumulative impacts on subsistence activities and harvest patterns from the activities described in Section 3.2 would be minor to moderate but could increase to major through impacts from cumulative oil spills and climate change. The potential impacts of the Proposed Action would likely comprise small, incremental contributions to the overall cumulative effects. Although cumulative impacts to communities and subsistence may be major—primarily through cumulative oil spills and climate change—the incrementally additive impact of the Proposed Action, in the context of these past, present, and reasonably foreseeable actions, is minor. While sources of cumulative impacts, such as vessel traffic, would overlap with impacts associated with the E&D Scenario, the Proposed Action would not contribute discernible additive or synergistic effects to the overall level of cumulative effects. The Proposed Action's incremental contribution over its 40-year duration may overlap in time and space with the increased incremental impacts from activities associated with the six OBBBA lease sales, potentially contributing to increased effects on the availability of subsistence resources to harvesters and space use conflicts. While total potential cumulative impacts may increase, the incremental contribution of the Proposed Action to the overall cumulative effects would be less prominent as post-lease activities from previous lease sales and the succeeding lease sales come into effect. Information published since the 2022 LS 258 FEIS (Section 4.11.3) expands BOEM's knowledge base regarding subsistence activities and harvest in Cook Inlet, including within the context of changing environmental conditions; however, the 2022 FEIS already accounted for changes to the environmental baseline when analyzing the cumulative impacts of the Proposed Action, and no updates to that analysis are warranted at this time.

4.11.7 Conclusion

BOEM has reexamined the analysis for communities and subsistence presented in the 2022 LS 258 FEIS. No new information was discovered that would alter the overall impact conclusion presented in that document, and the analysis and assessment of potential impacts still apply for LS 258. The expected effects on communities and subsistence described for the Proposed Action in the 2022 LS 258 FEIS also apply to all action alternatives, including Alternatives 7, 8, and 9. Under all action alternatives, instances of short-term and/or localized impacts to subsistence activities and harvest patterns could occur throughout the lifespan of activities resulting from LS 258 through effects on the availability of subsistence resources and space-use conflicts. Under Alternatives 7, 8, and 9, the overall level of activity described in the E&D Scenario (Appendix B) will stay the same as under the Proposed Action; the only change will be in the geographic areas where these activities could take place. Therefore, given the same level of activity, the different spatial configurations of Alternatives 7, 8, and 9 do not change the expected level of effects to communities and subsistence. Overall, impacts would be short-term and/or localized, generally minor, although they can become major in the event of a large oil spill and the subsequent response. The impacts of reasonably foreseeable future actions, when combined with post-lease activities that could occur as a result of LS 258, would be minor to moderate but could increase to major through impacts from cumulative oil spills and climate change.

4.12 Economy

BOEM has reexamined the analysis for the economy presented in the 2022 LS 258 FEIS based on the new information presented in Section 4.12.2 below. No new information was discovered that would alter the overall impact conclusion on the economy presented in the 2022 LS 258 FEIS.

A description of economic resources, along with the full analyses of the environmental consequences of the routine activities, accidental events, and cumulative impacts associated with the Proposed Action are presented in Section 4.12 of the 2022 LS 258 FEIS. Section 4.12.1 below presents a summary of the affected environment. Relevant new information that has become available since the 2022 FEIS was published is presented in Section 4.12.2. Sections 4.12.3 and 4.12.4, below, provide a summary of the impact analyses for the Proposed Action and Alternatives 3–5 that is incorporated by reference from the 2022 LS 258 FEIS. Sections 4.12.5 and 4.12.6 describe the environmental consequences of Alternatives 7, 8, and 9 and update the cumulative effects analysis, respectively.

4.12.1 Summary of Affected Environment

A detailed description of economic resources is found in Section 4.12.1 of the 2022 LS 258 FEIS and is summarized below. The oil and gas industry is a major economic driver for Southcentral Alaska and the SOA, contributing significantly through employment income, royalty revenues, property taxes, and spending. Oil and gas earnings are two and a half times greater than other Alaskan industries. Cook Inlet basin's oil and gas production primarily serves the local market’s energy needs. As oil and gas resources have declined, associated declines in employment, wages, and government revenues have declined as well. Natural gas production declines have led to the closure of both the Kenai LNG facility (2017) and the fertilizer plant (2007), while the Kenai refinery is still operating. Cook Inlet Gas Storage Alaska (CINGSA) is a gas storage facility built on a depleted gas reservoir and is used to balance seasonal swings in demand and supply.

4.12.2 New Information Available Since Publication of the 2022 LS 258 FEIS

New information was found for economic factors after searching relevant literature. This new information further supports the impact conclusions for economic factors presented in the 2022 LS 258 FEIS. The new information expands BOEM's knowledge base with regards to economic trends and activities in Cook Inlet since the 2022 LS 258 FEIS was published. While the information contributes to BOEM's knowledge base, it does not change the overall impact conclusion presented in the 2022 LS 258 FEIS Proposed Action. Therefore, the analysis and potential impacts detailed and summarized in those NEPA documents still apply for Cook Inlet LS 258.

A BOEM study (Cuyno, 2022) examined the population trends, economy, and institutions of the KPB and its diverse communities from 2008 to 2020 establishing a baseline for assessing future social and economic effects of oil and gas activity in the Cook Inlet OCS Planning Area.

Economic time series data—covering employment, wages, and government revenue—offered new insights from sources including the 2022 BOEM KPB Economy study, the KPB, Alaska Department of Revenue, Alaska Department of Natural Resources, Alaska Department of Labor and Workforce Development, and McKinley Research Group.

Direct employment related to oil and gas accounted for 2.3 percent of the total Alaskan workforce (out-of-state workers excluded) and 8.3 percent of total wages in 2023 (ADLWD, 2023); however, this does not include indirect jobs related to oil and gas pipelines, transportation companies, refineries, and many construction companies. Nonresidents represent 17 percent of the oil and gas workforce and earn 18 percent of its total wages. In 2022, the industry supported 36,200 direct jobs in Alaska, contributing $3.3 billion in wages. Another 33,050 jobs and $2.6 billion in wages are supported by government related revenues from oil and gas. Together, total economic impacts attributable to the oil and gas industry are 69,250 jobs and $5.9 billion in wages (McKinley Research Group, 2023).

Table 4-9 below provides updated detailed information on employment and wages associated with the KPB oil and gas industry.

Table 4-9: KPB Employment and Wages

Category	Employment	Wages ($ million)
Primary Companies (Alaska residents only)*	620	$148.5
Oil and Gas Support Services (Alaska residents only)*	821	$60.1
All other Indirect and Induced**	1,477	$86.7
Total Impacts (Direct, Indirect, and Induced):	2,918	$295.3

Notes : *Includes workers who are employed statewide but reside in the KPB, as well as workers who live and work in the KPB.
** Employees working in KPB but may reside elsewhere.
Source: Alaska Department of Labor and Workforce Development, data from Primary Companies, and McKinley Research Group estimates (2023).

Updated Cook Inlet natural gas production rates, as of 2024, are 72 Bcf per year, with gross production of 72 Bcf and 0 Bcf reinjected (ADNR email correspondence, 2025). Previously available information showed that gas was reinjected, and new information represents a shift in future natural gas consumption as aging fields deplete. Historically, natural gas production far exceeded consumption needs (with 100 Bcf reinjected) and represents an inflection point within the region. Cook Inlet natural gas production is anticipated to decline over the near- and long-term. It is uncertain what new sources of energy will replace natural gas as an energy source in the region and the economic impact on the local and regional economy.

Local and regional governments depend on petroleum related revenue sources. In FY 2024, SOA revenues totaled $6.6 billion, and petroleum revenue accounted for $2.5 billion of the total (ADOR, 2024). In 2019, total property taxes collected by the KPB were $78.9 million of which oil and gas property taxes were $15.9 million (ADOR, 2024).

4.12.3 Environmental Consequences of the Proposed Action

Economic factors explain and quantify the human behaviors that determine the positive and negative impacts of the proposed alternatives. Section 4.12 of the 2022 LS 258 EIS provides detailed economic and demographic data for KPB economic impact areas and provides background research regarding the offshore oil and gas industry. Activities occurring under the Proposed Action would lead to beneficial impacts arising from industry expenditures, government revenues, corporate profits, and other market impacts. Some of these impacts would be concentrated in the KPB, while others would be widely distributed. A lease sale could also lead to negative economic impacts (negligible to minor) arising from accidental events and disruptions to other industries.

4.12.4 Environmental Consequences of Alternatives 3A, 3B, 3C, 4A, 4B, and 5

There would be negligible to minor differences in economic impacts among alternatives 3A, 3B, 3C, 4A, 4B and 5, corresponding to the differences in the scales and distributions of likely activities. None of the restrictions identified by these alternatives would be expected to change the likelihood or severity of impacts on the economy. The alternatives should be viewed as having a beneficial economic impact in the context of the National OCS Oil and Gas Program, the numerous forces that can affect energy markets, Alaska specific economic factors, and the overall economy. The aggregate incremental economic impacts from a Proposed Action are forecast to be beneficial, although adverse impacts (negligible to minor) are possible, as mentioned above.

4.12.5 Environmental Consequences of Alternatives 7–9

A lease sale under Alternatives 7, 8, or 9 would have economic impacts similar to those of the Proposed Action. These impacts include changes to local, state, and national employment, wages, government revenues, and other indirect and induced economic activity. No new impacts have been identified that are not already noted in the 2022 LS 258 FEIS.

In all three alternatives, the overall level of activity described in the E&D Scenario (Appendix B) would stay the same; the only change would be in the geographic areas where these activities could take place. Alternative 7 would reduce the geographic area offered for lease by 49 percent. Alternatives 8 and 9 would reduce the geographic areas offered for lease by 22.5 and 20.9 percent, respectively.

A lease sale under Alternative 7, 8, or 9 would lead to beneficial impacts arising from industry expenditures, government revenues, corporate profits, and other market impacts. Some of these impacts would be concentrated in the KPB and the SOA, while others would be widely distributed. A lease sale could also lead to negative economic impacts (negligible to minor) arising from accidental events and disruptions to other industries. There would be some differences in economic impacts among the alternatives (e.g., Alternatives 7, 8, and 9), corresponding to the differences in the scales and distributions of likely activities. Economic impacts under Alternatives 7, 8, or 9 would remain the same as the Proposed Action because no changes in production or the E&D Scenario would occur, only the geographic location of these activities. The alternatives should be viewed considering the OCS Oil and Gas Program, as well the numerous forces that can affect energy markets, Alaska specific economic factors, and the overall economy.

4.12.6 Cumulative Effects

Most of the incremental contribution of cumulative impacts from a Proposed Action are forecast to be beneficial, although adverse impacts (negligible to minor) are foreseeable, as mentioned above. Cumulative impacts of current and past activities (OCS oil- and gas-related and non-OCS oil- and gas-related), however, would continue to occur. The updated PPRFFA scenario (Section 3.2) includes actions associated with the six OBBBA lease sales. The Proposed Action's small, incremental contribution over its 40-year duration may overlap in time with economic drivers resulting from post-lease activities association with the six OBBBAs. The incremental contribution of the Proposed Action to the overall cumulative effects would be less prominent as post-lease activities from previous lease sales and the succeeding lease sales come into effect. While many cumulative economic impacts are foreseeable, the addition of the effects of the Proposed Action to the effects of the past, present, and reasonably foreseeable future actions are the same as outlined in the 2022 LS 258 FEIS. Cumulative impacts of current and past activities (OCS oil- and gas-related and non-OCS oil- and gas-related), however, would continue to occur.

4.12.7 Conclusion

BOEM has reexamined the economic conclusions for economic factors presented in the 2022 LS 258 FEIS. No new information was discovered that would alter the impact conclusions for the economy presented in the 2022 LS 258 FEIS (Sections 4.12.2, 4.12.3, and 4.12.4), and the analysis and assessment of potential impacts still apply for LS 258. Post-lease activities for the Proposes Action, Alternatives 3–5, and Alternatives 7–9 that may result from LS 258, as described in the E&D Scenario have no new economic impacts due to no new information that was discovered that would alter the impact conclusion for economic factors presented in 2022 LS 258 FEIS documents. The impacts of past, present and reasonably foreseeable future actions, when combined with effects of the Proposed Action, remain the same as presented in the 2022 LS 258 FEIS. The economic effects of spills, spill drills, and spill response activities vary. Small spills have a minimal economic impact, as cleanup is typically managed by existing oil and gas sector employees, resulting in minor to negligible economic benefit for local communities. Oil spill drills have short-term and localized effects, with negligible economic consequences. In contrast, large spills can have a significant, short-term economic impact, as cleanup efforts may generate moderate to significant wages for local workers.

4.13 Commercial Fishing

A description of commercial fishing in the affected area, along with the full analyses of the environmental consequences of the routine activities, accidental events, and cumulative impacts associated with the Proposed Action are presented in Section 4.13 of the 2022 LS 258 FEIS. Section 4.13.1 below presents a summary of the affected environment. Relevant new information that has become available since publication of the 2022 LS 258 FEIS is presented in Section 4.13.2. Resource descriptions and impact analyses are incorporated by reference from 2022 LS 258 FEIS for the Proposed Action and Alternatives 3A, 3B, 3C, 4A, 4B and 5, and are summarized below in Sections 4.13.3 and 4.13.4, respectively. Environmental consequences of Alternatives 7, 8, and 9 are described in Section 4.13.5, and updates to the Cumulative Effects analysis and Conclusions are found in Sections 4.13.6 and 4.13.7, respectively, of this document. BOEM has reexamined the analysis for commercial fishing presented in the 2022 LS 258 FEIS based on the new information presented in Section 4.13.2.

4.13.1 Summary of Affected Environment

The affected environment description for commercial fishing resources is detailed in the 2022 LS 258 FEIS, Section 4.13.1 and is hereby incorporated by reference. The Gulf of Alaska supports large and diverse commercial fisheries for shellfish, salmon, herring, and groundfish which are managed by one or more state and federal entities. Some species that are currently commercially harvested elsewhere in Alaska, including herring, shrimp, crabs, sea urchin, and sea cucumber, have been closed or greatly reduced in Cook Inlet over recent decades due to low stock levels. It is possible that these fisheries could resume in Cook Inlet if population surveys showed harvestable abundances. Commercial harvest for scallops and clams occurs in Cook Inlet, though is limited in federal waters and is subject to periodic closures.

All five species of Pacific salmon are harvested commercially using purse seines, drift gillnets, and set gillnets from June through August in Cook Inlet. Second only to Alaska's groundfish fishery, Alaska's salmon fishery is one of the largest fisheries in volume and value. Within a fishing season, there are closed periods to allow for adequate spawning escapements and at times, management agencies may impose emergency closures. Pacific herring are harvested using gill nets in April and May, mainly for roe and sac roe on kelp.

Groundfish, including rockfish, flatfish, Pacific cod, lingcod, sablefish, and pollock, are harvested with trawls, pots, and longlines throughout the year. Pacific halibut is a major commercial fishery in Alaska. Commercial harvest of groundfish other than halibut have been declining primarily due to changes in Pacific cod populations, though catches of sablefish, rockfish, and pollock harvest also have been lower than in previous decades. Lingcod have seen an increase in harvest value in recent years.

4.13.2 New Information Available Since Publication of the 2022 LS 258 FEIS

Since the publication of the 2022 FEIS, there have been numerous management report updates on species of commercial interest present in Cook Inlet (Hollowell et al., 2023; Lipka and Stumpf, 2024; McKinley et al., 2024; Schuster et al., 2024) and the agencies responsible for some fisheries management decisions have changed (NOAA, 2025a). Though these documents are primarily intended for use by resource management agencies such as ADF&G and NMFS, they are useful to provide context in this analysis. Commercial harvest of salmon in 2022 was over 40 percent less than the recent 10-year average (Lipka and Stumpf, 2024) and there are additional federal fishery disaster requests pending for 2024 (ADF&G, 2025c; NOAA, 2025b). As discussed in the 2022 LS 258 FEIS, commercial fisheries are closely monitored and managed in real time. As marine heatwaves become more frequent and more intense, fishery managers will have additional factors to balance as they choose to employ fishery closures to protect target stock populations, such as the ones seen in recent years and described in the 2022 LS 258 FEIS. Szymkowiak and Steinkruger (2023) examined the effects of climate change and marine heatwaves on public discourse around Alaska fisheries. Alaskan fishers discussed impacts of the changing climate with fishery managers, particularly how the effects of fishery closures in response to marine heatwaves were compounded by the broader impacts to fishing operations from the COVID pandemic. The 2023 research suggests that fishery management decisions may become more collaborative, based on both science and user perspectives in the future.

In 2023, a genetic analysis of commercially important Cook Inlet razor clams found no differentiation between different east- and west-side beds (Gruenthal et al., 2023), which supports the assumptions in the 2022 LS 258 FEIS regarding recolonization and recovery. The main driver for Razor clam productivity appears to be mortality after larval settlement, not genetic variation. Thus, these findings suggest that highly localized razor clam recovery is expected through recolonization and repopulation after a disturbance and support the conclusions drawn in the 2022 LS 258 FEIS that these fishery resources would be expected to return once construction activities are completed.

New information about commercial fisheries was examined to assess its relevance to the Proposed Action. The new information updates BOEM's knowledge base with regard to current stock characteristics, and supports the assumptions used and conclusions drawn in the 2022 FEIS. No new information that was discovered significantly changed any resource level impacts; therefore, it does not change the conclusions presented in the 2022 LS 258 FEIS.

4.13.3 Environmental Consequences of the Proposed Action

Potential post-lease activities conducted as a result of LS 258, as described in the E&D Scenario, which could cause impacts to commercial fishing operations and targeted species include seismic surveys, platform installation, drilling, presence of structures, vessel traffic, and space use conflicts. Some impacts could be beneficial or adverse for fishery resources. Accidental events such as oil spills and spill cleanup activities can impact commercial fishing operations and targeted species. Most accidental spills would be localized and limited in area, but in a time-limited fishery, the impacts could be more pronounced. A large spill would affect only a small proportion of a given fish population within Cook Inlet but may damage fishing gear and could cause a fishery to be closed for an entire season or more, resulting in a 100 percent loss during the closure period. For more information on the effects of spills, spill drills, and spill response activities on fish and invertebrates, refer to Section A-3.14, Appendix A.

The 2022 LS 258 FEIS found that impacts from noise, disturbance, accidental small oil spills, and spill drills on commercial fishing in Cook Inlet for the Proposed Action would be short-term and localized, although in already time-limited fishing operations such as salmon gillnetting, some impacts could be greater due to the severity of the space-use conflict. In general, most impacts are not anticipated to result in a clear, long-lasting change in the resource’s function. Overall, activities associated with the E&D Scenario, accidental small spills, and spill drills are likely to have minor to moderate impacts, but the occurrence of a large oil spill would result in major effects on commercial fishing due to potential changes in target fish stocks and impacts expected from cleanup efforts.

4.13.4 Environmental Consequences of Alternatives 3A, 3B, 3C, 4A, 4B, and 5

Alternatives 3 and 4 excluded lease blocks (3A and 4A), imposed seasonal restrictions on seismic surveys on specific lease blocks (3B and 3C), or prohibited discharge of drilling cuttings or fluids and any seafloor disturbance (4B), which could reduce some adverse impacts of noise and disturbance in those specific areas and could benefit targeted species and commercial salmon fisheries. The impact designation for Alternative 3 (all sub alternatives) was reduced to minor for all activities, except for the addition of a large oil spill (which remained a major impact). Alternative 4A excluded lease blocks, which could decrease impacts in those localized areas. However, because the overall activity level did not change and would still occur in areas inhabited by target species or used for commercial fishing operations, the overall level of impact designation remained the same. Alternative 4B prohibited drilling discharges in some areas, which is unlikely to impact catch rates or access to commercial fishing grounds, so no change to impact level was warranted. Alternative 5 imposed a seasonal restriction on seismic surveys in the drift gillnet fishery area and impacts on the commercial drift gillnet fishery would become negligible, as no space-use conflicts or impacts to the targeted fishery would occur from seismic surveys. Seismic surveys would occur outside the drift gillnet fishing season, and other noise impacts as well as disturbance, accidental small oil spills, and spill drills may still occur as described in the analysis of the Proposed Action. The impact designation for Alternative 5 was reduced from a range of minor to moderate, to minor for all activities, except for the addition of a large oil spill (which remained a major impact).

4.13.5 Environmental Consequences of Alternatives 7–9

A lease sale under Alternatives 7, 8, or 9 would have impacts similar to those of the Proposed Action. These impacts include seafloor disturbance, habitat alteration, noise, presence of structures and lights, trash and debris, vessel traffic, and accidental spills and spill response activities. Analysis of Alternatives

7, 8, and 9 did not identify any activities in the new alternatives that are likely to produce additional or new impacts to commercial fisheries that were not analyzed in the original LS 258 FEIS.

In all three alternatives, disturbances from platforms near major anadromous fish streams would be reduced; however, the overall level of activity described in the E&D Scenario (Section 4.1, 2022 LS 258 FEIS) will stay the same; the only change would be in the geographic areas where these activities could take place. Alternative 7 would reduce the geographic area offered for lease by 49 percent, while Alternatives 8 and 9 would reduce the geographic areas offered for lease by 22.5 and 20.9 percent, respectively. The proposed new alternatives would likely decrease the effects of the action in the areas removed from leasing, though the overall level of activity described in the E&D Scenario would not change if some or all of the new Alternatives were implemented. Removal of lease blocks identified in these alternatives would lessen the anticipated impacts to the target species and their prey that are present in the area and could reduce space-use conflicts between some ocean users.

The expected impacts to commercial fishing described for the Proposed Action in the 2022 LS 258 FEIS would still occur under the new Alternative scenarios because the new alternatives do not affect the duration or types of anticipated activities, only the geographic locations in which the activities occur. While some of the new alternatives would occur in areas where commercial fishing would take place, none of the alternatives would fully eliminate impacts to commercial fishing. Thus, no change of impact designation from that identified in the 2022 LS 258 FEIS is warranted for these alternatives. Overall, impacts will be minor to moderate depending on the degree to which a specific target species or fishery is impacted, although they can become major in the event of a large oil spill and the subsequent response.

4.13.6 Cumulative Effects

While many cumulative impacts are foreseeable, the addition of the Proposed Action to the past, present, and reasonably foreseeable future actions (Section 3.2) is not expected to have widespread or persistent impacts on the health or community structure of target fish or invertebrate species living in Cook Inlet, or to the commercial fisheries that rely on them. The potential impacts of the Proposed Action would likely comprise small, incremental contributions to the overall cumulative effects. The updated PPRFFA scenario (Section 3.2) includes actions associated with the six OBBBA lease sales. The Proposed Action's small, incremental contribution over its 40-year duration may overlap in time and space with impacts on commercial fishing operations and target species and their habitat resulting from post-lease activities association with the six OBBBAs. The incremental contribution of the Proposed Action to the overall cumulative effects would be less prominent as post-lease activities from previous lease sales and the succeeding lease sales come into effect. Although cumulative impacts to commercial fishing may be significant due to changes in stock structure and fishery timing brought about by changing oceanographic conditions, the incrementally additive impact of the Proposed Action, in the context of these past, present, and reasonably foreseeable actions, is minor. While sources of cumulative impacts, i.e., climate change or vessel traffic, would overlap with impacts associated with the E&D Scenario, the Proposed Action would not contribute any discernible additive or synergistic effects to the overall cumulative effects. The effects of a warming ocean and future heatwaves on the marine food web that supports targeted species were analyzed in the 2022 LS 258 FEIS, and new research published since then does not present information that would change the conclusion from the FEIS.

4.13.7 Conclusion

BOEM has reexamined the analysis for commercial fishing presented in the 2022 LS 258 FEIS. No new information was discovered that would alter the overall impact conclusion for commercial fishing presented in that document, and the analysis and assessment of potential impacts for LS258 FEIS still apply for this SEIS. A lease sale under Alternative 7, 8, or 9 would have impacts similar to those of the

Proposed Action. In all three alternatives, the overall level of activity described in the E&D Scenario (Appendix B) will stay the same; the only change will be in the geographic areas where these activities could take place. Decreases in impacts that would occur in discrete areas under one or more of the new alternatives would not fully eliminate or decrease impacts on commercial fishing operations across Cook Inlet. Therefore, given the same level of activity, the different spatial configurations of Alternatives 7, 8, and 9 do not change the expected level of effects to commercial fishing.

4.14 Archeological and Historic Resources

BOEM has reexamined the analysis for archaeological and historic resources presented in the 2022 LS 258 FEIS. A description of archaeological and historic resources, along with the full analysis of the environmental consequences of the routine activities, accidental events, and cumulative impacts associated with the Proposed Action are presented in Section 4.14 of the 2022 LS 258 FEIS. A summary of the affected environment is presented below in Section 4.14.1. New information available since the publication of the 2022 LS 258 SEIS is presented in Section 4.14.2, below. Section 4.14.3 provides a summary of the impact analysis of the Proposed Action from the 2022 LS 258 FEIS. Section 4.14.4 and 4.14.5 describe the environmental consequences of Alternatives 3–5 and 7–9. Section 4.14.6 updates the Cumulative effects analysis.

4.14.1 Summary of Affected Environment

The affected environment description for archaeological and historic resources is detailed in the 2022 LS 258 FEIS, Section 4.14.1 and is hereby incorporated by reference. The Cook Inlet area has the potential to contain both onshore and offshore historic and pre-contact resources, including shipwrecks, downed aircraft, and archaeological sites potentially dating to approximately 8,000 before present (BP), and which may date to 17,000 to 14,000 BP. However, archaeologists have not systematically surveyed most of the Cook Inlet area, particularly areas of the OCS. In the 2022 LS 258 FEIS and in previous analyses, BOEM identified areas up to the 200-foot isobaths as those where submerged pre-contact sites—area that were once exposed above sea level and available to human occupation—could exist. Potential offshore historic resources include sites of ship and plane wrecks. Table 3.3.8-2 in BOEM (2016) identifies 68 known wrecks, obstructions, archaeological sites, occurrences, or sites marked as “unknown” within or in the vicinity of the lease sale area. Historic and pre-contact archaeological resources are documented onshore and along the coast.

4.14.2 New Information Available Since Publication of the 2022 LS 258 FEIS

New information was examined to assess its relevance to the Proposed Action. The new information expands BOEM’s knowledge base regarding potential presence and preservation of archaeological and historic resources in Cook Inlet. Review of the Alaska Heritage Resources Survey database, maintained by the Alaska Department of Natural Resources, Office of History and Archaeology, did not reveal additional documented locations of cultural resources since publication of the 2022 LS 258 FEIS.

A BOEM-funded study to identify coastal and submerged cultural heritage resources in federal waters offshore of the State of Alaska was published in 2024 (Sassorossi et al., 2024). The study developed multiple geographic databases, including an update of a May 2011 list of Alaska shipwrecks that is referenced in the 2022 LS 258 FEIS. The study identified four additional submerged vessels and one downed aircraft in Cook Inlet to add to the 2011 BOEM shipwreck database. However, two of the vessels and the aircraft were downed in 2000 or later and are not old enough to be considered historic, and none were wrecked in the LS 258 lease area.

Sassorossi et al. (2024) developed a submerged paleo landforms database that identifies areas of the Alaska OCS that would likely have been exposed and available for human occupation at various time periods since the Last Glacial Maximum (19–25,000 years BP). The project provides estimated sea levels for the periods of 10,000, 12,000, 14,000, 16,000, and 19–25,000 years BP. The effort confirms that much of the Lease Sale 258 area was above sea level and available for occupation to varying extents since the Last Glacial Maximum. At 10,000 years BP, the study data indicate paleo land areas intersect 167 lease blocks totaling over 317,000 hectares, and at 14,000 years BP and earlier, the entire Lease Sale 258 area was exposed. However, the study authors indicate that pre-contact resources are unlikely at depths greater than 140 m (459.3 ft) (Sassorossi et al., 2024). Areas with historically large volumes of sea ice and icebergs, where surface scouring or large glacial rock deposits are visible, have lower probability of being sites where preserved archaeological deposits might be identified. While the new information contributes to BOEM’s knowledge base, it does not change the overall impact conclusions presented in the 2022 LS 258 FEIS.

4.14.3 Environmental Consequences of the Proposed Action

The impact analysis for archaeological and historic resources is detailed in the 2022 LS 258 FEIS, Section 4.14.2 and is hereby incorporated by reference. Post-lease activities conducted as a result of LS 258 that could impact archeological and historic resources include ground or seafloor disturbance during platform installation, pipeline installation (both offshore and onshore), drilling, placement of equipment on the seafloor (e.g., nodes and cables for 3D surveys, anchors), and seafloor sampling. Impacts on archaeological and historic resources would be localized and occur where an activity directly disturbs the ground or seafloor. Should an offshore activity come into direct contact with a shipwreck or downed aircraft, it could physically damage the structure, or damage artifacts associated with the craft, resulting in permanent loss of archaeological data. Impacts to buried pre-contact sites may include destruction of artifacts and site features and disturbance of the stratigraphic context of the site.

For all potential impacts discussed in the 2022 LS 258 FEIS, the intensity of impact may vary depending on the level of damage to a resource(s), the extent of impacts would be localized to the area of disturbance, and the duration would be long-term because archaeological resources are nonrenewable. However, because laws and regulations are in place to protect archaeological resources and other historic properties, BOEM expects to avoid most potential impacts, so their likelihood of occurrence is low. BOEM would review site-specific information regarding potential archaeological resources prior to approving any post-lease activities with the potential to affect such resources. Lessees would be required to survey for pre-contact and historic resources prior to disturbing any areas where they may occur and to avoid or mitigate impacts to identified sites.

A large oil spill could result in long-lasting and widespread impacts on archaeological sites if resources are oiled. The greatest impacts from a large spill may be due to spill response and cleanup activities, which create opportunities for disturbances through vandalism (e.g., unauthorized removal of materials or artifacts by spill response personnel), or inadvertent damage. Impacts of spill cleanup and response would be long-term and localized or widespread if resources are oiled or sites are damaged during cleanup. For more information on the effects of spills, spill drills, and spill response activities on archaeological and historic resources, refer to Section A-3.15, Appendix A.

Overall, the impacts to archeological and historic resources from the E&D Scenario and accidental events would be negligible to minor, depending on the extent of damage to an archaeological resource if damage occurred, and the extent to which historical information is lost. When potential impacts of a large spill, including response and cleanup activities, are considered, the expected impacts could become moderate.

4.14.4 Environmental Consequences of Alternatives 3A, 3B, 3C, 4A, 4B, and 5

As described in Section 4.13.3 of the 2022 LS 258 FEIS, it is expected that most impacts of routine activities on archaeological and historic resources would be avoided under any action alternative through compliance with Section 106 of the National Historic Preservation Act (NHPA) and BOEM's requirements for protection of archaeological resources. The overall level of impacts to archeological and historic resources in the lease sale area from Alternatives 3A, 3B, 3C, 4A, 4B, and 5 would be essentially the same as the Proposed Action, mostly localized and minor but when adding the effects of a large spill and spill response, impacts would be potentially moderate.

4.14.5 Environmental Consequences of Alternatives 7–9

Under Alternative 7, 8, or 9 impacts would be similar to those of the Proposed Action. These impacts include potential for physical damage to pre-contact and historic resources — and loss of important historical information associated with such resources — should ground- and seafloor-disturbing activities come in contact with a shipwreck, plane wreck, or pre-contact resource. In all three alternatives, the overall level of activity described in the E&D Scenario (Appendix B) would stay the same; the only change would be in the geographic areas where these activities could take place. Alternative 7 would reduce the geographic area offered for lease by 49 percent. Alternatives 8 and 9 would reduce the geographic areas offered for lease by 22.5 and 20.9 percent, respectively.

Alternatives 7, 8, and 9 would limit the potential for impacts to archaeological and historic resources in the areas excluded from leasing, because seafloor-disturbing activities would not occur in those areas. The impacts from most activities would be limited to the areas leased under these alternatives. By removing certain lease blocks for each alternative, the expected impacts on archaeological and historic resources in those excluded areas would be avoided. While excluding certain areas from leasing may concentrate seafloor-disturbing activities in the remaining areas, it is expected that most impacts of routine activities on archaeological and historic resources would be avoided under any action alternative through compliance with Section 106 of the NHPA and its implementing regulations at 36 CFR 800, and BOEM's requirements at 30 CFR 550.194. These alternatives are not expected to change the likelihood or severity of impacts on archaeological resources evaluated for the Proposed Action. Unavoidable impacts related to unplanned oil spills and associated cleanup activities have potential to affect resources in both leased and excluded areas, so exclusion of blocks under various alternatives does not alter potential for impacts from accidental events.

The expected effects on archaeological and historic resources described for the Proposed Action in the 2022 LS 258 FEIS also apply to Alternatives 7, 8, and 9. This is because under any action alternative, impacts on archaeological and historic resources are expected to be avoided. Additionally, the alternatives do not change the type or duration of the anticipated E&D activities; they only change the geographic areas where those activities occur. Therefore, the overall impact conclusions provided in the 2022 LS 258 FEIS remain unchanged. Overall, the impacts on archaeological resources would be negligible to minor for E&D Scenario activities, accidental small spills, and spill drills, and could become moderate when considering the addition of a large spill and spill response.

4.14.6 Cumulative Effects

While many cumulative impacts are foreseeable, the addition of the Proposed Action to past, present, and reasonably foreseeable future actions (Section 3.2) is not expected to have widespread impacts on archaeological and historic resources in Cook Inlet. Many potential cumulative impacts would be mitigated or avoided by safeguards already in place through the NHPA and state and federal permitting processes. The updated PPRFFA scenario (Section 3.2) includes actions associated with the six OBBBA lease sales, including seafloor disturbing activities; however, adherence to provisions in the NHPA and BOEM's requirements regarding protection of archaeological resources would limit the likelihood of additional cumulative impacts from seafloor disturbing activities. Although cumulative impacts to historic and archaeological resources would be potentially major if numerous sites face damage from large oil spills and/or climate change, activities in the E&D Scenario are not expected to contribute measurably to cumulative impacts because most impacts would be avoided or mitigated. While sources of cumulative impacts, such as climate change or seafloor disturbing activities, would overlap with impacts associated with the E&D Scenario, the Proposed Action would not contribute any discernible additive or synergistic effects to the overall cumulative effects. Additionally, while studies published since publication of the 2022 LS 258 FEIS (Section 4.14.3) enhance information on the potential for archaeological and historic resources to be present in Cook Inlet, such information does not alter the assessment of cumulative impacts from the 2022 FEIS, and no updates to that analysis are warranted at this time. Cumulative impacts would be negligible to minor for most activities but could be potentially major if numerous sites face damage from large oil spills and/or climate change.

4.14.7 Conclusion

BOEM has reexamined the analysis for archaeological and historic resources presented in the 2022 LS 258 FEIS. No new information was discovered that would alter the overall impact conclusion for archaeological and historic resources presented in that document, and the analysis and assessment of potential impacts for LS 258 are still valid. A lease sale under Alternative 7, 8, or 9 would have impacts similar to those of the Proposed Action. In all three additional alternatives, the overall level of activity described in the E&D Scenario (Section 4.1, 2022 LS 258 FEIS) will stay the same; the only change will be in the geographic areas where these activities could take place. Additionally, under any action alternative, compliance with NHPA requirements and BOEM's regulations would help avoid impacts on archaeological and historic resources. Under any action alternative, the overall level of impacts on archeological and historic resources in the lease sale area would be mostly localized and negligible to minor but potentially moderate when adding the effects of a large spill and spill response. When added to impacts of past, present, and reasonably foreseeable future actions, impacts would be negligible to minor for most activities but could be potentially major if numerous sites face damage from large oil spills and/or climate change.

4.15 No Action Alternative

Under the No Action Alternative, Cook Inlet LS 258 would not have been held, and no exploration, development, or production activities associated with this sale would occur. If the estimated 0–192.3 MMbbls of oil and 229.5–301.9 Bcf of natural gas were not produced, there would be no chance of oil spills or gas releases occurring from wells, platforms, or pipelines. Potential impacts from LS 258, including OCS oil and gas activities described in the E&D Scenario (Appendix B), would be delayed or eliminated. Potential economic benefits including direct and indirect wage earnings, taxes, and royalties collected by the SOA and the federal government would not occur; however, Cook Inlet physical, biological, and socioeconomic resources would continue to be exposed to potential impacts from any ongoing activities in SOA waters and could be exposed to OCS oil and gas activities resulting from Lease Sale 244 and the six future OBBBA mandated lease sales.

Chapter 5 CONSULTATION, COORDINATION, AND PREPARERS

5.1 Cooperating Agencies

BOEM is the lead agency for the preparation of this SEIS. Pursuant to 43 CFR 46.155 and 43 CFR 46.225, BOEM invited BSEE and NPS to continue their respective roles as cooperating and participating agencies. Both agencies accepted; consistent with their involvement in the FEIS for LS 258.

5.2 Record of Decision

A ROD will be issued after the Final SEIS is made available, and the notice of its availability will be published in the Federal Register. The ROD will contain a concise summary of the decision made based on the analysis of the alternatives presented in the Final SEIS. The ROD will state the decision and rationale for the decision. The ROD will also describe mitigation measures intended to avoid effects from the chosen alternative. Once the ROD is published, the SEIS process is considered complete.

5.3 Consultation

5.3.1 Tribal Consultation & Government to ANCSA Corporation Consultation

EO 13175 establishes regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have Tribal implications. The order aims to strengthen United States government-to-government relationships with Indian Tribes (including Alaska Native Tribes and communities) and reduce the imposition of unfunded mandates when developing federal policies with Tribal implications. EO 13175 requires the head of each agency to designate an official “with principal responsibility for implementation” of the order.

Since the implementation of EO 13175, the USDOI has established a Tribal Consultation Policy to guide engagement with federally recognized Tribes. Secretarial Order (SO) 3317 further updated USDOI’s policy on consultation with Indian Tribes in compliance with EO 13175. SO 3317 emphasizes that USDOI officials must demonstrate a meaningful commitment to consultation “by identifying and involving Tribal representatives in a meaningful way early in the planning process,” and that consultation aims to create effective collaboration emphasizing “trust, respect, and shared responsibility.”

On August 10, 2012, USDOI issued the Policy on Consultation with ANCSA Corporations, reaffirming a provision of ANCSA requiring that “[t]he Director of the Office of Management and Budget [and all federal agencies] shall hereafter consult with Alaska Native corporations on the same basis as Indian tribes under EO 13175.” The policy distinguishes the federal relationship with ANCSA corporations from the government-to-government relationship between the federal government and federally recognized Indian Tribes, stating that this policy “will not diminish in any way that relationship.”

Previous Consultation Efforts Related to LS 258

During the development of the 2022 LS 258 FEIS, BOEM initiated opportunities for Government-to-Government tribal consultations through letters and follow-up communications with Tribes, ANCSA Corporations, Tribal entities, and local governments in the Cook Inlet and Kodiak Island region whose members could be affected by activities related to LS 258.

BOEM engaged in formal Government-to-Government consultation with the Kenaitze Indian Tribe, which expressed opposition to the Proposed Action through Resolution No. 2021-74, citing concerns about oil spills, climate change, industrialization of offshore areas, and other factors affecting resources and activities important to the Tribe's cultural, social, health, and economic well-being.

Additionally, the Seldovia Village Tribe, while not engaging in formal Government-to-Government consultation, provided written comments expressing concerns regarding the Cook Inlet beluga whale and northern sea otter populations. The Tribe also identified areas in State and OCS waters that were important for commercial, recreational, and subsistence fishing.

BOEM also reached out to the nine federally recognized Tribes associated with Kodiak Island to assess their level of interest in the lease sale and to develop a collaborative plan for engagement. Six of the nine Tribes expressed interest in being kept informed of future activities in the Cook Inlet Planning Area.

Current Status of Consultation for the SEIS

On August 1st and 4th, BOEM contacted the Tribes, ANCSA Corporations, Tribal entities, and local governments in the Cook Inlet and Kodiak Island region to reinitiate new consultations or follow-up communications with Tribes and ANCSA Corporations as appropriate. The Chugach Regional Resources Commission contacted BOEM via email on August 8, 2025 requesting a meeting to discuss the SEIS process. No other responses have been received to date.

5.3.2 Section 7, Endangered Species Act Consultation

The ESA (16 USC § 1531 et seq.) provides a program for the conservation of threatened and endangered plants and animals and the ecosystems on which they depend. Section 7(a)(2) of the ESA requires each federal agency to consult with USFWS and/or NMFS to ensure that any activity that it authorizes, funds, or carries out is not likely to jeopardize the continued existence of a listed species or result in the adverse modification of designated critical habitat.

BOEM and BSEE together, consulted with USFWS and NMFS concerning potential impacts to listed species and designated critical habitat from activities associated with LS 258. BOEM and BSEE specifically requested a Section 7 consultation for the first incremental step of lease activity. The first incremental step included possible activities associated with the exploration and delineation of leases, as identified by the E&D Scenario. Regulations at 50 CFR 402.14(k) allow consultation on a part of a larger activity if the following conditions are met: the incremental step does not violate Section 7(a)(2); there is a reasonable likelihood that the entire activity will not violate Section 7(a)(2); and the agency continues consultation with respect to the entire activity, obtaining a Biological Opinion (BO) for each step. Accordingly, at the lease-sale stage of LS 258, NMFS and USFWS evaluated the early lease activities (e.g., seismic surveying, ancillary activities, and exploration drilling) to ensure that possible activities under any leases issued in Cook Inlet will not result in jeopardy to a listed species or cause adverse modification of designated critical habitat. Section 7 consultation was completed in 2023.

USFWS provided BOEM and BSEE with a Final Biological Opinion (BO) on the effects of activities related to LS 258 on August 10, 2023. USFWS determined that possible activities related to LS 258 would not jeopardize the Steller's eider or the southwest Alaska DPS of the northern sea otter, nor adversely modify sea otter critical habitat. USFWS issued an Incidental Take Statement (ITS) for unintentional take of Steller's eiders and sea otters resulting from activities related to the first incremental step of LS 258. The BO included monitoring, and mitigation measures that BOEM and BSEE agreed to implement as part of the activities associated with LS 258 and Terms and Conditions that BOEM and BSEE are required to implement for compliance with the BO. Formal Section 7 consultation must be conducted for activities beyond the first incremental step. The ITS for sea otters is not valid without a take authorization issued under the MMPA.

NMFS provided a Final BO on August 25, 2023. NMFS determined that possible activities related to LS 258 would not jeopardize the Cook Inlet beluga whale, fin whale, Western North Pacific DPS of the humpback whale, Mexico DPS of the humpback whale, or Western DPS of the Steller sea lion, nor adversely modify critical habitat for these species. NMFS conducted a “framework programmatic consultation” per 50 CFR §402.14(i)(6). This type of consultation evaluates the effects of an agency program that provides a framework for a set of future activities. The framework program here consisted of BOEM’s and BSEE’s procedures for authorizing and overseeing oil and gas exploration, development, production, and decommissioning associated with LS 258. This was also an “incremental step consultation” focused on the first increment of lease activity. NMFS did not issue an ITS. Per 50 CFR §402.14(i)(6) and §402.02, an ITS is not required at the programmatic level where precise information on the specific number, location, timing, frequency, and intensity of activities is unknown. An ITS will be needed to authorize incidental take from LS 258 activities under this programmatic BO, especially exposure of ESA-listed species to sound above Level A or Level B harassment thresholds identified by NMFS under the MMPA (i.e., NMFS, 2024a).

The LS 258 ESA consultations are valid so long as the following conditions are met: the LS 258 program is conducted as described; the required monitoring and mitigation measures are applied; the required future consultations are carried out; the BOs continue to accurately describe the listed species, critical habitat, and potential effects of LS 258; effects of LS 258 occur generally as anticipated by the BOs; and, for USFWS BO only, the terms and conditions are carried out and take is maintained within the amount specified by the ITS. BOEM and BSEE will continue to closely evaluate and assess risks to listed species and designated critical habitat based on the most recent and best available information to ensure compliance of LS 258 with the ESA and will reinitiate consultation as necessary with NMFS and/or USFWS in the future.

5.3.3 Essential Fish Habitat Consultation

The MSA (as amended) requires federal agencies to consult with NMFS regarding actions that may adversely affect designated EFH. BOEM prepared an EFH assessment that identified adverse effects to designated EFH from potential oil and gas exploration activities in the LS 258 sale area. This assessment was provided to NMFS on January 20, 2022. NMFS responded on February 24, 2022, concurring that the lease sale itself was unlikely to adversely affect EFH, but that future development may have variable effects. BOEM provided a formal response to NMFS on October 14, 2022. During the preparation of the SEIS, BOEM revisited the 2022 consultation documents and determined that no additional activities or geographic scope would be added to the scenario presented in the FEIS. Therefore, BOEM determined that the EFH consultation would not need to be reopened. On July 31, 2025, BOEM notified NMFS of the scope of this SEIS and of its assessment that reinitiation of EFH Consultation was not warranted. To date, NMFS has not responded with concurrence.

5.3.4 Section 106, National Historic Preservation Act Consultation

Section 106 of the NHPA (Title 54, U.S.C. § 306108) and its implementing regulations at 36 CFR Part 800 require federal agencies to consider the effects of their undertakings on historic properties and provide the Advisory Council on Historic Preservation an opportunity to comment. Consultation under Section 106 includes coordination with the Alaska State Historic Preservation Officer (SHPO), Tribes, and other interested parties. In a letter dated September 23, 2020, BOEM acknowledged that a lease sale constitutes an undertaking under Section 106 but is not the type of activity expected to affect historic properties. SHPO concurred in an email dated November 16, 2021. On June 30, 2025, BOEM sent a follow-up letter to SHPO informing them of the SEIS and clarifying that no exploration, development, or production plans are currently under review or authorized. BOEM indicated that proposed activities are not expected to affect historic resources and that the letter was for informational purposes only. Any future site-specific proposals submitted by lessees will be reviewed under Section 106, including consultation with SHPO if appropriate.

5.4 List of Preparers

Table 5-1: List of Preparers

Name	Position Title	Contribution
Jeleena "Anne" Almario	Information Specialist	Graphics Design, Visual Information
Ryan Bare	Environmental Protection Specialist	NEPA Coordinator; Document Development and Review
Michael Bradway	Regional Supervisor, Resource Evaluation	E&D Scenario Development
Meghan Cornelison	Social Scientist	Communities and Subsistence; Archaeological and Historic Resources; NHPA Section 106 Consultation
Christopher Crews	Wildlife Biologist	Marine Mammals
Maureen De Zeeuw	Wildlife Biologist	Birds
Lorena Edenfield	Fish Biologist	Fish and Invertebrates; Commercial Fishing; Essential Fish Habitat Consultation
Greg Deemer	Oceanographer	OSRA Coordinator; Oil Spill Scenario
Shane Gray	Wildlife Biologist	Terrestrial Mammals; Recreation, Tourism, and Sport Fishing
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David Weekley	Geographer	GIS Map Production and Area Calculations
Eric Wolvovsky	Meteorologist	Air Quality Modeling; Lifecycle GHG Emissions and Social Cost of GHG Emissions

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APPENDIX A

Oil Spills and Gas Release Analysis

for Oil and Gas Lease Sale 258

Cook Inlet, Alaska

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Acronyms and Abbreviations

AAC	Alaska Administrative Code
API	American Petroleum Institute
bbl	barrel(s)
Bcf	billion cubic feet
Bbbl	billion barrels
BOEM	Bureau of Ocean Energy Management
BS	boundary segment
BSEE	Bureau of Safety and Environmental Enforcement
C_2H_6	ethane
CH	critical habitat
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
DOT	Department of Transportation
DPS	Distinct Population Segment
E&D	exploration and development
EIS	Environmental Impact Statement
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency
ERA	environmental resource area
ESA	Endangered Species Act
ESI	environmental sensitivity index
EVOS	*Exxon Valdez* Oil Spill
FEIS	Final Environmental Impact Statement
G&G	geological and geophysical
GIUE	Government Initiated Unannounced Exercise
GLS	grouped land segment
IBA	important bird area
km	kilometer(s)
LA	launch area
LOWC	loss of well control
LS	land segment
mi	miles
mm	millimeter(s)
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
NWR	National Wildlife Refuge
O_3	ozone
OCS	Outer Continental Shelf
OSRA	oil spill risk analysis
OWM	oil weathering model
PAH	polycyclic aromatic hydrocarbon
PL	pipeline
PM_{10} and $PM_{2.5}$	particulate matter (equal to or less than 10, and equal to or less than 2.5 micrometers diameter)
SINTEF	The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology
SO_2	sulfur dioxide
SUA	subsistence use area
TAH	total aromatic hydrocarbon
TAqH	total aqueous hydrocarbon
USDOI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service

VLOS	very large oil spill
VOC	volatile organic compound

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Accidental Oil Spills and Gas Release Information and Analyses

The U.S. Department of the Interior (USDOI), Bureau of Ocean Energy Management (BOEM) analyzes hypothetical oil spills, a gas release, spill drills, and response activities and their potential impact to physical, biological, sociocultural, and economic resources in relation to lease sales it holds on the Outer Continental Shelf (OCS). These analyses inform the overall assessments of environmental consequences of offshore oil and gas exploration, development, and production that may occur in the future as a result of Lease Sale 258 (LS 258) in Cook Inlet, Alaska. Section A-1 provides the background and framework information for the analyses. Section A-2 provides supporting information used to derive the Oil Spills and Gas Release Scenario (Spill Scenario) in Section 3.1 of this Environmental Impact Statement (EIS). Section A-3 provides analysis of impacts on resources, and Chapter 4 of this EIS summarizes these impacts by resource.

A-1 Background and Framework for Analysis

Oil spills or gas releases have varying potential to occur from activities associated with offshore oil and gas exploration, production, or transportation in or adjacent to the Lease Sale Area. BOEM has conducted a formal oil spill and gas release analysis, which starts by using the Exploration and Development Scenario (E&D Scenario) (this EIS, Section 4.1) to develop oil spill and gas release assumptions. The E&D Scenario provides one hypothetical view of how post-lease oil and gas exploration, development, production, and ultimately decommissioning could proceed as a result of LS 258. The E&D Scenario provides a framework from which BOEM can analyze the impacts of the Proposed Action, which does not by itself authorize any particular activity. The E&D Scenario considers a range of production that could occur long-term as a result of LS 258. The E&D Scenario estimates, at the high end, production of up to 192.3 million barrels of oil and 301.9 billion cubic feet (Bcf) of gas. BOEM then uses technical information and historical data about oil spills and gas releases, modeling results, statistical analysis, and professional judgment to estimate information about oil spills and gas releases (detailed in Section A-2). The impact analyses are based on a set of assumptions about the number, volume, and types of spill or release, and their weathering—collectively referred to as the Spill Scenario (this EIS, Section 3.1). Additionally, the *Oil Spill Risk Analysis* (OSRA) report (Ji and Smith, 2021) informs the analysis of a large oil 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. Because large spills and gas releases are an important concern to stakeholders, and no one can perfectly estimate future events, BOEM assumes a large spill or gas release will occur and conducts a large oil spill and gas release analysis for development and production activities. This conservative analysis addresses whether such spills could cause serious environmental harm and informs the decision maker of potential impacts should an unlikely large spill or gas release occur. Assuming more large spills or gas releases than the estimated mean number helps to ensure that this EIS does not underestimate potential environmental effects.

The Spill Scenario assumes:

- Approximately 410 small spills (spills less than (<) 1,000 barrels (bbl)) of crude, condensate, or refined oil occur over the life of post-lease activities that may result from LS 258, which the E&D Scenario has estimated to last 40 years.
- One large crude, condensate, or refined oil spill (greater than or equal to (≥) 1,000 bbl) over the 32 years of oil and gas development and production activities described in the E&D Scenario. This analysis assumes a large spill volume of 3,800 bbl.

- One large natural gas release (offshore or onshore), over the 32 years of gas production described in the E&D Scenario. This analysis assumes a gas release of 20–30 million cubic feet over one day.
- To ensure impacts of a spill are not underestimated, the impact analysis does not incorporate a potential volume reduction from cleanup and response; the entire spill or release volume(s) is analyzed. The impact analysis does incorporate BOEM estimates for impacts to resources from cleanup and response.

Very large oil spills and gas releases are very low probability, high impact events. Although very unlikely (frequency of spill exceeding 120,000 bbl is >0.00001–< 0.0001 per well) and not reasonably foreseeable, BOEM considered a hypothetical long duration loss of well control resulting in 120,000 bbl of oil and released gas. For an analysis of a very large oil spill (VLOS) (≥120,000 bbl) and gas release, which is not reasonably foreseeable as a result of Cook Inlet OCS oil and gas activities, refer to Section 4.12, Impacts of a Very Large Oil Spill and Appendix A, Section A-7, Very Large Oil Spill in *Cook Inlet Planning Area Oil and Gas Lease Sale 244 in the Cook Inlet, Alaska Final Environmental Impact Statement* (BOEM, 2016). The Lease Sale 244 Final Environmental Impact Statement (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. BOEM analysts reviewed the analysis and determined it still provided decisionmakers with a robust analysis of the potential impacts associated with low probability very large oil spills for oil and gas activities on the OCS (CEQ, 2010).

Once oil or gas enters the environment, it begins to degrade through physical, chemical, and biological processes referred to as weathering. The report *Beaufort Sea: Hypothetical Very Large Oil Spill and Gas Release* (BOEM, 2020; Section 4.1) details the major oil weathering processes. These include spreading, evaporation, dispersion, dissolution, emulsification, microbial degradation, photochemical oxidation, and sedimentation to the seafloor or stranding on the shoreline (Afenyo et al., 2016; Allen, 1980; Boehm, 1987; Lee et al., 2015; Payne et al., 1987; Tarr et al., 2016; Wiens, 2013). These processes are complex and act simultaneously as well as independently. Weathering processes affect various oil or gas constituents at differing rates ranging from hours to decades (Farrington, 2014). Spreading, evaporation, dispersion, emulsification, and dissolution are most relevant during the early stages of a spill, while photo-oxidation, sedimentation, and biodegradation are longer-term processes. Evaporation removes the more volatile, highly soluble, and toxic lower molecular weight components and leaves behind the less soluble, higher molecular weight components with lower toxicity potential (Di Toro et al., 2007). Along with the weathering processes, the physical environment, depth of release, spill volume, and unique composition and physical properties of oil determine the oil's fate in the environment (NRC, 1985, 2003a, 2014). Specific oil weathering estimates for assumed oil types and volumes are presented in Sections A-2.1.3 and A-2.2.2.

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. From that report, Section 5.3.4, Bureau of Safety and Environmental Enforcement (BSEE) Oil Spill Response Plan Drills, and Section 7, Description of Potential Response Actions, are incorporated by reference and summarized here. The report is available on BOEM's website at https://www.boem.gov/BOEM-2019-006/. BSEE periodically performs both announced and unannounced exercises to test the operator's spill response preparedness. Government Initiated Unannounced Exercises (GIUEs) are typically less than 8 hours in duration but can last longer and include exercising a response plan, tracking and surveillance, and countermeasures in localized areas. Response and cleanup actions would be implemented in the event of an oil spill or gas release and could require multiple technologies. Technologies and response efforts include surveillance and monitoring, waste management, wildlife response, source containment, and both mechanical and non-mechanical countermeasures. Mechanical recovery includes the physical removal of oil from the sea, ice, or shoreline surface typically accomplished using containment booms, skimmers, direct suction, heavy equipment, sorbents, temporary storage, separation, and disposal. Non-mechanical countermeasures to combat an oil spill include dispersants, surface collecting agents, and in-situ burning.

A-2 Oil Spills and Gas Release Information, Models, and Estimates

This section discusses the information and methods used to derive the Spill Scenario (this EIS Section 3.1). Oil spills are divided into two general phases of operations and two spill-size categories. These divisions reflect a difference in how the information about the spills or releases is derived and used. The two general activity categories considered in oil spill analysis are:

- Exploration and delineation
- Development, production, and decommissioning

The two spill-size categories considered in oil spill analysis are:

- Small spills: those <1,000 bbl, generally do not persist on the water long enough to follow their path in a trajectory analysis.
- Large spills: those ≥1,000 bbl, meaning that 1,000 bbl is the minimum size for a large spill. A large spill persists on the water long enough to follow its path in a trajectory analysis.

BOEM considers three oil types—refined, crude, and condensate—and natural gas, which is primarily made up of methane (CH_4) and ethane (C_2H_6).

A-2.1 Small Oil Spills

Small spills, although accidental, are relatively routine. Accidental small spills are likely to occur over the life of the exploration and development activities, and operators follow routine spill prevention and response measures. The majority of small spills could be contained on a vessel or facility. Generally, if a small spill does reach water, refined fuels would evaporate and disperse in a few days, but small crude oil spills take longer. Further, those spills reaching the water may be contained by booms or absorbent pads.

A-2.1.1 Exploration

Exploration includes both geological and geophysical (G&G) activities (marine seismic, geotechnical, and geohazard surveys) and exploration and delineation drilling activities. Small spills during exploration are likely to be refined oil products such as lube oil, hydraulic oil, gasoline, or diesel fuel.

A-2.1.1.1 Geological and Geophysical Activities

BOEM estimates small, refined spills occur from vessels during G&G activities, but large crude and diesel fuel spills do not. This is based on a review of potential fuel transfer discharge volumes and on the historical oil spill occurrence data for the Alaska OCS and adjacent state waters.

The estimated offshore vessel transfer spill size ranges from <1–13 bbl (BOEM, 2012b, 2013; BOEMRE, 2010a, b). The <1 bbl is the estimated volume of diesel fuel resulting from an offshore vessel fuel transfer accident assuming the dry quick disconnect and positive pressure hose (spill prevention devices) function properly. Where a transfer hose ruptures and spill prevention devices fail, assumed discovery and response times are 30 seconds for rupture discovery and 30 seconds to stop the pump. Approximately 13 bbl spills on the vessel or reaches the environment during the 60-second interval.

To estimate the number and volume of spills, BOEM assumes each G&G activity transfers fuel and every other activity has a spill. This estimate is very conservative based on the fact that no offshore fuel transfer spills have been reported from G&G activities in the Alaska OCS. BOEM assumes 11 G&G site clearances are typical per survey. Site clearances include shallow hazard surveys and point samples. A total of 5 surveys were assumed including the deep penetrating marine seismic survey (this EIS Table 4-1). BOEM estimates 3 small spills from G&G activities. Ninety-nine percent of the time, transfer spill prevention devices function properly during offshore fuel transfers. For two G&G activities, BOEM assumes spill prevention devices function properly and spills could range from 0–<1 bbl each for a total of <2 bbl. It is assumed that one G&G activity has a spill prevention device malfunction and a spill up to 13 bbl. Finally, BOEM assumes that spills do not occur in the same time and space.

A-2.1.1.2 Exploration and Delineation Drilling Activities

To estimate spills from exploration and delineation drilling activities, BOEM reviewed potential discharges, historical oil spill and modeling data, and the likelihood of oil spill occurrence. No large crude or diesel oil spills are estimated to occur based on the following considerations:

- The low rate (3.58×10^{-3} per well drilled (Bercha Group, 2014)) of OCS exploratory drilling well-control incidents spilling crude oil.
- Since 1971, more than 14,000 OCS exploratory wells have been drilled, and one OCS crude oil spill from the Deepwater Horizon event (large/very large) has occurred during temporary abandonment (converting an exploration well to a development well).
- The number (8) of exploration wells in the E&D Scenario (this EIS, Section 4.1).
- No crude oil would be commercially produced from the exploration wells, and the wells would be permanently plugged and abandoned.
- All exploration spills on the OCS have been small.
- No large spills occurred while drilling 86 exploration wells to depth in the Alaska OCS from 1975–2019.
- Pollution prevention and oil spill response regulations and methods implemented since the Deepwater Horizon spill have reduced the risk of spills and diminished their potential severity (BOEM, 2012a, 2019; Visser, 2011).

Small spills are likely to occur during exploration and delineation drilling activities. Historical OCS exploration spill data suggest that the most likely cause of an oil spill during exploration would be operational, and the spill is likely be relatively small. A 50-bbl ultra-low sulphur diesel fuel transfer spill was chosen as one spill volume in the small spill category and 5 bbl was selected as the typical volume. The spill volumes were based on historical exploration spill sizes in the Beaufort and Chukchi Sea OCS (BOEM, 2015, Appendix A, Table A.1-2), which were all small; OCS oil spill data, which indicated that 99.7 percent of all OCS spills are <50 bbl (Anderson et al., 2012); and estimates of U.S. Coast Guard worst-case discharge, average most probable discharge, and maximum most probable discharge for exploration plans (Shell, 2011, 2012). To estimate the number and volume of spills, BOEM assumes that every exploration drilling activity (3) has an offshore transfer fuel spill. One drilling activity has a worst-case discharge of 50 bbl, and the rest have a maximum most probable discharge of 5 bbl for a total of 60 bbl. These spills are not assumed to occur in the same space and time.

A-2.1.2 Development and Production

To estimate the number of small crude and refined spills and volume, oil spill rates from *Update of Occurrence Rates for Offshore Oil Spills* (Anderson et al., 2012) and *2016 Update of Occurrence Rates for Offshore Oil Spills* (ABS 2016) were applied. Data for the years 1974–2015 was used for spills ≥1 bbl to <1,000 bbl (ABS, 2016) and 1996 through 2010 was used for spills <1 bbl (Anderson et al., 2012). Using the E&D Scenario production volume and the spill rates, a total of 405 small crude and refined oil spills (<1,000 bbl) were estimated during the 32-year oil and gas production life. BOEM multiplied the total number of spills in each size by the median volume to estimate the total oil spill volume.

A-2.1.3 Modeling Simulations of Oil Weathering

Table A1 summarizes the fate and behavior results of a 1-, 5-, 13-, and 50-bbl diesel fuel spill and a 125-bbl crude oil spill. Based on the Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology (SINTEF) Oil Weathering Model (OWM) calculations, a 50-bbl diesel fuel oil spill lasts less than three days in open water during summer or winter.

Table A1: Weathering of Small Diesel Oil Spills in the Cook Inlet OCS

Scenario Element	**Summer Spill[1]**					**Winter Spill[2]**						
Time After Spill in Hours	**6**	**12**	**24**	**48**	**72**	**6**	**12**	**24**	**48**	**72**	**96**	**120**
1 bbl Diesel												
Oil Remaining (%)	26	2	0	na	na	0	na	na	na	na	na	na
Oil Dispersed (%)	55	75	77	na	na	85	na	na	na	na	na	na
Oil Evaporated (%)	19	22	23	na	na	15	na	na	na	na	na	na
5 bbl Diesel												
Oil Remaining (%)	30	4	0	na	na	0	na	na	na	na	na	na
Oil Dispersed (%)	52	73	76	na	na	85	na	na	na	na	na	na
Oil Evaporated (%)	18	23	24	na	na	15	na	na	na	na	na	na
13 bbl Diesel												
Oil Remaining (%)	26	2	0	Na	na	0	na	na	na	na	na	na
Oil Dispersed (%)	55	75	76	Na	na	85	na	na	na	na	na	na
Oil Evaporated (%)	19	23	24	Na	na	15	na	na	na	na	na	na
50 bbl Diesel												
Oil Remaining (%)	26	2	0	Na	na	36	5	0	na	na	na	na
Oil Dispersed (%)	55	75	76	Na	na	54	80	84	na	na	na	na
Oil Evaporated (%)	19	23	24	Na	na	10	15	16	na	na	na	na
125 bbl Diesel												
Time After Spill in Days	**1**	**3**	**10**	**30**		**1**	**3**	**10**	**30**			
Oil Remaining (%)	84	74	53	24		75	55	22	3			
Oil Dispersed (%)	5	13	31	56		14	32	62	80			
Oil Evaporated (%)	11	13	16	20		11	13	16	17			

Notes: Calculated with the SINTEF OWM Version 4.0 of Johansen et al. (2010) and assuming marine diesel and or Endicott crude of 23.1˚ API.

na = not applicable because no oil is estimated to remain.

[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).

[2] Winter Spill (November 1–March 31), 16-knot wind speed, 5 degrees Celsius, 1.8-meter wave. Average Marine Weather Area A (Brower et al., 1988).

Compiled by BOEM, Anchorage, Alaska Office (2020).

A-2.1.4 Small Spill Assumptions Summary

The analysis of small oil spill impacts assumes the following:

- Small spills are likely to occur during exploration, development, and production activities.
- Small spills are <1-, 5-, 13-, or 50-bbl for exploration and mostly 3-bbl, with two 125-bbl spills for development and production.
- Small spills from offshore refueling during G&G activities total <1 bbl annually with one individual spill of approximately 13 bbl over all G&G activities.
- Small spills during exploration and delineation drilling operations range from 5 up to 50 bbl.
- The oil types could be ultra-low sulphur diesel during exploration and delineation activities and crude, diesel, or condensate during development and production.
- The weathering for a 1-, 5-, 13-, or 50-bbl refined oil spill is as shown in Table A1, and the spill lasts <1–2 days on the water. A crude oil spill of 125 bbl lasts 30 days.
- All the oil reaches the vessel, facility, or the environment.
- There is no reduction in volume due to cleanup or containment (pollution prevention, containment, and cleanup are analyzed separately as mitigation and as disturbance).

- Small spills could occur any time of the year in open water or on landfast ice during exploration and delineation activities and at any time of the year during development and production.
- Chronic small spills are those occurring repeatedly for long periods in the same location (e.g., fueling or development facilities) or individual small spills of long duration (small undetected leaks).

A-2.2 Large Oil Spills

Large spills (≥1,000 bbl) are accidental and occur infrequently. The large spill analysis estimates their frequency and number and describes their source, the type of oil, and its weathering. The OSRA results refine the analysis by providing where a large spill may go and what it may contact, and the overall occurrence and contact from one or more large spills over the life of the proposed action.

BOEM estimates the mean number of large oil spills or gas releases is less than one. The chance of one or more large spills occurring is 19 percent and the chance of no large spills occurring is 81 percent over the E&D Scenario lifecycle considered for LS 258. BOEM assumes a large spill or gas release will occur and conducts a large oil spill and gas release analysis for development and production activities. This conservative analysis addresses whether such spills could cause serious environmental harm and informs the decision maker of potential impacts should an unlikely large spill or gas release occur. Assuming more large spills or gas releases than the estimated mean number helps to ensure that this EIS does not underestimate potential environmental effects.

A-2.2.1 Large Oil Spill Sizes, Source, and Oil Type

Because no large spills have occurred from Alaska OCS oil and gas activities, the large spill volume assumptions are based on the reported spills in the Gulf of Mexico and Pacific OCS (ABS, 2016). The Gulf of Mexico and Pacific OCS data show that a large spill most likely would occur from a pipeline or a platform. BOEM uses the median OCS spill volume as the likely large spill size because it is the most probable size for that spill-size category. The average is not a useful statistical measure because it can be skewed by outliers such as the Deepwater Horizon spill volume. The median size of a crude oil spill ≥1,000 bbl from a pipeline on the OCS from 1974–2015 was 3,750 bbl, and the average was 5,808 bbl (ABS, 2016, Table 24). The median spill size for a platform on the OCS from 1974–2017, was 3,283 bbl, and the average was 1,227,006 bbl (ABS, 2016, Table 13). BOEM calculated the median spill size for both platforms and pipelines from 1974–2015 to derive the median OCS spill volume of 3,750 bbl. For purposes of analysis, BOEM rounded to the nearest hundred, 3,800 bbl, and used this value as the likely large spill size.

The source is the place from which a large oil spill could originate. The sources are divided generically into production platforms or pipelines (ABS, 2016). The places where a large spill could occur are based on the E&D Scenario created for LS 258. Platform sources include spills from wells or diesel fuel tanks located on platforms. Large offshore pipeline spills include spills from the riser and from the offshore pipeline to the shore. Large onshore pipeline spills include spills from the shoreline to the refinery. The types of oil spilled from platforms are assumed to be crude oil, natural gas liquid condensate, or diesel oil. Large pipeline oil spills are assumed to be natural gas liquid condensate or crude oil.

A-2.2.2 Large Oil Spill Weathering

Estimates of the oil types that could spill, along with their weathering, inform analysis of the effect of a 3,800 bbl oil spill. Weathering includes how much oil evaporates, disperses, and remains after a certain time. BOEM uses the SINTEF OWM, Version 4.0 (Johansen et al., 2010) for diesel, condensate, and crude oil to derive weathering results for up to 30 days. The SINTEF OWM results are validated with data from three full-scale field trials of experimental oil spills (Brandvik et al., 2010; Daling and Strom, 1999).

A-2.2.2.1 Oil Weathering Scenario

The SINTEF OWM uses information about the general type of oil, laboratory weathering data, the volume of oil, the location of the spill, and the environmental parameters of temperature, wind speed, and ice concentration to simulate weathering. BOEM chose an ultra-low sulphur diesel oil and a condensate (Sliepner) with an American Petroleum Institute (API) gravity of 50°. The properties of crude oils are variable and when spilled result in different behavior. A medium crude oil, similar to crude oils representative of Trading Bay within the Cook Inlet Region, is used for this analysis. Crude oil samples recovered from wells within Cook Inlet state waters are characterized by a range of API gravity, which is a measure of how heavy or light the oil is compared to water. The crude oils in the Cook Inlet Region are estimated to range from API gravities of 20° to 40°. Given the existing information from crude oil samples recovered from Alaska state wells, BOEM chose the lower end of the range of API gravities which generally weather and degrade more slowly than higher API gravities. BOEM looked for data on crude oils with similar API gravity values that also had laboratory data on their weathering (evaporation, dispersion). Endicott 2001 crude oil has an API gravity of 23.1° and is representative for the oil weathering simulations because it is a medium crude oil that falls within the lower range of API gravity 20° to 40°.

Three general scenarios are simulated: one in which the oil spills into open water (April–November) and two in which the oil spills into open water or broken ice (December–March). BOEM assumes the spill starts at or quickly rises to the surface. Weathering of spills for open water and broken ice are modeled as if they are instantaneous spills. Although different amounts of oil could melt out of broken ice at different times, BOEM took the conservative approach and assumed all the oil was released at the same time.

A-2.2.2.2 Large Oil Spill Weathering and Persistence Results

Table A2 shows how much oil evaporates, disperses, and remains at the end of 1, 3, 10, and 30 days. In general, the low sulphur diesel fuel and condensate evaporate and disperse in a short period of time (1–10 days) during summer and remain longer in winter. The Endicott 2001 crude oil tends to evaporate and disperse more slowly.

The Endicott 2001 crude contains a relatively moderate amount of lower molecular-weight compounds that evaporate. Table A2 shows that approximately 17–20 percent of its original volume evaporates within 30 days at both summer and winter temperatures. Dispersion ranges from 1–56 percent (Table A2). However, at higher wind speeds (e.g., 15 meters per second wind speed), the oil spill will be almost removed from the sea surface within a day through evaporation and dispersion.

If an oil spill occurred and contacted shore, two important questions arise: (1) How much shoreline would be contaminated? and (2) How long would the contamination persist? Based on Equation 17 in Ford (1985), if a 3,800-bbl spill occurred and contacted land, about 26–35 kilometers (km) of coastline would be oiled (Table A2). The 35 km of coastline is approximately equal to the length of two land segments (LSs) in the OSRA model (see Section A-2.2.3). Table A.1-12 from Ji and Smith (2021) shows the environmental sensitivity index of Cook Inlet shorelines can range from low oil persistence to some shorelines where oil would persist for decades. In winter, ice along some portions of shorelines of the Cook Inlet could keep spills offshore away from the shoreline, and any oil that did reach shore may not penetrate into the frozen beach. For Cook Inlet shorelines, the relevance of persistence is much greater for spills during the summer than for spills during the winter.

Table A2: Weathering of a Large Oil Spill in the Cook Inlet OCS

3,800-Barrel Diesel Spill	Summer Spill[1]				Winter Spill[2]				Winter Spill (Broken Ice)[3]			
Time After Spill in Days	1	3	10	30	1	3	10	30	1	3	10	30
Oil Remaining (%)	40	1	na	na	10	0	na	na	65	19	0	na
Oil Dispersed (%)	36	66	na	na	69	77	na	na	11	40	54	na
Oil Evaporated (%)	23	33	na	na	21	23	na	na	14	41	45	na
3,800-Barrel Condensate Spill	**Summer Spill[1]**				**Winter Spill[2]**				**Winter Spill (Broken Ice)[3]**			
Time After Spill in Days	1	3	10	30	1	3	10	30	1	3	10	30
Oil Remaining (%)	0	na	na	na	0	na	na	na	0	na	na	na
Oil Dispersed (%)	29	na	na	na	29	na	na	na	29	na	na	na
Oil Evaporated (%)	71	na	na	na	71	na	na	na	71	na	na	na
3,800-Barrel Crude Spill	**Summer Spill[1]**				**Winter Spill[2]**				**Winter Spill (Broken Ice)[3]**			
Time After Spill in Days	1	3	10	30	1	3	10	30	1	3	10	30
Oil Remaining (%)	86	75	55	24	79	57	23	3	89	84	76	61
Oil Dispersed (%)	3	12	31	56	10	30	61	80	1	3	8	19
Oil Evaporated (%)	11	13	16	20	11	13	16	17	10	13	16	20
Discontinuous Area (km^2)[3, 4]	12	50	241	998	12	50	240	992	12	50	240	992
Estimated Coastline Oiled (km)[5]	35				26				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).

[2] Winter Spill (November 1–March 31), 16-knot wind speed, 5 degrees Celsius, 1.8- meter wave heights and for Broken Ice 50% ice. Average Marine Weather Area A (Brower et al., 1988).

[3] This is the discontinuous area of oiled surface.

[4] Calculated from Equation 6 of Table 2 in Ford (1985) and is the discontinuous area of a continuing spill or the area swept by an instantaneous spill of a given volume. Note that ice dispersion occurs for about 30 days before meltout.

[5] 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).

A-2.2.3 OSRA Model

The OSRA uses spill rates, statistical methods, and oil spill trajectory modeling to derive information about large oil spill patterns. The OSRA report (Ji and Smith, 2021), Sections 2, 3.1–3.3, and Appendices A and B, are incorporated by reference and summarized here. The OSRA report is available to the public at: https://www.boem.gov/environment/environmental-assessment/oil-spill-risk-analysis-reports. The Lease Sale 258 OSRA estimates the chance of: (1) one or more large spills occurring; (2) a spill contacting resource areas assuming a spill has occurred at a specific location (conditional probabilities); and (3) one or more spills occurring and contacting resource areas (combined probabilities) (Ji and Smith, 2021).

A-2.2.3.1 Mean Number and Chance of One or More Large Spills Occurring

The large spill rate (1.11 spills per billion barrels (Bbbl); ABS, 2016) is multiplied by the production volume (0.1923 Bbbl) to estimate the mean number of spills (0.21). The chance of one or more large spills occurring is 19 percent and the chance of no large spills occurring is 81 percent over the E&D Scenario lifecycle considered for LS 258.

A-2.2.3.2 Conditional and Combined Probabilities

BOEM studied how and where large OCS spills move by using an oil spill trajectory model with the capability of assessing the chance of large spill contact to specific resource areas (Smith et al., 1982; Ji et al., 2011). The study area is chosen to be large enough to allow most hypothetical oil spill trajectories to develop without contacting boundary segments through as long as 30 or 110 days. This model analyzes the likely paths of slightly less than 800,000 simulated oil spill trajectories in relation to physical, biological, and sociocultural resource areas. The trajectory is constructed using the wind, sea ice, and current data from a coupled ice-ocean model.

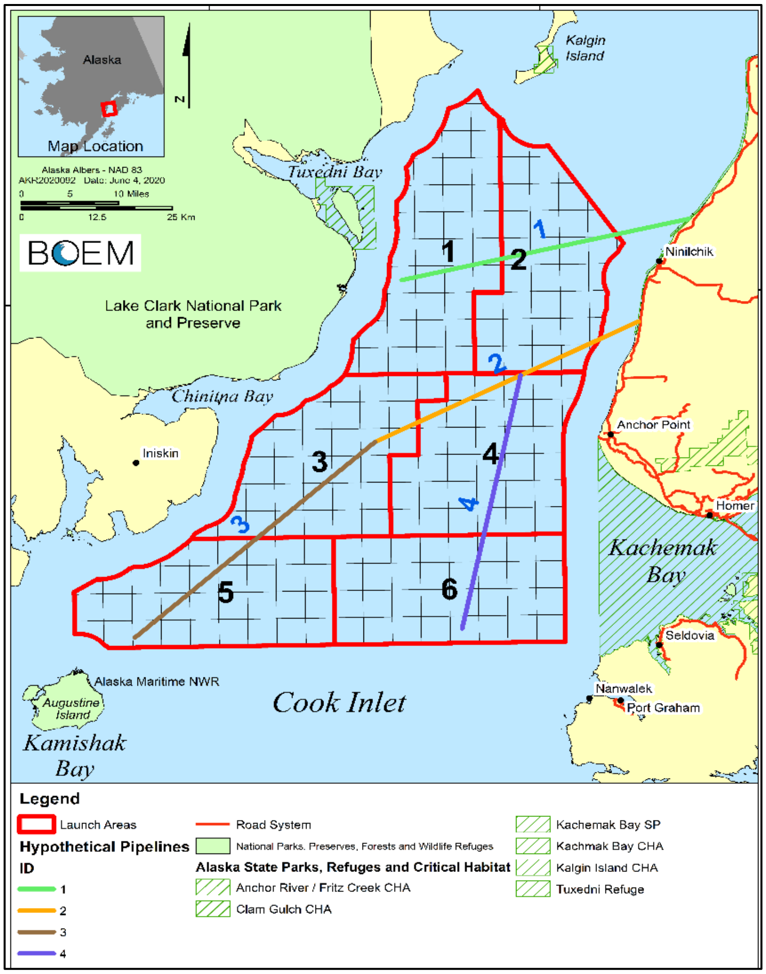

Figure A1: Areas Used in the Oil Spill Trajectory Analysis

The trajectory analysis in the OSRA used 6 hypothetical launch areas (LAs) and 4 pipelines (PLs) as locations where the hypothetical oil spill trajectory simulation starts. The LAs represent grouped locations of launch points that are spaced one per lease block throughout the Cook Inlet Proposed Action Area. The pipelines do not represent proposed pipelines or any real or planned pipeline locations. The LAs and PLs have no specific relation to the activities described in the LS 258 E&D Scenario. They are distributed throughout the Cook Inlet Area to evaluate differences in hypothetical oil spill trajectories from different locations. Figure A1 shows the 6 LA and 4 PL locations discussed in the OSRA report and how they were grouped geographically for this analysis.

Four types of onshore and offshore resource areas are used in the OSRA model: environmental resource areas (ERAs), land segments (LSs), grouped land segments (GLSs), and boundary segments (BSs). ERAs and BSs represent offshore areas while LSs and GLSs represent nearshore or onshore coastal areas of biological, social, or economic resource areas or resource habitats. BOEM analysts designated these resource areas by working with other federal and state agencies, academia, and various stakeholders who provided information, including local and traditional knowledge about these resources. Analysts also used information from BOEM's Environmental Studies Program research, literature reviews, and professional exchanges with other scientists to define these resource areas. The locations of resource areas, including islands and the coast within the model study area, were used by the OSRA model to tabulate the conditional and combined results for these areas (Ji and Smith, 2021).

The OSRA provides two datasets:

- Conditional Probabilities: Conditional probabilities are based on the assumption (condition) that a large oil spill has occurred at a given location. They reflect the hypothetical paths (trajectories) that oil would take based on modeled ocean surface currents, ice, and wind conditions in the study area. Tens of thousands of trajectories are simulated from each hypothetical spill point, and the percent chance of contact to resource areas within six different travel times (1, 3, 10, 30, and 110 days) are tabulated (Ji and Smith, 2021, Appendix A, Tables A.2-1–A.2-60). The conditional probabilities show statistically how, based on the surface current, sea ice, and wind patterns in the study area, spills originating in specific launch areas are more likely to contact particular resource areas than those originating in other locations.
- Combined Probabilities: Combined probabilities represent the estimated overall (combined) chance that one or more large spills will both occur and contact a specific resource area.

> Combined probabilities incorporate conditional probabilities, spill rates, volume of oil, and the transportation scenario over the E&D lifecycle (Ji and Smith, 2021, Appendix A, Tables A.2-61–A.2-64). The combined probabilities are sensitive to oil resource volumes and transportation scenarios, which could vary in a frontier area.

The resource volumes for the combined probabilities were derived using the National Assessment and are shown in Table A3 (BOEM, 2021).

Table A3: BOEM, Alaska Regional Office, RE Estimation of Oil Resources in Million barrels (MMbbl) per Oil Spill Risk Analysis Launch Area for Cook Inlet Lease Sale 258

LA1[1]	LA2	LA3	LA4	LA5	LA6	Total
57.08902576	49.91522035	17.45426331	48.24318318	10.39713584	9.201171556	192.3

A-2.3 Large Natural Gas Release

BOEM assumes one gas release from either an offshore or an onshore pipeline. Although unlikely, there exists some potential for a gas pipeline to rupture. The estimated rate of offshore gas pipeline ruptures in the Gulf of Mexico is 2.4 x 10^{-5} per pipeline mile per year (MMS, 2009). For 120 miles of offshore gas transmission pipelines, over a 32-year gas production life, the estimated number of incidents is 0.08 offshore gas pipeline ruptures. For onshore gas pipelines, the estimated spill rate for generic Department of Transportation (DOT) onshore gas transmission lines from 2002–2013 is 3.1 x 10^{-5} spill or release per pipeline mile per year (Lam and Zhou, 2016). Using DOT's rate, for the 1-mile onshore pipeline described in the E&D Scenario, 0.003 significant incidents are estimated over the 32-year gas production life of the E&D Scenario for LS 258. Under DOT regulation, significant incidents involve property damage of more than $50,000, injury, death, release of gas, or are otherwise considered significant by the operator.

If a major release of dry natural gas occurs, a sudden decrease in gas pressure would 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 estimated daily flow rate, BOEM estimates that approximately 20 million cubic feet could be released over one day. Onshore, any gas releases from an elevated pipeline would disperse into the atmosphere. There is some small potential for ignition and subsequent explosion, but ignition sources are not readily available.

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 x 10^{-4} gas blowouts per exploration well, and at 7.0 x 10^{-4} gas blowouts per development well drilled (IAOGP, 2010). The production well control blowout incident rate for production of gas is an order of magnitude lower, estimated at 5.7 x 10^{-5} blowouts per well year (IAOGP, 2010). 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 occurring is 4 percent over the life of the Proposed Action or its alternatives.

In year 7 of the timeline described in the E&D Scenario associated with LS 258, infrastructure will have been installed, and sale of natural gas from the Lease Sale Area would presumably begin. When this occurs, it is assumed that one well control incident of a single well on the facility could occur, releasing 30 million cubic feet of natural gas for one day. This is based on the average well production for one day from one well and the estimated rates of blowout duration for gas production wells.

A-2.4 Large Oil Spills: Historical, Current, and Future

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 estimated cumulative large oil spills resulting from current and future oil production for the onshore and offshore region of Cook Inlet. BOEM estimates 0–2 large spills from onshore and offshore state lands and from potential production resulting from development of leases sold in LS 244 and a future OCS lease sale beyond LS 258 (Table A4). BOEM assumes Cook Inlet LS 258 would contribute 0–1 additional large spill. For the number of large spills, the incremental contribution could range from 0–33%.

Table A4: Potential Large Spills from Current and Future Production

Location	Reserves/ Resources (Bbbl)	Spill Rate (spills/Bbbl)	Size Category (bbl)	Size (bbl) Pipeline/Facility	Mean Number of Spills	Number of Large Spills
State Onshore and Offshore	0.599[1]	1.11[4]	≥1,000	3,800	0.67	0–1
Cook Inlet OCS Sale 244	0.215[2]	1.11	≥1,000	3,800	0.24	0–1
Cook Inlet OCS (Future)	0.260[3]	1.11	≥1,000	3,800	0.29	
Total					1.2	0-2

Notes: [1] State Onshore and Offshore (USGS 2011).
[2] BOEM (2016).
[3] Future OCS Resources (Bradway 2020, pers. comm.).
[4] OCS spill rate (ABS Consulting, Inc., 2016).
Compiled by BOEM, Anchorage, Alaska Office (2020).

A-3 Oil Spills and Gas Release Analysis

The following sections analyze the impacts of small spills, a large spill or gas release, spill drills, and response activities on each physical, biological, sociocultural, and economic resource. The resource sections begin with an overview of general oil and gas exposure effects. Each of these hypothetical spills or releases has varying potential to result from OCS oil and gas exploration, development, and production. A set of assumptions, which collectively form the Spill Scenario (EIS Section 3.1), provides EIS analysts with a consistent and logical estimate of the size of spills, where a spill may go, how long it may take to contact an area of concern, and how oil will weather to inform the impact analyses through a common assessment framework.

For the large spill analysis, BOEM focuses the OSRA conditional information into one timeframe in each of two seasons to identify the season in which a large spill begins. The season determines wind and wave conditions and how much ice is present, contributing to the behavior of spilled oil and how long it persists. A 3,800-bbl crude oil spill persists in summer (open water) and in winter (sea ice) for up to 30 days. The season also informs the environmental analysis, including biota presence and abundance, and subsistence harvest patterns. The OSRA combined information is focused into an annual timeframe.

The OSRA model includes resource areas with defined geographic locations and temporal timeframes: coastal and estuarine habitat; invertebrates and fish; birds; marine mammals; terrestrial mammals; recreation, tourism, and sport fishing; subsistence activities and harvest patterns; and archaeological resources. The commercial fishing analysis considers fish resource areas. Non-spatial resources—air quality, water quality, sociocultural systems, community health, economy, and environmental justice—are not examined in the OSRA model, but the analyses consider the spatial extent where a large oil spill could travel and its timeframe.

The tables and figures in the following sections show resource areas with the highest chance of contact (≥1%) from any spill area within 30 days from a large spill during summer or winter. In this analysis, a large oil spill with ≤5% chance of contacting resources would likely be widely dispersed and weathered, and not estimated to produce appreciable impacts on invertebrates and fish, marine mammals, or terrestrial mammals, based on the spill assumptions in Appendix A, Section A-2. The conditional analysis for each resource tiers to BOEM (2016) Chapter 4 and each resource subsection titled Oil Spill Risk Analysis therein is incorporated by reference and summarized in each resource section below. The conditional and combined probability results are reported in Ji and Smith (2021).

A-3.1 Oceanography of Cook Inlet

The information provided below describes the oceanographic conditions of Cook Inlet that could affect conditions during an oil spill.

The physical oceanography in Cook Inlet is presented in the FEIS for Lease Sale 244 as part of the affected environment (BOEM, 2016a, Section 3.1.3). The information in that section is broadly summarized here and incorporated by reference. The information remains current and thus informative for understanding the oceanography of the region.

Cook Inlet is an estuary defined as a semi-enclosed coastal waterbody with a free connection to the open sea and within which the seawater is measurably diluted with freshwater from terrestrial sources. It is connected to marine waters via Shelikof Strait and the Gulf of Alaska, and to fresh waters via the many terrestrial rivers – the most prominent of which are the Susitna, Matanuska, and Knik rivers. The circulation of Cook Inlet is complex and varies at tidal, seasonal, annual, and interannual timescales (Musgrave and Statscewich, 2006). The region has the fourth largest tidal range in the world. Figure 3.1.3-1 from the FEIS for Lease Sale 244 shows the predominant surface currents in Cook Inlet. The general circulation pattern of lower and middle Cook Inlet is characterized by denser, saltier water (the Alaska Coastal Current (ACC)) that flows northward from the Gulf of Alaska along the eastern shore of the inlet. The relatively fresh silty upper Cook Inlet outflow mixes with the incoming ACC in the middle inlet, and the outflowing water moves southward along the western shore (LGL Alaska Research Associates, Inc., 2000). The overall circulatory patterns are dominated by tidal flows, although surface circulation varies seasonally due to freshwater outflows with the ACC water traveling farther north during periods of less freshwater input.

Overall, Cook Inlet is shallow with an area-weighted mean depth of 44.7 m (148 ft), but is as deep as 212 m (695 ft) at the south end (Zimmerman and Prescott 2014). However, depths >50 m (164 ft) occupy the central core of the inlet and extend in narrow bands past Kalgin Island; water depths >100 m (328 ft) occur almost entirely at the inlet's entrance.

Water temperature and salinity vary seasonally and geographically. Generally, however, the water in Cook Inlet begins to warm from March until July (Okkonen, Pegau, and Saupe, 2009). Water temperature is relatively constant between July and September, and water temperatures decrease from October to December and then remain low until March. Cook Inlet salinity changes seasonally and is driven by freshwater input. Freshwater riverine input is minimum in winter and increases by more than an order of magnitude during May. Input remains high through the summer and decreases from late September through November.

The amount of sea ice varies annually and is not prevalent across the Lease Sale Area. Sea ice is most widespread in the Lease Sale Area during winter. Sea ice generally forms in October or November, and increases through February. It recedes as it melts in March to April. There is seldom uniform ice cover due to tidal action and currents.

A-3.2 Air Quality

The airborne constituents associated with a release of refined or crude oil would release potentially harmful emissions into the atmosphere, particularly those pollutants regulated under the Clean Air Act: nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), and particulate matter (PM_{10} and $PM_{2.5}$). An oil spill or gas release would also include volatile organic compound (VOC) emissions, which are a precursor to ozone (O_3). Additional airborne constituents associated with oil or natural gas releases, which have environmentally harmful consequences, are methane and black carbon. Mechanisms that lead to impacts on air quality include:

- Aerosol formation by wind and wave action can transfer oil components into the atmosphere (Aeppli et al., 2013; Arey et al., 2007; de Gouw et al., 2011).
- Evaporation of volatile components degrades air quality in the immediate vicinity of the spilled oil (Hanna and Drivas, 1993; Harrill et al., 2014; Middlebrook et al., 2012).
- A fire or in-situ burning response operations increase emissions of nitrogen oxides (NO_x), SO_2, and CO, but decrease emissions of VOCs as compared to evaporation (Fingas, 2017).
- Response operations increase aircraft, surface vehicle, and ship emissions (Middlebrook et al., 2012).

Additional discussion of the general impacts of oil and gas spills on air quality is provided in the *Beaufort Sea: Hypothetical Very Large Oil Spill and Gas Release* report (BOEM, 2020, Section 4.2.1)

A-3.2.1 Small Oil Spills (<1,000 bbl)

The impacts of small spills at a given location would depend on the time of year; size, location, and duration of the spill; and meteorological conditions such as wind speed and direction. Evaporation of small accidental oil spills would cause brief localized increases in VOCs. However, the volume of VOC emissions resulting from such small spills is not expected to be sufficient to create conditions favorable for the formation of ozone.

The volatile components of diesel fuel would evaporate within the first 6–24 hours for a spill <1 bbl, 2 days for a spill of 50 bbl, and 30 days for a crude spill of 125 bbl (Table A1). This evaporation would potentially cause localized air quality degradation near the spill. Small crude oil spills would take longer to evaporate than refined product spills and result in air quality impacts over an extended timeframe in a localized area.

A-3.2.2 Large Oil Spill (≥1,000 bbl)/Gas Release

A natural gas release could adversely impact air quality, depending on the size and duration of the release and whether it is ignited. While methane, the principle component of natural gas, is a potent greenhouse gas, it is not a regulated criteria pollutant. But when methane is combusted, it generates emissions of NO_2, CO, SO_2, and PM. A condensate or diesel spill would evaporate and disperse within 1–13 days, and 17–20 percent of a crude oil spill would evaporate within 30 days (Table A2). An estimated 26 to 35 km of shoreline, and an area of 992 to 998 km^2 offshore, could be impacted (Table A2). A large, 3,800 bbl spill would increase VOC emissions over a larger area and for a longer period than a small spill. The emissions would continue until all the VOCs evaporated or the oil is removed from the water surface. The crude oil evaporates over 30 days (Table A2).

Offshore, assuming no oil would freeze into the sea ice, the distance, combined with the wind conditions over Cook Inlet, would likely disperse the VOCs. The emissions may be picked up by upper-level winds and transported away.

Emissions of VOCs from oil released near the shoreline could interact with existing NO_x emissions and lead to ozone formation near communities. The ability of VOCs to participate in the formation of ozone would depend on whether the large oil spill occurred in the summer or the winter. Along with a favorable mixing ratio of VOCs to NO_x, the formation of ozone requires sunlight. The intensity of sunshine over southcentral Alaska is moderate in the summer, and the opportunity for ozone formation exists. Ozone formation is unlikely to occur over Alaska in the winter when there is limited sunlight. A large crude oil spill would persist longer in the environment and is more widespread than a small spill.

A-3.2.3 Spill Drills and Response Activities

Emissions associated with spill drills, including GIUEs, would be caused by the combustion of diesel fuels from mobile sources (trucks and vessels). As a result, the dominant air pollutants produced during these exercises are those common to engine combustion: NO_x, $PM_{2.5}$, and PM_{10}. The amounts of emissions released as a part of spill drills are expected to be similar to the everyday emissions from ships regularly operating in that area. The resulting air quality impact would be localized to the immediate spill drill area and would last only for the duration of the drill. Within minutes to hours of the completion of the exercise, the air quality would recover and return to pre-exercise levels. It is likely the exercise would result in little to no air quality impacts.

Three response activities that could affect air quality are use of dispersants, in-situ burning, and mechanical recovery, all of which would include mobile sources of emissions from response vehicles. U.S. Environmental Protection Agency (EPA) suggests that using dispersants for oil spill cleanup would cause little or no impact on air quality (EPA, 2015). Most mobile emissions, including those of trucks or vessels participating in large spill response operations, have a limited impact to the air quality of any specific ground-based location. The dispersion of emissions from a moving source makes the accumulation of pollutants less of a concern at any specific downwind location. Pollutant concentrations decrease with increasing distance from the source. In-situ burning would result in short-term and widespread increases in emissions of NO_x, $PM_{2.5}$, and PM_{10}. Impacts of burning spilled oil are analogous to the emissions from engine combustion (described in EIS Section 4.3.2). In-situ burning also produces soot, or black carbon. This soot may be deposited on ice or snow and cause increased melting because the dark particles absorb heat (the albedo effect). Thus, the consequences of methods used to remove oil may actually outweigh the air quality impacts of the oil itself.

A-3.2.4 Conclusion

Impacts to air quality would be minor for small spills and minor to moderate for a large oil spill. A large gas release would have a minor to moderate impact to air quality, depending on the size of the release, its duration, and whether ignition occurs. Oil spill drills would have negligible impacts to air quality. Spill response and cleanup would have minor to moderate impacts to air quality.

A-3.3 Water Quality

The impacts of oil spills and gas releases on water quality are dependent on the type of oil; its chemical characteristics; how and where the oil is released into the water; the ambient temperature; sediment type and quality; and other environmental factors of the receiving environment at the time of the release. The fate and behavior of spilled oil, including weathering processes, also influence its impacts on water quality (Section A-2.1.2 and A-2.2.2, and BOEM, 2020, Section 4.4). Physical, chemical, and biological processes in the aquatic environment, coupled with the specific composition of the spilled oil, impact water quality.

- Impairment of water quality is regulated through the Clean Water Act administered by the EPA, and the State of Alaska's Water Quality Standards, 18 Alaska Administrative Code (AAC) 70 (ADEC, 2018).

- Water quality impacts are influenced by the spills' initial release to either the surface water, subsurface, or seafloor, affecting the distribution, composition, and persistence of oil constituents (Boehm, Neff, and Page, 2013; Camilli et al., 2010).
- Toxicity and persistence of petroleum hydrocarbons varies with time, specific hydrocarbons, and location within the water column (Allen et al., 2012; Capuzzo, 1987; Neff, 2002; Neff and Durrell, 2011; Speight, 2007; Wiens, 2013).
- Fate, toxicity, bioaccumulation, and bioavailability of petroleum settling to the seafloor or shoreline varies due to sediment type and quality (Allen et al., , 2012; Capuzzo, 1987; Hannam et al., 2009; Neff, 1979, 2002; Neff and Durrell, 2011; Sharma and Schiewer, 2016; Wade et al., 2011; Wang et al., 2003).
- Natural gas displaces oxygen in the water column, and when released at depth, has been linked to an increase of methanotrophic activity (Joye et al., 2011; Valentine et al., 2010; Wimalaratne et al., 2015; Yvon-Lewis et al., 2011).

Additional discussion of the general impacts of oil and gas on water quality is provided in the *Beaufort Sea: Hypothetical Very Large Oil Spill and Gas Release* report (BOEM, 2020, Section 4.2.2).

A-3.3.1 Small Oil Spills (<1,000 bbl)

Refined oils, such as gasoline, diesel, and aviation fuel, are not persistent, do not form emulsions, and usually evaporate rapidly provided they are exposed to air. Refined oils contain only light fractions of hydrocarbons and weather primarily through evaporation. The rate of evaporation accelerates with rising temperature and increased wind speed. Modeled weathering calculations provided in Table A1 show that diesel spills from <1 bbl to 50 bbl evaporate and disperse within 6–24 hours in open water, respectively. Immediate, yet temporary exceedances of water quality standards for total aromatic hydrocarbons (TAHs) would result with water quality expected to return to ambient conditions within 2 days.

By contrast, small crude oil spills persist longer in the environment. These spills have the potential for a greater extent of horizontal and vertical contamination of the surface waters and water column. Hydrocarbons can volatilize into the air, dissolve into the water column or water surface, oxidize via ultraviolet radiation or microbial activity, or emulsify and float or sink to the subsurface (NRC, 2003a). A crude oil spill of 125 bbl would impact water quality longer in summer (>30 days) than in winter (~30 days) (see Table A1) when dispersion and evaporation rates are less due to lower wind speeds and wave heights. A small crude spill, or repetitive small oil spills, in open water would introduce hydrocarbon contaminants of various weights and toxicities into the marine environment, causing a temporary decrease in water quality. During ice season, small crude oil and condensate spills could affect the localized surface quality of ice, as well as surface water quality if the spill occurred in broken ice. TAH concentrations would be more likely to freeze into the ice than to dissolve or disperse. After the onset of melting, oil spilled under ice returns to the surface in an un-weathered state.

A-3.3.2 Large Oil Spill (≥1,000 bbl)/Gas Release

A large, 3,800 bbl oil spill would impact water quality by introducing hydrocarbons onto the sea surface, into the water column, and in seafloor sediments. Crude oil on the sea surface spreads initially under the influence of gravity and surface tension to form slicks with an average thickness of less than 1 millimeter (mm), and often as low as 0.1 millimeters (mm) (Lee et al., 2013). Subsequently, the slick-thickness will either decrease or increase depending on characteristics of the oil, the influence of surface factors (wind, waves, currents, temperature, salinity, etc.), and spill response actions (Beyer et al., 2016). In-situ cold water measurements (Payne et al., 1987) indicated that concentrations of individual components in an oil slick decrease significantly over a period of hours to tens of days. The highest dissolution rates of TAHs from a slick occur in the first few hours of a spill, and they accumulate in the underlying water. Surface oil slicks become patchy, and the total area of widely separated patches is greater than the actual amount of surface area covered by oil.

Oil and oil residues can interact with settling particles in the water column, providing a natural removal process (Tarr et al., 2016). Polycyclic aromatic hydrocarbons (PAHs), a component of total aqueous hydrocarbons (TAqH), from any discharge quickly attach onto particulate matter, and large amounts from the water are then deposited in bottom sediments where they are readily accumulated by aquatic biota (Neff, 1986). A small portion of the oil from a surface spill would be deposited in the sediments in the immediate vicinity of the spill or along the pathway of the slick. The observed range in deposition of oil in bottom sediments following offshore spills is 0.1–8 percent of the slick mass (Jarvela et al., 1984). Generally, the higher percentage of deposition occurs in spills nearshore where surf, tidal cycles, and other inshore processes can mix oil into the bottom. Farther offshore, where suspended sediment loads are generally lower, only about 0.1 percent of the crude would be incorporated into sediments within the first 10 days of a spill (Manen and Pelto, 1984).

An oil spill during the winter could occur in broken ice conditions. The oil would freeze into, move with, and melt out of the ice the following spring. Oil-contaminated ice could drift for tens of km prior to melting out. Due to the reduced wave-induced emulsification process, oil released from the ice would have the characteristics of fresh oil (Barber et al., 2014). Decomposition and weathering processes for oil are much slower in cold waters than in temperate regions due to lower evaporation rates. Refined oils, condensates, and diesel products, would weather much more quickly than crude oil, as described above, and would be generally dispersed within 2 days. After 30 days, approximately 3–24 percent of crude oil is estimated to remain in open water and 61 percent in ice (Table A2).

Severe, potentially widespread and long-lasting impacts to water quality and exceedances of Alaska's water quality standards for both TAH and TAqH 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).

Little to no water quality impacts are expected during the short, 1-day duration of the gas release, but water 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 gaseous methane would react with air forming water and carbon dioxide (CO_2), which would then disperse into the atmosphere. The higher concentration of CO_2 near the surface would affect chemical and biological processes and reactions at the water-air interface such as egg and larvae respiration (GESAMP, 1995).

A-3.3.3 Spill Drills and Response Activities

There is potential for small, refined vessel oil spills during spill drills, including GIUEs; however, these events are infrequent and of short duration (<8 hours) and would result in little to no impact on water quality. Additional impacts on water quality would occur from spill response and cleanup activities for large oil spills, including impacts from vessels, in-situ burning of oil, dispersant use, and activities on shorelines associated with cleanup, booming, beach cleaning, and monitoring (BOEM, 2019). Permitted and incidental discharges from spill response vessels would temporarily impact localized water quality by increasing levels of low molecular weight hydrocarbons (TAH). However, the volatility of TAHs results in very short-term exposure durations, particularly if the source is intermittent as from passing motorized watercraft. Exposure to elevated TAH concentrations is likely in instances when watercraft are numerous and in a particular area for sustained periods. In-situ burning has the potential to impact water quality by increasing surface water temperatures while the oil slick is burning. Temperatures of crude oil burns on water vary from 900°C to 1,200°C; however, the temperature at the oil slick/water interface is never more than the boiling point of water and is usually around ambient temperature (Mullin and Champ, 2003). Any increase of surface water temperature would be temporary and short-term, if at all, returning to ambient temperature when the burning stops. Additionally, in-situ burning produces viscous oil and soot residues that initially float but may sink as they cool. In-situ residues (i.e., “tar paddies”) exhibit little water solubility and have no detectable acutely toxic compounds (Mullin and Champ, 2003). Toxicity of dispersants to aquatic life are species- and chemical-specific, but dispersant persistence and toxicity levels have been documented in the water column and marine sediments (Lewis and Pryor, 2013; White et al., 2014). Shoreline spill response activities disturbing contaminated shoreline sediments can reintroduce stranded oil from back into the water column and drive contaminates farther into shoreline sediments. Weathered, and more viscous higher molecular weight hydrocarbons would most likely be present, and although lower in toxicity, these PAHs can persist for decades in sediment.

A-3.3.4 Conclusion

Oil spills or a gas release could affect marine coastal, and tidal riverine waters with potentially toxic levels of hydrocarbons until the process of dispersion, dilution, degradation, and weathering reduce oil and oil residue concentrations. A small spill would cause minor impacts and would not result in any long-lasting change to water quality nor its function in the ecosystem, whereas a large spill would cause moderate impacts to water quality based on the volume of oil spilled. A large gas release or spill drills would cause negligible impacts to water quality, and spill response and cleanup actions would cause negligible to minor impacts.

A-3.4 Coastal and Estuarine Habitat

The magnitude and severity of oil spill impacts to coastal and estuarine habitats are contingent upon the type and amount of spilled oil, substrate and shoreline type, amount of vegetation coverage, plants’ seasonality at the time of the release (spring vs. fall), depth of penetration of the oil into the sediments, and type and effectiveness of any cleanup or remedial actions (NRC, 2003a). Oil spill impacts to coastal and estuarine habitat include:

- Impacts of persistent crude oil to wetlands and shoreline with permeable, fine-grained sediments include habitat smothering and oiling of beaches (Atlas and Bragg, 2013; Harper and Morris 2014; Mendelssohn et al., 2012; Michel et al., 2017; Michel and Rutherford, 2013).
- Crude oil exhibits less toxicity to plants than refined products such as diesel, however repetitive oiling to the root zone can cause plant death (Achuba, 2006; Hester and Mendelssohn, 2000; Jorgenson, 1997; Lin and Mendelssohn, 1996, 2012; McKendrick, 2000; Walker et al., 1978).
- Rehabilitation and restoration of vegetation from oil and diesel spills can be long-term with oil byproducts remaining in the soil for many years (Conn et al., 2001; Jorgenson et al., 2003; McKendrick and Mitchell, 1978).

Additional discussion of the general impacts of oil and gas on wetlands and vegetation is provided in the *Beaufort Sea: Hypothetical Very Large Oil Spill and Gas Release* report (BOEM, 2020, Section 4.2.3), and that analysis is incorporated by reference.

A-3.4.1 Small Oil Spills (<1,000 bbl)

Small offshore spills of light refined oil products can directly damage or kill vegetation by penetrating and destroying plant tissues (Behr-Andres et al., 2001). Diesel or refined product spills (<1–50 bbl) are estimated to evaporate in 24 hours in summer, and 6 hours in winter (Table A1). However, despite their evaporation rates, direct contact by diesel or refined product spills of any size could impact and cause lethality to emergent wetland vegetation. In contrast, crude oil shows little direct toxic effects to most plants unless the plant is heavily oiled, is a sensitive species, or oil has penetrated the soil/sediment and the roots are continuously exposed to oil. For a 125-bbl crude oil spill in summer, 24 percent remains after 30 days; in winter, 3 percent remains after 30 days (Table A1). Because of the rapid dispersion and evaporation during summer, it is very unlikely that impacts or injury to coastal and estuarine habitats, including wetlands and vegetation, would result from an offshore summer crude oil spill. Moreover, the majority of offshore small spills are contained on a vessel or platform, and spills making contact with water are expected to be contained by appropriate spill response activities. During winter, ice or snow could act as a barrier preventing oil and refined product from contacting estuaries, saltwater wetlands, and shorelines.

Most onshore small diesel spills are expected to occur during refueling on established roads or pads and are unlikely to contact wetland vegetation. Should a diesel spill occur during summer, direct contact with vegetation would result in immediate injury and potential lethality to vegetation. A 125-bbl crude oil spill has the potential to impact terrestrial vegetation and wetlands, particularly if the spill occurred during the summer. The spatial extent of impacted terrestrial wetland habitat depends upon wind and weather conditions at the time of the release, and the type of pipeline failure (pinpoint vs. rupture). Under windy conditions, a pressurized aerial mist could spray crude oil and impact many acres, but long-term injury resulting from heavy oiling or root penetration would not be expected. Winter spills with adequate snow cover are more readily cleaned up because contaminants can be removed as frozen material and soil penetration of oil contaminants is minimal (McKendrick, 2000).

A-3.4.2 Large Oil Spill (≥1,000 bbl)/Gas Release

An offshore large crude or refined oil spill during summer or broken-ice conditions could impact coastal and estuarine habitats, including shorelines, supratidal, intertidal, and subtidal communities. A large spill of crude oil would persist longer in the environment and result in greater, long-term impacts than spills of refined products which weather more rapidly. A 3,800-bbl crude oil spill in Cook Inlet is estimated to oil 35 km (21 miles (mi)) of coastline in summer and 26 km (16 mi) in winter (Table A2).

Alaska's coastal and estuarine habitats are rich in biological resources that are sensitive to spilled oil. During summer, these habitats are ideal environments for migratory birds, fish, invertebrates, and foraging mammals. Coastal and estuarine habitats of Cook Inlet are varied and have different vulnerabilities to oil exposure; persistence of oil also varies between supratidal, intertidal and subtidal habitats once exposed. Porosity of the shoreline substrate is an important determinant of the extent to which a shoreline may be impacted by an oil spill. Shorelines in upper Cook Inlet are primarily sheltered tidal flats and salt marshes, which are highly sensitive to oil spill impacts and would be expected to retain spilled oil longer with longer-lasting impacts on biota (Culbertson et al., 2008). In contrast, shorelines in middle Cook Inlet are characterized by exposed tidal flats that are less sensitive to oiling (NOAA, 2002). Exposed rocky cliffs, headlands, and sheltered rocky coasts are characteristic shoreline types in lower Cook Inlet.

BOEM analyzed the vulnerability of Cook Inlet's coastal and estuarine habitats to an oil spill (BOEM, 2016-069, Section 4.3.9.5, pp 4-179 through 4-184) and that analysis is incorporated by reference. BOEM's full analysis includes a thorough explanation of the vulnerability of Cook Inlet's diverse shorelines, supratidal, intertidal, and subtidal communities to oil impacts, and the relevant assumptions for these explanations. Specifically, this analysis includes a description of the impacts of the Exxon Valdez Oil Spill (EVOS) to different shore types in Prince William Sound, on the Kenai and Alaska Peninsulas, and in the Kodiak Archipelago. The environmental sensitivity index (ESI) used both in the EVOS and this OSRA, ranks shoreline types on a scale from 1 to 10 (10 being the most sensitive) based on predicted sensitivity to disturbance from oil spills and cleanup operations. Although the EVOS was a VLOS event spilling a much greater volume of crude oil than a large oil spill, the vulnerability and persistence of oil pollution to the various shore types and coastal habitats of Prince William Sound impacted by the EVOS, is pertinent to the shore types and coastal habitats found in Cook Inlet.

The concentration of low-molecular-weight alkanes and aromatics in crude oil is a primary determinant of toxicity. Heavy and medium crude oils exhibit a low level of direct toxicity upon contact to plants, whereas light crudes and refined products, such as diesel, can cause necrosis and plant mortality on contact (Mendelssohn et al., 2012). Oil and oil residues stranded in emergent wetland vegetation would be expected to persist for decades due to lower rates of dispersion and degradation. Destruction of emergent vegetation could occur if oil penetrates the root system (Mendelssohn et al., 2012). Oil contamination could persist for many years as oil in the sediments could be released back into the environment as a result of erosion or exposure of oiled sediments and soils. Oil persistence in marsh sediments could impact microbial communities in the soil and sediment resulting in long-term wetland effects and potential slow recovery (Delaune et al., 1990; Teal and Howarth, 1984; Teal et al., 1992).

An offshore gas release is expected to travel through the water column and dissipate quickly; coastal and estuarine habitats near the gas release could be exposed to lower oxygenated waters, however little to no impacts to coastal and estuarine habitats would be expected.

A large onshore spill of crude, condensate, or diesel would impact terrestrial vegetation and wetlands. The areal extent of the spill would depend on the season, wetland and soil type, wind conditions, and type of pipeline spill (rupture versus pinhole) at the time of the release. Should a pressurize pipeline fail and oil spray into the air, under windy conditions oil may be carried downwind and deposited over a widespread area (NRC, 2003b). During summer, a large spill could saturate wetland soils, penetrate the active layer of the soil and by coating plants' roots and rhizomes cause severe and detrimental impacts to wetland vegetation. In the case of a refined petroleum spill where direct toxicity is substantial, mosses and aboveground vascular plants would be killed on contact. During winter, snow and ice buffers vegetation from oil impacts and limits the extent of oil spreading. Cold temperatures would further retard oil from spreading, reducing the areal extent of impact.

An onshore gas release could result in thermal impacts to terrestrial vegetation and wetlands should ignition occur. The areal extent of thermal impacts and burning of vegetation would depend on the season, weather conditions, moisture content of vegetation, and suppression efforts. Little to no impacts to vegetation and wetlands is expected under most situations, unless an explosion, ignition, or fire ensues resulting in severe impacts.

A-3.4.2.1 Oil Spill Risk Analysis

The OSRA acronyms are LS Land Segment, LA Launch Area; and PL Pipeline. BOEM identified 112 LSs and their environmental sensitivity index (ESI) for this analysis (Ji and Smith, 2021; Tables A.1-11 and A.1-12; Figures B-3a–3d). The ESI is a numerical index ranking the vulnerability of a coastline's natural characteristics to impacts from oil spills. The higher the ESI number, the more vulnerable the coastline is to oil spills.

Conditional Probabilities. Table A5 and Figure A2 display 39 LSs with a ≥1 percent chance of contact in summer or winter. Although every LS in Table A5 has a chance of contact, most of these contacts range from 1–5 percent. For this analysis, only the 11 LSs with a ≥6 percent chance of contact during summer or winter are discussed further (Table A5). Overall, the pattern of contact from north to south, on western and eastern shorelines is similar between summer and winter seasons. The western LSs have a greater chance of contact than the eastern LSs, and the more northern LSs have a greater chance of contact than the southern LSs. As identified by the ESI (Ji and Smith, 2021, Table A.1-12), most of the shorelines within the LSs, are characteristically mixed sand/gravel beaches, exposed and sheltered tidal flats, wave-cut bedrock, and salt/brackish water marshes.

Summer. For a summer spill, 8 western LSs from Redoubt Point (36) to Amakdedulia Cove, Bruin Bay, Chenik Head (28), and Augustine Island (29) have a chance of contact. The highest chance of contact is the most northern of the contacted western LSs at Redoubt Point (36) from a LA1 spill (Ji and Smith, 2021, Table A.2-29). Chinitna Bay (33) has the greatest chance of contact from all LAs and PLs, and the chance of contact decreases steadily to Amakdedulia Cove, Bruin Bay, Chenik Head (28) in the south. Three eastern LSs have a similar chance of contact from a spill in LA6 or LA5: Cape Starichkof, Happy Valley (56), Barbara Point, Seldovia Bay (61) and Nanwalek, Port Graham (62) (Ji and Smith, 2021, Table A.2-29).

Winter. A winter spill has a chance of contacting the same western LSs as identified above for summer, with the addition of Iliamna Point (34). Chinitna Bay (33), as for a summer spill, has the greatest chance of contact from all LAs and PLs, and the chance of contact decreases steadily to the south at Amakdedulia Cove, Bruin Bay, Chenik Head (28). Only two eastern LSs, Cape Starichkof, Happy Valley (56) and Port Graham (62), have a chance of contact from LA6 and PL2, respectively (Ji and Smith, 2021, Table A.2-49).

Table A5: Highest Percent Chance of a Large Spill Contacting Coastal and Estuarine Resources (Assuming a Large Spill Occurs)[1]

OSRA Feature Type	Highest Chance of Contact	Summer: 30 days	Winter: 30 days
LS	≥0.5–<6	18, 19, 20, 21, 22, 23, 24, 25, 26, 34, 37, 38, 40, 54, 55, 57, 58, 60, 63, 79, 80, 81, 82, 83, 84, 85, 86, 87	21, 22, 23, 24, 25, 26, 27, 37, 38, 39, 40, 54, 55, 57, 58, 60, 61, 63, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88
LS	≥6–<25	28, 29, 30, 31, 32, 33, 35, 36, 56, 61, 62	28, 29, 30, 31, 32, 33, 34, 35, 36, 56, 62
Names of LSs Contacted: 18 Alinchak Bay, Cape Kekurnoi, Bear Bay; 19 Cape Kubugakli, Kashvik Bay, Katmai Bay; 20 Amalik, Dakavak and Kinak Bays, Cape Iiktugitak, Takli Island; 21 Kaflia Bay, Kukak Bay, Kuliak Bay, Missak Bay; 22 Devils Cove, Hallo Bay; 23 Cape Chiniak, Swikshak Bay; 24 Fourpeaked Glacier; 25 Cape Douglas, Sukoi Bay; 26 Douglas River; 27 Akumwarvik Bay, McNeil Cove, Nordyke Island; 28 Amakdedulia Cove, Bruin Bay, Chenik Head; 29 Augustine Island; 30 Rocky Cove, Tignagvik Point; 31 Iliamna Bay, Iniskin Bay, Ursus Cove; 32 Chinitna Point, Dry Bay; 33 Chinitna Bay; 34 Iliamna Point; 35 Chisik Island, Tuxedni Bay; 36 Redoubt Point; 37 Drift River, Drift River Terminal; 38 Kalgin Island; 39 Seal River, Big River; 40 Kustatan River,West Foreland; 54 Clam Gulch, Kasilof; 55 Deep Creek, Ninilchik, Ninilchik River; 56 Cape Starichkof, Happy Valley; 57 Anchor Point, Anchor River; 58 Homer, Homer Spit; 59 Fritz Creek, Halibut Cove; 60 China Poot Bay, Gull Island; 61 Barabara Point, Seldovia Bay; 62 Nanwalek, Port Graham; 63 Elizabeth Island, Port Chatham, Koyuktolik Bay; 79 Barren Islands, Ushagat Island; 80 Amatuli Cove, East & West Amatuli Island; 81 Shuyak Island; 82 Bluefox Bay, Shuyak Island, Shuyak Strait; 83 Foul Bay, Paramanof Bay; 84 Malina Bay, Raspberry Island, Raspberry Strait; 85 Kupreanof Strait, Viekoda Bay; 86 Uganik Bay, Uganik Strait, Cape Ugat; 87 Cape Kuliuk, Spiridon Bay, Uyak Bay; 88 Karluk Lagoon, Northeast Harbor, Karluk.			

Notes: [1] Highest percent chance from any launch area (LA) or pipeline area (PL) during summer or winter assuming a large spill occurs. Note that all LSs with <0.5 percent chance of contact are not shown.

Source: Ji and Smith (2021).

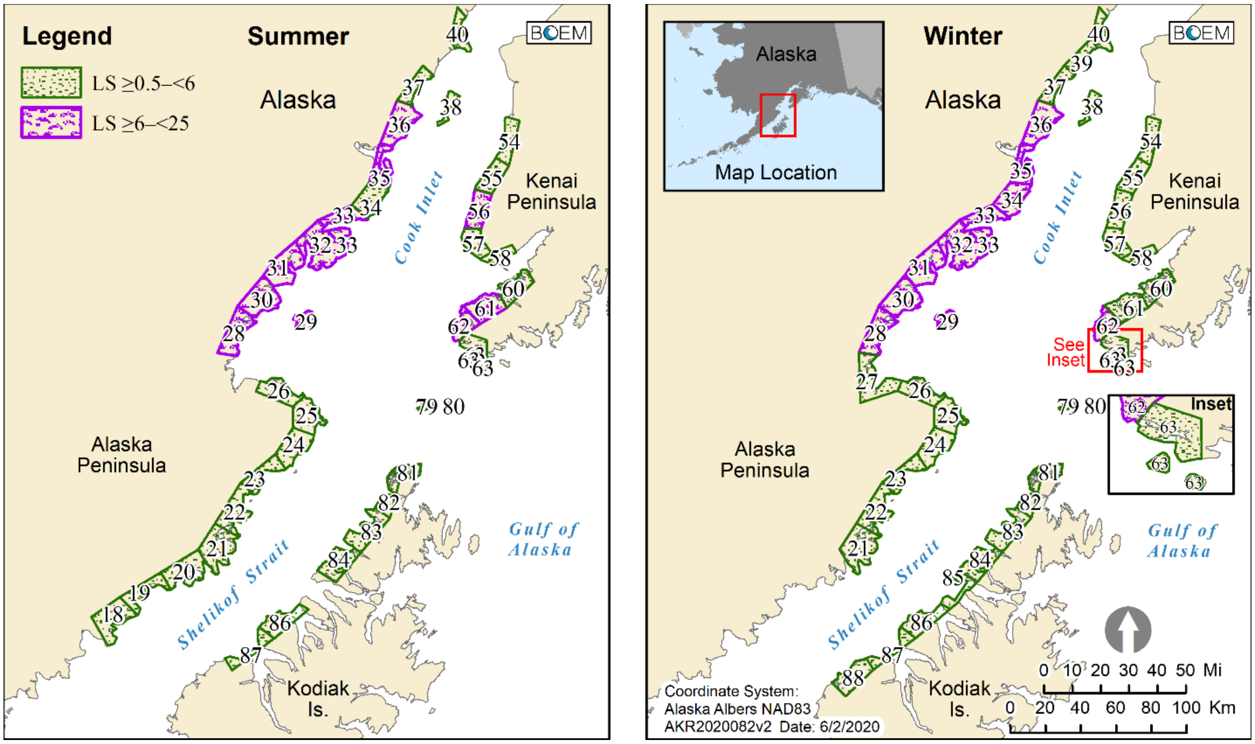

Figure A2: Location and ID number of Land Segments (Assuming a Large Spill Occurs ≥1% Chance of Contact within 30 Days): Summer and Winter

Combined Probabilities. The OSRA model estimates a <1–3 percent chance of one or more large spills occurring and contacting LSs 25, 28–36, 56, and 62 within 3 to 30 days (Ji and Smith, 2021, Table A.2-62). The greatest chances of occurrence and contact within 30 days are 3 percent for Chinitna Bay (33) and 2 percent for Chisik Island, Tuxedni Bay (35), both located on the western coastline of Cook Inlet; LSs 25, 28–32, 34, 36, 56 and 62 all have a 1 percent chance of occurrence and contact.

A-3.4.3 Spill Drills and Response Activities

Spill drills, including GIUEs, would be infrequent and localized and are expected to have little to no impacts to coastal and estuarine habitats.

Skimming, booming, in-situ burning, and other spill response and cleanup operations can be effective means of preventing offshore oil spills from reaching coastal and estuarine habitats, and shorelines (BOEM, 2019). Spill cleanup operations might impact coastal beaches if the removal of contaminated substrates affects beach stability and results in accelerated shoreline erosion. Vehicular and foot traffic during cleanup could mix surface oil into the subsurface, where it would likely persist for a longer time. Manual cleanup, rather than the use of heavy equipment, would minimize the amount of substrate removed due to effects of motorized vehicles on fragile soils.

Spill response for onshore contaminated wetland vegetation usually involves low pressure flushing to mobilize the oil and remove it, along with removal of the most highly contaminated soils. Scraping the surface is designed to leave plant parts (roots, rhizomes) intact so that sprouting will occur the following spring (Cater et al., 1999). Faster rehabilitation of vegetation and wetlands occurs if spill cleanup is aided by use of fertilizers and other bioremediation applications (McKendrick, 2000a

A-3.4.4 Conclusion

The environmental conditions at the time and location of an oil spill, the habitat type and substrate of the shoreline, oil type, and size of the spill are critical factors that influence the extent of impacts to coastal and estuarine habitats. Oil contamination on shorelines, supratidal, intertidal and subtidal habitats consisting of tidal flats, sand/gravel beaches, rocky shores, and saltwater marshes would have long-term and widespread impacts for many years. Impacts would be negligible to minor for small spills, and moderate to major for a large oil spill, contingent upon these defining factors. A negligible to minor impact would not result in any long-lasting detrimental effects on the overall ecological functions, species abundance, or composition of marine or freshwater wetlands or plant communities of Cook Inlet. A large gas release would have negligible impacts to coastal and estuarine habitats, unless there is an associated explosion or ignition, in which case impacts to wetlands and vegetation could be major. Spill response and cleanup activities, or spill drills, are expected to have negligible impacts to coastal and estuarine habitats, particularly if cleanup activities occur during the winter season.

A-3.5 Invertebrates and Fish

Exposure to oil or its toxic components causes lethal to sublethal toxicity to marine invertebrates. Impacts of oil on marine invertebrates vary depending on level of exposure, life history, feeding behavior, and ability of a species to metabolize toxins. Benthic and planktonic invertebrates are exposed to oil in different ways and vary in their ability to avoid exposure. Impacts from a spill can occur through exposure to toxins, changes in oxygen and light availability in the water, and physical damage to organisms by settled oils. Adverse impacts to fish and fish habitat from spills can occur in both freshwater and marine environments. Impacts can occur through exposure of various life stages of fish to toxins, impacts to prey and interference with access to important habitat areas. Although oil is toxic to fish at high concentrations, certain species are more sensitive than others, and oil can have toxic effects even in low concentrations. Potential impacts to marine invertebrates and fish related to accidental spills include the following:

- Direct toxic effects to marine invertebrates can include lethal or sublethal consequences such as impacts on biomass and community composition, as well as impacts on behavior, reproduction, growth and development, immune response, and respiration (Auffret et al., 2004; Bellas et al., 2013; Blackburn et al., 2014; Hannam et al., 2010).
- Spills that are not immediately lethal can have short- or long-term impacts on biomass and community composition, behavior, reproduction, feeding, growth and development, immune response, and respiration (Blackburn et al., 2014; Dupuis and Ucan-Marin, 2015). The level of toxicity is influenced by how marine invertebrates are exposed, their life history, feeding behavior, and ability of a species to metabolize toxins.
- Chronic exposure to oil and its byproducts can cause cellular damage and impair feeding, mobility, reproduction, growth, and development in marine invertebrates (Bellas et al., 2013; Blackburn et al., 2014).
- Indirect toxic effects can occur through the inhibition of air-sea gas exchanges and hypoxia from the degradation of oil (Abbriano et al., 2011; Blackburn et al., 2014; Ozhan et al., 2014).
- Other lethal or sublethal impacts include physical smothering of organisms by settled oil and reduced photosynthesis through changes in light penetration into the water column (Blackburn et al., 2014; González et al., 2013; Ozhan et al., 2014).
- Oil or its toxic components in plankton can biomagnify/bioaccumulate through food webs and affect higher trophic levels (Blackburn et al., 2014). This can reduce prey availability for fish and other marine animals.
- Immediate mortality or other sublethal impacts to fish can occur, such as abnormal development and growth, reproductive damage, and behavioral changes (Carls et al., 1999; Dupuis and Ucan-

Marin, 2015; Hjermann et al., 2007; Incardona, 2017; Nahrgang et al., 2016; Rice et al., 2000; Short, 2003).

- Toxic concentrations can build up in coastal areas where oil is trapped in shallow bays and inlets, and presence of oil can interfere with fish spawning or access to spawning grounds (Heintz et al., 2000; Wertheimer et al., 2000).

Additional discussion of the general impacts of oil and gas on invertebrates and fish is provided in the *Beaufort Sea: Hypothetical Very Large Oil Spill and Gas Release* report (BOEM, 2020, Sections 4.2.4 and 4.2.5).

A-3.5.1 Small Oil Spills (<1,000 bbl)

Small spills would have localized adverse impacts to planktonic and benthic invertebrates and fish. Toxic effects on organisms could occur in the immediate area of a spill. The majority of small spills are estimated to be less than 50 bbl (EIS, Table 3-1), and the impacts on invertebrates and fish would be short-term and localized to the spill area. Impacts to the overall marine invertebrate and fish populations of Cook Inlet would not likely be detectable for small, isolated accidental spills, especially if contained by platform or ice, or are cleaned up before they enter the water column. Most refined small spills that reach the water column will evaporate and disperse within days, which would limit the number of individuals exposed to the toxic effects. A crude oil spill of 125 bbl would likely affect a larger area, and therefore a greater number of fish and invertebrates, but population level impacts from that isolated event are not anticipated.

Chronic, repeated small oil spills could have an extended adverse effect on invertebrates and fish because residual oil can build up in sediments and affect living marine resources. However, these impacts would be limited to discrete areas around the development facilities. Planktonic invertebrate species would quickly repopulate the area via currents and no long-term population impacts are expected. Pelagic fish are expected to avoid the area, thus limiting the number of individuals exposed. Benthic invertebrate and fish communities that are exposed to chronic small spills may experience impacts for multiple generations. These impacts to benthic communities would be limited to the immediate area of the development facilities and would not result in population-level impacts when considering Cook Inlet as a whole. Over the life of the E&D Scenario, invertebrate and fish communities would not generally experience widespread, multi-year, multi-generational impacts.

A-3.5.2 Large Oil Spill (≥1,000 bbl)/Gas Release

Impacts of a large, 3,800 bbl spill on invertebrates and fish would be of greater magnitude and severity than from a small spill. In general, a greater area would be oiled, and more individuals would be impacted depending on the location, volume, trajectory of the spill, and the time of year it occurs. Oil spilled on landfast ice may not reach the water column in the winter, however, a spill occurring in winter may persist for a longer period than during ice-free conditions (Drozdowski et al., 2011), resulting in larger impacts on invertebrates and fish if it is trapped under the ice. The conditional analysis below shows resource areas that have the highest chances of contact for spill locations adjacent to them.

Spilled oil would dilute slowly when ice is present, and more swiftly in open water conditions. Most VOCs in spilled oil would evaporate within a couple of days, although some of the remaining oil could adhere to particles and sink to the seafloor and remain in the sediment. A large crude oil spill would persist longer in the environment and could result in greater impacts to benthic invertebrates and fish than small spills. Migratory and anadromous fish, including several species of forage fishes, could experience adverse effects from a large oil spill in spawning and rearing habitats. Impacts of a large spill in nearshore intertidal areas could persist for generations and might have additive impacts by affecting more than one life stage. Adverse impacts from a large spill, including mortality and community structure changes, could be widespread and persist for multiple generations.

A large gas release and potential ignition or explosion could cause death or physical damage to organisms in the immediate vicinity. Fish mortality associated with a gas release could range from only a few to hundreds of individuals. However, such an event would likely involve several species of fish and invertebrates, with no expected population-level impacts. Overall, mortality associated with a release is expected to have very short-term impacts on invertebrates and fish in the immediate area and little to no impacts on the overall invertebrate and fish communities.

A-3.5.2.1 Oil Spill Risk Analysis

BOEM identified 5 lower trophic (fish and invertebrates that are food for other animals) resource areas and 104 anadromous fish resource areas for the analysis (Ji and Smith, 2021; Tables A.1-2, and A.1-3; Figures B-2a; B-3a–d, and B-4a.1). The OSRA acronyms are: ERA Environmental Resource Area; LS Land Segment; and GLS Grouped Land Segment.

Conditional Probabilities. Conditional probabilities help illustrate the biologically important areas that may be contacted and assume that a spill occurs. Table A6 and Figure A3 and Figure A4 show resource areas with a ≥0.5 percent chance of contact in summer or winter. This analysis focuses on resource areas that have a ≥6 percent chance of contact. Depending upon the timing of seasonal ice and location of the spill, seasonal ice could affect the chance of a spill contacting nearshore resource areas.

Summer. All five of the ERAs identified for lower trophic organisms have ≥6 percent chance of being contacted by a spill occurring in the summer or winter (Table A6; ERAs 11, 153–155, GLS 138); two have ≥50 percent chance. In contrast, only 10 of 104 anadromous fish resources exceeded a 6 percent chance of contact (Table A6; LSs 28, 30–36, 56, 61, and 62). These LSs, which identify important spawning stream locations, are located adjacent to the middle of the Lease Sale Area, and with the exception of the area near Anchor Point, occur on the western edge of the Lease Sale Area. The chance of contact for lower trophic ERAs and GLSs ranged from ≥0.5–89 percent, while LSs that contained anadromous fish streams had comparatively low chances of contact that ranged from ≥0.5–20 percent.

In general, chances of contact are higher for an area when the spill originates close to the resource. For example, for invertebrates, the Barren Islands (155) have the lowest chance of contact and Polly Creek Beach (153) has the highest, except when the spill occurs in the lower portion of the Lease Sale Area. Oil spills originating from the upper and middle part of the Lease Sale Area are more likely to contact important resource areas than spills originating from the lower part of the Lease Sale Area. Regardless of where the spill occurs, Augustine (11), important for lower trophic organisms, shows consistent chances of contact, with higher chances of contact for spills occurring closest to the ERA. Of anadromous fish resources, Chinitna Bay has the most consistent risked contact, although Redoubt Point and Tuxedni Bay had the highest likelihoods to be contacted by a spill occurring in the summer and winter, respectively.

Winter. In general, the resource areas important for lower trophic organisms that are contacted by a large winter spill are the same as the summer, with relatively similar probabilities of contact. Some areas are higher, and some areas are lower, likely due to the expected influence of ice. The Clam Gulch (138) and the LS near Anchor Point (56) decrease to <6 percent in winter.

Table A6: Highest Percent Chance of a Large Oil Spill Contacting Lower Trophic Level or Anadromous Fish Resources (Assuming a Large Spill Occurs)[1]

OSRA Resource Type2	Highest Chance of Contact	Summer: 30 days	Winter: 30 days
ERA	≥0.5–<6	--	--
ERA	≥6–<25	154, 155	154 155
ERA	≥25–<50	--	--
ERA	≥50	11, 153	11, 153
GLS	≥0.5–<6	--	--

OSRA Resource Type2	Highest Chance of Contact	Summer: 30 days	Winter: 30 days
GLS	≥6–<25	138	138
LS	≥0.5–<6	18, 19, 20, 21, 22, 23, 24, 25, 26, 34, 37, 38, 40, 54, 55, 57, 58, 60, 63, 81, 82, 83, 84, 85, 86, 87	21, 22, 23, 24, 25, 26, 27, 37, 38, 39, 40, 54, 55, 57, 58, 60, 61, 63, 81, 82, 83, 84, 85, 86, 87, 88
LS	≥6–<25	28, 30, 31, 32, 33, 35, 36, 56, 61, 62	28, 30, 31, 32, 33, 34, 35, 36, 56, 62

Names of ERAs Contacted: 11 Augustine; 153 Polly Creek Beach; 154 Chinitna Bay; 155 Barren Islands.
Names of GLSs Contacted: 138 Clam Gulch Critical Habitat
Names of LSs Contacted: 18 Alinchak Bay, Cape Kekurnoi, Bear Bay; 19 Cape Kubugakli, Kashvik Bay, Katmai Bay; 20 Amalik, Dakavak and Kinak Bays, Cape Iiktugitak, Takli Island; 21 Kaflia Bay, Kukak Bay, Kuliak Bay, Missak Bay; 22 Devils Cove, Hallo Bay; 23 Cape Chiniak, Swikshak Bay; 24 Fourpeaked Glacier; 25 Cape Douglas, Sukoi Bay; 26 Douglas River; 27 Akumwarvik Bay, McNeil Cove, Nordyke Island; 28 Amakdedulia Cove, Bruin Bay, Chenik Head; 29 Augustine Island; 30 Rocky Cove, Tignagvik Point; 31 Iliamna Bay, Iniskin Bay, Ursus Cove; 32 Chinitna Point, Dry Bay; 33 Chinitna Bay; 34 Iliamna Point; 35 Chisik Island, Tuxedni Bay; 36 Redoubt Point; 37 Drift River, Drift River Terminal; 38 Kalgin Island; 39 Seal River, Big River; 40 Kustatan River,West Foreland; 54 Clam Gulch, Kasilof; 55 Deep Creek, Ninilchik, Ninilchik River; 56 Cape Starichkof, Happy Valley; 57 Anchor Point, Anchor River; 58 Homer, Homer Spit; 59 Fritz Creek, Halibut Cove; 60 China Poot Bay, Gull Island; 61 Barabara Point, Seldovia Bay; 62 Nanwalek, Port Graham; 63 Elizabeth Island, Port Chatham, Koyuktolik Bay; 81 Shuyak Island; 82 Bluefox Bay, Shuyak Island, Shuyak Strait; 83 Foul Bay, Paramanof Bay; 84 Malina Bay, Raspberry Island, Raspberry Strait; 85 Kupreanof Strait, Viekoda Bay; 86 Uganik Bay, Uganik Strait, Cape Ugat; 87 Cape Kuliuk, Spiridon Bay, Uyak Bay; 88 Karluk Lagoon, Northeast Harbor, Karluk.

Notes: -- No highest percent chance in this range.

[1] Highest percent chance from any launch area (LA) or pipeline area (PL) during summer or winter assuming a large spill occurs. Note that all resource areas with <0.5% chance of contact are not shown.

[2] Invertebrates and Fish are represented by ERAs and GLSs. Anadromous Fish resources areas are represented by LSs.

Source: Ji and Smith (2021).

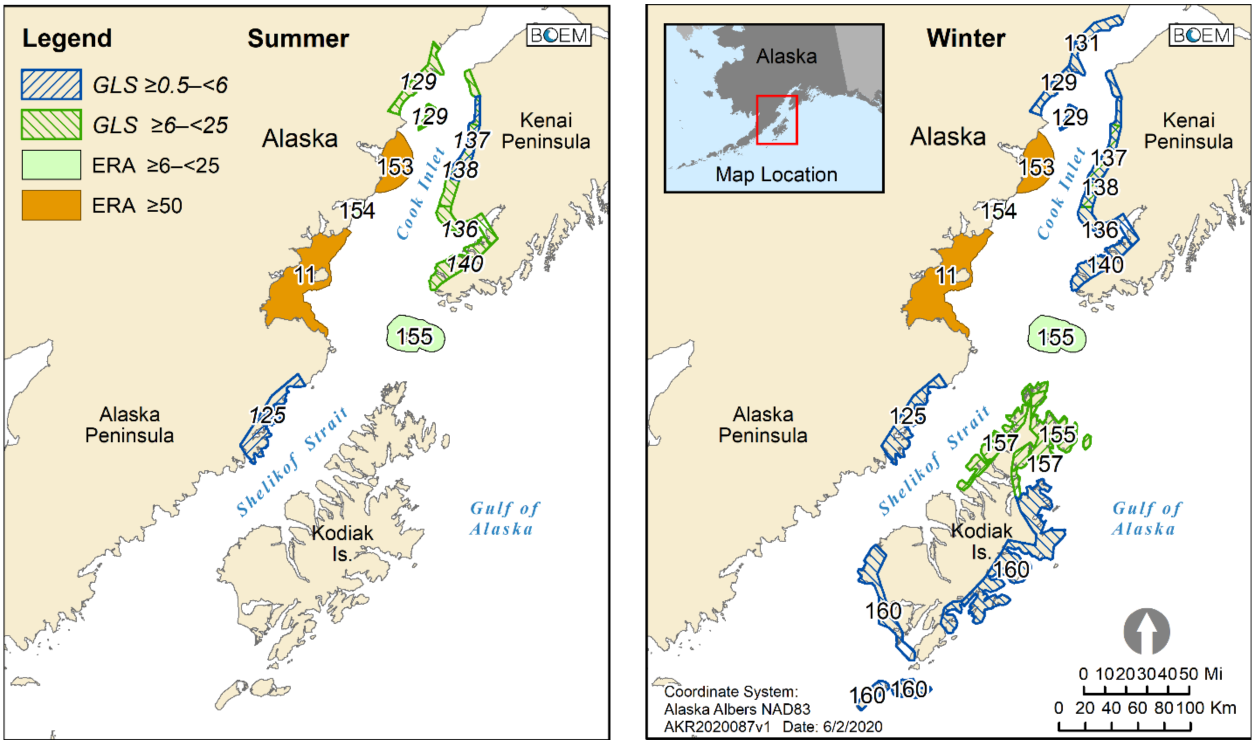

Figure A3: Location and ID number of Invertebrate Resource Areas (Assuming a Large Spill Occurs ≥1% Chance of Contact within 30 Days): Summer and Winter

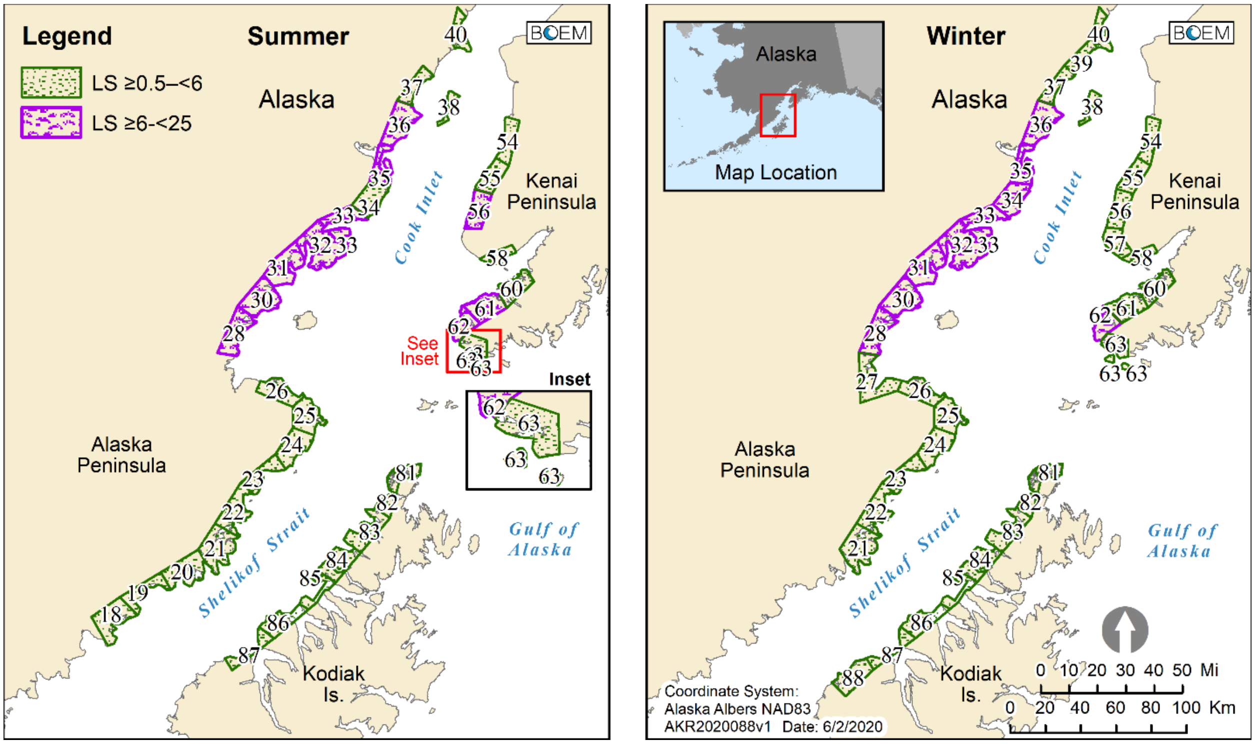

Figure A4: Location and ID number of Anadromous Fish Resource Areas (Assuming a Large Spill Occurs ≥1% Chance of Contact within 30 Days): Summer and Winter

Combined Probabilities. When analyzing the combined probabilities, the resource areas for lower trophic organisms that are impacted are generally the same ones described in the conditional analysis, but the magnitude of contact is reduced due to factoring in the probability of a large spill occurring. Most areas have a combined probability of occurrence and contact <1 percent within 30 days; the highest is Augustine (11), which has a 6 percent chance within 30 days.

A-3.5.3 Spill Drills and Response Activities

Spill drills, including GIUEs, would impact invertebrates and fish through vessel traffic, noise, and discharges, and possibly through testing of mechanical recovery methods. Spill response activities could include mechanical recovery methods and in-situ burning, as well as use of dispersants (BOEM, 2019). Increased vessel traffic, with corresponding increases in vessel discharges and noise, would also be associated with spill cleanup. If cleanup operations include sections of the beach or intertidal zones, access to spawning habitat for some species may be restricted.

Spill impacts and cleanup operations would be influenced by time of year. Response efforts would be both hindered and aided by the presence of ice. Ice would contain a spill, concentrate it, and may act as a barrier to shoreline oiling. However, ice may also make a spill difficult to detect, locate, and access. Volatile components of the spill would be more likely to freeze into the ice rather than evaporate.

Physical damage to invertebrates and fish from containment and collection procedures could occur. Lethal impacts may occur to planktonic organisms but are not expected to be detectable at the population level. Pelagic fishes may be affected by mechanical recovery of spilled material but are expected to avoid an oiled area and to move away from vessels and booms or skimmers. If spill response activities occur during spawning runs, some fish could experience difficulty reaching their spawning grounds. However, these avoidance impacts would be short-term and localized to the spill area. Benthic invertebrates and fish would not likely be affected by mechanical recovery activities occurring at the surface. In-situ burning could impact organisms in the immediate area due to residue from the burn sinking to the bottom. Death of planktonic invertebrates and pelagic fishes that did not move away from the spill is possible in the immediate burn area. At the seafloor, habitat can be altered by residue from a burn. Some benthic organisms may be smothered. Impacts from mechanical recovery or burning are expected to be short-term and localized to the area of the spill.

The use of dispersants has been shown to increase the exposure of fish eggs to toxic levels of hydrocarbons because the dispersants make the oil more easily cross the egg membrane (Ramachandran et al., 2004). Dispersants used in spill response activities can result in greater toxic impacts to invertebrates than crude oil alone (Almeda et al., 2013; Lee et al., 2012), and can also have negative impacts on the food web (Lee, 2013;Ortman et al., 2012; Trannum and Bakke, 2012).

Impacts from a large spill response could be long-lasting and widespread for fish and invertebrate communities if a large spill occurs near spawning grounds or dispersants are used. Impacts from small spill response and spill drill activities would be localized and short-term, especially if pelagic individuals are able to avoid areas of activity. Impacts to the benthic community from spill response and spill drills would be limited spatially by the settling of oil and dispersants, and no population-level impacts are expected to be observable for the Cook Inlet overall.

A-3.5.4 Conclusion

Impacts from small spills would be minor because invertebrate and fish communities in the Cook Inlet would not generally experience widespread, multi-year, multi-generational impacts and there would not be a clear, long-lasting change in this resource’s function in the ecosystem. In contrast, a large oil spill could have widespread and long-lasting, and therefore moderate, impacts depending on the season and location of the spill. Spills originating in the upper and middle portion of the Lease Sale Area have the greatest potential to affect fish and invertebrates through contact with oil. A large gas release would have negligible impacts on the overall community structure of fish and invertebrates in Cook Inlet. Spill response and cleanup could have minor to moderate impacts on fish and invertebrates, depending on where the spill is located and if dispersants are used. Spill drills are short-term and localized and are expected to have negligible impacts on fish and invertebrates.

A-3.6 Birds

Spills can have lethal and sublethal physiological and behavioral effects on birds, and indirect impacts via contamination and disturbance of prey resources and habitats. The impacts of oil spills on birds are well documented and the evidence for these impacts is briefly discussed below. In particular, potential oil spill impacts to birds include the following:

- Mortality or reduced fitness resulting from direct contact (Balseiro et al., 2005; Haney, Geiger, and Short, 2014a, b; Maggini et al., 2017; O’Hara and Morandin, 2010).
- Toxic (lethal or sublethal) reactions from inhalation, direct ingestion, or ingestion of contaminated prey (Balseiro et al., 2005; Bursian et al., 2017).
- Effects to migration and reproduction via physiological damage to adults (Dorr et al., 2019; Golet et al., 2002).
- Other productivity effects, such as via oil contamination of eggs and nest material or adults delivering contaminated prey to chicks (Stout et al., 2018; Zuberogoitia et al., 2006).
- Modified prey abundance (Esler et al., 2002; Golet et al., 2002; Irons et al., 2000).
- Damage to and displacement from foraging or molting habitat (Day et al., 1997; Esler et al., 2002; Henkel et al., 2014; Wiens et al., 2004).

- Disturbance and displacement of breeding or migrating birds, and nest failure from cleanup activities in nesting habitat (Andres, 1997; Fraser and Racine, 2016; DWH Trustees, 2016).

Additional discussion of the general impacts of oil and gas on birds is provided in the *Beaufort Sea: Hypothetical Very Large Oil Spill and Gas Release* report (BOEM, 2020, Section 4.2.8).

A-3.6.1 Small Oil Spills (<1,000 bbl)

Most of the 410 small spills are not expected to impact migratory birds. This is because some spills may be associated with vessels, vehicles, and heavy equipment, but birds typically move away from operational disturbances (EIS Section 4.7.2).

Some small spills, however, could affect foraging or nesting birds, localized areas of open water and wetland nesting habitat, or marine prey (Sections A-3.3.1, A-3.4.1, and A-3.5.1). The greatest impact could occur if there was chronic annual oiling in an important forage area or if the 125-bbl crude oil spill occurred where hundreds or more birds are densely concentrated or rapidly moving through an area (Fraser and Racine, 2016). Various groups of birds that could be immediately vulnerable include spring migrants in an open ice lead; dense flocks of foraging birds in pelagic waters or in summer near a seabird colony; molting ducks concentrated in the post-breeding period in nearshore waters; or migrating shorebirds and waterfowl staging in spring or fall in coastal habitat. Healthy populations would withstand the short-term and localized impacts of a one-time event (Henkel, Sigel, and Taylor, 2012).

A-3.6.2 Large Oil Spill (≥1,000 bbl)/Gas Release

The same bird concentrations described above as vulnerable to small spill impacts would likely experience the highest numbers of direct mortality if they were contacted by a large, 3,800 bbl spill. The species most vulnerable to a large marine spill are mostly pelagic seabirds, not only because of their long exposure time at sea, but because their long-lived, delayed maturation, and limited offspring life history strategies mean that the loss of relatively few breeding age adults can have population-level effects (Fraser and Russell, 2016). Additionally, harm to habitats and prey that could result from a large spill (Sections A-3.4 and A-3.5) could produce impacts to more birds and more bird populations even if those birds are not initially present during spill contact. As an example, a large spill may initially only contact (i.e., affect) seabirds and phalaropes in offshore waters and reach coastal mudflats at a time before abundant coastal species are present, but large numbers of staging shorebirds and waterfowl could later arrive on the mudflats and be affected by lingering oil or reduced or contaminated prey. This would not only increase the number of affected individuals but also the number of species and populations affected.

Spill timing and location as well as characteristics of spill response efforts influence the magnitude and extent of spill impacts to birds. For example, a terrestrial pipeline spill would have localized impacts on a variety of landbirds, shorebirds, waterfowl, raptors, and cranes if it occurred in preferred wetland habitat during the breeding season or if impacts to habitat persisted into the breeding season. Impacts to most locally breeding birds would generally be short-term and confined to the local area because most of these species have large and widely dispersed breeding distributions. However, a marine spill that occurred, for example, when certain seabirds are experiencing, or struggling to recover from, one of the increasingly common widespread breeding failures or starvation-related die-offs could potentially keep the population depressed for several years. A spill that contacted or decreased food availability for some of the largest colonies or flocks (e.g., Barren Islands colonies or molting or wintering Kamishak Bay flocks) could potentially impact enough birds of a given population or populations to affect them for several years. The combined analysis below estimates that the highest chances of occurrence and contact may be considered relatively low (i.e., <10 percent), but does include high population areas (e.g., Barren Islands). Contact with a large proportion of a vulnerable population or long-term damage to its habitat, such as Pribilof Island rock sandpiper and its wintering habitat in places like Redoubt Bay, would have long-term, potentially severe impacts. The combined analysis does show Redoubt Bay as among the areas with the highest, albeit still <4 percent, chance of a spill occurrence and contact.

Impacts to birds would not only be long-term but potentially widespread if dense flocks of staging, molting, or wintering birds are affected. This is because flocks during these periods are typically made up of migratory individuals from multiple widespread breeding populations. Birds' trophic relationships with multiple habitats can complicate and widen a spill's impacts (Henkel, Sigel, and Taylor, 2012). The conditional analysis below shows chances of contact are highest to some high-use breeding, molting, wintering, and migratory stop-over areas and pelagic resources.

A natural gas release would have potential to harm birds, but only if large numbers happened to be in the immediate vicinity at the time of certain types of release. A gas release with an ignition and explosion could physically injure staging or diving flocks of birds. Also, if the gas release was ignited at night or during a period of low visibility in spring or fall, the bright light could attract, disorient, and cause the collisions of many migrating species, including gulls and Endangered Species Act (ESA) listed Steller's eiders. Collision of a large flock of a vulnerable population could potentially have widespread and long-lasting impacts, but the chance of all predictive factors occurring together (e.g., explosion, low visibility conditions during heavy migration, and presence of a vulnerable population) is unlikely. Any flocks that actually were to fly through the release of natural gas would be unlikely to experience long-term impacts because of the quickly dissipating nature of the gas in air, and very low level of hydrogen sulfide or other toxins (Shell Gulf of Mexico Inc., 2015).

A-3.6.2.1 Oil Spill Risk Analysis

BOEM identified 48 bird resource areas for analysis (Ji and Smith, 2021; Table A.1-8; and Figures B-2a–d, and f– h; B-3a–c; B-4b). The OSRA acronyms are: ERA Environmental Resource Area; LS Land Segment; LA Launch Area; and PL Pipeline.

Conditional Probabilities. Table A7 and Figure A5 show that if a large spill occurred from any location in the summer or winter it would contact up to 21 of the 48 resource areas with a ≥0.5 percent chance. Up to 9 of those areas, have a ≥10 percent chance of contact (Ji and Smith 2021, Tables A-2.24, and A-2.44). Outer Kachemak Bay Important Bird Area (IBA) (145) and Lower Cook Inlet 153W59N IBA (146) are the only areas with ≥50 percent chance of contact, and up to 97 percent, depending on spill location (Ji and Smith 2021, Table A-2.24 and A.2.44). Depending on the season and spill location 4 resources areas in or adjacent to the Lease Sale Area are contacted ≥25–<50 percent. Those areas with <0.5 percent chance of contact are mostly coastal areas south of Shelikof Strait, or on the eastern shores of the Kodiak Archipelago and Kenai Peninsula. In general, there is a lower chance of winter spills contacting bird resource areas than summer spills because there is a temporal aspect to most bird resource areas, and seabird breeding colony sites are not active during winter.

Summer. The areas with the greatest chance of contact (>25 percent) for a summer spill are Outer Kachemak Bay/IBA (145), Kamishak Bay IBA (136), and Tuxedni Island Colony IBA (138), which means pelagic seabirds, seaducks, and phalaropes foraging offshore of the mouth of Kachemak Bay, numerous seabird colonies in Tuxedni Bay and Kamishak Bay, and molting seaducks in Kamishak Bay will be some of the most vulnerable marine birds. With a 6–<25 percent chance of contact, among the next most vulnerable would be Redoubt Bay and Shaw Island seabird colonies (140 and 135), seabirds foraging in Lower Cook Inlet (146), Steller's eider in nonbreeding habitat in the Clam Gulch vicinity (144), and the quarter of a million seabirds, including over 100,000 fork-tailed storm petrels and 17 other species, that nest on the Barren Islands (147 and 148) (Kettle, 2017). The OSRA estimates a >0.5–<6 percent chance that a summer spill would contact the foraging areas of western Kodiak Island (ERAs 111 and 112, and LS 87), seabird colonies in Shelikof Strait (130, 132, 133, and 134) and Semidi Islands (122), and extend east of Kodiak into Gulf of Alaska foraging areas (119).

Winter. The winter chances of contact follow roughly the same patterns as discussed above for a summer spill, with the following notable differences. Fewer resource areas would be contacted because the spill would have <0.5 percent chance of extending as far to the south down Shelikof Strait as in summer. Figure A2 shows that a summer spill may have >0.5 percent chance of contact as far south as Alinchak

Bay, Cape Kekumoi, Bear Bay (18), while a winter spill may only have >0.5 percent chance of contact as far south as Kaflia, Kukak, Kuliak, and Missak Bays (21). Furthermore, many bird resource areas are seabird colonies with a temporal component, meaning that large numbers of birds are most vulnerable in those areas only during the summer breeding season. There is still a >0.5 percent chance that a winter spill from the southern LAs or PLs would extend to the Gulf of Alaska (151) where hundreds of thousands of seabirds forage year-round.

Table A7: Highest Percent Chance of a Large Oil Spill Contacting Bird Resources (Assuming a Large Spill Occurs)[1]

OSRA Feature Type	Highest Percent Chance Contact	Summer: 30 days	Winter: 30 days
ERA	≥0.5–<6	111, 112, 119, 122, 130, 132, 133, 134, 137, 149, 151	151
ERA	≥6–<25	135, 139, 140, 144, 146, 147, 148	140, 144
ERA	≥25–<50	136, 138	137, 139
ERA	≥50	145	145, 146
LS	≥0.5–<6	87	87
Names of ERAs Contacted: 111 NW Afognak Is IBA; 112 Uganik And Viekoda Bay IBAs; 119 Gulf Of Alaska Shelf IBA; 122 Semidi Islands Marine IBA; 130 South Alinchak Bay Colony; 132 Amalik Bay Colonies IBA; 133 Ninagiak Is Colonies; 134 Kiukpalik Is ; 135 Shaw Is Colony; 136 Kamishak Bay IBA; 137 Kamishak Bay STEI Habitat; 138 Tuxedni Is Colony IBA; 139 Tuxedni Bay IBA; 140 Redoubt Bay IBA; 144 Clam Gulch STEI Habitat.; 145 Outer Kachemak Bay/IBA; 146 Lower Cook Inlet 153W59N; 147 Barren Islands Marine IBA; 148 Barren Islands Colonies IBA; 149 SW Kenai Pen Marine IBA; 151 Gulf of AK Shelf 151W58N IBA Names of LSs Contacted: 87 Uyak Bay			

Notes: [1] Highest percent chance from any launch area (LA) or pipeline area (PL) during summer or winter assuming a large spill occurs. Note that all resource areas with <0.5 percent chance of contact are not shown.

Source: Ji and Smith (2021).

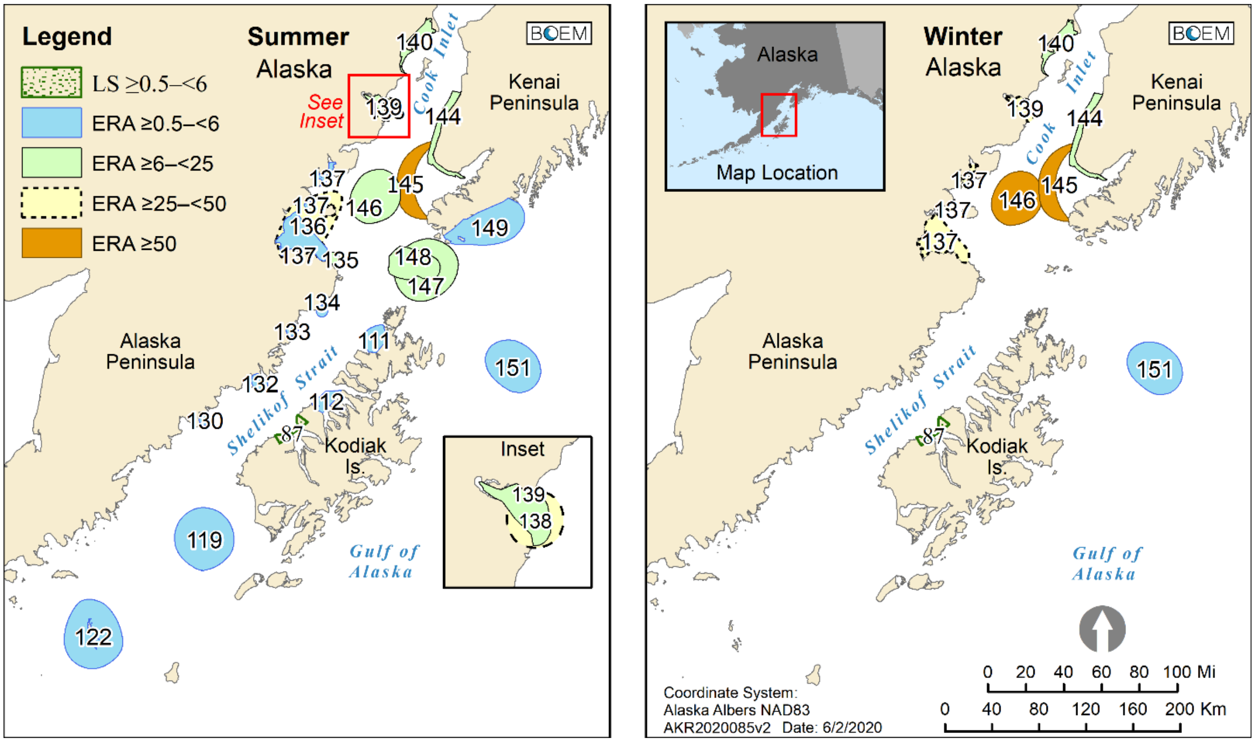

Figure A5: Location and ID number of Bird Resource Areas: (Assuming a Large Spill Occurs ≥1% Chance of Contact within 30 Days) Summer and Winter

Combined Probabilities. The OSRA estimates the highest chance of a large spill both occurring and contacting an important bird resource area is 9 percent within 10 days for Outer Kachemak Bay IBA (145) (Ji and Smith, 2021, Table A.2-61). There is a 1–5 percent chance of a large spill occurring and contacting 9 other resource areas within 30 days, including summer colony activity of Kamishak Bay IBA (136), Tuxedni Island Colony IBA (138), Barren Islands Marine IBA (147), and Barren Islands Colonies IBA (148); post-breeding and winter shorebird and waterfowl activity of Tuxedni Bay IBA (139); wintering seabird habitat of Lower Cook Inlet 153W59N IBA (146); and Steller's eider (and other seaduck) wintering habitat of Kamishak Bay (137) and Clam Gulch (144) (Ji and Smith, 2021, Table A.2-61). Redoubt Bay IBA (140) falls into this 1–5 percent category as well where seabird, waterfowl, and shorebird resources could be at risk year-round. Redoubt Bay IBA shorebirds include a large proportion of the world's population of Pribilof Island rock sandpiper which shelters in Redoubt and Tuxedni bays when the coldest winter days push them south from the Susitna Flats/Trading Bay areas (Ruthrauff, Gill, and Tibbitts, 2013).

A-3.6.3 Spill Drills and Response Activities

Spill drills, including GIUEs, would be infrequent, localized at areas of high human activity, and are expected to have little effect on birds. Spill response operations, however, can impact birds. The dense concentrations of birds most vulnerable to oil can also be fouled by burn residue from in-situ burning and the emulsions of oil created by dispersants and suspended in the water column (Chen and Denison, 2011; Fritt-Rasmussen, Wegeberg, and Gustavson, 2015). Depending on timing and location, large concentrations of nesting, molting, or staging birds may be disturbed or displaced during spill cleanup operations in or near oil-affected onshore and nearshore habitats. Nests, especially those of shorebirds, waterfowl, landbirds, and cranes, could be destroyed (Andres, 1997; Harwell and Gentile, 2006; Jenssen, 1994). Besides spill characteristics, the size and extent of spill response impacts on birds ultimately depends on techniques, siting in relation to bird seasonal timing and densities, efficacy of cleanup, and how many seasons response activities may last.

A-3.6.4 Conclusion

Most accidental small spills or spill drills would be localized and limited in area and have no more than minor impacts on birds. A large spill that contacts many marine birds or reaches coastal areas could have impacts that are more persistent, require remediation, and impact a greater number of birds and species. If it occurred during a period of high bird use in coastal waters, it would be expected to foul large numbers of staging and migrating birds from widespread populations. Foraging, resting, and sheltering habitat for staging, migrating, and nesting birds would be fouled, with mechanical damage to foraging habitat and possibly nests during the cleanup process. Some populations that experience spill-related effects to large numbers of birds would be expected to take several years to recover. Long-term damage to otherwise vulnerable seabird breeding populations (e.g., chronically failing murres and black-legged kittiwakes) would be possible. The long-term and widespread impacts from a large spill would be considered less than severe, and therefore moderate, for most species because the various populations affected would be expected to eventually recover. Depending on location and timing however, contact with wintering rock sandpipers or their habitat would have potentially major population-level impacts. Spill response would typically have short-term and localized displacement-related impacts, but impacts would range up to long-term and moderate if involving both marine and land-based activities when large concentrations of birds are present or nesting. In the unlikely event that migrating or staging birds were within the vicinity of a gas explosion, a few hundred individuals from disparate populations could be killed, which would have a localized and minor level of impact on bird resources as a whole.

A-3.7 Marine Mammals

Oil spills can affect marine mammals, their habitats, and their prey through a variety of direct and indirect pathways which can have both long-term individual impacts and population-level impacts depending on the spill size, location, and environmental factors present at the time of the spill (Helm et al., 2015). An oil spill affects each group of marine mammals differently. Marine mammals live in offshore and nearshore waters and could be exposed to spilled oil at sea. Seals, sea lions, and sea otters can also be exposed to spilled oil at terrestrial nearshore areas. The effects of oil spills on marine mammals have been observed in studies on spill effects and from controlled experiments on marine mammals. These effects include, but are not limited to, the following:

- Short- and long-term respiratory effects such as pulmonary emphysema and inflammation and infection of respiratory tissue through inhalation of VOCs from crude oil or natural gas (Geraci and St. Aubin, 1990; Godard-Codding and Collier, 2018; Hansen, 1985; Helm et al., 2015; Neff, 1990; Schwacke et al., 2014).
- Inflammation, ulcers, bleeding, and damage to organs from ingestion of oil (and dispersants) directly or via contaminated prey. However, some marine mammals may metabolize and eliminate hydrocarbons (Engelhardt, 1982, 1983; Geraci and St Aubin, 1990; Kooyman, Gentry, and McAlister, 1976).
- Irritation, inflammation, or necrosis of skin, as well as chemical burns of skin, eyes, and mucous membranes from dermal contact (Hansen, 1985; Engelhardt, 1982, 1983; Werth, Blakeney, and Cothren, 2019).Venues of dermal contact include oiling of whale baleen, fur on sea otters, oiling of skin, eyes, conjunctive membranes, and cetacean blowholes.
- Elevated cortisol and altered endocrine levels in some individual marine mammals from exposure to hydrocarbons (Geraci and St Aubin, 1990).
- Short- and/or long-term reductions in prey availability, habitats, and populations (USFWS, 2015a; Section A-3.4).
- Disruption of social groups leading to decreased survival and lowered reproductive success (Geraci and St Aubin, 1990; Matkin et al., 2008).
- Habitat degradation (Geraci and St Aubin, 1990; Hoover-Miller, Parker, and Burns, 2001; Helm et al. 2015).
- Delayed recovery of habitat from chronic exposure to residual oil components, which could produce lingering effects on marine mammals (Peterson et al., 2003).
- Disturbance or displacement from cleanup crews, vessels, or aircraft during spill response activities (USFWS, 2015a NMFS, 2019; Ziccardi et al., 2015).

Additional discussion of the general impacts of oil and gas on whales, seals and -other marine mammals is provided in the respective sections below and is detailed in the *Beaufort Sea: Hypothetical Very Large Oil Spill and Gas Release* report (BOEM, 2020, Section 4.2.6).

A-3.7.1 Cetaceans

Beluga, killer, and minke whales, Dall’s and harbor porpoises, and Pacific white-sided dolphins are resident cetaceans that occur in Cook Inlet throughout the year. Fin, gray, and humpback are migrant cetaceans that occur in Cook Inlet from spring to fall and could only be directly affected by oil spills in that window of time. Fin, gray, and humpback whales migrate from and to their wintering areas in spring and fall respectively. Gray whales usually pass by the outlet of Cook Inlet on their way to and from their primary summer feeding areas in the Bering and Chukchi seas. Some fin and humpback whales return specifically to Cook Inlet for summer feeding, while others periodically show up near the Lease Sale Area to feed. Cook Inlet beluga whales spend most of the ice-free months feeding on aggregations of anadromous fish in upper Cook Inlet, north of Kalgin Island. When ice begins forming in the inlet, these whales relocate to lower Cook Inlet. Killer and minke whales, Dall’s and harbor porpoises, and Pacific white-sided dolphins occasionally show up in different parts of Cook Inlet throughout the year, as sea ice permits.

A-3.7.1.1 Small Oil Spills (<1,000 bbl)

Small spills in winter would occur when most whales are absent. Beluga whales would be present in Lower Cook Inlet, as might a few killer whales, Dall's and harbor porpoises, and Pacific white-sided dolphins. Small, refined spills dissipate in less than 2 days while portions of a 125-bbl crude oil spill could persist up to a month (Table A1). These small spills would be localized in extent and could be cleaned up.

In the event of a small spill during summer, individual whales or their prey could come into contact with oil. Temporary exposures to small spills over highly localized areas would be infrequent with few consequences. Since oil poorly adheres to cetacean skin, chronic impacts from epidermal contact would be unlikely for them (Engelhardt, 1983; Geraci and St Aubin, 1986). Furthermore, small spills occurring over localized areas could only affect small quantity of prey resources. For these reasons the impacts of small spills would not affect cetacean populations and would have a very limited ability to affect individual cetaceans. Because small spills dissipate or are cleaned up rapidly, the likelihood of impacting cetaceans or their populations would be further reduced.

A-3.7.1.2 Large Oil Spill (≥1,000 bbl)/Gas Release

Large spill (3,800 bbl) impacts to whales would depend on the location, timing, duration, sea and climatic conditions, and response to the spill event. There is little potential to impact large numbers of cetaceans which are few in number inside lower Cook Inlet at any time; however the small population sizes for belugas, humpback, fin and North Pacific right whales in or near Cook Inlet means adverse impacts to a small number of individuals could lead to a cascade of impacts to their populations. The magnitude of such a cascade would vary based on the type of impact, the overall stock/population size, number of individuals affected, and the genetic diversity in the population. The conditional analysis below shows probability of contact is highest for cetacean resource areas near the outlet of Cook Inlet Shelikof Strait, and the southern Kenai coastline in summer. The probability of a large spill contacting summer Critical Habitat for Cook Inlet beluga whales, or areas in the upper inlet where they usually occur in summer, remains low so individuals from their population are less likely to be impacted by a large summer spill than individuals of other cetacean species who regularly occur in the Lease Sale Area and nearby areas. A large spill in winter could affect belugas and their winter Critical Habitat areas, and such an event could have major impacts on the stock due to the small population size and their restricted winter range in the inlet.

Although individuals may experience temporary and/or permanent injury and non-lethal impacts through inhalation, ingestion, or contact, mortality would be unlikely. Temporary displacement from high value feeding and resting areas might occur, depending on spill characteristics. Whale prey (schooling forage fish and zooplankton) could be reduced or contaminated leading to modified whale feeding distributions. However, reduction or contamination of food sources would be localized relative to the available prey in Cook Inlet and the Gulf of Alaska. This effect on discrete food sources could be short- or long-term but would not likely have population-level impacts on whales or their prey. The seasonal presence of migrant whale species such as fin, gray, and humpback whales, means the likelihood of them contacting a large spill must occur between late spring and early fall when they are present. Resident cetaceans such as beluga, killer, and minke whales, Dall's and harbor porpoises, and Pacific white-sided dolphins could be affected by a large spill at any time; however, they only occur in small numbers within the inlet, and belugas spend most of the year in the upper inlet areas of Knik and Turnagain Arms, away from the Lease Sale Area. For these reasons, population-level impacts to these species would be unlikely.

A gas release during winter would not affect migrant whales since they would be absent from the inlet. A gas release during spring, summer, or fall could expose some cetaceans to natural gas at high concentrations. However, natural gas VOCs would disperse rapidly upon release, and it is unlikely many individuals of any species would be close enough to the gas release site to be affected. A gas release could temporarily reduce the available food for whales in a small, localized area (Section A-3.5.2).

Oil Spill Risk Analysis

BOEM identified 51 cetacean resource areas for the analysis (Ji and Smith, 2021; Table A.1-4; and Figures B-1a, B-2a–g). The OSRA acronyms are ERA Environmental Resource Area and LA Launch area.

Conditional Probabilities. Cetacean species are collectively addressed for the conditional analysis. Table A8 and Figure A6 show 33 and 23 cetacean resource areas with a ≥0.5 percent chance of contact in summer and winter respectively. Some biologically important areas for whales are not estimated to be contacted (<0.5 percent) or have a <6 percent chance of contact. This analysis focuses on those areas having a ≥6 percent chance of contact in summer (20) or winter (11) shown in Figure A6. For all LAs, there is a lower chance of contacting cetacean resource areas in the winter than in the summer when more habitat is occupied, and migrant cetaceans are present. Figure A6 shows resource areas located in western Cook Inlet coastal areas have the greatest chances of contact and resource areas between Kachemak Bay and Shelikof Strait-Kodiak Island have the second highest chances of contact.

Summer. Within 30 days a large spill has the highest chance (≥50 percent) of contacting the Cook Inlet 4- Harbor Porpoise (104) and West Cook Inlet-Beluga Critical Habitat (CH) (72). To a lesser extent, the Middle Cook Inlet-Beluga CH (71), Kachemak-Humpback Whale (75), Shelikof MM 1 (80), Barren Islands-Fin Whale (90), Cook Inlet 2-Harbor Porpoise (102), Cook Inlet 3-Harbor Porpoise (103), and Cook Inlet 5-Harbor Porpoise (105) had chances of contact ranging from ≥25–<50 percent.

Winter. Within 30 days a large spill has the highest chance of contacting (≥50 percent) the Cook Inlet-Beluga CH (72). Other cetacean resource areas showing higher chances of contact are Middle Cook Inlet-Beluga CH (71), Shelikof MM 1 (80), and Barren Islands-Fin Whale (90).

Table A8: Highest Percent Chance of a Large Oil Spill Contacting Cetacean Resources (Assuming a Large Spill Occurs)[1]

OSRA Feature Type	Highest Chance of Contact	Summer: 30 days	Winter: 30 days
ERA	≥0.5–<6	70, 73, 78, 84, 85, 86, 87, 89, 91, 92, 97, 99, 109	16, 26, 27, 70, 76, 78, 89, 91, 94, 97, 99, 109
ERA	≥6–<25	16, 76, 77, 81, 82, 83, 94, 95, 98, 101, 108	24, 25, 75, 77, 95, 98, 108
ERA	≥25–<50	71, 75, 80, 90, 102, 103, 105	71, 80, 90
ERA	≥50	72, 104	72
Names of ERAs Contacted: 16 Inner Kachemak Bay; 24 Shelikof MM 2; 25 Shelikof MM 3; 26 Shelikof MM 4; 27 Shelikof MM 5; 70 Forelands-Beluga CH; 71 Middle Cook Inlet-Beluga CH; 72 West Cook Inlet-Beluga CH; 73 NPRW Feeding Area; 75 Kachemak-Humpback Whale; 76 Shelikof-Humpback Whale; 77 N Kodiak-Humpback Whale; 78 E Kodiak-Humpback Whale; 80 Shelikof MM 1; 81 Shelikof MM 1a; 82 Shelikof MM 2a; 83 Shelikof MM 3a; 84 Shelikof MM 4a; 85 Shelikof MM 5a; 86 Shelikof MM 6a; 87 Shelikof MM 9; 89 Shelikof MM 11; 90 Barren Islands-Fin Whale; 91 NE Kodiak-Fin Whale; 92 Kodiak-Gray Whale Feeding; 94 Lower E Kenai-Gray Whale; 95 NE Kodiak-Gray Whale; 97 SE Kodiak-Gray Whale; 98 Shelikof-Gray Whale; 99 N Shumagin-Gray Whale; 101 Cook Inlet 1-Harbor Porpoise; 102 Cook Inlet 2-Harbor Porpoise ; 103 Cook Inlet 3-Harbor Porpoise; 104 Cook Inlet 4-Harbor Porpoise; 105 Cook Inlet 5-Harbor Porpoise; 108 Shelikof-Killer Whale; 109 E Kodiak-Killer Whale.			

Notes: [1] Highest percent chance from any launch area (LA) or pipeline area (PL) during summer or winter assuming a large spill occurs. Note that all ERAs with <0.5 percent chance of contact are not shown.

Source: Ji and Smith (2021).

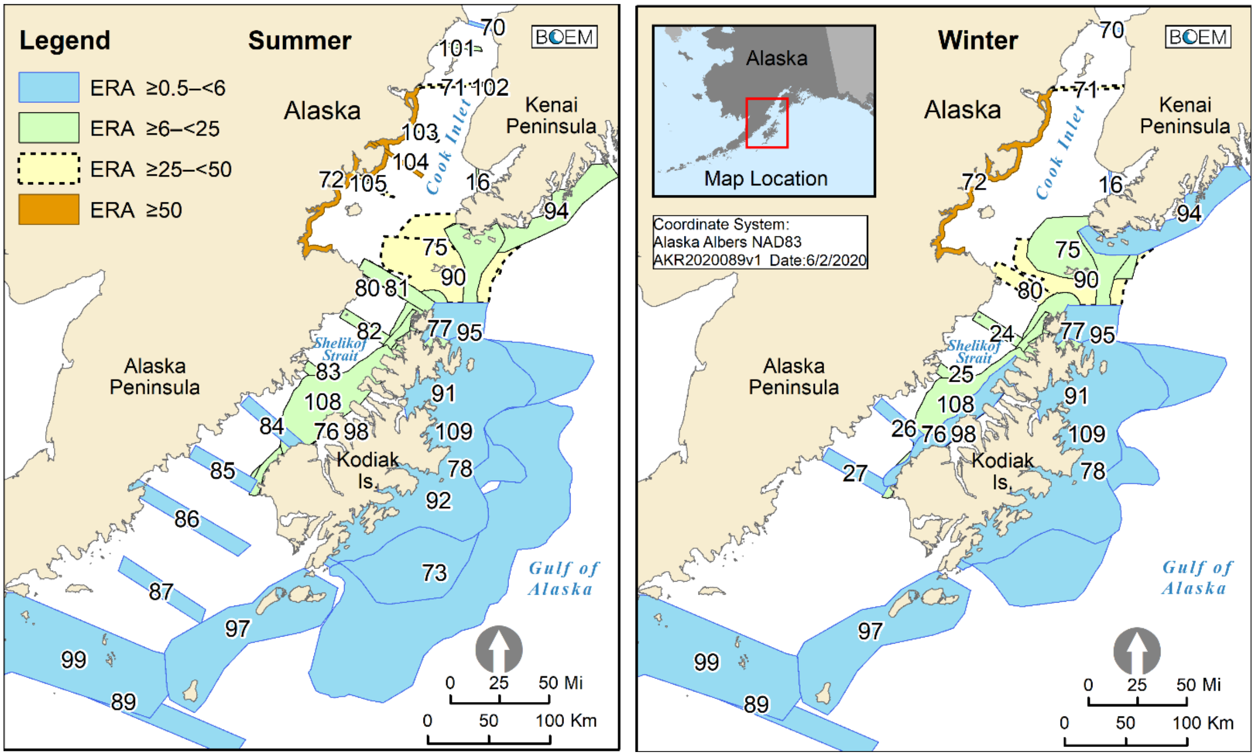

Figure A6: Location and ID number of Cetacean Resource Areas (Assuming a Large Spill Occurs ≥1% Chance of Contact within 30 Days): Summer and Winter

Combined Probabilities. Combined probabilities for 30 of 51 cetacean resource areas are <0.5 percent and 19 are ≥1–<6 percent (Ji and Smith, 2021, Table A.2-61). The OSRA estimated the highest chance of a large spill both occurring and contacting is 11 percent within 30 days to the West Cook Inlet-Beluga CH (72) (Ji and Smith, 2021, Table A.2-61).

A-3.7.1.3 Spill Drills and Response Activities

Spill drills, including GIUEs, would result in short-term and localized displacement of cetaceans due to increased vessel activity and disturbance. Whales would be expected to resume their normal activities after the drills are complete.

The National Oceanic and Atmospheric Administration (NOAA) developed oil spill response guidelines for whales and noted that most impacts to whales from spill response activities would likely be from vessel and aircraft presence (NMFS, 2019). Cleanup activities could involve multiple marine vessels operating in the spill area for extended periods of time. As noted in the discussion of impacts associated with vessel traffic (EIS Section 4.8.2), whales may react to the approach of vessels with avoidance behavior, and potential for whale-vessel collisions could increase. Whales would likely avoid the louder noises related to a spill response, reducing the potential for them contacting oil; however, porpoises and dolphins sometimes seek out vessels in order to play. After an oil spill, helicopter and fixed-wing aircraft overflights would typically be used to track the spill and to monitor distributions of marine wildlife. Impacts to cetaceans from aircraft encounters would be transient, and animals would typically resume normal activities after aircraft leave the area. Depending on the spill location, oil spill response could take some time to mobilize vessels and aircraft. Any delay in the cleanup activities could increase the number of individual cetaceans exposed to spilled oil.

Cleanup and response activities could result in localized, short- or long-term displacement of cetaceans and their prey from preferred habitats and disturbance through increased human interactions. Conversely, response activities would also decrease the likelihood of contact with oil by removing oil from the environment and displacing animals from oiled areas. The use of dispersants, while not immediately harmful to cetaceans, can create disruptions in food webs (Section A-3.5). While there would likely be impacts to individual animals, these activities and their potential impacts to whales, porpoises, or dolphins would not have population level effects.

A-3.7.1.4 Conclusion

Due to small size, localized and temporary impacts, and rapid weathering, it is expected that small spills would not impact cetacean populations. Depending on the spill location, timing, and duration, the sea and climatic conditions, and the spill response, a 3,800 bbl large spill would have inconsequential impacts on whale populations, with the possible exception of Cook Inlet belugas. Although unlikely, a large spill contacting aggregations of Cook Inlet belugas could have permanent and adverse population-level effects due to the small number of individuals in the population. A large gas release, cleanup and response activities, and spill drills would also have inconsequential impacts on cetacean populations.

A-3.7.2 Pinnipeds

Harbor seals and Steller sea lions occur in the Lease Sale Area and could be affected by oil spills at any time of year. They occur throughout lower Cook Inlet though both use coastal haulouts, and mostly remain in shallower coastal areas. Both species feed on fishes throughout the water column. Harbor seals in the inlet belong to the Cook Inlet-Shelikof Strait stock and Steller Sea Lions belong to the Western Distinct Population Segment (DPS).

A-3.7.2.1 Small Oil Spills (<1,000 bbl)

Few individual seals or sea lions would be expected to be contacted by small spills given the spills' limited size and extent. Furthermore, seals have demonstrated an ability to eliminate small amounts of ingested crude oil from their bodies (Geraci and St. Aubin, 1990). Seals and sea lions would not likely be harmed by small spills, because spills would be cleaned up, or disperse and weather quickly, limiting the duration and severity of any exposures.

A-3.7.2.2 Large Oil Spill (≥1,000 bbl)/Gas Release

Impacts to pinnipeds from a large, 3,800 bbl spill would depend on the location, timing, and duration of the spill, sea and climatic conditions, and spill response. The conditional analysis below shows the chance of contact in summer or winter is highest for areas of western Cook Inlet, particularly in and around Kamishak Bay (Figure A6), but less likely around Kalgin Island and Kachemak Bay.

A large spill in open water would only affect a few seals or sea lions before cleanup and weathering would occur, and impacts would be temporary and mildly injurious, with no lingering impacts to individuals.

A gas release could expose some seals and sea lions to natural gas at high concentrations through inhalation, ingestion, and physical contact. However, rapid atmospheric dispersion and a short residence time of gas in the ocean would reduce the window for potential contacts with pinnipeds, and the severity of those contacts. It is unlikely more than a few individuals present near a gas release would be affected, and the impacts on harbor seals and Steller sea lions would consist of temporary prey reduction over a localized area (Section A-3.5.2). For these reasons, the impacts of a gas release on pinnipeds would be short-term, localized, and non-injurious.

Oil Spill Risk Analysis

BOEM identified 34 pinniped resources for the analysis (Ji and Smith, 2021; Table A.1-5; Figures B-2a–e, h). The OSRA acronyms are ERA Environmental Resource Area.

Conditional Probabilities. Table A9 and Figure A7 show harbor seal and Steller sea lion resource areas with a ≥1 percent chance of contact in summer and winter. Many areas were not contacted (<0.5 percent) or have a <6 percent chance of contact. This analysis focuses on resource areas with a ≥6 percent chance of contact (Table A9). For conciseness, only areas with chances of contact within 30 days and are ≥25 percent are discussed.

Summer. Within 30 days Augustine (11), South Cook HS 1a (12), South Cook HS 1b (13), South Cook HS 1c (14), and Clam Gulch HS (17) have a ≥50 percent chance of contact. The pinniped resource areas having the next highest chances of contact were South Cook HS 1d (15) and Tuxedni HS (18), with a chance of contact ≥25–50 percent. The greatest chances of contact were to the western portions of lower Cook Inlet. Areas with lower chances of contact occurred outside of Cook Inlet, mostly around the Barren Islands and in Shelikof Strait. Spills contacting those areas could affect Steller sea lions which have rookeries there, but the chances of contacting any area outside of Cook Inlet are <25 percent, with most <6 percent.

Winter. A large oil spill occurring in winter has similar chances of contacting pinniped resource areas as described for summer except the Clam Gulch HS (17) increases to ≥50 percent chance and three resources, in northern Cook Inlet (16, 20) and central Shelikof Strait (26), are contacted slightly less.

Table A9: Highest Percent Chance of a Large Oil Spill Contacting Seal and Sea Lion Resources (Assuming a Large Spill Occurs)[1]

OSRA Feature Type	Highest Chance of Contact	Summer: 30 days	Winter: 30 days
ERA	≥0.5–<6	21, 27, 28, 29, 30, 31, 32, 37, 38, 43	16, 20, 26, 27, 28, 29, 30, 31, 37, 43
ERA	≥6–<25	16, 19, 20, 23, 24, 25, 26	19, 23, 24, 25
ERA	≥25–50	15, 18	15, 17, 18
ERA	≥50	11, 12, 13, 14, 17	11, 12, 13, 14
Names of ERAs Contacted: 11 Augustine; 12 South Cook HS 1a; 13 South Cook HS 1b; 14 South Cook HS 1c; 15 South Cook HS 1d; 16 Inner Kachemak Bay; 17 Clam Gulch HS; 18 Tuxedni HS; 19 Kalgin Island HS; 20 Redoubt Bay HS; 21 Trading Bay HS; 23 Barren Is. Pinniped; 24 Shelikof MM 2; 25 Shelikof MM 3; 26 Shelikof MM 4; 27 Shelikof MM 5; 28 Shelikof MM 6; 29 Shelikof MM 7; 30 Shelikof MM 8; 31 Kodiak Pinniped 1; 32 Kodiak Pinniped 2; 37 Port Chatham Pinniped; 38 Port Dick Pinniped; 39 Two-Arm Bay Pinniped; 43 AK Peninsula Pinniped 1			

Notes: [1] Highest percent chance from any launch area (LA) or pipeline area (PL) during summer or winter assuming a large spill occurs. Note that all resource areas with <0.5 percent chance of contact are not shown.

Source: Ji and Smith (2021).

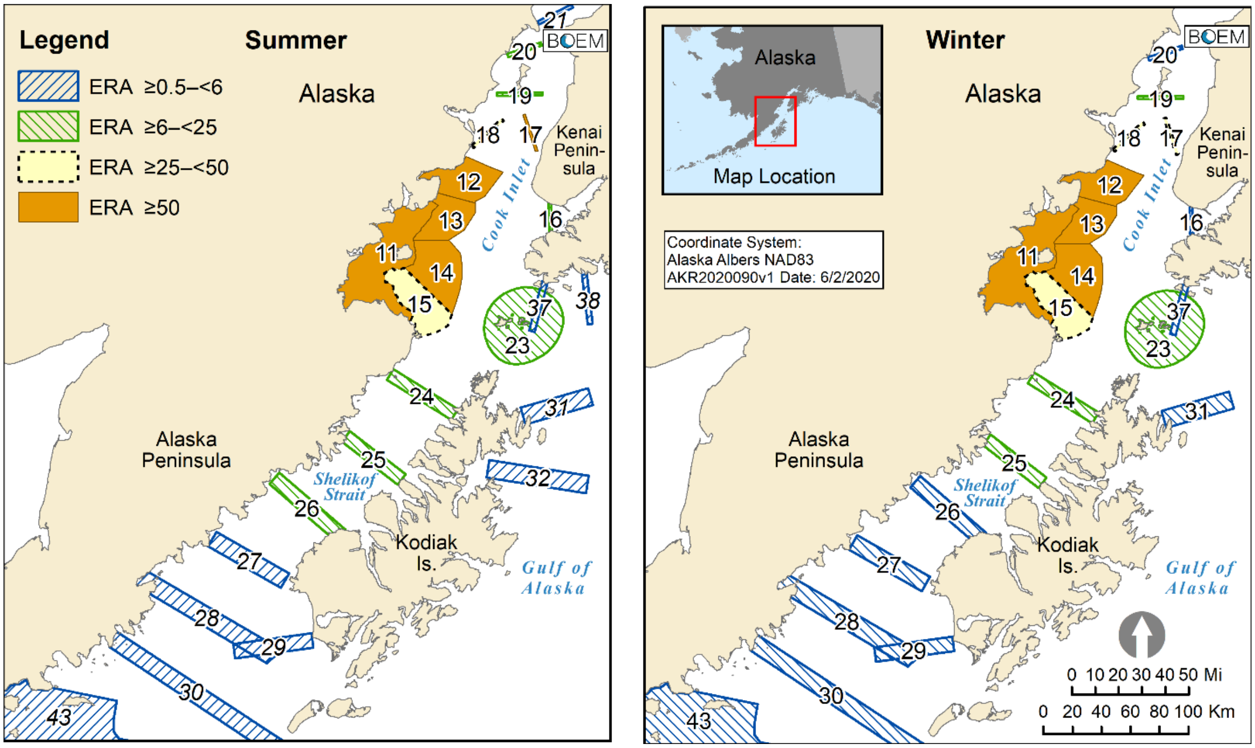

Figure A7: Location and ID number of Seal and Sea Lion Resource Areas (Assuming a Large Spill Occurs ≥1% Chance of Contact within 30 Days): Summer and Winter

Combined Probabilities. Harbor seal resource areas Augustine (11), South Cook HS 1a (12), South Cook HS 1b (13), South Cook HS 1c (14), and Inner Kachemak Bay (16) have 6–13 percent combined probabilities. However, the remaining resource areas for harbor seals and Steller Sea lions are <6 percent with most <3 percent (Ji and Smith, 2021, Tables A.2-61).

A-3.7.2.3 Spill Drills and Response Activities

Spill drills, GIUEs, and spill response activities could disturb and displace pinnipeds from affected marine and coastal areas. Vessel and aircraft traffic, and activities such as in-situ burning, animal rescue, and the use of skimmers and booms could displace or stress individuals. Typical responses of pinnipeds to any of these disturbances would consist of leaving the local area for the duration of the disturbance.

The use of dispersants is unlikely to have any immediate direct impacts on harbor seals or Steller sea lions; however, there may be some adverse consequences from using certain types of dispersants which may affect the food web (Section A-3.5), and the long-term impacts of dispersant use may extend beyond the contaminated area to varying degrees.

Because impacts would be limited to temporary avoidance of an area for the duration of the disturbance, no injuries to pinnipeds from spill drills, GIUEs, and spill response would be expected. For spill responses, any negative short-term impacts from disturbance would be outweighed by beneficial impacts from intentionally or unintentionally deterring individual animals away from oiled areas, resulting in little or no impacts to harbor seals or Steller sea lions.

A-3.7.2.4 Conclusion

Small and large oil spills, and a large gas release would not impact pinniped populations because of the limited spatial area contacted, weathering processes, short duration of potential contact incidents, and the mostly temporary duration of impacts on individual pinnipeds, though impacts to a few individuals from a large oil spill could be lethal. Spill response and cleanup would produce disturbances displacing harbor seals and Steller sea lions from oiled areas while removing oil from the environment. However, if spill response were delayed or precluded, a greater number of individual pinnipeds could be exposed to oil. This OSRA demonstrates the likelihood of spilled oil contacting haulouts for either species would be remote, though some CH for the Western DPS of Steller Sea lions could become oiled. Overall, impacts to pinniped populations from large oil spills would be non-injurious, temporary, and non-chronic, though impacts to a few individuals could be fatal.

Sea Otters

Sea otters occur in the Cook Inlet area year-round and could be affected by oil spills during any season. The potential impacts would be greatest near the coastlines of lower Cook Inlet where sea otters aggregate, particularly in CH for the Southwestern Alaska sea otter stock.

A-3.7.2.5 Small Oil Spills (<1,000 bbl)

While a small spill could contact individual sea otters or their prey, contact remains unlikely because most small spills would cover a small area. Moreover, spills would be cleaned up quickly and cleanup activities would deter sea otters from entering the areas further reducing the likelihood of impacts.

Small spills would also be contained or weather quickly, further reducing chances of contacting a sea otter. If a small spill were to contact sea otters some could perish if their pelts became saturated with oil. Consequently, the impacts of small spills on small numbers of sea otters would be short-term, localized, and most likely inconsequential.

A-3.7.2.6 Large Oil Spill (≥1,000 bbl)/Gas Release

The extent of impact of a large oil spill to sea otters would be influenced greatly by the volume, trajectory, and timing of the spill as well as the residence time of spilled oil in the environment. (Helm et al., 2015). The likelihood of individual sea otters being contacted by spilled oil varies with individual responses to the spill, currents and tides, spill volumes, spill locations, coastal topography, and weather patterns (Geraci and St. Aubin, 1990; Garrott et al., 1993).

A large spill contacting sea otter habitat could compromise its future value to sea otters as hunting, resting, and reproduction habitat and may require a decade or more for populations to recuperate (Ballachey et al. 2014; Monson et al. 2000; Garshelis and Johnson, 2013). If a large spill were to contact a sea otter aggregation area such as feeding areas, higher numbers of fatalities could occur (DeGange et al., 1995).

A pipeline gas release would rapidly disperse into the atmosphere, so the event would not directly impact sea otters unless the gas ignites or explodes, or if they inhale hazardous concentrations of gas. Although high concentrations of natural gas could be hazardous to sea otters in the short-term, the VOCs would rapidly disperse from the release site, for this reason it is unlikely any sea otters, other than those immediately around a gas release, would be impacted.

Other impacts of a gas release would be short-term disturbances from response and possible localized prey reduction for sea otters in the area. An explosion could kill or injure nearby sea otters. For these reasons a pipeline release of gas would not impact sea otter populations. The conditional analyses show contact in summer and winter is most likely along the western coast of Cook Inlet, particularly the CH areas around Kamishak Bay and adjacent areas, including islands, and areas around Kachemak Bay. Gas releases in the Lease Area would not likely affect sea otters.

Oil Spill Risk Analysis

BOEM identified 43 sea otter resource areas for the analysis (Ji and Smith, 2021; Table A.1-6; Figures B-2a, b, e, f, h, 3a-c, and 4b). The OSRA acronyms are: ERA Environmental Resource Area; LS Land Segment; and GLS Grouped Land Segment.

Conditional Probabilities. Table A10 and Figure A8 show 23 sea otter resource areas with a ≥1 percent chance of contact in summer or winter. The areas with the greatest chance of contact occurred in western portions of lower Cook Inlet and to a lesser degree, the entrance of Kachemak Bay and Clam Gulch.

Summer. Within 30 days a large oil spill has a ≥50 percent chance of contacting Outer Kachemak Bay (46); SW Cook Inlet (47); or Kamishak Bay (48). The remaining resource areas identified for sea otters have <25 percent chances of contact.

Winter. Table A10 and Figure A8 show roughly the same patterns as discussed above for a summer spill, with the following notable differences. The chance of contact to Clam Gulch (45) increases and Outer Kachemak Bay (46) decreases to ≥25–<50 percent. The remaining resource areas identified for sea otters would have chances of contact at <25 percent, with most at <6 percent.

Table A10: Highest Percent Chance of a Large Oil Spill Contacting Sea Otter Resources (Assuming a Large Spill Occurs)[1]

OSRA Feature Type	Highest Chance of Contact	Summer: 30 days	Winter: 30 days
ERA	≥0.5–<6	50, 51, 59, 60, 65, 66	50, 57, 59, 60, 65
ERA	≥6–<25	45, 49, 64, 67, 68	49, 64, 67, 68
ERA	≥25–<50	--	45, 46
ERA	≥50	46, 47, 48	47, 48
LS	≥0.5–<6	84, 86, 87	84, 86, 87
LS	≥6–<25	35	35
GLS	≥0.5–<6	124, 152, 159	124, 152, 159
GLS	≥6–<25	141	141
Names of ERAs Contacted: 45 Clam Gulch; 46 Outer Kachemak Bay; 47 SW Cook Inlet; 48 Kamishak Bay; 49 Katmai NP; 50 Becharof NWR; 51 Alaska Peninsula NWR- N; 57 Trinity Islands; 59 Kodiak NWR-south; 60 Kodiak NWR-west; 64 Afognak-west; 65 Afognak-north; 66 Afognak-east; 67 Shuyak; 68 Kenai Fjords-west Names of LSs Contacted: 35 Chisik Island; Tuxedni Bay; 84 Malina Bay; Raspberry Island; Raspberry Strait; 86 Uganik Bay Uganik Strait; Cape Ugat; 87 Cape Kuliuk; Spiridon Bay; Uyak Bay Names of GLSs Contacted: 124 Kukak Bay; 141 Seldovia side Kachemak Bay; 152 Barren Islands; 159 Kupreanof Strait			

Notes: [1] Highest percent chance from any launch area (LA) or pipeline area (PL) during summer or winter assuming a large spill occurs. Note that all resource areas with <0.5 percent chance of contact are not shown.
-- No highest percent chance in this range.
Source: Ji and Smith (2021).

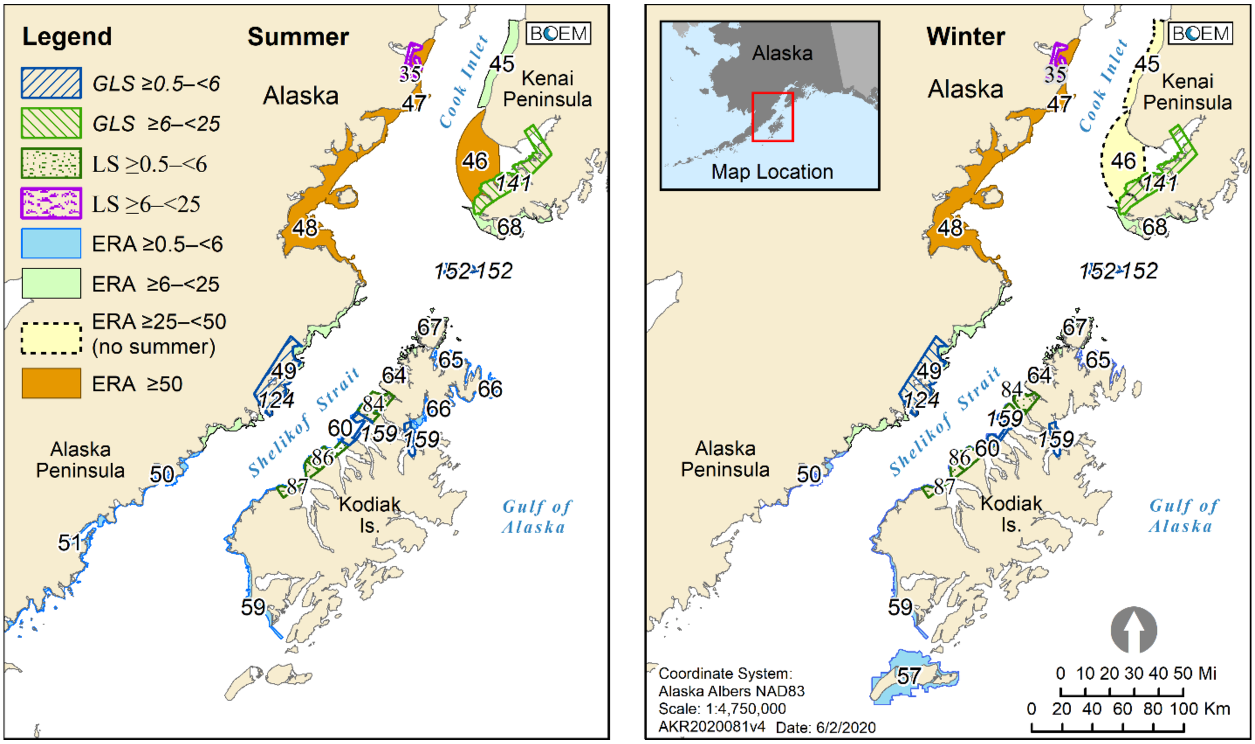

Figure A8: **Location and ID number of Sea Otter Resource Areas (Assuming a Large Spill Occurs ≥1% Chance of Contact within 30 Days): Summer and Winter**

Combined Probabilities. Combined probabilities for 33 of 43 sea otter resource areas are <0.5 percent and 8 are <6 percent (Ji and Smith, 2021, Tables A.2-61). The estimated percent chance of occurrence and contact within 30 days to sea otter resource areas was greatest for SW Cook Inlet (47) (6 percent) and the Outer Kachemak Bay/IBA (46) (10 percent), which are areas adjacent to the Lease Sale Area.

A-3.7.2.7 Spill Drills and Response Activities

Spill drills, including GIUEs, and spill responses would result in short-term displacement of sea otters from habitats due to increased human interaction and disturbance. Sea otters are expected to resume normal behaviors after the activities conclude. Standard monitoring practices and approved deterrence procedures to move sea otters away from areas of activity would further limit adverse impacts. Impacts associated with response activities were analyzed in the *Biological Opinion for the Alaska Federal/State Preparedness Plan for Response to Oil & Hazardous Substance Discharges/Releases* (USFWS, 2015a).

Some sea otters may be curious and approach personnel who are in vessels. Typically, authorizations from the U.S. Fish and Wildlife Service (USFWS) include hazing as a method of keeping sea otters away from oiled areas. Oiled individuals may be captured and transported for cleaning and treatment (USFWS, 2015a; NMFS, 2019). Although deterrence would likely cause stress and disturbance among individuals, such events would be infrequent so large numbers of individuals would not be affected.

Spill drills and response activities could range from little to no impacts, to infrequent, temporary, and short-term disturbance or displacement of individual sea otters and their prey from preferred habitats. Delays in spill response could cause additional otters to make contact with spilled oil.

A-3.7.2.8 Conclusion

Small spills would not impact sea otter populations, though some individuals could perish. Overall, depending on the trajectory and timing of a large spill, and the residence time of oil in the environment, a large spill could have lethal impacts to sea otters in localized areas, but small and temporary effects on either stock of sea otters. A gas release could be fatal to a small number of sea otters if their pelts became fouled with condensate; however, population-level impacts would not occur. Spill drills and response activities would not produce population-level impacts, mostly disturbing sea otters near drill and response activities.

A-3.7.3 Overall Marine Mammal Conclusion

Small oil spills, a large gas release, spill drills, and spill response are expected to have limited potential to affect marine mammal populations. Due to the relatively small size of the area affected, weathering processes in Cook Inlet, the short duration of incidents, and the remote likelihood for population-level impacts, small spills, a large gas release, spill drills, and spill response are not expected to affect marine mammal populations. Effects to marine mammals are likely to be short-term and temporary, producing temporary behavioral responses for a limited number of individuals. Large oil spills are not expected to substantively affect most marine mammal populations, though fatal effects could occur for a few individuals. Impacts to beluga whale and sea otter populations from a large oil spill would likely be inconsequential. However, beluga whales and sea otters often aggregate in key habitat areas largely designated as Critical Habitat throughout the Cook Inlet region. If a large oil spill impacts an area where beluga whales or sea otters are aggregated and they are subsequently injured, their populations could be adversely affected.

A-3.8 Terrestrial Mammals

The general effects of an oil spill on terrestrial mammals can be both immediate and long-term from physical contact, inhalation, and/or ingestion of contaminants (Osweiler 2018; AMAP 2010; BOEM, 2020, Figure 4-3). Impacts can range from temporary injuries such as skin irritation and damage, to long-term disease and organ failure; for example, cancer, liver disease, and compromised immune or reproductive systems (Osweiler, 2018). Mortality may occur due to just one, or a combination of exposures, but is most commonly associated with hypothermia and inhalation. Spills may also affect vertebrate animals through habitat degradation and prey or forage contamination by toxic compounds, including PAHs (Burns et al., 2014). Potential effects of an oil spill on terrestrial mammals may include:

- Effects of oil contact: irritation, inflammation, or necrosis of skin; chemical burns of skin, eyes, or mucous membranes; absorption of toxic compounds through skin (Osweiler, 2018); and hypothermia resulting from compromised fur (Garshelis and Estes, 1997). Short- and long-term respiratory effects may include inflammation, pulmonary emphysema, or infection (MDNR, 2019).
- Effects of oil ingestion: gastrointestinal inflammation; ulcers; bleeding; liver, kidney, and brain tissue damage; cancer/tumor development; compromised immune/reproductive systems; and altered respiration and heart rate (MDNR, 2019; AMAP, 2010; Burns et al., 2014; Frisch, Øritsland, and Krog, 1974).
- Effects of oil spills on habitat include physical and chemical degradation (Burns et al., 2014).

Additional discussion of the general impacts of oil and gas on terrestrial mammals is provided in the *Beaufort Sea: Hypothetical Very Large Oil Spill and Gas Release* report (BOEM, 2020, Section 4.2.7).

A-3.8.1 Small Oil Spills (<1,000 bbl)

Small spills from an onshore pipeline or machinery leaks are more likely to contact and affect terrestrial mammals or their habitat than offshore small spills, which are highly likely to disperse and weather prior to reaching land. Winter spills would be unlikely to contact terrestrial mammal habitat because ice and snow slow the spread of oil and provide a barrier to oiling of habitat, thus allowing for more effective spill cleanup.

During summer, small spill size (<1,000 bbl), and low densities of highly mobile terrestrial mammals would be expected to limit impacts, and it is likely that few individuals would be contacted. A small summer pipeline spill would be expected to contact a relatively small area of terrestrial mammal habitat, and individuals would readily move away from the affected area. This situation would provide little opportunity for oiling terrestrial mammals. Spills could remain near the soil surface and terrestrial mammals could contact oil until spill cleanup and remediation.

During winter, few terrestrial mammals are present/active, further decreasing the likelihood of contact with a small spill. Impacts from small spills in summer and winter would be limited to avoidance of the area because of the presence and strong odor of hydrocarbons, and the disturbance created by spill cleanup.

A-3.8.2 Large Oil Spill (≥1,000 bbl)/Gas Release

Impacts to terrestrial mammals from oil exposure could include any one or a combination of those impacts summarized above. A large, 3,800 bbl onshore pipeline oil spill could have a large affected area if the oil was discharged under pressure and the spill occurred in summer (Conn et al., 2001). As with small spills, a large winter spill would be constrained by snow and ice, allowing for more effective cleanup. However, a large spill in any season has a greater potential to oil terrestrial mammals, and temporarily or permanently remove habitat, depending on the use and success of cleanup procedures.

Brown bears utilize tidal flats and marshes for spring foraging to recover from hibernation, and salmon runs in area rivers are also heavily used during summer and fall. Because they use these habitats, brown bears could be exposed to oil from a large spill and experience the general impacts described above. Impacts would, however, be spatially limited due to large bear home ranges and the limited extent of oiled shoreline (Table A2). No more than a few bears would potentially be affected.

Overall, the potential impacts of a large spill on terrestrial mammals would be lessened by weathering processes that reduce the quantities and toxicity of oil present in the environment, and by spill cleanup and response activities that disturb or displace terrestrial mammals. These factors decrease the likelihood that terrestrial mammals would come into contact with oil and therefore decrease potential impacts.

A large gas release has a lower potential for impacts on terrestrial mammals because it would rapidly disperse into the atmosphere and be transported away from the release site by winds. Concentrations of methane would not be sufficient to asphyxiate terrestrial mammals in the vicinity of the release. If ignition and/or explosion occurred in association with a gas release, terrestrial mammals could be injured or killed in close proximity to the release site. The loss of habitat due to burning would vary depending on season, weather, and range condition (wet/dry status of vegetation) and whether or not any suppression efforts occurred. Overall, mortality would be expected to be low due to low densities of terrestrial mammals in proximity to onshore pipelines for most of the year, and the unlikely event of a gas release and subsequent fire and explosion.

A-3.8.2.1 Oil Spill Risk Analysis

BOEM identified 15 terrestrial mammal resource areas for the analysis (Ji and Smith, 2021; Table A.1-7; and Figures B4a–b). The OSRA acronym is GLS Grouped Land Segment.

Conditional Probabilities. Table A11 and Figure A9 show 9 resource areas with a ≥0.5 percent chance of contact within summer or winter. Figure A9 shows 5 resources with a ≥6 percent chance of contact in summer or winter. Six biologically important areas for terrestrial mammals are not estimated to be contacted (<0.5 percent). This analysis focuses on the five resource areas with a ≥6 percent chance of contact.

Summer. The chances of contacting resource areas important to terrestrial mammals are highest for Redoubt Bay Brown Bears (129), West Kenai Brown Bears (136), and West Kenai Black Bears (140). Each resource area is generally contacted the most from a large spill directly adjacent to their geographic location. Redoubt Bay (129) habitats provide important high protein forage food for brown bears during the spring and early summer when the animals are recovering from loss of body mass due to hibernation (Smith and Partridge, 2009). Area rivers, particularly the Kustatan River located within Redoubt Bay (129) (ADNR, 2009), support large populations of salmon that return to the rivers to spawn in mid- to late summer. The salmon are an extremely important source of fat and protein for brown bears preparing to return to hibernation (ADF&G, 2020). Portions of West Kenai Brown Bears (136) serve as moose (ADNR, 2009) and caribou (ADF&G, 2003) calving grounds during the spring, providing brown bears with additional food sources. Area rivers support summer and fall salmon runs, which brown bears rely on heavily. Tidal flats and marshes in area West Kenai Black Bears (140) provide important food sources during the spring, with summer and fall salmon runs in coastal rivers. Together with the lower densities of brown bears (Selinger, 2011), these factors make this an important foraging area for black bears.

Winter. The patterns of winter contact are generally similar to summer with lower chances of contact to areas that are not utilized by the resource for much of the winter (hibernation) and contact with a few additional resource areas. Chances of contacting terrestrial mammal resource areas are highest for GLSs Afognak, Raspberry Winter Elk (155) and Afognak Black Tail Deer (157). The beaches in these areas provide important wintering areas for black tailed deer and elk. Woody browse provides the majority of the winter diet for both species (ADF&G, 2020; AKNHP, 2011; Wallmo and Schoen, 1979), and black tailed deer also take advantage of accumulations of kelp washed ashore (Veeramachaneni et al., 2006).

Table A11: Highest Percent Chance of a Large Oil Spill Contacting Terrestrial Mammal Resources (Assuming a Large Spill Occurs)[1]

OSRA Feature Type	Highest Percent Chance Contact	Summer: 30 days	Winter: 30 days
GLS	≥0.5–<6	125, 137	125, 129,131, 136, 137, 140,160
GLS	≥6–<25	129, 136, 140	155, 157
Names of GLSs Contacted: 125 Spring Bear Concentration 1;129 Redoubt Bay Brown Bears;131 Trading Bay Moose, 136 West Kenai Brown Bears;137 West Kenai Moose; 140 West Kenai Black Bears; 155 Afognak, Raspberry Winter Elk; 157 Afognak Black Tail Deer;160 Kodiak Black Tail Deer			

Notes: [1] Highest percent chance from any launch area (LA) or pipeline area (PL) during summer or winter assuming a large spill occurs. Note that all GLSs with <0.5 percent chance of contact are not shown.

Source: Ji and Smith (2021).

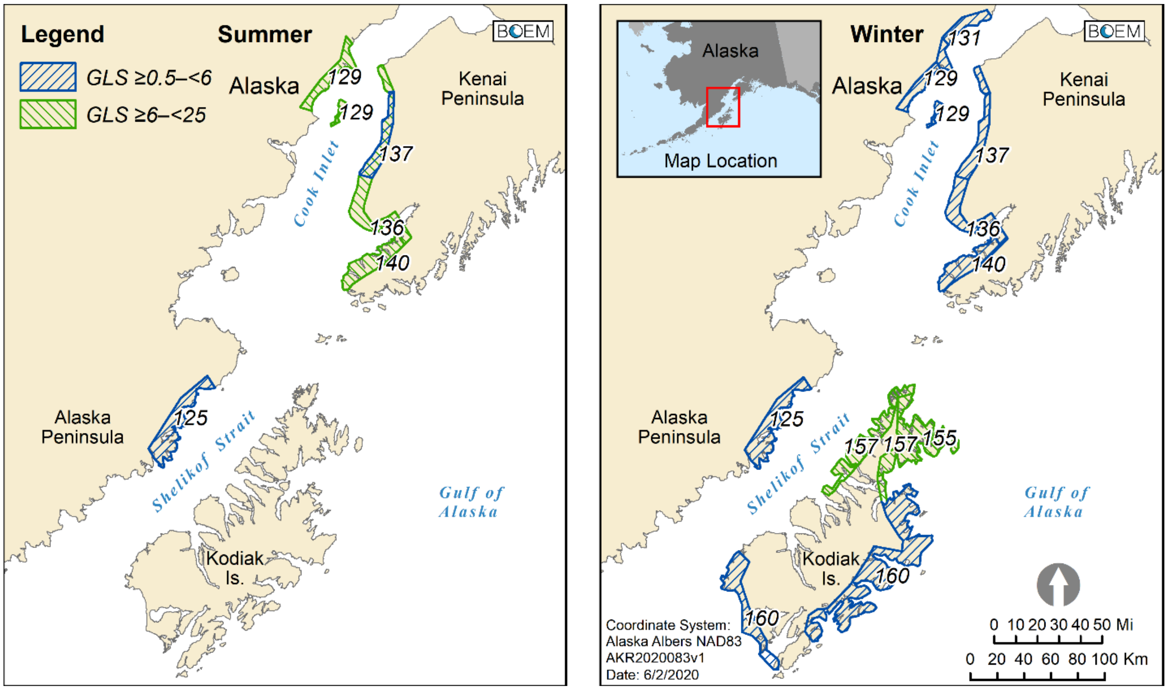

Figure A9: Location and ID number of Terrestrial Mammal Resource Areas (Assuming a Large Spill Occurs ≥1% Chance of Contact within 30 Days): Summer and Winter

Combined Probabilities. There is a 1 percent chance of a large spill occurring and contacting Redout Bay Brown Bears (129), West Kenai Brown Bears (136), West Kenai Black Bears (140) and Afognak& Raspberry Winter Elk (155) within 30 days. All other combined probabilities for terrestrial mammal resource areas were <0.5 percent within 30 days (Ji and Smith, 2021, Table A.2-63).

A-3.8.3 Spill Drills and Response Activities

The presence of humans, vessels, equipment, vehicles, and aircraft during spill drills (including GIUEs), or spill response could displace some terrestrial mammals. Aircraft operating below 1,000 feet above ground level can cause panic and injurious escape reactions among most terrestrial mammals. Vessels usually produce much less of a disturbance unless they are operating in coastal or riverine areas with terrestrial mammals nearby.

Activities such as in-situ burning and animal rescue would most likely displace some animals, and bears could be disturbed while feeding on carcasses. These disturbances could lead to bear-human conflicts, particularly during shoreline cleanup. Although beach cleaning may be performed with greater efficiency using newer technologies (Painter et al., 2011), spill response activities on shorelines may still impact terrestrial mammals. In general, broken ice spill response would have limited impacts on brown bears due to their habitat use and other factors (described above in Section A-3.8.2).

The overall impacts of spill drills and response activities on terrestrial mammals would vary depending on the area disturbed, extent of coastal area contacted by spilled materials, and the scale and effectiveness of the spill response. Mammals subject to other stressors, such as moose displacement from coastal wetland habitat, may be slightly more susceptible to disturbance impacts from these activities. Spill drills and response activities have the potential to discourage access to activity areas, which for spill response would reduce some of the more direct impacts from oil exposure. Overall, the beneficial impacts from spill drills and response activities, including GIUEs, would outweigh any negative impacts on terrestrial mammals resulting primarily from disturbance and temporary displacement.

A-3.8.4 Conclusion

Small spills, a large spill, and a gas release would have no more than minor impacts to terrestrial mammals. This is due to the limited number of resource areas that are estimated to be contacted by an offshore spill; long distances between spill sites and important terrestrial mammal habitats; weathering processes that reduce oil quantity and toxicity; and terrestrial mammal scarcity during winter.

Spill response activities would reduce the likelihood that terrestrial mammals would contact spill materials, and the activities would discourage terrestrial mammals from entering the affected area. Spill drills are generally brief, lasting one to several days, and involve human activity that would temporarily discourage terrestrial mammals from entering or remaining in an affected area. Because of the brief duration of spill drills and low level of disturbance, the impacts of spill response and spill drill activities on terrestrial mammals would be negligible.

Overall, due to a low potential for contacting spill materials, the nature of human activity associated with spills, and the low level of potential behavioral responses, the impacts of small spills, one large spill, a gas release, spill drills, and spill response on terrestrial mammals would be expected to be no more than minor.

A-3.9 Recreation, Tourism, and Sport Fishing

Effects of a spill on recreation and tourism would depend on its size, location, and trajectory. Recreational areas that a spill is most likely to affect are those located adjacent to or along the shoreline. Some of the effects of spills on coastal recreational resources might include altering the use of recreational lands or waters and reducing the scenic quality of the recreational experience. Spills could oil the water and shoreline and cause changes to the scenery, behavior of wildlife, or patterns of visitor use, or visitors' experiences in the natural setting. Impacts to sport fishing would likely be limited to work occurring during summer months, which is the primary sport fishing season. Impacts to sport fishing as a result of accidental spills could extend beyond the summer recreational fishing season, depending on the size of the oil spill involved. Potential effects of an oil spill on recreation, tourism, and sport fishing may include:

- Recreation and tourism industry incur losses caused by direct damage in the spill-affected area(s) (Cirer-Costa, 2015; Eastern Research Group, 2014; McDowell Group, 1990; Ritchie et al., 2013).
- Altered use of recreational lands or waters and reducing the scenic quality of the recreational experiences (Hausman et al., 1995).
- Changed scenery, behavior or wildlife, or patterns of visitor use or visitors' experiences in the natural setting.
- Limited ability of sport halibut and salmon fishers to depart from oiled locations. Sport fishing charter operators could lose business (Herrmann et al.,2001).

A-3.9.1 Small Oil Spills (<1,000 bbl)

Small spills of refined oil (such as lube oil, hydraulic oil, gasoline, or diesel fuel) would float on the water surface and would disperse and weather rapidly. The volatile components of the fuel would evaporate within 24 hours and would be unlikely to have long-lasting or widespread effects on recreation and tourism. Small spills of crude oil would persist longer in the environment and could result in greater impacts than spills of refined products. However, even small crude oil spills are not expected to persist on the water long enough to affect waterborne recreational activities or reach recreational areas along the shoreline. Small spills would result in little or no impact and thus have negligible effects on recreation and tourism.

Small spills would predominantly occur within the confines of or adjacent to the offshore. Furthermore, these small spills are anticipated to be contained with the on-site spill response resources, further minimizing the geographic extent of any impact. Therefore, for isolated small crude oil and condensate spills, minor impacts are expected to sport fishing resources.

A-3.9.2 Large Oil Spills (≥1,000 bbl)/Gas Release

In contrast to small spills, a large, 3,800 bbl spill would persist on the water surface longer than a few hours or days, depending on the type of oil spilled. Large spills of refined oil (such as lube oil, hydraulic oil, gasoline, or diesel fuel) would float on the water surface and would disperse and weather rapidly. The volatile components of the fuel would evaporate within 3 days and would be unlikely to severely affect recreation, tourism, and sport fishing. Large spills of crude oil will persist longer in the environment and could result in long-lasting and widespread impacts to recreation, tourism, and sport fishing.

Oil spill persistence on water or on the shoreline can vary widely depending on the size of the oil spill; the environmental conditions at the time of the spill; the substrate of the shoreline; and, in the case of portions of Cook Inlet, whether the shoreline is eroding. Oil clings to certain types of shoreline, including marshes, peat, fine-grained sediments, and armored cobbled shores, and tends to weather slowly. Oil that reaches the shorelines of recreational areas would have the greatest potential to adversely affect recreation and tourism. The presence of oil on the shoreline of a recreational area would reduce the attractiveness of that area to recreationists and tourists. As long as oil is visually present, those portions of the recreational areas would be closed to visitation. After the initial cleanup is completed and the areas reopened, recreationists and tourists would still likely avoid visiting those areas for some extended time due to a perception of contamination. Consequently, oiling of the shorelines of recreational areas from a large spill would reduce the quality of the recreational experience and alter patterns of use of those shorelines. These effects could be long-term and widespread.

An oil spill could result in closure of ports in Homer, Kenai, and elsewhere along the west side of the Kenai Peninsula. Ports probably would be closed to protect the port and vessels from being oiled. Oil spills can cause economic losses to boat owners and fishers by contaminating fishing gear and vessels. Oiled vessels would need to be cleaned, and oiled gear cleaned or replaced. It is anticipated that fishers would fish alternate areas because of port closures. Charter operators would avoid going out of port into Cook Inlet to avoid fouling their gear and vessels. Public perception of oil spill damage or contamination, real or perceived, would diminish the number of sport fishers. Sport fishers likely would target alternate fishing grounds until the quality of the fishing experience, real or perceived, in the oil spill area returned to previous conditions. These effects could last for one or more fishing seasons and be widespread depending on the timing of the large oil spill.

Oil contacting the beaches could affect clam gathering. People gather razor clams and other clams for sport along the east and west sides of Cook Inlet, and mussels and steamer clams in small bays in Kachemak Bay. Populations of intertidal organisms in any area contacted by oil would be depressed measurably for about a year, and small amounts of oil would persist in the shoreline sediments for more than a decade. The difference in effect between large and small spills is in the extent of areal coverage of impacted shoreline. While small spills would not be expected to impact the nearshore environment, large spills may have a long-term and widespread impact on clam gathering. There is a chance that the oil could migrate to the coastline and nearshore environments resulting in long-term closure of these areas and thus adversely affecting clam gathering.

An accidental release of natural gas into the environment would be expected to rise and disperse and is unlikely to affect recreation, tourism, or sport fishing. A single day release of gas would not be expected to have long-lasting and widespread impacts on sport fishing but could temporarily exclude sport fishers from the immediate area of the blowout. The impacts of a gas blowout and resulting explosion or fire are considered minor.

A-3.9.2.1 Oil Spill Risk Analysis

BOEM identified 28 areas of special concern for the analysis (Ji and Smith, 2021; Table A.1-10; and Figures B3c and B4a–b).

Conditional Probabilities.

Table A12 and Figure A10 show 21 resources with a ≥1 percent chance of contact and 11 resources with a ≥6 percent chance of contact in summer or winter. Seven important areas for recreation, tourism, and sport fishing are not estimated to be contacted (<0.5 percent) and 10 have a <6 percent chance of contact from any location. This analysis focuses on the 11 resource areas with a ≥6 percent chance of contact. The OSRA acronyms are: LS Land Segment; and GLS Grouped Land Segment.

Summer. The chances of contacting resource areas important to recreation, tourism and sportfishing is highest (≥50 percent) for the shorelines in the Alaska Maritime National Wildlife Refuge (NWR) (127) in western Cook Inlet. Shorelines of Tuxedni State Game Refuge (35), Katmai National Park (123), Lake Clark National Park & Preserve (128), Alaska State Management Areas (126, 135, 138, 153), Alaska Maritime NWR (142, 154) and Kodiak NWR (156) are contacted ≥6 percent. These areas provide important outdoor recreation and tourism opportunities for wilderness camping and backpacking, hiking, hunting, wildlife viewing, sport fishing, and exploring. Tuxedni Bay (35), which is located within the Alaska Maritime NWR (127), is the home of seabirds, bald eagles, peregrine falcons, and other birdwatching opportunities. Katmai National Park (123) is a wilderness park that attracts people from all over the world to view brown bears and enjoy world-class fishing.

Winter. The patterns of contact are similar to summer except the highest chance of contact is to the shorelines in the Alaska Maritime NWR (127) and Lake Clark National Park & Preserve (128).

Table A12: Highest Percent Chance of a Large Oil Spill Contacting Areas of Special Concern (Assuming a Large Spill Occurs)[1]

OSRA Feature Type	Highest Percent Chance	Summer: 30 days	Winter: 30 days
LS	≥0.5–<6	38	38
LS	≥6–<25	35	35
GLS	≥0.5–<6	113, 114, 122, 130, 139, 143, 158, 164	114, 122, 130, 139, 143, 158, 161, 164
GLS	≥6–<25	123, 126, 135, 138, 142, 153, 154, 156	123, 126, 135, 138, 142, 153, 154, 156
GLS	≥25–<50	128	--
GLS	≥50	127	127, 128

Names of LSs Contacted: 35 Tuxedni State Game Refuge; 38 Kalgin Island Critical Habitat
Names of GLSs Contacted: 113 Alaska Peninsula NWR; 114 AMNWR SW Shelikof/GOA; 122 Becharof NWR; 123 Katmai National Park; 126 McNeil River State Game Sanctuary & Refuge; 127 AMNWR W Cook Inlet ; 128 Lake Clark National Park & Preserve; 135 Kenai AK State Rec Mgmt Areas; 138 Clam Gulch Critical Habitat 139; Kachemak Bay State Park and Wilderness Park Kachemak Bay State Critical Habitat Area 142; AMNWR E Cook Inlet 143; AMNWR W Outer Kenai/GOA 153; Shuyak Island State Park 154; AMNWR Afognak and Shuyak Islands 156; Kodiak National Wildlife Refuge 158; AMNWR W Kodiak/Shelikof 164; Afognak Island State Park

Notes: [1] Highest percent chance from any launch area (LA) or pipeline area (PL) during summer or winter assuming a large spill occurs. Note that all resource areas with <0.5 percent chance of contact are not shown.
-- No highest percent chance in this range.
Source: Ji and Smith (2021).

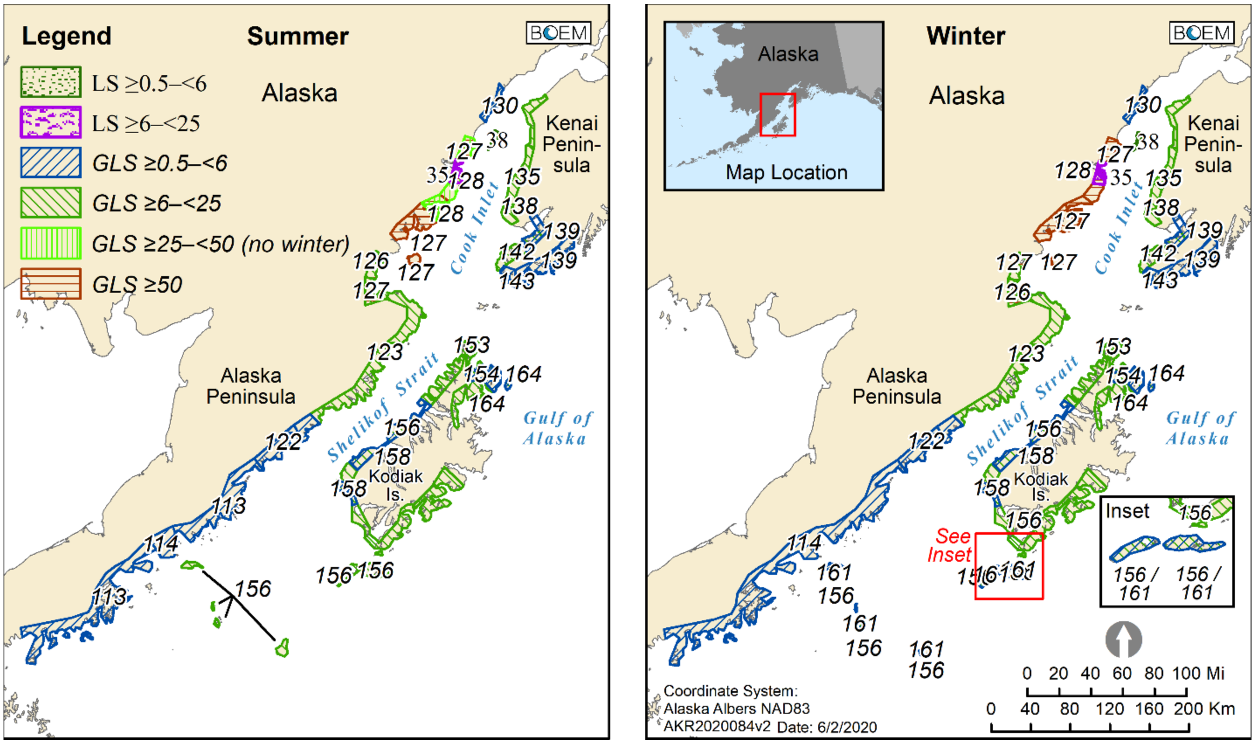

Figure A10: Location and ID number of Areas of Special Concern (Assuming a Large Spill Occurs ≥1% Chance of Contact within 30 Days): Summer and Winter

Combined Probabilities. Except for Alaska Maritime NWR (127) and Lake Clark National Park & Preserve (128), all combined probabilities for recreation, tourism and sportfishing resource areas were ≤2 percent within 30 days (Ji and Smith, 2021, Tables A.2-63). There is a 10 percent and 7 percent chance of a large spill occurring and contacting Alaska Maritime NWR (127) and Lake Clark National Park & Preserve (128), respectively, within 30 days.

A-3.9.3 Spill Drills and Response Activities

Spill drills, including GIUEs, are infrequent, short-term, and use existing equipment. If spill drills were carefully sited away from recreation use areas, they would have little to no adverse impacts to recreation and tourism.

Spill response activities could include mechanical recovery methods, use of dispersants, and in-situ burning of spilled materials. Increased aircraft and vessel traffic, and corresponding increases in vessel discharges and noise, would also be associated with spill cleanup operations. Depending on the size of the spill and whether or not it contacted intertidal and onshore resources, response and cleanup time and extent of response activities could be short-term and localized or long-lasting and widespread.

The effects of response and cleanup for a large oil spill on recreation, tourism, and sport fishing would depend on a variety of factors including location of the spill, time of year, size of the spill, and weather conditions. Waterborne recreational activities such as marine boating, sport fishing, and waterborne wildlife viewing are expected to be directly affected when the spill area is closed to facilitate the spill response. Waterborne activities in portions of the Lease Sale Area that adjoin the spill area would be indirectly affected by the noise, increased level of activity, and number of vessels, which would reduce the quality of the recreational experience. These effects would last at least as long as the spill response and cleanup is ongoing.

A-3.9.4 Conclusion

Impacts to recreation and tourism would be negligible for small spills and moderate with the addition of a large oil spill. A large gas release could have minor impacts to recreation and tourism. Spill drills would have negligible impacts to recreation and tourism. Spill response and cleanup activities could have minor to moderate impacts to recreation and tourism.

Impacts to sport fishing could be minor for small spills and moderate with the addition of a large oil spill. A large gas release could have minor impacts to sport fishing activities. Spill drills would have negligible impacts to sport fishing. Spill response and cleanup would have minor to moderate impacts to sport fishing activities.

A-3.10 Sociocultural Systems

Oil spills cause psychological, social, public health, economic, and cultural impacts in society. The sociocultural system includes social organization, cultural identity, and local institutions. Impacts from an oil spill on the sociocultural system of local communities could come from disruption of subsistence through oiling of habitats and subsistence resources; spill response and cleanup activities, including changes in population, employment, and income; and social and psychological stress due to fears of potential contamination of resources (Palinkas et al., 1993). An oil spill or gas release would likely have impacts on the sociocultural system of communities in Cook Inlet and the surrounding region, with the level of consequences depending on the size, timing, location, movement, and type of product(s) spilled. Impacts could include:

- Increased social stress in communities, including loss of credibility and trust in authorities, frustration and anger, breakdown in family ties, and a weakening of community well-being (Chang et al., 2014; Impact Assessment, 1990; Lord et al., 2012, 1–23; Palinkas, 2012, 203–222; Webler and F. Lord, 2010, 723–738).
- Social and psychological distress over potential losses of cultural values and identity (Palinkas et al., 1993; Webler and Lord, 2010).
- Increased demand on the health and social services available in communities (Chang et al., 2014; Goldstein et al., 2011; Impact Assessment, Inc., 1990; Palinkas et al., 1993; Rodin et al., 1992).
- Higher rates of substance abuse, crime, domestic violence, and mental illnesses (Chang et al., 2014; Goldstein et al., 2011; Impact Assessment, Inc., 1990).
- Disruption of economy and interruption of way of life, along with decreased emphasis on subsistence as a livelihood and increased emphasis on earning wages, particularly through participation by local individuals in spill response and cleanup employment (Lord et al., 2012; Palinkas, 2012; Palinkas et al., 1993; Webler and Lord, 2010). Such disruptions would likely depend in part on the perception of impact by subsistence harvesters.

A-3.10.1 Small Oil Spills (<1,000 bbl)

Potential impacts from small spills of all kinds are not likely to cause disruptions to sociocultural systems except as discussed in Section A-3.11 for subsistence harvest patterns. Small spills of refined oil (such as lube oil, hydraulic oil, gasoline, or diesel fuel) would float on the water surface and would disperse and weather rapidly and would be unlikely to affect sociocultural systems. Small spills of crude oil would persist longer in the environment and could result in more impacts than spills of refined products but are expected to be short-term and localized. Effects on cultural values could occur if oil spills alter subsistence harvest patterns. In subsistence-oriented communities, traditional emphasis is on kinship, community, cultural continuity, cooperation, and sharing. There could be little to no or short-term and localized impacts to subsistence harvest patterns from small spills, and levels of sociocultural impacts in subsistence communities would be the same.

A-3.10.2 Large Oil Spill (≥1,000 bbl)/Gas Release

A 3,800 bbl, large oil spill event would likely have effects on the sociocultural systems of communities in the Lease Sale region with the level of consequences depending on the timing, location, movement, and type of crude or refined product(s) spilled. The effects would be felt in three areas of sociocultural systems: social organization, cultural values, and institutions. For example, a large oil spill that affected salmon fisheries would have effects not only on subsistence and personal use harvests, but also on commercial and sport fisheries. The portion of the regional economy connected to healthy salmon populations would be disrupted, affecting the people whose livelihood is connected to salmon. Kinship relations and commercial fishing crew organization would change to respond to diminished or prohibited fish harvests (Section A-3.14). The cultural values placed on cooperation in fish harvesting, processing, sharing, and distribution could be impacted for one or more fishing seasons.

A large spill has potential to result in long-term and widespread, and possibly severe, impacts to subsistence activities and harvest patterns (Section A-3.11). Disruptions to subsistence harvest patterns from a large spill can cause social stress and anxiety from reduction or loss of traditional practices, cultural well-being, and identity. Interruption of subsistence for one or more seasons would impact sociocultural systems by impeding distribution of harvested resources within and between communities. People who rely on receiving subsistence foods to maintain their cultural values and identities would be impacted. This is especially the case for community members who are not able to hunt and fish for themselves (e.g., elders). Cultural identity would also be impacted from decreases in harvest, processing, and teaching youth the subsistence way of life. In addition, the sociocultural systems of coastal communities could be impacted by social and psychological stress due to potential contamination of subsistence food resources (Impact Assessment, Inc., 2011b; Palinkas et al., 1993).

Existing institutions are less likely to be affected by a large oil spill. Borough, city, and tribal governments would continue in the event of a large oil spill but could take on additional roles to cope with spill response and cleanup activities.

Impacts from a large spill of crude oil could be long-lasting and widespread, and possibly severe, depending on the spill location relative to the resources impacted and the duration and extent of disruption to subsistence activities and social organization. Impacts on the smaller subsistence-oriented communities in the region would likely be a greater disruptor to sociocultural systems than would be felt in larger, more heterogeneous communities less dependent on subsistence harvests. Impacts from a large spill would have a severe effect on sociocultural systems if subsistence harvesting or commercial fishing were disrupted for one or more seasons (Sections A-3.11 and A-3.14).

An offshore gas release over one day would be localized and of short duration with rapid dissipation. Implementation of safety exclusion zones would make it unlikely that subsistence or commercial fishermen would approach close enough to an offshore development to be injured from a potential blowout and gas release. Temporary and localized impacts are possible in the event of a large release of natural gas from an onshore pipeline, especially in the unlikely event of ignition near a community or near active subsistence harvesters. Impacts to the sociocultural system from a large gas release lasting one day are expected to be short-term and localized. Potential impacts to the sociocultural system from a large gas release could be avoided by siting pipelines to come ashore far from communities.

A-3.10.3 Spill Drills and Response Activities

Spill drills, including GIUEs, are infrequent, usually last less than 8 hours, and normally use existing equipment. If oil spill cleanup and response drills were carefully sited away from small communities and subsistence use areas, they would have little to no adverse impacts to sociocultural systems in those communities. Spill drills based out of existing industrial support areas in larger towns or cities would not likely be disruptive to sociocultural systems and would have little to no impact.

Effects to social and institutional organizations can occur due to local employment in spill response and cleanup activities. Cleanup employment of residents could place stresses on local village and town infrastructures by drawing local workers away from community service jobs (Palinkas et al., 1993). Other social impacts, which have been documented for VLOS-size spills but are informative for a large spill, include increased demands on community service providers, increased crime rates, labor shortages, disruption of local government activities, and social conflicts between local residents and outsiders coming to town to work on spill cleanup jobs (Palinkas et al., 1993; Webler and Lord, 2010). Over a longer duration (one or more seasons) and more widespread area, large spill cleanup activities could cause social relations and community cohesion to deteriorate in impacted communities (Palinkas et al., 1993; Palinkas, 2012). The level of impacts would depend on where cleanup activities occur in relation to communities and how long cleanup efforts last. For a 3,800-bbl spill, the impacts on local sociocultural systems would depend on the extent and duration of cleanup activities and how many residents were employed in cleanup work (Section A-3.13). Impacts would most likely be short-term and localized due to the temporary nature of initial response and cleanup jobs.

Because subsistence harvest, processing, and sharing are key supporting elements of sociocultural systems in many rural coastal communities, effects on subsistence activities and harvest patterns (Section A-3.11), would impact sociocultural systems. Short-term and localized or long-lasting and widespread effects on subsistence and sociocultural systems could occur if clean-up operations include sections of the beach or intertidal zones, or if contamination from chemicals used in cleanup generate avoidance of subsistence resources. Overall, impacts to sociocultural systems from spill response and cleanup activities are expected to be short-term and localized, to long-term and widespread, depending on the extent and location of the spill and to what extent subsistence harvest patterns are disrupted.

A-3.10.4 Conclusion

Impacts to sociocultural systems from small spills are expected to be minor due to their limited geographic and temporal effects. Impacts from a large spill of crude oil could be major, depending on the spill location relative to the resources impacted and the duration and extent to which impacts from a large spill disrupt subsistence activities, commercial fishing, and social organization. A large gas release over one day would be expected to have minor impacts to sociocultural systems. Spill drills would have negligible impacts to sociocultural systems, and spill response and cleanup activities could have minor to moderate impacts to sociocultural systems.

A-3.11 Subsistence Activities and Harvest Patterns

Impacts of oil spills on subsistence activities and harvest patterns could occur through changes in the availability, quality, and use of subsistence resources. Impacts would result from contact of crude oil with shorelines and fish and wildlife, and potential contamination of subsistence foods. Subsistence harvesters could purposively avoid affected subsistence areas and reduce their harvests of a particular subsistence food resource due to potential contamination (Fall et al., 2006; Impact Assessment, Inc., 2011a). Important subsistence resources could become unavailable or undesirable for one or more seasons, resulting in substantial and sustained food insecurity (Suprenand et al., 2018). Impacts could include:

- Direct mortality of targeted subsistence resources or their prey, displacement of subsistence resources, or reduced numbers of species used for subsistence purposes (Fall et al., 2006; Picou and Martin, 2007).
- Displacement of people from traditional harvest areas and/or increased competition for subsistence resources (Impact Assessment, Inc., 2011a).

- Contaminated resources unfit for human consumption or undesirability of subsistence resources as foods and avoidance of oiled resources and areas (Impact Assessment, Inc., 2011b).
- Reduced consumption of subsistence foods and other products, food insecurity, and loss of or reductions in traditional subsistence practices (Impact Assessment, Inc., 2011b; Suprenand et al., 2018).

A-3.11.1 Small Oil Spills (<1,000 bbl)

A range of impacts could occur for subsistence fishing and hunting. Impacts would be related to contaminated resources unfit for human consumption, undesirability of subsistence foods, and avoidance of resources and harvest areas affected by small spills. Most small spills would evaporate or disperse within hours to one day and would result in little to no impact on subsistence activities and harvest patterns. Small, refined spills that occur offshore would float on the water surface and would disperse and weather rapidly. Small spills of crude oil would persist longer in the environment and could result in more adverse impacts than spills of refined products. Onshore spills of crude oil or refined products would be contained to localized areas and would mostly evaporate or be cleaned up quickly. Overall, there would most likely be little or no impacts to terrestrial mammal hunting from small spills because hunters would be able to pursue large game at areas outside those contacted by spills. Small spills that contact fishing, marine invertebrate gathering locations, or marine mammal or waterfowl hunting areas at shorelines or river mouths would have localized and mostly short-term impacts on subsistence activities in those areas. Longer-term impacts are possible at locations of chronic spills, at harvest locations that are only available for limited time periods due to regulations, or where spills result in avoidance of the area by subsistence harvesters. For example, 24 percent of a small crude spill is estimated to remain after 30 days in the summer (Table A1), which would result in up to 30 bbl, or 1,260 gallons of oil remaining in the environment. If this occurred in a subsistence use area, harvesters would likely avoid the affected area while the oil remained and potentially for a longer period such as the remainder of the harvest season and potentially longer. Harvester perception of impacts, and of the area and timeframe harvesters avoid affected spill locations, may impact subsistence activity. This impact would be localized, and harvesters may be able to access other locations for targeted resources. However, harvesters may incur economic impacts if they need to travel farther distances for resources that are not affected by a small spill, or if they harvest other resources to replace those affected by the spill (Keating et al., 2020). Harvest locations that, under regulation, are only open for short periods of time such as the set gillnet fisheries around Kachemak Bay and near Seldovia and Port Graham (Brown et al., 2021), could become unavailable for part or all of a season if a small spill contacted those locations in the timeframe of the open season. Because small spills in shoreline areas or at river mouths would not spread over large areas, impacts would remain localized to individual harvest locations. Spills that occur farther offshore would have little to no, to short-term and localized impacts on subsistence fishing, depending on their size and type, but would not make salmon or other fish unavailable to harvesters.

A-3.11.2 Large Oil Spill (≥1,000 bbl)/Gas Release

Potential impacts to subsistence harvest patterns from a large, 3,800 bbl oil spill include direct mortality of targeted subsistence resources or their prey, displacement of subsistence resources making them unavailable or more difficult to access for subsistence harvesters, and contamination of subsistence use areas and subsistence resources. Traditional harvest locations may have resources deflected due to oiling of the environment, or resources may not be available in adequate quantities to satisfy traditional harvest patterns.

A large oil spill could affect the availability of subsistence resources through impacts on the abundance and distribution of subsistence species. Long-lasting and widespread impacts from a large spill may occur for marine invertebrates, fish, and most bird populations (Sections A-3.5 and A-3.6), and these impacts could affect the availability of resources to subsistence harvesters. Most marine mammals harvested for subsistence in the Cook Inlet region are not expected to experience population-level impacts from a large spill, except for beluga whales (for which the subsistence harvest is currently closed) (Section A-3.7).

A large spill that reaches nearshore and shoreline areas could impact subsistence harvest of multiple resources. Resource harvest locations for communities overlap to a large degree. For example, a community may harvest several types of resources from the same area, so a spill contacting that area would affect the community's harvest of several resources. Community harvest locations for Seldovia, Nanwalek, and Port Graham in the Kachemak Bay area overlap to varying degrees for salmon, non-salmon fish, marine mammals, marine invertebrates, birds and eggs, and some terrestrial mammals (Jones, B. and Kostick, M. 2016). Likewise, Tyonek's harvest locations for various resources overlap on the western side of Cook Inlet (Jones et al. 2015). Oil contact to a community's harvest area could disrupt subsistence activities for multiple resources and make those resources unavailable or undesirable for use for a substantial portion of a subsistence season, or for more than one season. A summer spill would have a greater chance of contact to harvest areas for several communities and would also coincide with the harvest season for many resources. In addition, some communities share harvest areas, so a spill contacting one area could impact harvest for several communities. For example, for the communities of Seldovia, Nanwalek, and Port Graham, nearshore waters as well as bays and river mouths in southern Kachemak Bay provide harvest locations for salmon and other resources (Jones, B. and Kostick, M. 2016). A large spill that contacts shoreline areas around Kachemak Bay, especially on the southern shore of outer Kachemak Bay, would potentially affect harvest locations for multiple communities. Residents of other Kenai Peninsula communities also harvest resources in the Kachemak Bay area, and some residents harvest fish or shellfish on the western side of Cook Inlet in or near Tyonek's harvest areas. Similarly, communities on parts of Kodiak Island share general harvest areas as do several communities on the upper Alaska Peninsula (BOEM 2016; Morris, 1987). BOEM estimates a large spill would affect about 26–35 km of shoreline (Table A2), which could affect a substantial portion of subsistence use areas for communities. Subsistence areas could be impacted for a substantial portion of a season or more than one season if oil persists in the substrate of the harvest area. For example, if oil contacts set gillnet fishery areas around Kachemak Bay or shellfish harvest locations, areas may be closed for harvest or avoided for one or more seasons. A large oil spill that contacts communities' harvest areas, would have widespread, long-lasting, and possibly severe impacts.

Contamination of resources, and the concern about tainted subsistence foods may (1) affect harvesters' decisions about the level of effort placed into harvesting resources, (2) limit people's consumption of subsistence products, and (3) cause people to completely stop eating traditional subsistence resources for varying lengths of time following a spill event. Avoidance of subsistence resources potentially impacted by an oil spill was noted following the *Selendang Ayu* spill near Unalaska in 2004. Although state-sponsored subsistence foods testing revealed no significant threat from hydrocarbons a couple years after the spill, some residents continued to express uncertainty about the safety of foods from the affected area (Impact Assessment, Inc., 2011b). Additionally, studies conducted after the 1989 EVOS provide insight into potential effects of oil spills on use of subsistence resources. While the EVOS was a VLOS event and was many times larger than the spill size assumed for this analysis (approximately 240,000 bbl vs. 3,800 bbl), the impacts documented after the EVOS are informative of the types of impacts that could occur from a large spill. A study conducted by the Alaska Department of Fish and Game, Division of Subsistence in 2003 and 2004 found approximately half of the households surveyed reported lower total subsistence uses than before the EVOS, and 39 percent blamed spill effects for continuing lower uses of at least one resource (Fall et al., 2006). Concerns were identified in eight study communities; these were related to paralytic shellfish poisoning, which was linked to the effects of the EVOS, and inhibited marine invertebrate harvesting. Overall, 72 percent of respondents said that the traditional way of life had not recovered from the spill. Over time, other long-term impacts of EVOS on subsistence communities have been documented related to economic and social changes, including abrupt changes in cash economies from settlement payments (Keating et al., 2020). The extent of impacts would be considerably less for a

3,800-bbl spill than for a VLOS; fewer communities would likely experience the levels of impacts documented for the EVOS. However, one or more communities could experience effects within their localized harvest areas based on the conditional analysis of potential for contact from a large spill (Section A-3.11.2.1). Contamination-related impacts caused by a large spill are expected to be long-lasting and widespread and possibly severe for subsistence harvest patterns and traditional practices.

A well control incident and gas release, with a possible explosion and fire could have impacts on subsistence resources (i.e., fish, birds, and marine and terrestrial mammals) in the immediate vicinity of the blowout. A release of methane into the water column has the potential to affect fish utilized as a subsistence resource (Section A-3.5). Fish mortality associated with a gas pipeline release could range from a few to hundreds of individuals without population-level impacts (Section A-3.5). Most gas escaping and contacting water would dissipate quickly, producing no effect on marine mammals hunted for subsistence purposes. If a 1-day natural gas pipeline release occurred, subsistence harvesters would likely avoid searching in the immediate vicinity for a short time period. If the release caused an explosion and fire, there is a chance subsistence resources in the vicinity would be injured or killed. A large natural gas release over one day is expected to have short-term and localized effects on subsistence harvest patterns in the Lease Sale Area.

A-3.11.2.1 Oil Spill Risk Analysis

BOEM identified 12 subsistence use areas (SUAs) for the analysis (Ji and Smith, 2021; Table A.1-9; Figures B-2a, d, and B-4a). The OSRA acronyms include ERA for Environmental Resource Area, and GLS for Grouped Land Segment.

Conditional Probabilities. Table A13 shows 9 SUAs with a ≥0.5 percent chance of contact in summer and winter. Figure A11 shows the location of these SUAs with a ≥0.5 percent chance of contact. Two of the SUAs are not estimated to be contacted (<0.5 percent chance). Four SUAs have a ≥6 percent chance of contact, of which, two have a ≥25–<50 percent chance of contact.

Table A13: Highest Percent Chance of a Large Oil Spill Contacting Subsistence Resources (Assuming a Large Spill Occurs)[1]

OSRA Feature Type	Highest Percent Chance	Summer: 30 days	Winter: 30 days
ERA	≥0.5–<6	2, 7, 8, 9	7, 8, 9
ERA	≥6–<25	5, 6	3, 5, 6
ERA	≥25–<50	3, 4	4
GLS	≥0.5–<6	116	--
Names of ERAs Contacted: 1 SUA: Tyonek Beluga; 2 SUA: Tyonek North; 3 SUA: Tyonek South; 4 SUA: Seldovia, Port Graham, Nanwalek; 5 SUA: Port Lions; 6 SUA: Ouzinke; 7 SUA: Larsen Bay; 8 SUA: Karluk; 9 SUA: Akhiok; 10 SUA: Old Harbor Names of GLSs Contacted: 116 Chignik, Chignik Lagoon			

Notes: [1] Highest percent chance from any launch area (LA) or pipeline area (PL) during summer or winter assuming a large spill occurs. Note that all resource areas with <0.5 percent chance of contact are not shown.
-- No highest percent chance in this range.
Source: Ji and Smith (2021).

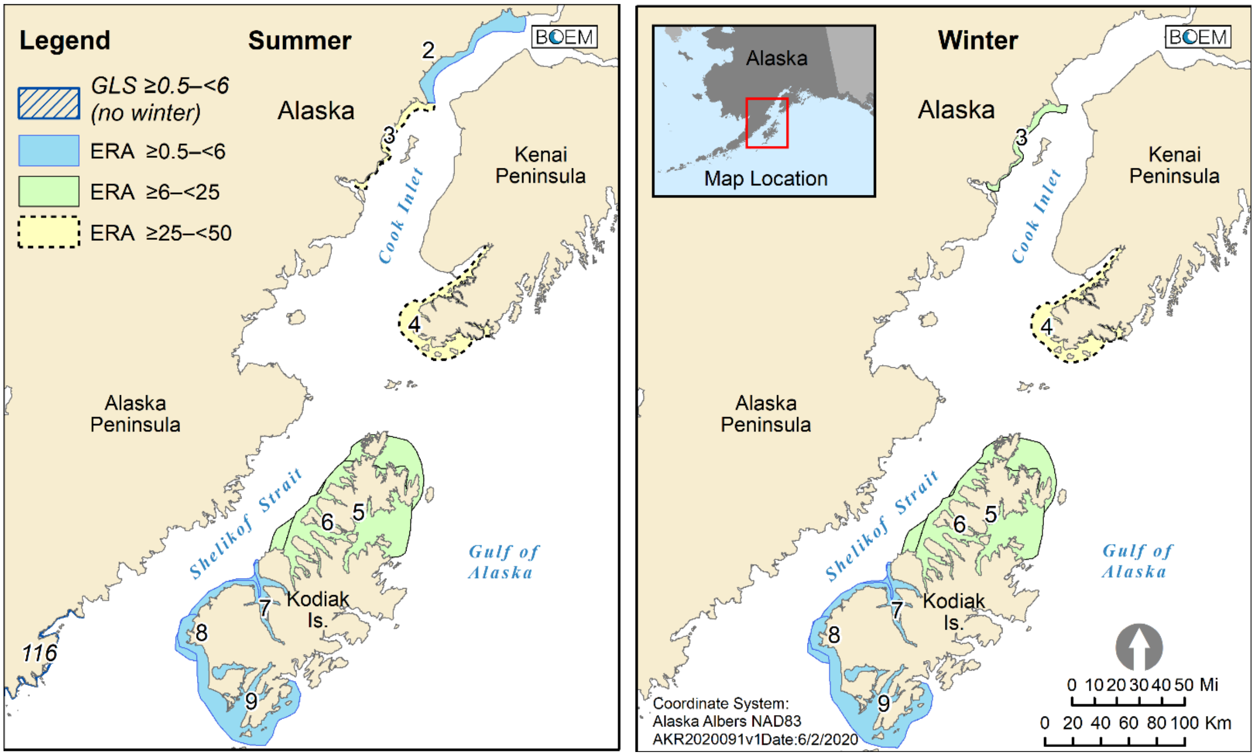

Figure A11: Location and ID number of Subsistence Use Areas (Assuming a Large Spill Occurs ≥1% Chance of Contact within 30 Days): Summer and Winter

Summer. SUAs used by Tyonek, Seldovia, Port Graham, Nanwalek, Larsen Bay, Karluk, Akhiok, Port Lions, Ouzinkie, and the Chigniks have a chance of contact from a large spill within 30 days or less. The Tyonek South (3) and Seldovia, Port Graham, Nanwalek (4) SUAs have the highest chance of contact ranging from ≥25–<50 percent. The northern Kodiak Island SUAs have the next highest chance of contact ranging from ≥6–<25 percent. SUAs farther to the north or south of the Lease Sale Area, Tyonek North (2) in upper Cook Inlet and the Chignik, Chignik Lagoon (116) on the Upper Alaska Peninsula, have a lower chance of contact (≥1–<6 percent).

Winter. The winter patterns are the same as discussed above for a summer spill, with the following notable differences. Chignik, Chignik Lagoon (116) and Tyonek North (2) are unlikely to be contacted (<0.5 percent). The percent chance of contact decreases for the Tyonek South (3) SUA to ≥6–<25 percent.

Combined Probabilities. Except for Tyonek South (3); Seldovia, Port Graham, Nanwalek (4); Port Lions (5); and Ouzinke (6) with a 1–2 percent chance of occurrence and contact, the combined probabilities for other SUAs were <0.5 percent (Ji and Smith, 2021, Tables A.2-61 and A.2-63).

A-3.11.3 Spill Drills and Response Activities

Spill drills, including GIUEs, are infrequent, short-term, and use existing equipment. If spill drills were carefully sited away from subsistence use areas or scheduled outside harvest seasons, they would have little to no impacts to subsistence activities and harvest patterns.

Spill response and cleanup activities may interfere with or disrupt subsistence harvest patterns. This could occur due to the implementation of emergency regulations that create exclusion zones to protect cleanup work areas or prohibit subsistence harvests in certain areas. If cleanup operations include sections of the beach, or intertidal zones, access to subsistence fishing and shellfishing areas, and areas used for coastal hunting of terrestrial mammals, could be restricted. Additionally, increased aircraft and vessel traffic and corresponding increases in vessel discharges and noise associated with spill cleanup operations would create disruptions and space-use conflicts that could extend beyond the immediate area of cleanup activities. Restriction of access to subsistence harvest areas could last for part of a harvest season or for one or more seasons. Impacts would be short-term and localized or long-lasting and widespread, depending on the area affected and the length and season of cleanup activities.

Mechanical methods used to recover spilled oil offshore would most likely not impact fishing practices or other subsistence activities because harvesters would avoid affected areas and active cleanup operations. The use of dispersants and in-situ burning could result in avoidance of harvesting marine resources for one or more harvest seasons due to potential contamination. The potential for contamination of wild foods could result in long-lasting and widespread cessation of subsistence harvest of marine resources including fish, invertebrates, and marine mammals.

Subsistence activities and harvest patterns could be affected by spill response and cleanup activities that involved volunteer or paid employment of residents. Subsistence harvesters' time, effort, and equipment could be diverted from subsistence activities to oil spill response and cleanup. Earning cash from paid work in spill response and cleanup may allow some subsistence harvesters to purchase newer equipment and fuel needed to effectively pursue subsistence activities. Impacts to subsistence harvest patterns caused by spill response and cleanup activities could be short-term and localized or long-lasting and widespread, depending on the extent and location of the spill.

A-3.11.4 Conclusion

Impacts to subsistence activities and harvest patterns could be negligible to minor for small spills. Impacts from a large oil spill could cause severe and thus major impacts to subsistence harvest patterns. Such impacts would be due to the potential to disrupt subsistence activities, or to make subsistence resources unavailable or undesirable for use—or only available in greatly reduced numbers—for a substantial portion of a subsistence season. A large gas release would be expected to have minor impacts to subsistence activities and harvest patterns. Spill drills would have negligible impacts to subsistence activities and harvest patterns. Spill response and cleanup would have minor to moderate impacts to subsistence activities.

A-3.12 Community Health

An oil spill or gas release could impact community health. Potential adverse impacts to health from large oil spills fall into four categories (Goldstein et al., 2011):

- Impacts related to worker safety
- Toxicological effects in workers, visitors, and community members
- Mental health effects from social and economic disruption
- Environmental effects that have consequences for human health

There is evidence in the literature of a positive relationship between exposure to spilled oils and the appearance of physical, psychological, endocrine, and gene-level effects in exposed humans, especially those involved in response and cleanup (Aguilera et al., 2010; Diaz, 2011). Large oil spills have caused serious mental health impacts such as post-traumatic stress disorder. Mental health impacts are caused by social disruption, income loss, loss of economic and subsistence resources, and high levels of worry over contamination of the environment and foods harvested from oiled environments (Eykelbosh, 2014; Grattan et al., 2011; Laffon et al., 2016; Osofsky et al., 2011; Palinkas, 2012).

Additional discussion of the general impacts of oil and gas on human health is provided in the *Beaufort Sea: Hypothetical Very Large Oil Spill and Gas Release* report (BOEM, 2020, Section 4.2.10).

A-3.12.1 Small Oil Spills (<1,000 bbl)

In water, ambient hydrocarbon concentrations of small, refined oil spills would persist for a shorter time than a crude oil spill of the same volume. Gasoline and diesel fuels contain substances such as benzene, toluene, and xylenes, which can enter the environment and cause adverse health effects. Impacts on subsistence harvest patterns could decrease nutritional and social well-being (EIS Section 4.11). Most small spills would likely be contained on a vessel or facility and would occur outside communities, and exposure of community members would be limited. Impacts to community health from small accidental spills are expected to be no more than short-term and localized.

A-3.12.2 Large Oil Spill (≥1,000 bbl)/Gas Release

A large, 3,800 bbl oil spill could have mental health impacts for residents living in the affected area. For example, in Alaskan communities impacted by the EVOS, residents showed changes in indicators of post-traumatic stress including greater degrees of stress in the forms of recurrent, unprovoked, negative thoughts about the spill and avoidance behaviors such as suppression of thoughts and behaviors related to the spill (Picou et al., 1992). Indicators of personal and social stress were observed in community residents following the *Selendang Ayu* incident which spilled approximately 7,990 bbl of mixed fuels near Unalaska in the Aleutian Islands (Impact Assessment, Inc., 2011b). These observations suggest spills smaller than the EVOS can produce localized stress. A 3,800-bbl spill would be expected to have less extensive impacts on mental health than a VLOS, such as the EVOS, but similar effects could occur at a smaller scale in one or more communities. Impacts could range from short-term and localized to long-term and widespread, depending where spilled oil contacts shorelines in relation to communities and resource use areas.

A large oil spill that disrupts subsistence resources and harvest patterns (Section A-3.11) could result in long-lasting and widespread impacts to health in coastal communities. These impacts would primarily be realized through long-lasting, widespread, and potentially severe disruptions to subsistence practices, loss of harvest opportunities, and avoidance of subsistence resources (Section A-3.11). Impacts to community health and individual mental health would include compromised nutrition and general decreases in community organization and cultural well-being due to a lack of traditional foods and inability to engage in traditional practices such as sharing food with elders (Sections A-3.10 and A-3.11).

In the event of an offshore gas release of 20–30 million cubic feet occurring over one day, most gas escaping and contacting water would dissipate quickly, producing little to no effects to public health. While natural gas is a simple asphyxiate in confined spaces, the gas would dissipate quickly upon release. Upon reaching the surface, gaseous CH_4 would react with air, forming CO_2 and water, which would then disperse into the atmosphere. Temporary and localized impacts are possible from a 1-day large release of natural gas occurring at an onshore pipeline, especially if there was ignition and an explosion and fire near a community or near active subsistence harvesters. Air and water quality are not expected to be adversely affected to the point of affecting human health. Impacts to community health from a large gas release are expected to be short-term and localized.

A-3.12.3 Spill Drills and Response Activities

If spill drills, including GIUEs, were carefully sited away from communities and subsistence use areas, they would have little to no adverse impacts to community health.

Spill response and cleanup workers from both inside and outside communities could experience exposure to oil and its toxic components resulting in acute or chronic health impacts. Hazards to oil spill workers include drowning, cold exposure, falls, and back injuries. Additionally, impacts to community members related to social conflicts could occur when they work on spill response and cleanup alongside outside workers who may be unfamiliar with and insensitive to the cultures of Alaska Native peoples.

Impacts of spill response and cleanup activities on subsistence harvests would affect community health if they resulted in reduction of subsistence foods or stress about availability or quality of subsistence resources (Section A-3.11). Subsistence-related impacts could cause short-term and localized, or long-lasting and widespread impacts to community health related to the level of impact to subsistence harvest.

Increased employment in spill response could place stresses on community health infrastructure such as hospitals and health clinics by drawing local workers away from community service jobs or by increased medical visits from outside cleanup workers. These changes could increase healthcare demands and social conflicts between residents and outsiders. The deterioration of social relationships, anxiety, stress, and depression may result from long-term and widespread spill response and cleanup operations (Palinkas et al., 1993; BOEM, 2016). Potential impacts from cleanup efforts for a 3,800-bbl spill would range from short-term and localized to long-term and widespread depending on where cleanup efforts are based and the duration of cleanup efforts.

A-3.12.4 Conclusion

Impacts of small spills to public and community health are expected to be minor, because they would be short-term and localized. In the case of a large oil spill, impacts to public and community health could be short-term and localized to long-lasting and widespread, and thus minor to moderate, depending on the size and location of a spill and whether impacts disrupt resource harvest activities for one or more seasons, alter local health care provisions, disrupt traditional sharing networks, and/or threaten cultural values and identities. A large gas release is expected to have minor impacts to community health. Spill drills would have negligible adverse impacts to community health, and impacts from spill response and cleanup activities are expected to be minor to moderate.

A-3.13 Economy

Oil spills can have both adverse and/or beneficial impacts on local markets, employment, income, and revenues. Geography, type and amount of oil, social values, climatic conditions, laws, timing of the spill, and cleanup logistics all significantly affect an oil spill's economic impact (Etkin, 1999; White and Molloy, 2003; Xin and Wirtz, 2009). The three most important predictors of an impact are determined by its size, location, and the existing natural resources. The economic impacts of oil spills include:

- Mixed economy (market and subsistence economy) losses occur for communities dependent on the marine environment for subsistence resources (Impact Assessment, Inc. 1990, 2011a, b; McDowell Group, 1990; Picou et al., 2009).
- Local businesses incur losses caused by direct damage in the spill-affected area(s) (Cirer-Costa, 2015; Eastern Research Group, 2014; McDowell Group, 1990; Murtaugh, 2010; Ritchie et al., 2013).
- Increases in disaster response spending cause an increase in short-term employment, income, and revenues in the spill-affected areas (Cohen, 1993, 1997; Fall et al., 2001).
- Local governments experience revenue impacts (Impact Assessment, Inc., 1990, 2011a, b; Recovery and Relief Services, 2015).

Additional discussion of the general impacts of oil and gas on economy is provided in the *Beaufort Sea: Hypothetical Very Large Oil Spill and Gas Release* report (BOEM, 2020, Section 4.2.9).

A-3.13.1 Small Oil Spills (<1,000 bbl)

Small spills would be contained to a limited area, and overall impacts would depend on the size and spill response time. Workers would consist of primarily on-site personnel with the exception of a 125-bbl spill which may include additional local oil spill response organization personnel. Wages earned and other economic impacts would range from no impacts to impacts that are short-term and localized.

A-3.13.2 Large Oil Spill (≥1,000 bbl)/Gas Release

The primary economic impacts of a large, 3.800 bbl oil spill would occur through response and cleanup efforts (discussed below). Some communities in the region participate in a mixed economy that relies on subsistence sharing. A large oil spill impacting subsistence (Section A-3.11) would have greater impacts on these participating communities than other, more market-based economies where resources are available for purchase. Commercial fisheries could be impacted as well. A large oil spill (3,100-bbl *Glacier Bay* tanker spill) occurred in upper Cook Inlet in 1987 and affected the salmon fisheries. Losses reported by driftnet fishers ranged from approximately $10 to $108 million; setnet fishers reported losses ranging from $12 to $82 million (MMS, 1990). Beyond subsistence and commercial fisheries, impacts to wages earned and other economic impacts would range from no impacts to impacts that are short-erm and localized. KPB oil and gas property taxes would not be impacted. The State of Alaska would have a short-term minor or negligible revenue loss associated with 8(g) zone petroleum revenue. A gas release would not have measurable economic impacts because the natural gas volume would not be substantially reduced during the 1-day event.

A-3.13.3 Spill Drills and Response Activities

While spill drills, including GIUEs, have little to no economic impact to affected communities, response and cleanup could provide economic benefits. Increases in disaster response spending can create a recovery boom that benefits any tourism business that provides accommodations and transportation for those participating in the recovery process. Recovery spending can also support local retailers, contractors, and workers displaced from primary industries. If local procurement for goods and services takes place after disasters, impacts on the local economy can increase short-term economic benefits (Chang et al., 2014).

Assessment of employment, income, and revenues for oil spill response is based on the most relevant historical experience of a spill in Alaskan waters—the 1989 EVOS—which was 240,000 bbl. Although orders of magnitude larger than a large spill, the EVOS event provides an illustrative example of what could happen on as smaller scale. EVOS generated substantial employment of up to 10,000 workers doing cleanup work in relatively remote locations. Smaller numbers of cleanup workers returned in the warmer months of each year until 1992. EVOS also had adverse impacts on jobs and income associated with commercial and recreational fishing. During EVOS, numerous local residents quit their jobs to work on the cleanup, often at significantly higher wages. This generated additional adverse impacts in the form of sudden and significant inflation in the local economy (Cohen, 1993). This effect could also occur under the Spill Scenario, but at a smaller scale proportional to the volume spilled. Based on employment from EVOS, BOEM proportionally estimates a large spill of 3,800 bbl could generate up to 160 jobs. Local businesses may experience a shortage of workers because of the substantial increase in pay cleanup efforts provide. Cleanup efforts could last several seasons due to ice, but the majority of oil is expected to be removed within the first season. Therefore, the majority of the economic benefit in terms of wages earned would occur in the first year of spill response. This impact would provide a temporary and localized increase in household income in the local economy.

A-3.13.4 Conclusion

Economic impacts for affected communities range from negligible to minor for small spills, and up to minor for a large spill. For small spills, most of the cleanup would stem from those already working. However, for a large spill, up to 160 additional cleanup workers could be required which may provide a substantial, short-term amount of wages earned for the affected community. A large gas release or spill drills would have a negligible impact to the economy. Overall, spill response would have a negligible to minor impact.

A-3.14 Commercial Fishing

Oil spills can affect commercial fishing through impacts to the targeted species, or through direct effects on fishing gear or access to fishing grounds. Impacts could include:

- Federal and state waters closed to commercial fishing in an effort to protect seafood safety and ensure consumer confidence (McCrea Strub et al 2011; Moller et al. 1999; Ritchie, 1995).
- Perception of affected sites as unclean and unsafe to eat from which can undermine the image of the sites and reduce demand of commercially harvested species in the months following a spill (Choeng, 2012; Garza-Gil et al. 2006, Morgan et al 2016; Surís-Regueiro et al. 2007).
- Reduction in product, caused by direct mortality or habitat loss (Chang et al., 2014; Section A-3.5).
- Contamination of vessels and gear (ITOPF, 2014).

Effects of oil on targeted species are discussed in Section A-3.5 of this document. The economic impact of a large oil spill (Section A-3.13.2) to the commercial fishing industry is primarily due to fishing closures, real or perceived catch tainting, and gear contamination. Fouling of gear and equipment could occur, which would limit commercial fishing opportunities. Oil spills during the summer or fall seasons may result in the greatest impact to commercially important migratory species, such as salmon, because this is when they are most abundant and have sensitive life stages (eggs and juveniles) present in the region. Important spawning areas, including subtidal and intertidal habitats, could have small amounts of oil persist for years if contacted resulting in longer-term effects on the fish and invertebrates that rely on those areas. These effects can have cascading impacts on commercial fishers. The occurrence of a large spill during winter is likely to reduce the extent of closures and economic losses that would occur during the following spring and summer. There are fewer ongoing commercial fisheries in winter, so closure of commercial fisheries due to a large oil spill in the winter is much less likely than for a large spill that occurred in the spring. Ice could contain and weather the oil, and most commercially important species are unlikely to be contacted. Therefore, economic losses to the commercial fishing industry due to a large winter oil spill likely would be less than expected for an identical spill occurring in the spring.

A-3.14.1 Small Oil Spills (<1,000 bbl)

The majority of small spills are estimated to be less than 50 bbl and are not expected to have population-level effects on commercially important fish or shellfish species (Section A-3.5); thus, they are unlikely to have impacts on commercial fishing operations. A crude oil spill of 125 bbl would persist longer in the environment and could result in short-term and localized impacts to commercial fishing opportunities if the spill occurred in a targeted fishing area. Most small spills are expected to be contained or rapidly weather; but if chronic small spills occurred near important habitat areas for commercially targeted fish, impacts may be felt during multiple fishing seasons. Rapid cleanup or containment could minimize the geographic extent of potential impacts to commercial fishing opportunities. Small spills are not expected to result in fishery closures or reduced market values of fish over the life of the Proposed Action.

A-3.14.2 Large Oil Spill (≥1,000 bbl)/Gas Release

A large, 3,800 bbl spill could depress numbers of fish in subpopulations of some commercially important fish or invertebrate species in Cook Inlet, although the level of effects would depend on a variety of factors (location, volume, trajectory of the spill, and the time of year, see Section A-3.5). Even if fish stocks were not reduced as a consequence of a spill, specific fisheries could be closed due to actual or perceived contamination of fish or shellfish tissues. Such closures during peak salmon fishing could result in severe impacts to commercial fishing and major losses of income for commercial fishers.

A large oil spill may cause local fish stocks or subpopulations to decline, leading to fishery closures. These declines in population, however, are unlikely to affect the entirety of Cook Inlet migratory fish populations, and recovery within a few generations would be expected. Fisheries for groundfish are less likely to be closed than pelagic fish in the case of a large oil spill, because the target species occur at depths that are unlikely to be oiled and are not expected to come in contact with a floating oil slick. Regardless, groundfish could become commercially unacceptable for market due to actual or perceived contamination and tainting. Gear used to target commercially important species, such as longlines, seines, and gillnets, could be fouled with amounts of oil and become unfit for future use. A large oil spill before or during commercial fishing season could result in closures of high-value commercial fisheries to protect gear or harvests from potential contamination. A large spill could also result in large areas being closed to commercial fishing until cleanup operations or natural weathering occurred and oil concentrations are reduced to safe levels or the target population has recovered. This process can take years and could result in long-term, severe economic impacts. These possibly widespread fishing closures could have major adverse impacts to commercial fishers and their livelihoods. Spills originating near established fishing grounds have the greatest potential to affect commercial fishers.

A large gas release and ensuing explosion and fire could kill some commercially important species or damage fishing gear in the immediate area. Blowouts of natural gas condensates that did not burn would disperse rapidly at the blowout site and would be unlikely to affect commercial species populations or fishing gear. The impacts of a gas blowout and resulting explosion or fire are considered negligible to minor.

A-3.14.2.1 Oil Spill Risk Analysis

Specific resource areas were not defined for commercial fishing resources, since fishing occurs throughout the Lease Sale Area and targets several different species. OSRA results for anadromous fish, which are most likely to experience impacts from large spills, are be used to represent contact to commercial fishing since they are the targeted species most likely to be impacted by contact with oil.

OSRA results for anadromous fish resources (Table A6) estimate a large spill is likely to contact the western side of Cook Inlet in both summer and winter. LSs along the western shore of the Kenai Peninsula and the southwestern shore of Cook Inlet contain numerous rivers and streams with anadromous runs of salmonids that could be affected during the summer and fall. The highest combined probabilities of occurrence and contact within 30 days range from 1–3 percent for the west side of Cook Inlet (LS 25, 28, 30–36) and to 1 percent for the east side of Cook Inlet (LS 56 and 62). Although unlikely, oil contact with the shore and nearshore environment could alter the migratory behavior of returning adult salmon and impact commercially important species for one or more fishing seasons. Oil impacts could restrict commercial fishing activities in the Lease Sale Area and potentially force fishing activities to relocate to avoid the large oil spill.

A-3.14.3 Spill Drills and Response Activities

Spill drills, including GIUEs, would impact commercial fishing through vessel traffic, noise, and possibly through testing of mechanical recovery methods. Spill response activities could include mechanical recovery methods and in-situ burning of spilled materials, as well as use of dispersants (BOEM, 2019). Avoidance behavior of fish could affect availability of targeted species for commercial fishing, but these effects would be short-term and localized to the spill area.

The use of dispersants could result in impacts on targeted species as well as their preferred fish and invertebrate prey. These effects could be multi-generational and widespread for commercially harvested fish and shellfish if a large spill occurs, and dispersants are used on eggs or juvenile fish. Effects would be limited spatially by the settling of oil and dispersant. Increased vessel traffic from drills and cleanup activities could cause space-use conflicts with commercial fishing vessels and closures of commercial fishing areas for cleanup activities could prevent fishing. Depending on the size of the spill and whether or not it contacted intertidal and onshore resources, response and cleanup time and extent of response activities could be short-term and localized or long-lasting and widespread.

A-3.14.4 Conclusion

Impacts from small spills would be minor because commercial fishers in the Cook Inlet would generally experience short-term, localized effects to target species and fishery closures are not anticipated and there would not be a clear, long-lasting change in this resource's function. In contrast, large spills could have moderate effects on pelagic fishes that are important for commercial harvest and sale, including several species of Pacific salmon. This would especially be the case if important fish habitat areas were contaminated from a large oil spill and commercial fishing closures occurred during the peak salmon fishing period. Therefore, as a consequence of reduced catch, loss of gear, and/or loss of fishing opportunities for an entire season or more and during cleanup and recovery periods, the overall effects of a large spill could result in major impacts to commercial fishing in Cook Inlet, depending on the season and location of the spill. A large gas release would have negligible impacts on commercial fishing opportunities in Cook Inlet. Impacts of spill response and cleanup activities on commercial fisheries could range from minor to moderate. Spill drills are short-term and localized and are expected to have negligible impacts on commercial fishing, unless they overlap with ongoing fishing seasons.

A-3.15 Archaeological Resources

Oil spills, the use of chemical dispersants, and cleanup operations can have impacts on archaeological resources resulting in contamination, degradation, disturbance, or vandalism. These impacts can occur to sites both on land and underwater. Potential oil spill impacts to archaeological resources include:

- Oiling of known or unknown cultural or archaeological sites (Jesperson and Griffin, 1992; Reger et al., 2000; Wooley and Haggarty, 2013).
- Changes in the biodegradation rate of wood and the increase of soft-rot fungal activity in the presence of crude oil (Ejechi, 2003).
- Disruption of the composition and metabolic function of biota colonizing archaeological resources degrades wood and corrodes metal (Damour et al., 2019; Mugge et al., 2019; Salerno et al., 2018).
- Crude oil contamination of organic material used in C-14 dating; although there are methods for cleaning contaminated C-14 samples, greater expense is incurred (Dekin, 1993).
- Disturbance and potential vandalism to cultural or archaeological sites (Wooley and Haggerty, 2013; Reger et al., 2000).

Additional discussion of the general impacts of oil and gas on archaeological resources is provided in the *Beaufort Sea: Hypothetical Very Large Oil Spill and Gas Release* report (BOEM, 2020, Section 4.2.11).

A-3.15.1 Small Oil Spills (<1,000 bbl)

Small spills of refined oil (such as lube oil, hydraulic oil, gasoline, or diesel fuel) would float on the water surface and would disperse and weather rapidly. Most of the volatile components of the fuel would evaporate and not impact seafloor archaeological resources. Small, refined spills would likely have little to no impact as they are expected to disperse and volatize or be cleaned quickly. Small crude spills would persist longer in the environment and could affect shipwrecks or terrestrial surface sites through contamination from oiling. Small spills of crude oil could adhere to particles in the water column, sink, and impact a shipwreck site or exposed precontact site on the seafloor. However, due to the high-energy environment of Cook Inlet, it is expected that the portion of small crude spills that had not dispersed would be quickly transported away by strong currents (Johnson, 2008). Offshore small spills that reach the shoreline have potential for localized contact to resources in nearshore areas. Crude oil that may reach the shoreline or the seafloor is expected to be in low concentration and would have little or no impact, to potentially localized impacts, depending on the volume of oil that reaches an archaeological resource.

A-3.15.2 Large Oil Spill (≥1,000 bbl)/Gas Release

A large, 3.800 bbl spill of refined oil would float on the water surface and would disperse and weather rapidly. The volatile components of the fuel would evaporate and would be unlikely to affect seafloor archaeological resources. A large spill of crude oil would persist longer in the environment and could adhere to particulate matter in the water column, sink, and impact a shipwreck site or an exposed precontact site on the seafloor. Submerged materials are usually colonized by organisms and typically achieve a state of equilibrium that protects the material from further deterioration. Oil can destabilize this equilibrium, causing a die off of the biota protecting the site and increasing the potential for renewed degradation. Findings of field and laboratory studies conducted following the Deepwater Horizon spill indicate that exposure to oil and/or dispersants may alter bacterial community composition and corrosion potential of wooden and steel hulled shipwrecks and their debris fields (Damour et al., 2019; Mugge et al., 2019; Salerno et al., 2018). For a 3,800-bbl spill, impacts from such events are expected to be localized, affecting the immediate wreck area, but any damage would be irreversible, and therefore long-term. Impacts to a shipwreck would only occur if an oil spill intersected and contacted a shipwreck location.

Some archaeological resources in coastal land segments and intertidal zones could be directly exposed to oil and contaminated. Oil affecting larger areas of the coastline may have a higher potential to impact archaeological resources. BOEM estimates that up to 35 km of coastline could be oiled by a large crude oil spill (Table A2). Contamination by oil would make radiocarbon dating of a site difficult, because spilled oil would seep into charcoal, bone, wood, or other organic materials that would be used for radiocarbon dating (Dekin, 1993). A large refined or crude spill would be expected to have little or no impact if an archaeological resource is not oiled. If one or more resources are oiled, impacts could be long-term, and could be localized or widespread.

A gas release would dissipate rapidly, with no impact on submerged or coastal archaeological resources expected from exposure to gas. A large gas release that results in a blowout or explosion and possible fire could impact any archaeological resource in the vicinity of the blowout or explosion. Pre-drilling geohazard surveys should preclude the possibility of archaeological resources occurring within the immediate vicinity of well sites, which would reduce the expected impacts of a gas blowout and resulting explosion to little or no impacts. A large onshore gas release from a pipeline and potential explosion and fire could impact archaeological resources should ignition occur and if resources are in the vicinity. Although unlikely to occur, if an archaeological resource was damaged by an explosion or fire it could result in the loss or other permanent damage of the resource within the localized area of the incident. Performing pre-construction site clearance surveys in pipeline rights-of-way and creating avoidance boundaries around identified archaeological resources would reduce the possibility of an impact.

A-3.15.2.1 Oil Spill Risk Analysis

Archaeological resources such as historic shipwrecks, aircraft, and artifacts may be found anywhere within the OSRA study area or along the shoreline. Submerged shipwrecks, aircraft, and precontact sites located within the vicinity of the LAs (**Error! Reference source not found.**) are at most risk of being impacted. BOEM identified 112 LSs for this analysis (Ji and Smith, 2021; Appendix A, Tables A.1-11; Figures B-3a–d). Table A5 and Figure A2, in Section A-3.4.2.1, display 39 LSs with a ≥1 percent chance of contact from any individual LA within 30 days summer or winter. The LAs closest to the shoreline have a ≥6 percent chance of contact to 11 individual LSs: Amakdedulia Cove, Bruin Bay, Chenik Head (28) to Redoubt Point (36) on the western side of Cook Inlet; and Cape Starichkof, Happy Valley (56); Barabara Point, Seldovia Bay (61); and Nanwalek, Port Graham (62) on the eastern side of Cook Inlet.

A-3.15.3 Spill Drills and Response Activities

Spill drills, including GIUEs, would be infrequent and localized and are expected to have little to no impact on submerged archaeological resources, because spill drill activities typically do not disturb the seafloor. Onshore impacts are also not expected as typical spill drills normally do not occur onshore.

Spill response and cleanup activities could damage some archaeological sites. Increased human activity, vessel anchoring and mooring, dispersants, and looting could all contribute to impacts on archaeological resources. Vessels involved in spill response may need to anchor at locations throughout the spill area. Anchors have the potential to contact and damage submerged archaeological resources. Additionally, like the impacts of oiling, introduction of dispersants into the marine environment may impact the resident microbial communities that colonize and provide a protective coating to submerged archaeological resources.

A main source of potential impact during spill response at shorelines and onshore is from looting and vandalism stemming from increased human presence around resources. Spill response workers have, at times, damaged or collected artifacts during response activities (Dekin et al., 1993; Wooley and Haggarty, 2013). Looting and vandalism could be mitigated by employing archeologists on the spill response teams and providing training to cleanup crews. Following proper procedures and cleanup protocols developed during and following the EVOS and Deepwater Horizon Oil Spill events would mitigate impacts of spill response. The first measure is avoidance, which could mitigate negative impacts by informing cleanup crews of culturally sensitive areas to avoid. This measure would require a cleanup crew supervisor to consult with archaeologists that inspected a site to advise on where planned cleanup could impact a cultural site. Additionally, spill response efforts would be coordinated with appropriate land managers to protect documented sites. Second, artifact collection under the management of an archaeologist would mitigate overall impacts to archaeological resources by preventing them from being harmed by cleanup activities or removed by cleanup workers. Third, education and training provided to cleanup crews could mitigate impacts by informing workers about the types of sites and artifacts to be aware of and instructing them on what to do and who to call should they find artifacts (Haggarty et al., 1991; Wooley and Haggarty, 1995).

In some cases, the discovery and reporting of archaeological sites could also result in their documentation and protection. For the EVOS, researchers concluded that <3 percent of the archaeological resources within the spill area suffered any significant impacts (Dekin et al., 1993; Wooley and Haggarty, 2013). While following the established spill response mitigation measures would mitigate most impacts, some impacts may still result in the loss of cultural or historic information. Onshore spills would not cover a large area, and therefore any spill cleanup and looting would be limited. Depending on whether a large spill contacted intertidal and onshore resources, response and cleanup time, and extent of response activities, impacts could be localized or widespread and long-lasting.

A-3.15.4 Conclusion

In the case of accidental spills, some impacts to shoreline archaeological and historic sites, historic shipwrecks, and submerged precontact archaeological resources may occur. Impacts from small spills would be negligible to minor because the oil is unlikely to contact archaeological resources, and any contact that does occur would be highly localized. A large oil spill could have moderate impacts based on the location of the spill and the proximity of archaeological resources. A large gas release resulting in a fire or explosion could have long-term and localized or widespread impacts in the unlikely event of ignition occurring and damaging nearby resource(s). Overall, the impact of a gas release is expected to be no more than minor. Spill response and cleanup could have moderate impacts on archaeological resources from impacts of vessel anchoring, dispersants, and damage caused by response personnel. GIUEs and spill drills would have negligible impacts on archaeological resources because they are not expected to contact a site.

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APPENDIX B

Exploration and Development Scenario for Oil and Gas Lease Sale 258

Cook Inlet, Alaska

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EXPLORATION AND DEVELOPMENT SCENARIO

E&D scenarios are hypothetical views of future oil and gas activities based upon professional judgment of the geologic features within the area offered for lease coupled with an analysis of current exploration and production activities. E&D scenarios provide a plausible set of post-lease activities that may result from leasing. The LS 258 E&D Scenario is only one possible view of how the potential resources of the lease sale area could be developed. It provides a set of activities to frame BOEM's environmental analyses and to inform decision-makers and the public of potential environmental effects of the Proposed Action (to hold a lease sale). The full E&D Scenario, explaining the basis for the assumptions, is available on BOEM's website at https://www.boem.gov/ak258/.

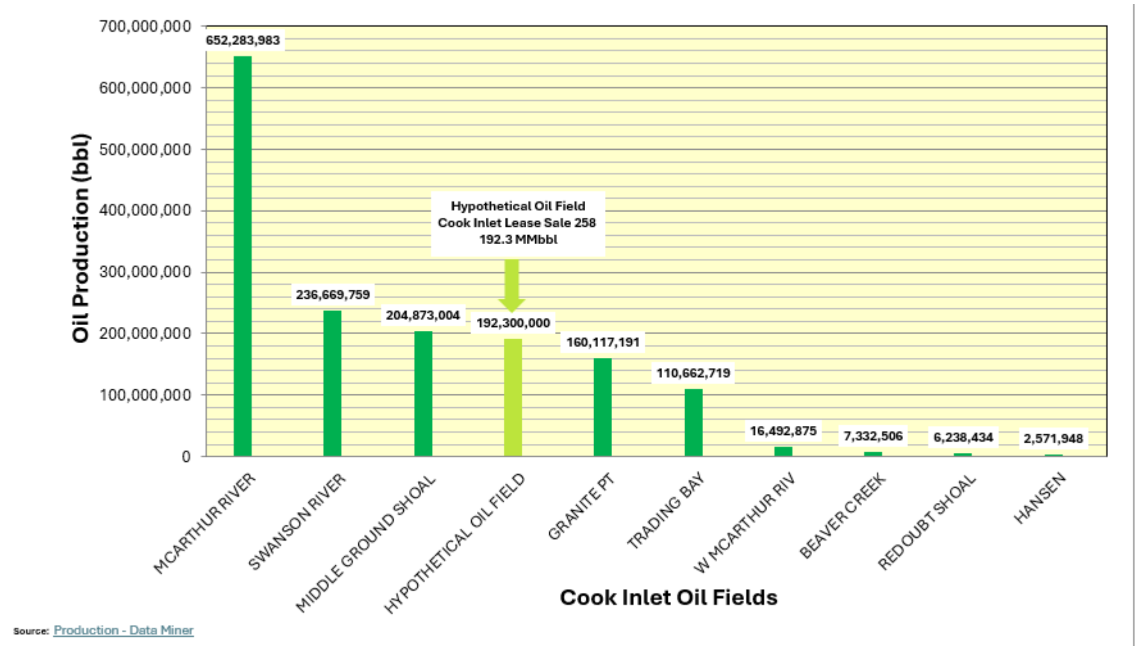
The E&D Scenario is based on both modeling and professional judgment of the interpreted geologic features, coupled with an analysis of current and historic exploration and production activities. Scenario estimates for levels of post-lease oil and gas activity are based on interpretation of available geologic data and specific assumptions about the methods required to extract oil and gas from a given number of fields.

The Scenario identifies a range of low, medium, and high hydrocarbon production levels (referred to individually as the low, medium, and high "case"). This range of production and the activities associated with each case provide the basis for the analyses in the SEIS. The E&D Scenario considers a range of oil production between 0 and 192.3 MMbbl (million barrels) and a range of natural gas production between 229.5 and 301.9 Bcf (billion cubic feet). The high case assumes production of 192.3 MMbbl of oil and 301.9 Bcf of natural gas.

So as not to underestimate the potential impacts of the Proposed Action, BOEM is analyzing the high case. The tables in this section display the low to high range of activity. Where only one value is provided for a certain activity, it means the same level of that particular activity is expected across the low, medium, and high cases. The E&D Scenario has been used to prepare environmental analyses that overestimate, as opposed to underestimate, impacts of the Proposed Action. To that end, the E&D Scenario's high case 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, the result of two lease sales, have been drilled in the Cook Inlet OCS since 1978, with the last well drilled in 1985.

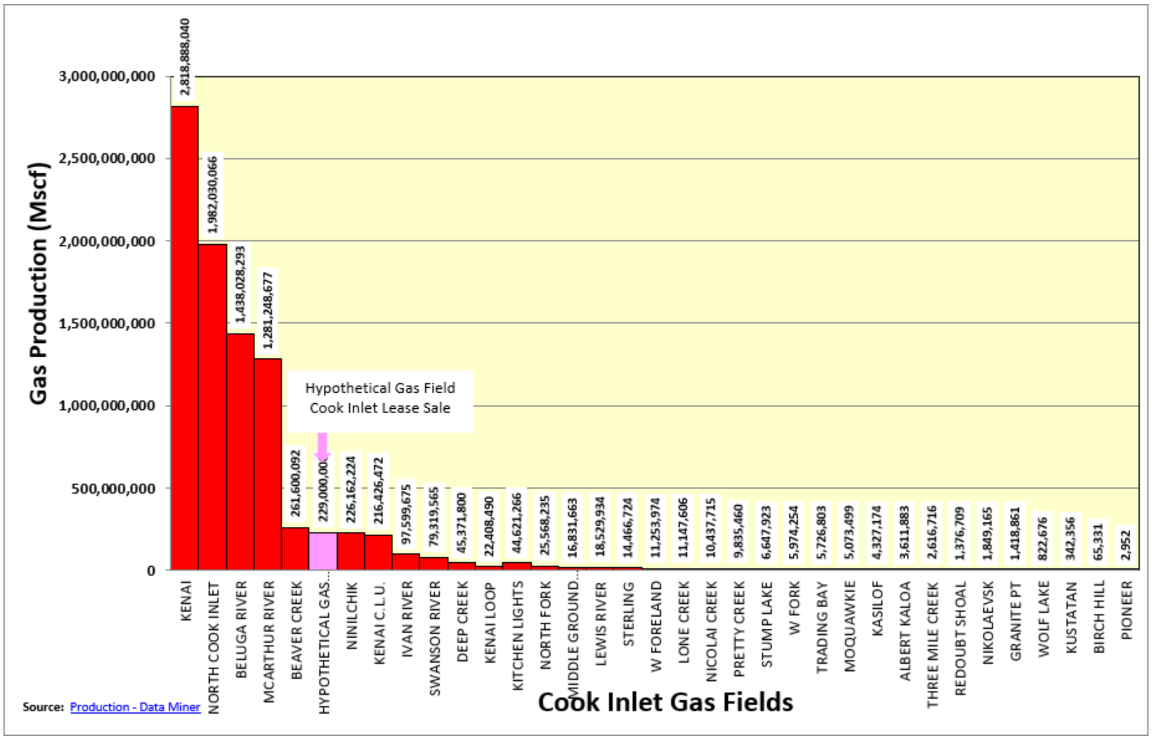
The high case assumes one oil and one gas field are discovered and developed as a result of LS 258. Developing these discoveries is estimated to occur over a 40-year period, and is categorized into three phases: exploration, development and production, and decommissioning.

Figure 1 and Figure 2 show how the hypothetical oil and gas fields for this scenario compare to producing fields in the Cook Inlet region.



Source: Production - Data Miner

Figure 1: Oil Production Assumed in the Lease Sale 258 E&D Scenario's Medium and High Cases



Source: Production - Data Miner

Note: Cook Inlet LS 258 (pink bar), in context with historical production from other Cook Inlet gas fields (red bars). Historical production data is from the Alaska Oil and Gas Commission.

Figure 2: Gas Production Assumed in the Lease Sale 258 E&D Scenario's Low Case (Gas Only Production)

Exploration Activities

The purpose of exploration activity is to locate and characterize oil and gas fields. Geological and geophysical (G&G) surveys are used to understand seabed and subsurface conditions. Geological surveys consist of bottom sampling and coring. Geophysical surveys include seismic surveys (which use reflected sound waves to estimate subsurface properties) and geomagnetic surveys (which use magnetic anomalies to locate features). Seismic surveys play the most significant role in supplying data for oil and gas exploration. The E&D Scenario includes the following types of G&G surveys:

1. Seismic Surveys –
    A. Deep Penetrating Marine Seismic Surveys – Used to locate subsurface oil and gas prospects. They are used to cover large areas and map geologic structures on a regional scale. Airguns are the typical sound source for two dimensional (2D) and three dimensional (3D) seismic surveys.
    B. Geohazard Surveys – Used to evaluate potential hazards on the ocean bottom and document any potential cultural resources or benthic communities. The types of equipment used during a typical geohazard survey include echosounders, side-scan sonar, sub-bottom profilers, and boomers.
2. Airborne Geophysical Survey – Used to detect subsurface materials by measuring the earth's magnetic field.
3. Geotechnical Surveys – Used to collect ocean bottom samples to obtain physical and chemical data. The type of equipment used during a typical geotechnical survey includes core sampler, grab sampler, or dredge sampler.

Table 1 describes the exploration activities for this E&D Scenario, which represent the following assumptions:

- One deep penetrating marine seismic survey would be conducted to determine the location of prospects for exploration drilling.
- Geohazard and geotechnical surveys characterize individual sites to determine if the seafloor is suitable for exploration and development activity. Multiple sites may be examined in a single survey.
- A mobile offshore drilling unit (MODU) such as a jack-up or drillship would be used for exploration drilling, depending upon availability and site-specific water depths.
- If the exploration wells are successful, delineation wells would be drilled to determine the extent of the field. These wells would also be drilled by MODUs.
- Exploration and delineation drilling operations would take between 30 and 60 days per well depending on the depth of the well, delays during drilling, and time needed for well logging and testing operations.
- Up to three exploration or delineation wells per MODU could be drilled, tested, and plugged during a single drilling season.

Table 1: Exploration Activities Assumed in the LS 258 E&D Scenario's Low to High Cases for the Life of the Scenario (40 years)

Element	Number	Line Miles or Area	Season	Comment
Deep Penetrating Marine Seismic Surveys	1	28 Blocks (3D)	Open Water	One 3D seismic survey will be conducted.
Airborne Geophysical Survey	1	1 million acres	Year-Round	Airborne geophysical survey could be conducted over the leasing area.
Geohazard & Geotechnical Surveys	1 to 4	1,403–4,596-line miles and point sampling locations	Open Water	G&G surveys include shallow hazard site clearances (11-36) and point sampling locations. For geohazard surveys, multiple sites may be cleared in a single survey.
Total number of exploration and delineation wells drilled[1]	3-8	N/A	Open Water	Drilling would be done from MODUs such as a jack-up or drillship.
Maximum number of exploration and delineation rigs in a year	1	N/A	Open Water	Exploration and delineation wells are drilled from the same rig.
Volume of rock cuttings discharged for exploration and delineation wells (cy)[2]	1,764–4,704	N/A	Open Water	Exploration and delineation wells would average 588 cy of dry rock cutting per well.
Volume of drilling fluids from exploration and delineation wells (bbl)[3]	27,000–72,000	N/A	Open Water	On average, 9,000 bbl of drilling fluid would be used per exploration well.

Notes: cy = cubic yards bbl = barrels G&G = geohazard and geotechnical N/A = not applicable

[1] All exploration and delineation wells would be permanently sealed with cement.

[2] Cuttings would be discharged in accordance with NPDES permit requirements.

[3] Water-based drilling fluids would be discharged in accordance with the terms of the NPDES permit issued in accordance with the Clean Water Act. Oil-based drilling fluids are not anticipated to be used for exploration drilling (EPA, 2015b).

Development and Production 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 2 and Table 3 describe development and production activities and infrastructure for the LS 258 E&D Scenario based on the following assumptions:

- A reservoir could be discovered and developed at any location leased under this sale.
- Offshore developments resulting from LS 258 would use 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 of in service wells.
- Up to 128.7 km (80 mi) of offshore and 128.7 km (80 mi) of onshore oil pipelines would be installed to connect the offshore oil field to the oil refinery at Nikiski.
- Up to 193.1 km (120 mi) of new offshore gas pipelines would be installed with 1.6 km (1 mi) of new onshore gas pipeline installed that would connect to the existing gas pipeline that runs from Homer to Nikiski.

Table 2: Development and Production Activities Assumed in the LS 258 E&D Scenario's Low to High Cases for the Life of the Scenario (40 years)

Element	Number	Footprint Area (Acres)	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 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[2]	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: cy = cubic yard bbl = barrels Bcf = Billion cubic feet MMbbl = million barrels
Mbbl = thousand barrels MMcf = million cubic feet N/A = not applicable

[1] Water-based drilling fluids and cuttings would be discharged under the NPDES permit in accordance with the Clean Water Act. Oil-based drilling fluids are not anticipated to be used for development drilling.

[2] In the high case, the additional gas (72.4 Bcf) is gas associated with the produced oil.

Table 3: Pipelines Assumed in the LS 258 E&D Scenario's Low to High Cases for the Life of the Scenario (40 years)

Element	Number	Footprint Area (Acres)	Season	Comment
Onshore Oil Pipeline (mi)	0–80	0–290	Year-Round	Footprint based on an estimated 9.1-m (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 9.1-m (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 9.1-m (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 9.1-m (30-ft) wide disturbance for pipeline installation. Offshore pipeline would be buried where practical.
New Pipelines to shore	1–2	N/A	N/A	New shoreline crossings of pipelines provided in this table.

Notes: All values are for entire lifespan of the scenario. N/A = not applicable

Decommissioning Activities

Operators would begin well and facility shutdown when income from production no longer covers operating expenses. Decommissioning activities are regulated by BSEE under 30 CFR Part 250, Subpart Q.

- Decommissioning would be completed in stages with hub platforms remaining in service the longest, because production would continue to flow through them from satellite platforms to nearshore facilities.
- Wellhead equipment would be removed, and wells would be permanently plugged with cement. Processing modules would be moved off the platforms.
- Subsea pipelines would be decommissioned by cleaning out inner diameter, plugging both ends, and leaving them buried in the seabed.
- Platforms would be disassembled and removed from the area and the seafloor site restored to a practicable predevelopment condition.
- Any seafloor or terrestrial disturbance would be reclaimed per standards of the applicable land management agency.
- Post decommissioning geohazard surveys would be required to confirm that no debris remains, and pipelines were decommissioned properly.

Transportation

The E&D Scenario includes assumptions about transportation for the entire lifespan of the scenario. Personnel and materials would be transported to exploration and production sites by helicopter, and/or marine supply vessels from an existing onshore base or dock. The highest number of trips by helicopter or supply vessel would occur during platform installation (development) and then during decommissioning. Supply vessel trips may drop to two per week per platform during normal production operations. Table 4 describes transportation activity assumptions used for the effects analyses.

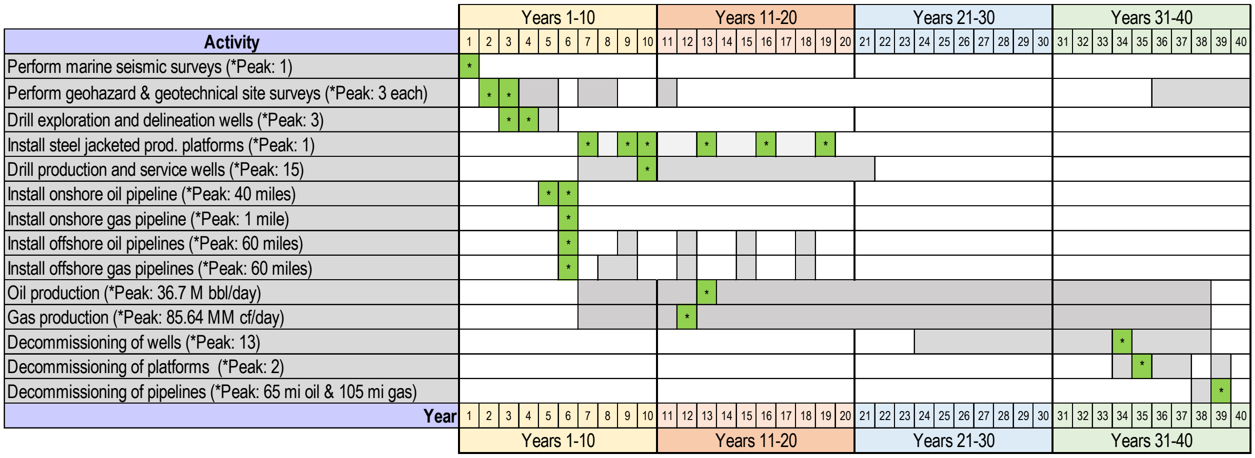
Table 4: Transportation Activities Assumed in the LS 258 E&D Scenario's Low to High Cases for the Life of the Scenario (40 years)

Element	Number of Activities	One Way Distance (Miles)	Season	Comment
Flights per week during peak exploration activity	14	700[1]	Year-Round	Approximately 2 flights per day. Flights would depart from Homer or Nikiski.
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[1]	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[1]	Open Water	Number of platforms range from 1 – 6. Vessels would depart from Homer.

Notes: All values are for entire lifespan of the scenario.
[1] Estimates use 50 mi as the typical distance traveled.

Schedule of E&D Scenario Activities Over Life of Field

Exploration, development and production, and decommissioning activities would occur over the 40-year lifespan of the E&D Scenario as shown in Figure 3. The range of years depicted for a given activity covers the number of years in which the activity could occur, although activities may not occur in each year within the range. Peak activity is the highest maximum number of occurrences within a year. For example, no more than three geohazard and geotechnical surveys (Table 1) would occur in any one year.



	Years 1-10										Years 11-20										Years 21-30										Years 31-40									
Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Perform marine seismic surveys (*Peak: 1)	*																																							
Perform geohazard & geotechnical site surveys (*Peak: 3 each)		*	*	▨	▨		▨	▨			▨																									▨	▨	▨	▨	▨
Drill exploration and delineation wells (*Peak: 3)			*	*	▨																																			
Install steel jacketed prod. platforms (*Peak: 1)							*	▨	*	*	▨	▨	*	▨	▨	*	▨	▨	*																					
Drill production and service wells (*Peak: 15)							▨	▨	▨	*	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨																			
Install onshore oil pipeline (*Peak: 40 miles)					*	*																																		
Install onshore gas pipeline (*Peak: 1 mile)						*																																		
Install offshore oil pipelines (*Peak: 60 miles)						*			▨			▨			▨			▨																						
Install offshore gas pipelines (*Peak: 60 miles)						*		▨	▨			▨			▨			▨																						
Oil production (*Peak: 36.7 M bbl/day)							▨	▨	▨	▨	▨	▨	*	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		
Gas production (*Peak: 85.64 MM cf/day)							▨	▨	▨	▨	▨	*	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		
Decommissioning of wells (*Peak: 13)																								▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	*	▨	▨	▨	▨		
Decommissioning of platforms (*Peak: 2)																																		▨	*	▨	▨		▨	
Decommissioning of pipelines (*Peak: 65 mi oil & 105 mi gas)																																						▨	*	
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	Years 1-10										Years 11-20										Years 21-30										Years 31-40									

Notes: Maximum number of occurrences for each activity in given year.
Gray shaded areas denote years of activity.
Green squares with * denote years of peak activity.

Figure 3: E&D Scenario Schedule and Peak Activity

APPENDIX C

Life Cycle Greenhouse Gas Emissions

for Oil and Gas Lease Sale 258

Cook Inlet, Alaska

List of Tables

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LIFE CYCLE GREENHOUSE GAS EMISSIONS

The Bureau of Ocean Energy Management (BOEM) estimates greenhouse gas (GHG) emissions for oil and gas leasing on the Cook Inlet Outer Continental Shelf (OCS) for Lease Sale 258 (LS 258). This analysis encompasses GHG emissions resulting from the full life cycle of potential oil and gas exploration, development, production, processing, transmission, and consumption. Also estimated are the GHG emissions reductions as a result of potential OCS oil and gas production and consumption under the Proposed Action displacing production and consumption of substitute energy sources (e.g. oil imports and onshore domestic oil and natural gas) that would have been produced and consumed in the absence of the Proposed Action. While the Cook Inletkeeper et. al. v. Department of the Interior and State of Alaska court decision (Case No. 3:22-cv-00279-SLG) did not find deficiency in the GHG analysis for the 2022 LS 258 Final Environmental Impact Statement (FEIS), BOEM has updated the GHG analysis for this Supplemental EIS (SEIS) to include the most recent and available data and model versions. The updates to this analysis are summarized below:

- Updated modeling inputs and energy market baseline.
- Updated model runs and GHG emissions estimates.
- Updated framing of GHG emissions.
- Added quantification of foreign oil upstream GHG emissions.
- Removed comparison of emissions to climate targets and carbon budgets.
- Removed application of the social cost of greenhouse gases to estimates of emissions.
- For context, added comparisons of GHG emissions estimates to various state level emissions.
- Added references to sensitivity testing completed since the previous analysis.

GHGs are the key driver of climate change as increasing atmospheric concentrations of carbon dioxide (CO_2) and other GHGs, such as methane (CH_4) and nitrous oxide (N_2O) reduce the ability of solar radiation to re-radiate out of Earth's atmosphere and into space. All three of these GHGs have natural sources, but the majority of these GHGs are released from anthropogenic activity. Since the industrial revolution, the rate at which solar radiation is re-radiated back into space has slowed, resulting in a net increase of energy in the Earth's system (Solomon et al., 2007). This energy increase presents as heat, raising the planet's temperature and causing climate change.

BOEM's analysis of GHG life cycle emissions resulting from the Proposed Action indicates that emissions from OCS oil and natural gas are similar to those resulting from displaced energy substitutes when the scope is confined to domestically produced or consumed fuels. This finding stems from OCS production partially displacing other energy sources and their associated emissions. BOEM also considers the changes in foreign oil production and consumption and associated changes in global emissions in response to the Proposed Action. BOEM's analysis finds that global emissions would likely increase under the high activity level for the Proposed Action.

BOEM recognizes the global scope of the impacts of GHG emissions, their effects to climate-related factors, and the potential contributions of the effects of agency actions to global GHG concentrations. As such, BOEM provides a detailed methodology of the life cycle GHG analysis and presents distinct domestic and foreign estimates of emissions related to shifts in domestic versus foreign energy markets as a result of the Proposed Action.

Life cycle refers to emissions from all activities related to the exploration, development, production, processing, transmission, and consumption of a resource. For hydrocarbon resources, the activities are often grouped into three stages: upstream, midstream, and downstream (Figure 1). Upstream activities include the exploration, development, and production described in the Exploration and Development (E&D) Scenario.[1] Midstream activities are associated with refining, processing, storage, and distribution of fuels produced from leases issued via LS 258. Finally, downstream activities are associated with the consumption of those fuels.

Figure 1: Life Cycle Stages of Greenhouse Gas Emissions

The activities associated with each stage would result in GHG emissions, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These three GHGs are the primary GHGs globally, and the only ones deliberately released as part of the life cycle. Emissions of these GHGs contribute to climate-related factors globally. The analysis below quantifies projected GHG emissions that could occur from the Proposed Action through the subsequent consumption of the produced fuels. The life cycle GHG emissions related to the Proposed Action serve as a proxy for assessing the potential environmental impacts associated with changes in atmospheric and oceanic GHG concentrations.

To consider the full impact of OCS leasing, BOEM estimates emissions associated with additional OCS oil and natural gas production and emissions reductions associated with potential energy market substitutes displaced by OCS production from new leases. In accordance with the economic theory of the law of supply and demand, additional OCS production would increase supply and lower prices, resulting in an increase in the quantity demanded for oil and natural gas. In turn, and in cooperation with the economic theory of substitution effects, as consumers switch to consuming more OCS oil and natural gas, they reduce their consumption (demand) of substitute energy sources like coal, biofuel, renewables, and onshore or imported oil and natural gas. Further, due to the reduced demand for energy substitutes, prices for those energy sources would also decline, causing suppliers to reduce their production of these substitute energy sources. BOEM's life cycle analysis considers these substitute sources and the emissions that they would generate if not for OCS production.[2] BOEM further discusses the concepts of displacement and substitute energy sources in later sections of this document.

Given the global nature of energy, in particular oil, and the GHG emissions resulting from energy production through consumption, the quantitative GHG emissions analysis can be categorized into two

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[1] To generate estimates of anticipated future oil and gas production, BOEM develops oil and gas exploration and development scenarios under a given leasing schedule. The scenarios describe the development and production activities required to explore for, extract, and transport to market the anticipated oil and gas production.

[2] This displacement of substitute sources does not occur on a 1:1 basis (a concept known as "perfect substitution"). The decline in oil and gas prices leads to an increase in overall energy consumption of roughly 12% of the new OCS production modeled by BOEM using the exploration and development scenarios. The remaining 88% of the new OCS production represents displacement of substitute energy sources. BOEM's modeling suggests that the displaced energy sources are primarily oil imports and domestic onshore oil and natural gas.

components: 1) estimated GHG emissions resulting from domestically produced or consumed fuels, and 2) estimated GHG emissions when considering the shift in foreign oil production and consumption. BOEM can model domestic energy markets with sufficient reliability to estimate the energy substitutes consumed or produced domestically. However, global energy markets cannot be modeled to the same level of detail as domestic energy sources.

BOEM's GHG analysis also considers a No Action Alternative in which there would be no LS 258. Because there is no new leasing in the No Action Alternative, there are no associated GHG emissions assigned to the No Action Alternative as they are considered the baseline level of emissions. They are treated as part of the modeling baseline along with all other sources of energy not directly stemming from a new OCS lease sale. To the extent existing leases' production or other energy sources are displaced by the Proposed Action's production, BOEM accounts for the emissions reductions within its estimate of the total Proposed Action emissions. Total Proposed Action emissions are those associated with OCS exploration, development, and production from a lease sale under the Proposed Action after accounting for those emissions displaced from substitute energy sources which are not produced or consumed under the Proposed Action.

BOEM frames energy substitutes in this SEIS as displacements occurring under the Proposed Action rather than as substitutions under the No Action Alternative as described in BOEM's GHG analyses for previous lease sales including the 2022 LS 258 FEIS. This change was made in response to comments received from stakeholders on BOEM's 10th National OCS Program. Specifically, the U.S. Environmental Protection Agency (EPA) provided comments recommending that BOEM present a No Action Alternative with no emissions resulting from the Proposed Action.[3] As such, this analysis shows GHG emissions associated with the substitute energy sources that are displaced by new OCS LS 258 oil and gas production as negative values reducing total GHG emissions under the Proposed Action rather than as positive values increasing GHG emissions under the No Action Alternative. Thus, the total Proposed Action emissions are the GHG emissions from new LS 258 OCS production plus the reduction in GHG emissions from displaced energy substitutes.

The framing of the analysis here has no impact on the estimated GHG emissions associated with the Proposed Action. BOEM's previous analysis included an estimate of incremental emissions (i.e., Proposed Action emissions less No Action Alternative emissions), whereas this analysis includes an estimate of total Proposed Action emissions (i.e., Proposed Action emissions plus displaced energy emissions).

Table 1 provides an illustration comparing BOEM's previous GHG emissions estimates results table format used in the 2022 LS 258 FEIS to the current format used in this SEIS. In the previous analysis, energy substitute emissions are shown as occurring under the No Action Alternative. The analysis showed the difference in emissions between the No Action Alternative and the Proposed Action. BOEM's current approach does not associate any emissions with the No Action Alternative and instead presents substitute energy sources as displaced (i.e., negative) emissions associated with the Proposed Action. As shown in Table 1, the absolute value of the net emissions (illustrated here as 'Z') remains the same. However, the Total Proposed Action Emissions are now shown as being negative rather than a positive increase in emissions under the No Action Alternative.

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[3] In a comment on the 2024-2029 National OCS Oil and Gas Program, the USEPA stated: "[A] No Action Alternative with no new lease sales or substitution…serve[s] as a baseline of comparison for greenhouse gas (GHG) emissions among the action alternatives. …Ideally, BOEM would estimate the displaced sources from the substitution and their accompanying emissions to calculate net emissions for the action alternatives. Displacement or substitution emissions should be accounted for in the action alternatives." (Tomiak, 2023).

Table 1: Example Tables Illustrating the Change to BOEM's Framing of Proposed Action Emissions

Previous Format Categories	Previous Format CO_2e
No Action Alternative (A)	Y
Proposed Action (B)	X
Difference (A-B)	Z

Current Format Categories	Current Format CO_2e
OCS Oil & Gas Emissions	X
Displaced Energy Emissions	-Y
Total Proposed Action Emissions	-Z

Table 2 presents BOEM's overall GHG modeling approach. BOEM quantitatively considers the GHG emissions associated with domestically produced or consumed energy. BOEM provides quantitative estimates of GHG emissions from changes in foreign oil production and consumption. BOEM qualitatively considers other changes in foreign markets, including changes in foreign oil midstream emissions and energy market substitutions, but cannot quantify these at this time.

Table 2: *BOEM's Life Cycle GHG Modeling Approach*

Emissions Source	Upstream	Midstream	Downstream
Domestically Produced or Consumed Energy – New OCS oil and natural gas production	Quantified (Table 6)	Quantified (Table 7)	Quantified (Table 7)
Domestically Produced or Consumed Energy – Displaced substitute energy sources	Quantified (Table 6)	Quantified (Table 7)	Quantified (Table 7)
Non-U.S. Consumed Energy – Foreign oil market change	Quantified* (Table 11)	Qualitatively	Quantified* (Table 13)
Non-U.S. Consumed Energy – Displaced substitutes for oil in foreign markets (natural gas, coal, biofuels, renewables, reduced demand)	Qualitatively	Qualitatively	Qualitatively

Notes: * Foreign oil production and consumption are not modeled as dynamically as domestic oil consumption. The Market Simulation Model's estimate of foreign oil market does not include cross-price effects.

The resulting analysis indicates that, when considering only emissions associated with domestically produced or consumed energy, selection of the Proposed Action results in total GHG emissions that are very close to baseline level emissions under the No Action Alternative. However, when the analysis is expanded to also consider emissions from foreign energy markets, BOEM finds the Proposed Action results in higher global GHG emissions than under the No Action Alternative baseline. BOEM recognizes that many variables are uncertain within its life cycle GHG analysis and considers some of these uncertainties. In addition, BOEM places the estimated volumes of the GHG emissions attributable to the Proposed Action into context with a discussion of potential impacts to the human and natural environment resulting from changes in atmospheric and oceanic GHG concentrations.

Life Cycle Greenhouse Gas Estimation Methodology

BOEM's life cycle greenhouse gas estimation methodology was first described in Wolvovsky and Anderson (2016). The methodology has been updated since then. The most recent version prior to this publication is found in the *Gulf of America Regional OCS Oil and Gas Lease Sales: Final Programmatic Environmental Impact Statement* (BOEM, 2025), as well as the Economic Analysis Methodology for the 2024–2029 National Outer Continental Shelf Oil and Gas Leasing Program (BOEM, 2023). The scope of BOEM's quantitative GHG analysis includes full life cycle (upstream, midstream, and downstream) GHG emissions from domestically produced or consumed energy, as well as the upstream and downstream GHG emissions from a shift in foreign oil production and consumption under the Proposed Action. The analysis relies on three models to estimate results: Market Simulation Model (MarketSim) (Industrial Economics Inc., (IEc) 2023a),[4] the Offshore Environmental Cost Model (OECM) (IEc, 2023b, 2018),[5] and Greenhouse Gas Life Cycle Energy Emissions Model (GLEEM) (Wolvovsky, 2024).[6] For a full description of these models, please refer to their documentation and associated reports.

BOEM acknowledges that these models were developed for analysis at a national level and that there may be limitations on the scalability of the models to this regional analysis. However, the models incorporate a regional framework and specify assumptions for the unique Cook Inlet OCS planning area when applicable. The models represent the best science and methodology available for estimating energy market impacts, rates of displacement of the substitute energy sources, and emissions rates, which are important factors in the larger analysis of GHG emissions that could occur under the Proposed Action.

When estimating emissions, BOEM's models quantify the three main GHGs: CO_2, CH_4, and N_2O. To provide a single metric for estimating an action alternative's emissions profiles, BOEM provides combined totals of all three GHG emissions in CO_2 equivalent (CO_2e). This approach allows for a direct, aggregate, comparison between emissions of CO_2, CH_4, and N_2O which have varying potentials to trap heat and different atmospheric lifespans, known as Global Warming Potential (GWP) (EPA, 2025a). For example, emission of one metric ton of CH_4 has an impact similar to 25 metric tons of CO_2. The analysis uses the GWP conversion factors developed by the EPA (EPA, 2023) (see Table 3).

Table 3: Global Warming Potential in Metric Tons

Greenhouse Gas	CO_2	CH_4	N_2O
Global Warming Potential (CO_2e)	1	25	298

Source: EPA, 2023

BOEM evaluates life cycle GHG emissions assuming annual exploration, development, and production occur as estimated under the high activity level described in the LS 258 E&D Scenario.[7] To estimate the volume of substitute energy sources displaced by new OCS oil and natural gas under a given Proposed Action's potential exploration and development production scenario, BOEM uses MarketSim. The displacement estimates are then used as inputs in the OECM and GLEEM (Figure 2).

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[4] Available at https://www.boem.gov/oil-gas-energy/energy-economics/national-ocs-program.

[5] Available at https://www.boem.gov/oil-gas-energy/energy-economics/national-ocs-program.

[6] Available at https://www.boem.gov/environment/greenhouse-gas-life-cycle-energy-emissions-model.

[7] To generate estimates of anticipated future oil and gas production, BOEM develops oil and gas exploration and development scenarios under a given leasing schedule to describe the development and production activities required to explore for, extract, and transport to market the anticipated oil and gas production.

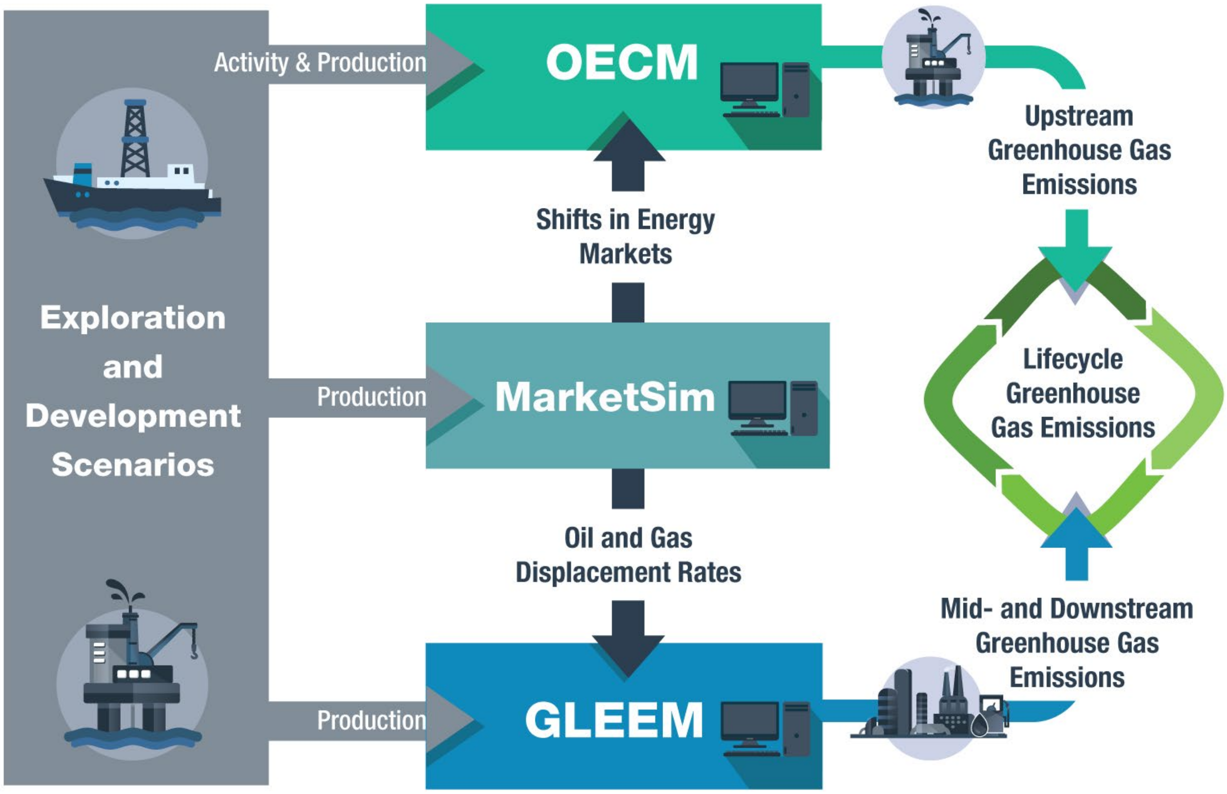

Figure 2: Illustration BOEM's Models and GHG Estimation Methodology

The Market Simulation Model (MarketSim)

MarketSim is a Microsoft™ Excel™-based model for the oil, gas, coal, and electricity markets. BOEM uses MarketSim to estimate the energy commodity price changes expected to occur with new OCS oil and gas production, and then calculates the displacement of energy market substitutes (refer to Table 5) that would occur given those price changes (e.g., the volumes of substitute oil and natural gas imports, domestic onshore oil and gas, and renewable energy displaced by new OCS oil and gas production).

MarketSim's baseline is adapted from a special run of the U.S. Energy Information Administration's (EIA's) National Energy Modeling System (NEMS). BOEM requested specialized runs from the EIA that modified the *2023 Annual Energy Outlook (*AEO*)* reference case to remove new OCS oil and gas lease sales and associated production starting in 2023 (EIA, 2023; Sommer, 2023). Removing the expected production from new OCS leasing from EIA's projections allows BOEM to use MarketSim to investigate the impact of alternative new OCS leasing scenarios such as the LS 258 E&D Scenario analyzed here and associated production within the EIA's broad energy market projections.

MarketSim makes no assumptions about future technology or policy changes other than those reflected in the EIA's 2023 AEO reference case (IEc, 2023a). The EIA's 2023 AEO Reference Case reflects laws and policies current as of 2022. As such, the baseline used in MarketSim includes impacts from Inflation Reduction Act provisions modeled by the Energy Information Administration.

While U.S. policy affecting energy markets has changed since the 2023 AEO was developed, nonetheless, it is representative of the best available modeling baseline compatible with MarketSim. BOEM acknowledges many substantial changes to national and worldwide economies beyond those projected within the 2023 AEO and MarketSim's baseline. Accordingly, BOEM has conducted a sensitivity analysis to illustrate the impacts these changes could have on the estimates of displacement rates of energy substitutes and the associated change in emissions. The sensitivity analysis is discussed briefly in a later section of this Appendix with regard to the MarketSim baseline. This section also outlines the process, timelines and challenges associated with obtaining the specialized runs from the EIA. For further details on the sensitivity testing, methodology, modeling assumptions and results refer to Chapter 4 of the Final EAM paper, and the appendix to the MarketSim documentation (BOEM, 2023; IEc, 2023a).

To estimate the GHG emissions associated with the Proposed Action, BOEM adds the estimate of future production from the LS 258 Proposed Action high activity level scenario into MarketSim as an addition to the energy market baseline. *MarketSim* uses price elasticities[8] and adjustment rates[9] to calculate a new energy market equilibrium and the volumes of substitute energy sources displaced by the potential OCS production under the Proposed Action. Collectively, elasticities and adjustment rates determine the change in supply and demand of alternative energy sources given a change in the anticipated production from the Proposed Action scenarios. MarketSim evaluates a series of simulated price changes until each fuel market reaches equilibrium where supply equals demand. The differences between the baseline and simulated supply and demand provide BOEM the necessary data to use in the OECM and GLEEM to estimate GHG emissions from the OCS oil and gas as well as those from the displaced energy substitutes. Additional details about how MarketSim incorporates energy market equilibrium and displacements of energy market substitutes are described in the MarketSim documentation (IEc, 2023a).

Table 4 shows the high activity level potential oil and natural gas production volumes of the Proposed Action (see also Appendix B). BOEM evaluates life cycle GHG emissions using the potential annual exploration, development, and production in its high activity level scenario as this represents the upper range of anticipated OCS activity and production from the Proposed Action. By doing this, BOEM's estimates represent an upper bound of the GHG emissions.

Table 4: Proposed Action Potential Production (in MMBOE)

Activity Level	OCS Oil (MMBOE)	OCS Natural Gas (MMBOE)*	Total Proposed Action OCS Production (MMBOE)
High Activity Level	192.3	53.73	246.02

Note: * A conversion factor of 5,620 cubic feet of natural gas per barrel of oil equivalent (BOE) to convert the 301.95 billion cubic feet of anticipated natural gas production to millions of BOE (MMBOE).

Table 5 shows the amount of displaced energy sources as a percentage of the Proposed Action's potential production. For example, with the production of the Proposed Action, oil and natural gas net imports would be reduced as they would be displaced by the Proposed Action production. In the high activity scenario, approximately 54 percent of the 246 MMBOE anticipated production would displace oil and natural gas net imports (i.e., oil and gas net imports would be reduced by 130 MMBOE in the Proposed Action). The model estimates that roughly 12 percent of the OCS production would not displace any energy source and represents additional demand under the Proposed Action.

Table 5: Displaced Energy Sources as a Percentage of Proposed Action Oil and Natural Gas Production

Substitute Energy Source	% of Proposed Action Potential Production
Onshore Production	24
Onshore Oil	12

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[8] Elasticity, simply defined, is a mathematical value that expresses the percent change expected in one economic variable given a 1% change in another economic variable (e.g., supply, demand, or price).

[9] Adjustment rates are the limits MarketSim sets on how much of the long-term change estimated by the elasticity values can occur in 1 year.

Substitute Energy Source	% of Proposed Action Potential Production
Onshore Gas	12
Production from Existing State/Federal Offshore Leases	*
Imports	54
Oil Imports	53
Gas Imports	1
Coal	*
Electricity from Sources Other Than Coal, Oil, and Natural Gas**	2
Other Energy Sources***	8
Reduced Demand/Consumption	12

Notes: The estimates in this table represent the volume of a specific substitute energy source (as the percent of potential OCS production) that is displaced by potential OCS production (or in the case of the last row, energy not displaced which is an increase in demand) with the selection of the Proposed Action. For example, the volume of onshore natural gas displaced by new OCS production is estimated at 12% of potential Proposed Action production at the high activity level. Numbers may not sum due to rounding.

* Value is less than 0.5% and thus rounds to 0%.

** Includes electricity from wind, solar, nuclear, and hydroelectric sources. BOEM does not assign life cycle GHG emissions to these energy sources. For the upstream, BOEM does not currently have the data needed to determine how much renewable energy generation is reduced by either curtailing utilization of existing capacity or building of new capacity. For the midstream, only nuclear would have modeled emissions, which would be de minimis. None of these sources would have any downstream emissions.

*** Includes primarily natural gas liquids (roughly 80%), with the balance from biofuels, refinery processing gain, product stock withdrawal, liquids from coal, and “other” natural gas not captured elsewhere. BOEM does not assign upstream, midstream, or downstream GHG emissions with biofuels, which is a very small portion of “Other Energy Sources” that would be de minimis.

The OECM and Upstream GHG Emissions Estimates

BOEM uses the OECM to estimate upstream emissions from OCS production and displaced energy sources (IEc, 2018; 2023a, b). The OECM uses the level of exploration, development, and production activities associated with the potential production to estimate the OCS upstream GHG emissions. Compared to the previous analysis in the 2022 LS 258 FEIS, this SEIS uses updated emissions factors to estimate the upstream GHGs. In the past, BOEM estimated GHG emissions based on assumptions of what a hypothetical facility in the Alaska OCS would look like. To be conservative these assumptions were based on platforms that had high emissions. Since BOEM’s previous analysis, new information, based on plans submitted by an operator, has become available. While estimates are still conservative, they have resulted in lower upstream emissions estimates. BOEM’s upstream emissions factors for OCS oil and natural gas activities and displaced substitutes can be found in Table 5 of the OECM documentation (IEc, 2023b)[10].

GLEEM: Midstream and Downstream GHG Emissions Estimates

GLEEM uses potential production and MarketSim’s estimates of energy substitutes’ displacement to generate the midstream and downstream GHG emissions estimates. The model calculates the emissions associated with onshore processing (refining and storage), delivery of energy (i.e., oil, natural gas, or other energy substitutes) to the final consumer, and consumption of the oil and gas products. GLEEM relies on the MarketSim estimates of substitute energy displacement to estimate midstream and downstream emissions from displaced energy substitutes associated with the Proposed Action. More details on GLEEM are available in the model documentation (Wolvovsky, 2024).

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[10] The OECM estimates emissions from upstream activity, which includes (1) propulsion and auxiliary engines operated onboard vessels, (2) drilling operations, (3) platform operations including flaring, (4) helicopters and light aircraft, (5) use of above-ground pipelines, (6) construction (onshore and offshore), and (7) accidental oil spills and gas releases.

Life Cycle Greenhouse Gas Emission Estimates: Domestically Produced or Consumed Energy

Table 6 shows the upstream GHG emissions estimates of domestically consumed or produced energy for both OCS production and displaced energy substitutes under the Proposed Action. The first row shows the estimate of GHG emissions from upstream activities (exploration, development and production) under the Proposed Action. To capture the total GHG emissions associated with the Proposed Action BOEM uses MarketSim to estimate the resulting changes in energy markets associated with this new OCS production. BOEM models the displacement of other energy sources in response to the potential production from the Proposed Action. The emissions associated with these displaced energy sources are included in the second row. These emissions are negative as they are emissions reductions from displaced energy substitutes under the Proposed Action that would have otherwise occurred under the No Action Alternative baseline. The sum of these two estimates is the total Proposed Action emissions, which is shown in the last row.

BOEM determined that the other action alternatives, which exclude certain lease blocks, will not increase the total level of activity considered under the high activity case E&D Scenario. While these alternatives would focus activities away from certain areas or prohibit activities during certain times of the year, the overall lifespan or volume of air emissions of the lease sale activities would be similar and not vary significantly among Action Alternatives, including GHG emissions from direct emissions, transportation, or life cycle emissions from combustion of resources. Thus, the downstream life cycle of CO_2e emissions for all other action alternatives will be similar to those for the Proposed Action.

Table 6: Upstream GHG Emissions from Domestically Produced or Consumed Energy (in thousands of metric tons)

OCS, Displaced, or Total	CO_2e	CO_2	CH_4	N_2O
OCS Oil & Gas Emissions*	4,194	4,112	2	**
Displaced Energy Emissions*	-9,901	-6,608	-131	**
Total Proposed Action Emissions***	-5,708	-2,496	-129	**

Note: Values rounded to nearest 1,000 metric tons.

* Upstream OCS Oil & Gas Emissions are those associated directly with potential production from the Proposed Action and include GHG emissions from the transport of the portion of that potential production estimated to be part of U.S. gross oil exports. Upstream Displaced Energy Emissions include the GHG emissions from the change in the production and transport to U.S. shores of U.S. gross oil imports. When added together, this ensures that upstream total Proposed Action emissions account for the change in U.S. net oil imports.

** Values are between -0.5 and 0.5.

*** The total Proposed Action emissions are the emissions associated with the potential OCS oil and gas of the Proposed Action plus those of the displaced energy sources. These are the total GHG emissions attributable to the Proposed Action, i.e., row 1 plus row 2.

For the upstream portion of life cycle emissions (Table 6), BOEM estimates about 4.2 million metric tons of CO_2e would be emitted from OCS oil and natural gas exploration and production associated with LS 258. However, because this production displaces other energy sources that would have generated 9.9 million metric tons of CO_2e upstream emissions total Proposed Action emissions are reduced to negative 5.7 million metric tons of CO_2e. In other words, with a decision for the Proposed Action, upstream GHG emissions, measured in CO_2e, are estimated to be 5.7 million metric tons lower than they would be under the No Action Alternative. OCS oil and gas emissions comprise approximately 40 percent of displaced emissions, resulting in a reduction in upstream emissions from domestically produced or consumed energy under the Proposed Action. Collectively the displaced substitute energy sources have higher GHG emissions per unit of production (also known as “GHG intensity”) compared to domestically produced OCS oil and natural gas.

Table 7 shows the midstream and downstream emissions associated with the Proposed Action. Mid- and downstream emissions from OCS oil and gas are larger than those of the displaced substitutes, resulting in an increase in emissions over the baseline. This increase is due to slightly higher consumption and fuel switching towards OCS oil and natural gas under the Proposed Action. BOEM calculates that, under the Proposed Action, the additional OCS production would result in slightly lower oil prices when compared to the No Action Alternative baseline.[11] With the lower energy prices, MarketSim estimates that all domestic energy demand over the 32-year production would be approximately 29.2 MMBOE higher (roughly 12 percent of the OCS production). For oil and natural gas specifically, MarketSim estimates U.S. consumption to be higher by 14.4 million barrels of oil and 44.5 billion cubic feet of natural gas under the Proposed Action. Although oil and natural gas demand are expected to be higher in the Proposed Action, BOEM anticipates that there would be a reduction in domestic onshore production (oil and natural gas) and imports (mainly oil), in addition to lower coal consumption and production.

As shown in Table 7, BOEM estimates that OCS oil and gas would emit 80.5 million metric tons of CO_2e from combined midstream and downstream activities associated with the Proposed Action. The potential OCS production displaces substitute energy sources and accounts for 69.3 million metric tons of CO_2e emissions. This results in total Proposed Action midstream and downstream emissions of 11.1 million metric tons of CO_2e.

Table 7: Midstream and Downstream GHG Emissions from Domestically Produced or Consumed Energy (in thousands of metric tons)

OCS, Displaced, or Total	CO_2e	CO_2	CH_4	N_2O
OCS Oil & Gas Emissions*	80,455	79,415	35	1
Displaced Energy Emissions*	-69,330	-68,546	-25	-1
Total Proposed Action Emissions**	11,125	10,868	10	***

Note: Values rounded to nearest 1,000 metric tons.

* Midstream and downstream OCS Oil & Gas Emissions are those associated directly with potential production from the Proposed Action and include GHG emissions from the portion of that potential production estimated to be part of U.S. gross oil exports. Midstream and downstream Displaced Energy Emissions include the GHG emissions from the change in U.S. gross oil imports. When added together, this ensures that midstream and downstream total Proposed Action emissions account for the change in U.S. net oil imports.

** The total Proposed Action emissions are the emissions associated with the potential OCS oil and gas of the Proposed Action plus those of the displaced energy sources. These are the total GHG emissions attributable to the Proposed Action, i.e., row 1 plus row 2.

*** Values are between -0.5 and 0.5

Table 8 shows the life cycle GHG emissions estimates from domestically produced or consumed energy. The GHG emissions from OCS oil and gas production are close to the volume of displaced GHG emissions from substitute energy sources. The modeling indicates that under the Proposed Action total GHG emissions from domestically produced or consumed energy are higher by 5.4 million metric tons of CO_2e and represent an increase of 6.8 percent relative to the volume of GHG emissions displaced by OCS production from the Proposed Action.

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[11] The average price reductions under the Proposed Action over the 32 years of oil and natural gas production anticipated from LS 258 at the high activity level are $0.03 per barrel for oil, $0.74 per million cubic feet for natural gas, $0.23 per thousand tons for coal, and $0.01 per megawatt for electricity.

Table 8: Full Life Cycle GHG Emissions from Domestically Produced or Consumed Energy (in CO_2e, thousands of metric tons)

OCS, Displaced, or Total	Upstream	Mid- & Downstream	Full Life Cycle
OCS Oil & Gas Emissions*	4,194	80,455	84,649
Displaced Energy Emissions*	-9,901	-69,330	-79,232
Total Proposed Action Emissions**	-5,708	11,125	5,418

Note: Values rounded to nearest 1,000 metric tons.

* Full life cycle OCS Oil & Gas Emissions are those associated directly with potential production from the Proposed Action and include GHG emissions from the transport of the portion of that potential production estimated to be part of U.S. gross oil exports. Full life cycle Displaced Energy Emissions include the GHG emissions from the change in the production and transport to U.S. shores of U.S. gross oil imports. When added together, this ensures that midstream and downstream total Proposed Action emissions account for the change in U.S. net oil imports.

** The total Proposed Action emissions are the emissions associated with the potential OCS oil and gas of the Proposed Action plus those of the displaced energy sources. These are the total GHG emissions attributable to the Proposed Action, i.e., row 1 plus row 2.

Table 9 provides context for the domestic life cycle GHG emissions analysis by comparing the emissions presented in Table 8, to annual state emissions for Alaska in 2022. As shown in the table, the 37 years of OCS oil and gas activity are estimated to generate a similar volume of GHG emissions as 1 year and 9 months of the average emissions generated in Alaska in 2022. After accounting for displaced energy GHG emissions, Total Proposed Action Emissions are similar to roughly 6 weeks of the average emissions generated in Alaska during 2022. When comparing the average annual total emissions from the Proposed Action, these are comparable to 1 day of the average emissions generated in Alaska during 2022. Meanwhile peak year OCS oil and gas activity will likely generate about the same volume of emissions as those generated in Alaska during an average 6 weeks of 2022. The total Proposed Action peak year emissions would generate about the same volume of GHG emissions as those generated by Alaska during an average 3 days of 2022.

Table 9: Comparison of GHG Emissions and State Level Emissions (in millions of metric tons)

Proposed Action GHG Emissions*	CO_2e	Comparable State Emissions (2022)	CO_2e
OCS Oil & Gas**	84.65	Alaska (1 Year and 9 months)	82.01
Total Proposed Action**	5.42	Alaska (6 weeks)	5.41
Average Annual Total Proposed Action	0.15	Alaska (1 day)	0.13
Peak Year (2039) OCS Oil & Gas	5.34	Alaska (6 weeks)	5.41
Peak Year (2039) Total Proposed Action	0.44	Alaska (3 days)	0.39

Note: State level emissions from EPA, 2025b.

* This GHG Emissions in this column are for the full life cycle emissions from domestically produced or consumed energy.

** These first two rows of emissions under the Proposed Action are the emissions from the entire 37 years of potential OCS activity and production under the high activity scenario (see rows 1 and 3 of Table 8). For illustrative purposes, these emissions are compared to emissions from selected states in the year 2022 (most recent data available).

Small changes in the exploration and development activity, the volumes of oil to natural gas production within the Proposed Action scenario, and underlying assumptions within the models could lead to different results. The primary modeling assumptions affecting the results are elasticities, adjustment rates, differences in emission factors, and regional energy market differences. The interplay of all these variables, along with the ratio of oil versus natural gas production within the exploration and development scenario, drive differences in GHG emissions estimates between new OCS production and displaced energy substitutes. The factors contributing to uncertainty are discussed later in this Appendix.

In the 2022 LS 258 FEIS, BOEM compared the GHG emissions from domestically produced or consumed energy to climate targets and carbon budgets. However, given the change in administration and policy, the U.S. is no longer party to the Paris Agreement. Due to the fact that the U.S. does not have GHG emission reduction goals these comparisons have been removed from this Supplemental EIS. The contribution of the proposed action to effects on the human and natural environment are discussed in Chapter 4 of this Supplemental EIS, where relevant.

Foreign GHG Emissions Methodology and Estimates

BOEM's foreign GHG emissions analysis estimates the change in global emissions not captured in the domestic life cycle GHG emissions analysis. The goal of the foreign GHG analysis is to consider the impact of the Proposed Action's potential production on global GHG emissions while accounting for emissions not already captured within the domestic GHG emissions analysis. As a global commodity, any oil price changes resulting from OCS production would impact global production and consumption. Further, GHG emissions are a global pollutant; emissions do not remain localized only to the emission source but rather, disperse throughout the global atmosphere. Thus, just like the emissions associated with foreign activities impact the U.S., similarly domestic emissions impact U.S. citizens and their interests globally.

BOEM first uses MarketSim to estimate changes in foreign oil production and consumption. Then, using the best available information, BOEM converts the changes in global oil production and consumption into an estimate of the change in related GHG emissions. The Section below, " Foreign Oil Upstream Methodology and Estimates" explains BOEM's calculation of foreign upstream emissions, and Section "Foreign Oil Downstream Methodology and Estimates" explains BOEM's calculations for foreign downstream emissions.

As described in a later section of this Appendix, foreign energy market simulations using MarketSim are necessarily more simplistic given limited information available for foreign markets when compared to that available for the U.S. domestic energy markets. BOEM uses MarketSim's current assumptions to estimate shifts in foreign oil markets in response to OCS leasing decisions but acknowledges that the foreign analysis is less detailed than the domestic analysis. BOEM expects to continue to make refinements to its foreign GHG analysis as data and methodologies develop for future analyses.

Foreign Oil Upstream Methodology and Estimates

Since BOEM's previous GHG analysis for the 2022 LS 258 FEIS, BOEM has expanded its foreign GHG emissions methodology to include estimates of the change in foreign oil's upstream GHG emissions. BOEM uses MarketSim's estimate of the change in foreign oil production resulting from the Proposed Action and adjusts the result accounting for emissions already included in the domestic analysis. BOEM calculates the overall change in foreign oil production, subtracting any change in foreign oil exports to the U.S. (U.S. gross oil imports) already accounted for in BOEM's domestic GHG analysis. Life cycle GHG emissions from U.S. gross oil imports are included in the displaced energy substitutes emissions within the domestic GHG analysis.

As shown in Table 10, BOEM's modeling suggests that the Proposed Action results in a decrease of 84 million barrels of foreign oil production. However, BOEM's domestic analysis already accounts for the displaced emissions associated with a decrease of 122 million barrels in U.S. gross oil imports (foreign gross oil exports) under the Proposed Action. The difference, negative 84 minus negative 122, represents foreign oil production available for foreign consumption under the Proposed Action instead of as exports to the U.S. Because BOEM already accounted for the reduction in life cycle emissions associated with the displaced U.S. gross oil imports, the foreign analysis accounts for the upstream emissions associated with the 38 million barrels available for foreign consumption.

Table 10: Increase in Foreign Oil Supply under the Proposed Action

Step of Adjustment (description)	Millions of barrels
Change in Foreign Oil Production under the Proposed Action	-84
Change in Foreign Oil Gross Exports to U.S.	-122
Adjusted Change in Foreign Oil Supply (row 1 minus row 2)	38

Note: Change in foreign oil gross exports to the U.S. is equivalent to the change in U.S. oil gross imports. The adjusted change in foreign oil supply shown here is the decrease in foreign oil production minus the decrease in foreign oil gross exports to the U.S. It does not add U.S. oil exports since these were not subtracted from the domestic analysis and are already accounted for when taking a global view.

The difference of 38 million barrels shown in Table 10 plus an increase in U.S. oil gross exports (roughly 4 million barrels) is the supply necessary to meet the increase in foreign consumption of 42 million barrels under the Proposed Action shown in Table 12. In other words, the increase in foreign consumption, due to lower oil prices resulting from increased OCS production under the Proposed Action, is made possible by an increase in U.S. oil gross exports and a decrease in foreign oil gross exports to the U.S (i.e., U.S. oil gross imports).

BOEM then applies the same OECM emissions factor used for overseas oil production that is exported to the U.S. to the estimate of the annual change in foreign oil supply shown in Table 10. BOEM assumes the change in foreign oil production would have the same GHG emissions factor as the foreign oil that is produced and exported to the U.S. This simplifying assumption is necessary and appropriate given the lack of information on the specifics of where foreign oil production could change in response to OCS production. Table 11 shows the increase in foreign upstream GHG emissions associated with the increase in foreign oil supply shown in Table 10. To put the foreign oil upstream increase in emissions in context, the 2.2 million metric tons of CO_2e over the 37-year Proposed Action in the high activity case are comparable to the 2.1 million metric tons of CO_2e emissions generated in Alaska for an average of 16 days in 2022 (EPA, 2025b).

Table 11: Foreign Upstream: Increase in Oil Supply GHG Emissions under the Proposed Action (in CO_2e, thousands of metric tons)

OCS, Displaced, or Total	CO_2e	CO_2	CH_4	N_2O
Foreign Oil Upstream Emissions	2,153	1,490	26	*

Note: Values rounded to nearest 1,000 metric tons.

* Values are between -0.5 and 0.5.

Foreign Oil Downstream Methodology and Estimates

BOEM's MarketSim model estimates the increase in foreign oil consumption that occurs under the Proposed Action. However, some of that increase in oil consumed in foreign markets is already included in BOEM's GHG emissions analysis of domestically produced or consumed energy. This is because BOEM's domestic downstream analysis treats the full value of the Proposed Action's exploration and development scenarios' potential OCS oil and gas production as being consumed domestically. However, a small amount of that OCS oil is exported and consumed in foreign markets. Thus, to extend the analysis to include foreign consumption, an adjustment is necessary to capture the actual or true value of the foreign consumption. BOEM adjusts (subtracts) MarketSim's foreign oil consumption estimate to account for the amount that is already included within the domestic downstream analysis. The adjusted increase in foreign oil consumption is presented in Table 12. BOEM continues to review and refine its foreign emissions methodology and could further refine this change for future analyses.

Table 12: Increase in Foreign Oil Consumption (adjusted) Resulting from the Proposed Action

Step of Adjustment (description)	Millions of barrels
Global (domestic plus foreign) shift in oil consumption estimated by MarketSim	57.7
Shift in U.S. domestic oil consumption used in GLEEM	15.3
Adjusted shift in foreign oil consumption (row 1 minus row 2)	42.4

GLEEM takes the adjusted annual change in foreign consumption and applies an emissions factor attributable to combusted oil. For this analysis, BOEM uses a single set of EPA emissions factors called ‘Other Oil <401°F’ (EPA, 2023). This emissions factor set is a miscellaneous factor set used when the end petroleum product consumed is unknown. Typically, rather than using a single emissions factor, it would be preferable to use a range of emissions factors that correspond to the different end uses of petroleum products after oil refining. However, for this analysis, BOEM applies this emissions factor to all combusted oil due to a lack of information about the end petroleum products consumed in foreign markets. The consumption of oil and its end uses vary from country to country, as the consumption of oil and its end uses vary from country to country. GLEEM’s calculations for non-combustion uses of oil is based on the U.S. market as an approximation (Wolvovsky, 2024). This approach is unlikely to change the results substantially, as the amount of oil used globally in non-combustion products is small.

Although the U.S. non-combusted oil products are used as a proxy for global non-combusted oil, taking a similar approach for emissions factors would likely produce less accurate results. For instance, in 2019, the most recent year for which data are available, about 20 percent of European Union oil was consumed as motor gasoline (Eurostat, 2022), while in the U.S. that portion was more than double, i.e., approximately 45 percent of all oil was consumed as motor gasoline (EIA, 2022). The different emissions factors for each type of fuel (EPA, 2023) would likely result in significant changes in multiple ways. This variability applies to all countries around the world, including variability in oil product consumption within the European Union. Therefore, a U.S. consumption model would not apply to most other countries, and though these figures are available for the European Union, as well as some other countries, they are not available globally. As a result, BOEM has decided to use a generic emissions factor that does not corollate with specific oil products but that does give a reasonable approximation of emissions from oil consumed in other countries without introducing other uncertainties into the results.

Table 13 presents the increase in GHG emissions attributable to the higher foreign consumption of oil under the Proposed Action. At the high activity level, the selection of the No Action Alternative results in an estimated 16.4 million metric tons of CO_2e fewer GHG emissions than if the Proposed Action is selected. To put these emissions into context the 16.4 million metric tons of CO_2e is similar to the 15.6 million metric tons of CO_2e released during an average 4 months in Alaska in 2022 (EPA, 2025b.

Table 13: Foreign Downstream: Change in Oil Consumption GHG Emissions under the Proposed Action (in thousands of metric tons)

Category	CO_2e	CO_2	CH_4	N_2O
Foreign Oil Upstream Emissions	16,437	16,383	1	*

Note: Values rounded to nearest 1,000 metric tons.

* Values are between -0.5 and 0.5.

When considering the increase in foreign oil supply associated emissions in Table 10 and the increase in foreign oil consumption associated emissions in Table 12, BOEM finds that foreign emissions would increase under the Proposed Action.

Impacts from GHG Emissions

In the 2022 LS 258 FEIS, BOEM provided additional context for the effects of the estimated GHG emissions under the Proposed Action by applying estimates of the per-metric-ton social cost of GHG to those estimates. As a result of recent policy changes, the use of the SC-GHG has been removed in this SEIS.

The National Environmental Policy Act (NEPA) does not require an agency to quantify project impacts through a specific methodology, such as estimating the "social cost of carbon," "social cost of methane," or "social cost of greenhouse gases." A protocol to estimate what is referenced as the "social cost of carbon" (SCC) associated with GHG emissions was developed by a federal Interagency Working Group on the Social Cost of Greenhouse Gases (IWG).

Executive Order 14154, Unleashing American Energy (January 20, 2025), disbanded the IWG and withdrew any guidance, instruction, recommendation, or document issued by the IWG. Section 6(c) of Executive Order 14154 states:

> The calculation of the "social cost of carbon" is marked by logical deficiencies, a poor basis in empirical science, politicization, and the absence of a foundation in legislation. Its abuse arbitrarily slows regulatory decisions and, by rendering the United States economy internationally uncompetitive, encourages a greater human impact on the environment by affording less efficient foreign energy producers a greater share of the global energy and natural resource market. Consequently, within 60 days of the date of this order, the Administrator of the EPA shall issue guidance to address these harmful and detrimental inadequacies, including consideration of eliminating the "social cost of carbon" calculation from any Federal permitting or regulatory decision.

Executive Order 14154 further directs agencies to ensure consistency with the guidance in OMB Circular A-4 of September 17, 2003, when estimating the value of changes in GHG emissions from agency actions.

BOEM has not included any estimates for the SCC for this Supplemental EIS for multiple reasons. First, this action is not a rulemaking. Rulemakings are the administrative actions for which the IWG originally developed the SCC protocol. Second, Executive Order 14154 clarifies that the IWG has been disbanded and its guidance has been withdrawn.

Further, NEPA does not require agencies to conduct a cost-benefit analysis. Including an SCC analysis without a complete cost-benefit analysis, which would include the social benefits of the Proposed Action to society as a whole and other potential positive benefits, would be unbalanced, potentially inaccurate, and not useful to foster informed decision-making. Any increased economic activity—in terms of revenue, employment, labor income, total value added, and output—that is expected to occur as a result of the Proposed Action is simply an economic impact, not an economic benefit, inasmuch as any such impacts might be viewed by another person as a negative or undesirable impact due to a potential increase in the local population, competition for jobs, and concerns that changes in population will change the quality of the local community. "Economic impact" is distinct from "economic benefit," as understood in economic theory and methodology, and the socioeconomic impact analysis required under NEPA is distinct from a cost-benefit analysis, which NEPA does not require. In addition, many benefits and costs from agency actions cannot be monetized and, even if monetizable, cannot meaningfully be compared directly to SCC calculations for a number of reasons, including because of differences in scale (local impacts vs global impacts).

Finally, purported estimates of SCC would not measure the actual environmental impacts of a Proposed Action and may not accurately reflect the effects of GHG emissions. Estimates of SCC attempt to identify economic damages associated with an increase in carbon dioxide emissions—typically expressed as a one metric ton increase in a single year—and typically includes, but is not limited to, potential changes in net agricultural productivity, human health, and property damages from increased flood risk over hundreds of years. The estimate is developed by aggregating results across models, over time, across regions and impact categories, and across multiple scenarios. The dollar cost figure arrived at based on consideration of SCC represents the value of damage avoided if, ultimately, there is no increase in carbon emissions. But SCC estimates are often expressed in an extremely wide range of dollar figures, depending on the particular discount rates used for each estimate, and would provide little benefit in informing the Secretary of the Interior's decision. For these reasons, the Department of the Interior has also rescinded its memorandum of October 16, 2024, entitled, "Updated Estimates of the Social Cost of Greenhouse Gases," which had directed Interior bureaus to calculate SCC using the methodology contained in the Environmental Protection Agency's Final Rule of March 8, 2024, 89 Fed. Reg. 16,820.

To summarize, BOEM, is not evaluating SCC for this EIS because: (1) BOEM is not engaged in a rulemaking for which the now-rescinded SCC protocol was originally developed; (2) the IWG has been disbanded and all technical supporting documents and associated guidance have been withdrawn; (3) NEPA does not require agencies to prepare SCC estimates or cost-benefit analyses; (4) costs attributed to GHGs are often so variable and uncertain that they are unhelpful for BOEM's analysis; and (5) the full social benefits of carbon-based energy production have not been monetized, and quantifying only the costs of GHG emissions, but not the benefits, would yield information that is both potentially inaccurate and not useful.

With removal of the estimates of the social cost of GHG, BOEM provides context for the volumes of GHG emissions in terms of how those volumes compare to those of state level emissions. Additionally, BOEM recognizes that changes in GHG emissions lead to changes in the atmospheric and oceanic concentrations of those GHG emissions. These changes in turn lead to changes in global mean temperatures, precipitation, ocean acidity, and sea levels. Finally, those changes result in the impacts to the human and natural environment affecting health, mortality, habitat and species decline, biodiversity, coastal erosion, crop failure, property life and value. The contribution of the Proposed Action to effects on the human and natural environment are discussed in their relevant chapters within this SEIS.

Foreign Qualitative Life Cycle Greenhouse Gas Analysis

As shown in Table 11 and Table 13, BOEM estimates GHG emissions associated with the potential changes in foreign oil supply and consumption resulting from the Proposed Action. BOEM recognizes that these changes are not a complete accounting of all potential changes in foreign markets and are not as comprehensive as the estimates of life cycle emissions from domestic production or consumption (Table 8). BOEM recognizes that there are additional foreign energy market responses and impacts that cannot be quantified at this time (Table 13); however, these are considered qualitatively in this section.

In developing the global life cycle GHG analysis, BOEM consulted with the contracted developer of MarketSim, IEc[12] to assist in refining and expanding its analysis. Through this expert review, IEc extensively evaluated BOEM's approach to estimating the change in emissions associated with the shift in

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[12] IEc is a consulting firm that engages on a wide variety of projects including economics, public policy, and natural resource management.

foreign energy consumption. However, given the model's current capabilities and limitations, IEc acknowledged that MarketSim would not allow a complete estimation of foreign life cycle GHG emissions at that time. Since that initial consultation, BOEM has implemented IEc's intermediate solution to use the overseas oil production emissions factors that the OECM uses for oil imports to the U.S. and apply those emission factors to the shift in foreign oil production estimated by MarketSim. While BOEM has made some progress in the estimation of the Proposed Action's impact on foreign life cycle GHG emissions, there are still many life cycle stage components that BOEM is unable to quantify as explained below.

According to IEc, to provide a complete and quantitative estimate of the impact of OCS leasing on the global energy market and resulting GHG emissions, the model would need demand-driven and competition-driven substitution effects for all major global energy forms as well as upstream, midstream, and downstream emissions profiles for OCS oil and gas and domestic and foreign substitutes (Price, 2021). To derive these substitution effects, the model requires a detailed global baseline energy forecast that includes multiple categories of supply, demand, and prices at a regional level. IEc indicated it was unaware of any such existing forecasts with the required level of detail that have been published by a major organization. IEc suggested that, in theory, BOEM could develop its own projections of foreign supply, demand, and prices based on less detailed forecasts, but doing so would "require a number of assumptions that would introduce significant uncertainty into MarketSim's results" (Price, 2021).

Currently, MarketSim estimates total non-U.S. supply and demand for oil. However, its specification of foreign oil demand does not include cross-price elasticities that would capture how foreign demand for oil changes in response to other energy prices. Similarly, the model does not capture how foreign demand for oil substitutes changes in response to oil prices. MarketSim also does not capture foreign production of gas and coal consumed outside the U.S. or foreign consumption of gas or coal produced outside the U.S. A comprehensive accounting of all these effects would require a significant expansion of MarketSim in scope and complexity, as well as the development of baseline supply and demand projections beyond what is included in the EIA's AEO.

Despite the extensive data requirements and limitations needed to estimate the Proposed Action's influence on foreign GHG emissions, BOEM determined that, for this analysis, BOEM could reasonably quantify the GHG emissions from foreign production and consumption of oil. Meanwhile, BOEM continues to evaluate options to improve methodologies to estimate midstream emissions from foreign oil production, as well as those relating to the adjustment of foreign oil consumption, for use in future analyses.

Evaluating the foreign energy market qualitatively, the price decreases for oil under the Proposed Action would be felt beyond U.S. borders given that oil is a globally traded commodity. The displacements of substitute energy sources discussed earlier for the domestic energy market also occur in the foreign markets in response to the decrease in the price of oil. In this case, as the price of oil declines, increased consumption of oil would displace substitute energy sources such as coal, natural gas, biofuels, and others, but at different rates than within the U.S. depending on each country's or region's energy infrastructure and market.

Foreign Oil Life Cycle Change: Midstream Emissions

According to IEc, BOEM lacks the ability to estimate foreign oil midstream GHG emissions. First, BOEM does not have information on the volume of foreign midstream oil, and even if that were available, BOEM would be unable to estimate where changes in foreign oil midstream emissions would occur. BOEM needs this information to derive foreign midstream oil GHG emission factors. For the domestic markets and analysis, BOEM uses the USEPA's midstream emissions inventory data to derive midstream emission factors for domestic oil. The GHG emissions associated with activities such as refining differ based on the quality of crude oil and the technological capabilities of different refining sectors within the foreign oil midstream, as the GHG emissions intensity of petroleum refining varies across countries. Thus, to be able to estimate foreign midstream emissions, BOEM requires projections of where oil is being refined. This requires knowledge and understanding of the total midstream GHG emissions and the volume of oil passing through the midstream. BOEM does not have a comparable data set for foreign markets.

Given these data limitations, BOEM considers these impacts qualitatively. If BOEM were to quantify foreign oil's midstream GHG emission by applying the same domestic refining GHG emissions data to the portion of global oil midstream not estimated in BOEM's domestic midstream analysis, it would represent an increase in global GHG emissions under the Proposed Action relative to the No Action Alternative. BOEM will continue to investigate potential updates to its methodology for future analyses.

Substitutes for Oil in Foreign Markets

Limitations with Data Sources

To understand the complexities and limitations of estimating foreign energy market oil substitutes and their emissions, it is useful to provide context from BOEM's domestic analysis. The inputs for BOEM's domestic GHG model are based on the best available and most credible information. They are illustrative of the range and depth of data necessary to credibly conduct a full quantitative analysis of changes in foreign GHG emissions. BOEM's MarketSim model adopts assumptions from the EIA (the primary Federal Government entity on energy statistics and analysis) and from economics literature cited in the model documentation. These assumptions help BOEM estimate where the likely substitute sources of oil and gas would come from (e.g., oil and gas production from State submerged lands, onshore domestic production, and international imports) and the other types of energy sources that would be utilized to balance demand and supply (i.e., coal, biofuels, nuclear, and renewable energy). Accurately estimating this mix of substitute energy sources is important because each substitute energy source has a different life cycle GHG emissions profile over the course of its production, transportation, refining, and/or consumption.

BOEM does not have complete data for the rest of the world, like that of the EIA for the U.S. As such, BOEM cannot evaluate the full set of substitutions that occur globally. To fully consider the substitution impact of the change in foreign oil consumption, BOEM would need information on the suite of energy sources that are displaced by the increased oil consumption and the supply and demand elasticities (including cross-price demand elasticities) associated with them. These displacement patterns vary throughout the world. BOEM and IEc are currently unaware of data sets and model parameter estimates that would allow for modeling foreign energy market substitutions between oil, gas, coal, electricity, and reduced demand. And, if BOEM were able to develop the data set, developing an appropriate model that could conduct the required domestic and foreign substitution calculations would represent a significant challenge.

BOEM's Assumptions for Foreign Oil Downstream Emissions

In the Proposed Action, the increase in oil consumption leads to an increase in total downstream GHG emissions because oil has a higher GHG intensity than most other energy sources. Accordingly, BOEM models the increase in foreign oil downstream emissions in Table 13. However, were BOEM able to quantify energy substitution for oil in foreign markets, the total change in foreign downstream emissions would not be as large as that estimated in Table 13 given the unquantified emissions reductions associated with displaced substitute energy sources in foreign energy markets. In some areas, the additional oil consumption could replace coal, leading to a net reduction. While BOEM does not quantify displacement of substitute energy sources by oil in foreign energy markets under the Proposed Action, BOEM acknowledges that displacement substitutes would certainly occur and that a portion of the increased emissions currently quantified would be mitigated by displaced GHG emissions from energy substitutes.

The same uncertainty exists regarding estimating the displacement of GHG emissions from energy substitutes in the upstream and midstream. IEc highlighted the complexities and wide range of data required to consider these substitutions. IEc found that the change in GHG emissions associated with the full life cycle for all energy sources other than oil produced and consumed in foreign markets under the Proposed Action cannot be quantified without making significant assumptions and concluded that these effects are more appropriately addressed qualitatively.

Though oil is a global commodity, the regional nature of gas, coal, and electricity would require MarketSim to consider regional price differences and calculate regional equilibriums for these other fuels. IEc characterized the necessary updates to create this global-regional analysis as “a major challenge” (Price, 2021). Furthermore, regarding the necessary underlying data that would be required to support a model if built, IEc stated the following:

We are unaware of any existing forecasts published by EIA, the International Energy Agency, or other organizations that include this level of detail. In the absence of such a forecast, BOEM could develop its own based on less detailed forecasts that may be available, but this would likely require a number of assumptions that would introduce significant uncertainty into MarketSim’s results (Price, 2021).

Summary of Foreign Emissions

In summary, BOEM’s domestic analysis estimates the GHG emissions associated with the full life cycle of energy substitutes displaced under the Proposed Action, but BOEM’s foreign analysis is limited to quantifying the GHG emissions from changes in the foreign upstream and downstream of only oil under the Proposed Action. Missing from the foreign analysis are changes in foreign oil’s midstream emissions and estimates of foreign energy market substitutes displaced in response to changes in oil prices. Because the quantifiable foreign analysis is not comprehensive, domestic production and consumption GHG emissions are not directly comparable to the foreign estimates. Therefore, BOEM is not providing a combined quantitative estimate of domestic and foreign emissions because it would be potentially misleading to simply add them together.

BOEM is investigating methods to incorporate the foreign oil midstream GHG emissions and estimate the full life cycle GHG emissions of foreign energy substitutes displaced by oil. However, even with those additions, BOEM expects global GHG emissions would likely still be higher for the Proposed Action than the No Action Alternative baseline level. In the domestic analysis, emissions associated with the downstream consumption of oil far outweigh upstream and midstream emissions, the currently unquantified reductions (foreign oil substitutes) and additions (foreign oil midstream) would not be high enough to offset the increase in GHG emissions currently estimated from foreign oil’s upstream and downstream. Moreover, downstream emissions account for the majority of the life cycle emissions, meaning most of the foreign GHG emissions have already been quantified in this analysis.

Areas of Uncertainty in Modeling Inputs

BOEM’s GHG analysis is subject to much uncertainty in several key variables. As described earlier, BOEM uses several models to estimate these impacts. Each of these models have different components, assumptions, or baseline data that, while based on the best available information, are uncertain. Differences in these variables can impact the analysis results. The key areas of uncertainty include the following:

- anticipated levels of OCS activity and production, i.e.,
  - exploration and development activity per barrel of oil equivalent (BOE) of potential production and
  - the ratio of potential oil versus gas;
- model inputs including levels of elasticities and adjustment rates used;
- emission factors used for OCS production and displaced substitute energy sources; and
- baseline energy projections.

The uncertainty related to modeling inputs (elasticities, adjustment rates, and baseline energy projections) and their impact on results is covered extensively in BOEM documentation. See Chapter 4 of the Final Economic Analysis Methodology for the 2024–2029 National OCS Oil and Gas Leasing Program (BOEM, 2023) as well as Appendix A of the MarketSim documentation (IEc, 2023a) for additional discussion. Emission factors are discussed in both the OECM documentation (IEc, 2023b, 2018) and GLEEM documentation (Wolvovsky, 2024).

Activity and Production

The basis of BOEM's GHG analyses is the estimate of potential OCS production and associated activity. BOEM assumes that, if the Proposed Action is approved, industry would develop oil and gas resources in the planning area.

In addition to estimating the potential production that could result from a Proposed Action, BOEM estimates the associated activities and facilities required for the exploration and development of the potential production (i.e., number of wells drilled and operated; miles of pipelines laid; and platforms and other infrastructure installed, operated, and removed).

BOEM models potential OCS oil and natural gas activity and production under the Proposed Action at the high activity level to act as an upper bound that accounts for uncertainties in market conditions, price volatility, consumer demand, and variable cost conditions. Potential production for the high activity levels is shown in Table 4. Considerable uncertainty surrounds any future OCS production as this production is contingent on, in some cases, billions of dollars of investment risk. Additionally, the levels of exploration and development activity required to meet production within the exploration and development scenarios are uncertain. Both the activity and production projections within exploration and development are key contributors to the results of the GHG analyses given that each type of activity has a specific GHG emissions profile.

Baseline Energy Projections: Supply, Demand, and Prices

A fundamental source of uncertainty within BOEM's modeling is the composition of future energy needs and markets. BOEM's models rely on a baseline energy market projection and assumptions of elasticity (how prices respond to changes in supply and demand and vice versa). Also, the MarketSim baseline is derived from specialized NEMS runs from the AEO. For this analysis, BOEM used the specialized runs developed by EIA from the 2023 AEO which relies on laws and policies in effect in late 2022. There is a potential that this baseline will differ from future projections as those laws and policies have changed. The EIA did not publish an AEO in 2024, but did publish their 2025 AEO on April 15, 2025. Given the process outlined below, BOEM was not able to update the modeling to include the 2025 AEO as baseline. However, BOEM has also outlined in this section its consideration of how the baseline could have affected the analysis results.

EIA NEMS MarketSim Process

The EIA is considered the U.S. government's official and formal forecast for energy projections and is widely used across industry and government entities. Typically, EIA publishes the AEO annually each spring. The standard NEMS runs used in the AEO include OCS oil and gas production from both existing leases and future leases. Thus, BOEM is not able to use the published reference case to estimate the impact of new leasing as it requires a "no new leasing" baseline for comparison. For the MarketSim baseline, BOEM requests a specialized version of the NEMS runs which only include production from existing OCS leases and assumes no future leasing. This is often referred to as the "constrained" case. BOEM collaborates with EIA on the timing of its request and the availability of EIA staff and leadership to conduct and review the constrained runs. The entire process is lengthy and requires completion of several sequential tasks. First, BOEM provides EIA with estimates of the portion of the resource base that are leased or unleased. EIA uses this information to complete the NEMS runs. EIA must provide domestic data which is included in the AEO as well as international data which are published separately on a different publication schedule. The constrained case is then thoroughly reviewed within EIA. While BOEM is not fully aware of EIA's methodology, BOEM's understanding is that this is a complex and time-consuming task.

Once BOEM receives the AEO data from the constrained NEMS runs, it must convert the data into the MarketSim model. This includes converting certain data and model parameters and locating alternate data sources for variables not included in the AEO. Because EIA updates data categories between AEO's, BOEM must verify the validity of all data elements. Any items that are missing or altered must be accounted for and resolved. When BOEM initially designed MarketSim, all the baseline update data were available from the EIA. However, in recent years, BOEM and EIA have needed to engage in additional communications to finalize the MarketSim baseline update. The total timeframe to update the model based on the AEO constrained case is entirely dependent on what stage EIA is in the process of developing the AEO. If BOEM's request is made at the same time as the AEO is under development, EIA is not able to provide the specialized runs until after the AEO reference case is finished. The changes in AEO categories, publishing schedule, personnel shortages and changes, and model enhancement, have increased the time to develop the constrained case and implement it into the MarketSim.

EIA published their 2025 AEO on April 15, 2025. The 2025 AEO "only considers laws and regulations implemented as of December 2024" and thus does not incorporate or reflect policy changes announced by the Trump administration since January 2025. Based on the schedule for preparing and publishing this SEIS, and the time required for runs of MarketSim and subsequent consolidation of modeling results, BOEM would have needed the constrained NEMS run baseline by mid-March, which was prior to release of the non-constrained AEO 2025. Thus, BOEM relies on this "EIA NEMS MarketSim Process" section to explain the use of a baseline derived from the AEO 2023. The "Implications of Changes to MarketSim Baseline" document (IEc, 2025), provides a supplemental analysis that speaks to how results might be different given potential influences on the baseline since publication of the AEO 2023. Even if BOEM had had enough time to request constrained model runs and incorporate them into the MarketSim, they would still not be reflective of current policies.

Further, there is still great uncertainty in the laws and policies that will be implemented throughout the AEO forecast period. Thus, irrespective of whether BOEM is able integrate the most recent AEO baseline in the MarketSim model, policy gaps will exist. Any forecast, including EIA's annual forecasts, are simply projections over a certain period and include an element of uncertainty that are difficult to account for. Any change in assumptions, laws and policies will result in changes to the forecasts and ultimately the baseline used by BOEM for its analyses.

Impact on GHG Analysis

Given the challenges above as well as the inability of EIA to provide BOEM the specialized runs, using a baseline from AEO 2025 was not feasible. However, BOEM provides an analysis demonstrating the impacts of changing its baseline. This analysis is presented in a paper "Implications of Changes to MarketSim Baseline" (IEc, 2025).

Using previously conducted sensitivity analyses, the paper highlights how changes in the baseline would affect BOEM's projected displacement rates of energy substitutes as well as associated GHG emissions. In addition, the paper also discusses differences between the baseline used for this SEIS, and projections used in AEO 2025. Lastly, the document provides a qualitative analysis of changes not included in AEO 2025 (announced since January 2025) that could potentially affect BOEM's results.

Overall, the differences between AEO 2025 and the constrained AEO 2023 data, coupled with the sensitivity results performed suggest that updating MarketSim to use the AEO 2025 baseline would not have a significant impact on the projected displacement patterns and associated GHG emissions. Several key metrics of U.S. energy markets (oil, natural gas, coal and electricity) show little change between the two baselines, and the sensitivity cases performed demonstrate that given the magnitude of baseline changes, it is unlikely to have a substantial impact on MarketSim's results.

BOEM contracted a study that demonstrates the effect of different modeling assumptions, including modifying the baseline, on the displacement rates of energy substitutes and subsequent estimates of potential OCS leasing on GHG emissions. The sensitivity tests highlight the importance of varying modeling assumptions and uncertainty in the parameters that are likely to affect the analyses. The testing shows that small changes to the modeling baseline have minimal impact on results. However, larger changes to both baseline and demand and supply response patterns have a significant impact on the results. The results of this sensitivity analysis are presented and discussed in Appendix A.5 of the MarketSim documentation (IEc, 2023a). The results are also summarized in Chapter 4 of the Final Economic Analysis Methodology for the 2024–2029 National OCS Oil and Gas Leasing Program) (BOEM, 2023).

GHG Analysis Summary

BOEM's analysis and modeling of life cycle GHG emissions resulting from the Proposed Action indicates that domestic emissions from OCS oil and natural gas are higher than those resulting from displaced energy substitutes. However, when considering the impact of changes in foreign oil production and consumption (Table 10 and Table 12), global emissions increase under the Proposed Action. Although BOEM's analysis includes quantification of GHG emissions from foreign oil production and consumption, lack of needed information currently precludes quantification of foreign oil's midstream GHG emissions and foreign substitutes' full life cycle emissions. However, such estimates would not be expected to change BOEM's conclusion that global GHG emissions would be higher under the Proposed Action.

Nonetheless, BOEM acknowledges the limitations and continues to explore ways to improve its methodology. BOEM will continue to review and refine the entire life cycle analysis as new data and methodologies become available. BOEM developed the global component of this using the most complete, recent information currently available with a sufficient level of detail for assessing these effects. This includes baseline projections of non-US energy consumption and production and non-US GHG emissions factors.

Changes to underlying modeling assumptions and uncertainty in the parameters may impact BOEM’s analyses. As demonstrated by the sensitivity tests, summarized in Chapter 4 of the Final Economic Analysis Methodology for the 2024–2029 National OCS Oil and Gas Leasing Program (BOEM, 2023), significant changes in energy demand and supply trends would likely change the displacement rates of energy substitutes and lead to estimates of total Proposed Action GHG emissions that are different than BOEM’s current analyses, which is based on the 2023 AEO reference case projections. BOEM provides this information to underscore the uncertainty and importance of key variables in its analyses. Subject to available resources, BOEM continually seeks ways to improve its analysis, including the underlying areas of uncertainty within its analysis.

BOEM’s quantitative and qualitative GHG analyses together represent the best available approach for comparison of GHG emissions from the Proposed Action and No Action alternatives and serve as a proxy for evaluating and comparing impacts to climate change under both scenarios.

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