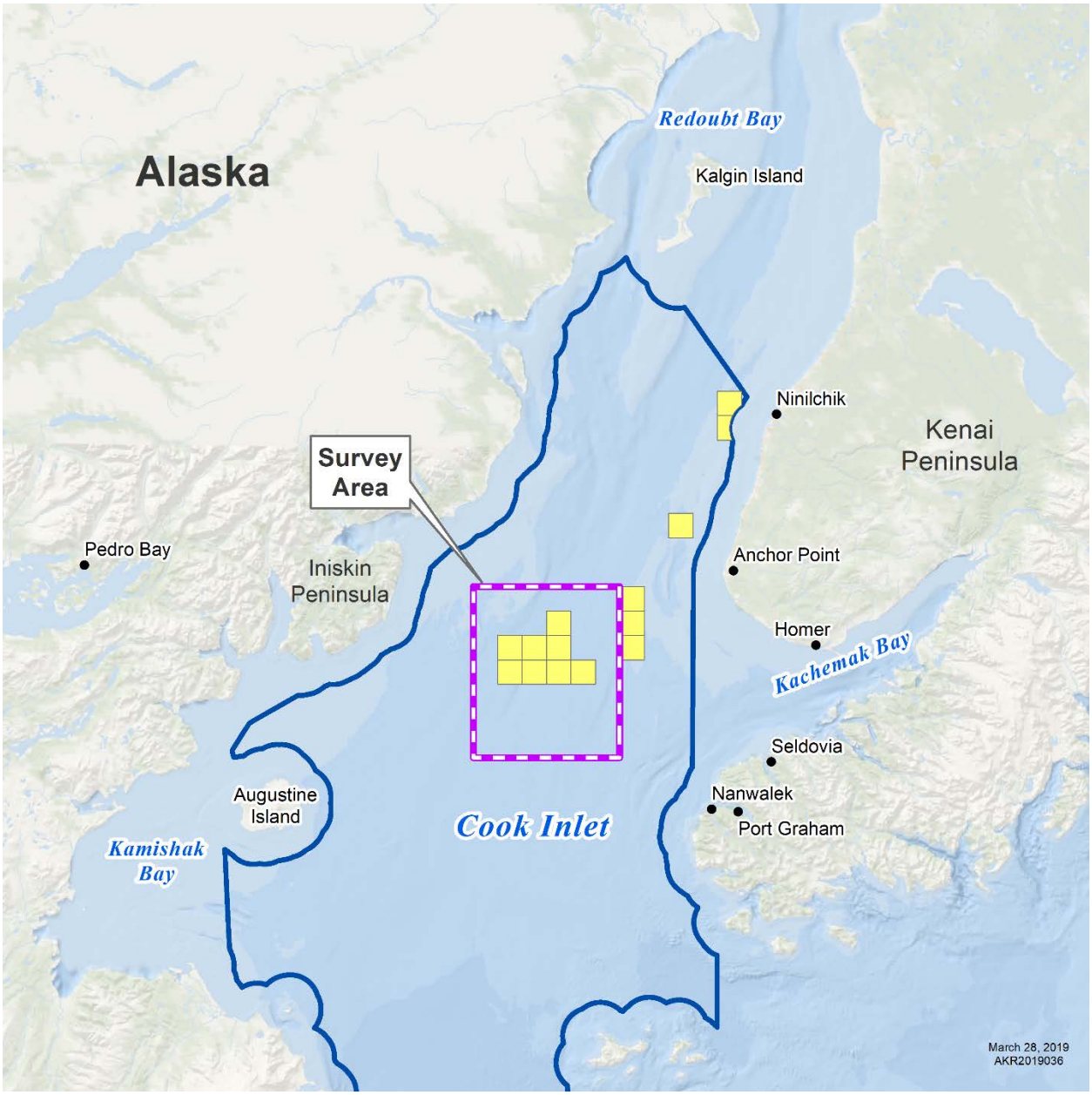
Alaska Outer Continental Shelf

Hilcorp, Alaska, LLC.
Geological and Geophysical Exploration
Cook Inlet, Alaska

ENVIRONMENTAL ASSESSMENT



BOEM
Bureau of Ocean Energy Management

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

2019-035

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ACRONYMS AND ABBREVIATIONS

3D	three dimensional
4MP	Marine Mammal Monitoring and Mitigation Plan
ADEC	Alaska Department of Environmental Conservation
ADOLWD	Alaska Department of Labor and Workforce Development
AWQS	Alaska Water Quality Standards
BO	Biological Opinion
BOEM	U.S. Dept. of the Interior, Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
CO_2	carbon dioxide
CO_{2e}	carbon dioxide emissions
CEQ	Council on Environmental Quality
dB	decibels
DOI	Department of the Interior
DPS	Distinct Population Stock
EA	environmental assessment
EFH	essential fish habitat
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
EZ	exclusion zone
FEIS	Final Environmental Impact Statement
FMP	Fishery Management Plan
ft	feet
G&G	Geological and Geophysical
GHG	greenhouse gases
GOA	Gulf of Alaska
HAK	Hilcorp Alaska, LLC
Hz	hertz
in^3	cubic inches
ITR	Incidental Take Regulations
kHz	kilohertz
KPB	Kenai Peninsula Borough
LS	Lease Sale
m	meters
MMPA	Marine Mammal Protection Act
ms	milliseconds

MMT	million metric tons
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_x	nitrous oxides
NPDES	National Pollution Discharge Elimination System
NPFMC	North Pacific Fishery Management Council
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
psi	pounds per square inch
PSO	protected species observer
PTS	permanent threshold shift
RMS	root mean square
RPM	Reasonable and Prudent Measures
SEL	sound exposure level
SHPO	State Historic Preservation Office
SO_x	sulfur oxides
SOA	State of Alaska
SPL	sound pressure level
SSV	sound source verification
SZ	safety zone
T&Cs	terms and conditions
TTS	temporary threshold shift
USC	United States Code
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service

CHAPTER 1. PURPOSE AND NEED

Hilcorp Alaska, LLC (HAK) submitted a Geological and Geophysical (G&G) Exploration Permit Application (Permit Application) to the U.S. Department of the Interior (DOI), Bureau of Ocean Energy Management (BOEM) on October 18, 2018, pursuant to BOEM regulations at 30 Code of Federal Regulations (CFR) Part 551. HAK's proposed seismic survey (Proposed Survey) would acquire data on approximately 375 square miles of the Outer Continental Shelf (OCS) located in lower Cook Inlet, including several of HAK's lease blocks.

The purpose of the proposed seismic program is to gather geophysical data that helps identify and map potential hydrocarbon-bearing formations and the geologic structures that may surround them. This information would provide critical insight into the depositional and structural history of the petroleum system and viability of possible oil and gas prospects. A three dimensional (3D) G&G survey provides unique data that are necessary for future planning and subsequent exploration and development of OCS leases in Cook Inlet.

The need for this action is to further the orderly development of OCS resources in accordance with Outer Continental Shelf Lands Act (OCSLA) (43 United States Code (USC) § 1331 *et seq*.). OCSLA requires the OCS to be made available for expeditious and orderly development, subject to environmental safeguards, in a manner consistent with the maintenance of competition and other national needs (43 USC § 1332 (3)).

The Proposed Survey is described in HAK's Permit Application. Since the Proposed Survey area includes OCS acreage currently leased by Hilcorp, the Permit Application also constitutes a notice of ancillary activities per 30 CFR 550.208.

BOEM has prepared this environmental assessment (EA) to determine whether the Proposed Action would result in significant effects to the environment, and to assist the agency in making an informed decision on HAK's proposed activities.

1.1 Additional Applicable Analyses

The National Environmental Policy Act (NEPA) requires Federal agencies to use a systematic, interdisciplinary approach to protecting the human environment, which is broadly construed to include the natural and physical environment, and the relationship of people with that environment. This approach ensures the integrated use of the natural and social sciences in any planning and decision-making that may have an impact on the environment. The level of NEPA review for a particular proposed project depends on OCSLA stage (516 DM 15), the scope of the Proposed Action, and the agency's findings on the potential effects of the Proposed Action.

BOEM completed an environmental impact statement (EIS) before holding Lease Sale 244 in Cook Inlet (Final Environmental Impact Statement, Cook Inlet Planning Area Oil and Gas Lease Sale 244 (Alaska Outer Continental Shelf (OCS) EIS/EA BOEM 2016-069) December 2016 (hereafter LS 244 FEIS). HAK's leased acreage and other tracts that are within the Proposed Survey area were part of the zone considered in that analysis (HAK obtained the leases it hopes to survey through LS 244). The LS 244 FEIS recognized that the "proposed OCS lease sale in Cook Inlet may lead to oil and gas exploration, development, and production," (LS 244 FEIS p.1-1) and thus included analyses on potential impacts of post-lease activities. The Cook Inlet lease sale area included 224 OCS blocks encompassing about 20% of the Cook Inlet Planning Area (LS 244 FEIS Fig. 1-1) and evaluated six alternatives. The preferred alternative offered the potential lease of 224 blocks, and subject to several mitigation alternatives

designed to avoid and/or minimize impacts to beluga whale critical habitat, northern sea otter critical habitat, and the gillnet fishery.

This EA tiers from the LS 244 FEIS. In the interest of conducting site-specific analysis relevant to the Proposed Survey while avoiding repetitive or redundant NEPA reviews, BOEM has incorporated by reference, where relevant, portions of the LS 244 FEIS that are applicable here.

BOEM and other federal agencies have completed additional NEPA reviews of Cook Inlet OCS activities, and reviews of resources that occur within Cook Inlet Alaska OCS Region waters. Documents relevant to the current analysis include, but are not limited to:

- Environmental Assessment, SAExploration, Inc. 3D Cook Inlet Geological and Geophysical Seismic Survey, 2015.
- U.S. Fish and Wildlife Service Biological Opinion for Oil and Gas Activities Associated with Lease Sale 244 (USFWS 2017).
- National Marine Fisheries Service Biological Opinion for Oil and Gas Activities Associated with Lease Sale 244 (NMFS 2017).
- National Marine Fisheries Service Biological Opinion for Hilcorp Alaska and Harvest Alaska Oil and Gas Activities, Cook Inlet, Alaska Incidental Take Regulations AKRO-2018-00381 (NMFS 2019).

The EA and EIS listed above are available on the BOEM Alaska Region website at: https://www.boem.gov/ak-eis-ea/. This EA builds upon these previous analyses by analyzing site- and project-specific information, and by incorporating new information where possible. The Biological Opinions are available on BOEM's website at https://www.boem.gov/ak-consultations/, or on the USFWS or NMFS websites, or by contacting them directly.

This EA also considers information and analyses provided in HAK's Environmental Evaluation Document submitted in September 2018, and amended in October 2018. BOEM also considered the information and analyses provided in Hilcorp's two *Petitions for Incidental Take Regulations, Hilcorp Alaska and Harvest Alaska, Oil and Gas Activities, Cook Inlet, Alaska*, submitted to the USFWS and NMFS. The Incidental Take Regulations (ITRs) describe the 3D seismic survey, as well as lay out a 5-year plan of additional activities that are independent of the survey evaluated here.

CHAPTER 2. PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

Under the Proposed Action, BOEM would authorize HAK to collect 3D seismic data over an area that is approximately 375 square miles. The Proposed Survey area is comprised of 42 OCS blocks in lower Cook Inlet, 8 of which are leased by HAK (6357, 6405, 6406, 6407, 6455, 6456, 6457, and 6458).

Seismic surveys are used to produce detailed images of subsurface geology to determine the location and size of possible oil and gas reservoirs. Sound waves are emitted into the seafloor and are bounced off rock formations. The waves that reflect back to the surface are captured by sensors for later analysis. The survey program, which includes vessel mobilization/demobilization, deployment of gear, and the survey itself, would last for approximately 45 to 60 days, depending on delays due to weather, equipment, and/or marine mammal presence. Active data collection would take approximately 30 days. The Proposed Survey would occur during late summer / early fall of 2019.

2.1.1 Sound Generation and Data Recording

HAK plans to use a Bolt 1900 LLXT dual gun array. The airguns would likely be configured as 2 linear arrays or "strings," with each string having 7 airguns shooting in an alternating pattern, for a total of 14 airguns. The airguns would range in volume from 45 to 290 in^3 for a total of 1,945 in^3. The first and last guns would be spaced approximately 46 feet apart, and the strings separated by approximately 33 feet. The two airgun strings would be distributed across an approximate area of 98 by 46 feet and towed 984 to 1,312 feet behind the stern of the vessel, at a depth of approximately 16 feet.

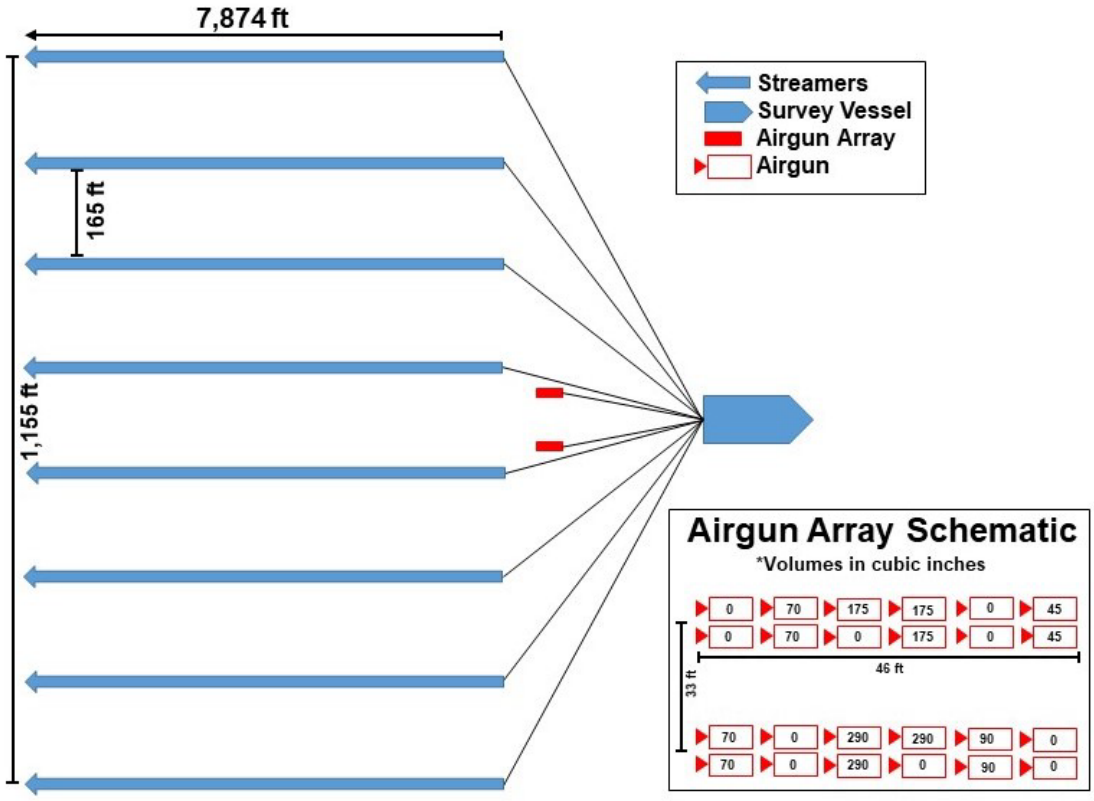

Figure 2-1 Diagram of Survey Vessel, Streamers, and Airgun Array

The firing pressure of the array would be approximately 2,000 pounds per square inch (psi). The airguns would fire approximately every 2.5 to 6 seconds, depending on the exact speed of the vessel. When fired, a brief (25 milliseconds [ms] to 140 ms) pulse of sound would be emitted by all airguns nearly simultaneously (generating an in-water peak sound source level of 247 decibels (dB); see Table 3-5 for in-water travel distances). Airguns would be turned off during turns.

HAK would perform a sound source verification (SSV) survey at the beginning of the 3D seismic survey program to characterize the levels of sound and propagation, and to verify the Exclusion Zone [EZ] and Safety Zone [SZ], as described in Section 4.3.2 of HAK's Environmental Evaluation Document (HAK 2018). An exclusion zone is an area in which all operations are shut down in the event a marine mammal enters. This is done to prevent injury to the marine mammal.

HAK would use 8-10 Sercel Sentinel solid streamers to record seismic data. Each streamer would be approximately 1.5 miles in length and would be towed approximately 26 to 49 feet below the surface of the water. The streamers would be placed approximately 165 feet apart to provide a total streamer spread of 1,312 to 1,640 feet.

Acoustic units and lateral birds (a fin attached to the streamer to help with steering) would be used to position the streamers and ensure that they move through the water parallel to each other, in-line with the vessel, and are towed as closely and uniformly together as possible to improve image quality. The survey vessel, Polarcus Alima, uses lateral-towed control and positioning units on the streamers that emit a very small pulse for positioning the streamers.

Vessels

The Proposed Action includes one seismic acquisition vessel, one support vessel, and one or two chase vessels. The seismic acquisition vessel would tow the airgun array and the streamers. The support vessel would provide general support for the source vessel, including supplies, and crew changes, etc. The chase vessel(s) would monitor the in-water equipment and maintain a security perimeter around the streamers.

Table 2-1 Vessels to be Used in Cook Inlet 3D Seismic Survey

Name	Primary Activity	Specifications
M/V Polarcus Alima (or similar)	Source/streamer/Recording Vessel	92.0 m length x 21.0 m breadth
		7.5 m draft
		7,420 to 7,894 gross tonnage
		Built in 2010
		Bahamas flag
M/V Maria-G or Victory-G (or similar)	Support vessel Supports crew changes, supplies, etc.	53.80 m length x 13.80 m breadth
		3.80 m draft
		1,081 gross tonnage
		Built in 2009
		Panama flag
TBD (1 or 2)	Chase vessel(s) Maintains security around streamers	TBD

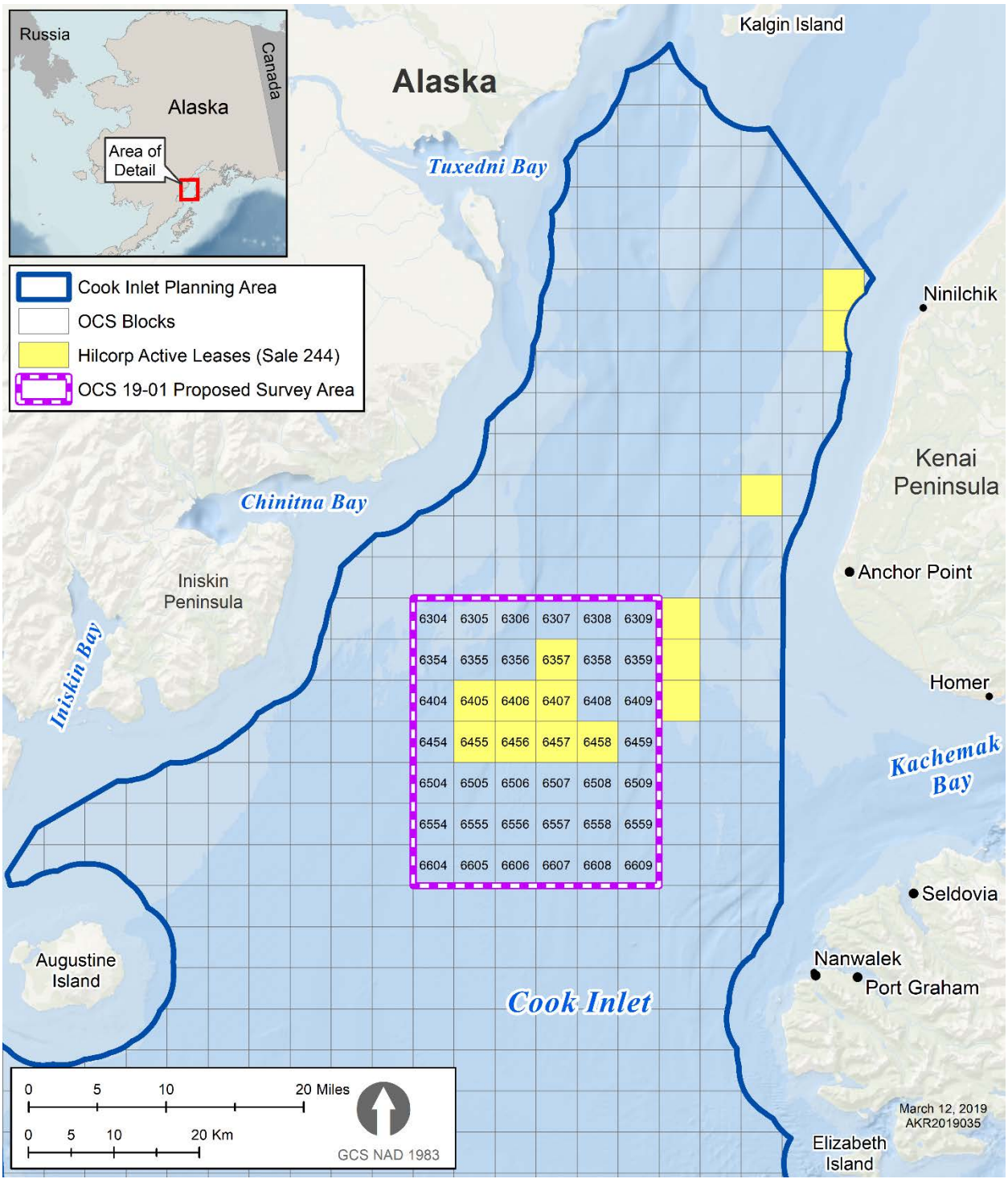

Figure 2-2 Location of the Cook Inlet 3D Seismic Survey

2.1.2 Design Features and Mitigation Measures Built into the Permit Application

HAK's Permit Application incorporates the following design features and mitigation measures intended to reduce potential environmental impacts from the Proposed Survey:

1. To reduce potential conflict with other user groups in the lower Cook Inlet area, Hilcorp would develop and implement a Stakeholder Engagement Program. The purpose of the program is to notify interested parties about the proposed project, gather feedback about potential impacts, and work with stakeholders to mitigate impacts of the project. Stakeholders include local Alaskan communities, industry and special interest groups, and interested individuals.
2. Hilcorp would work with the U.S. Coast Guard (USCG) to publish a Notice to Mariners of pending seismic survey to ensure there are no conflicts with local vessels while the seismic survey takes place. In addition, the support vessels would monitor for local traffic on the water and use radio communications to minimize conflicts with recreational boaters and sport fishing charters.
3. The source vessel, Polarcus Alima, would comply with the stringent DNV CLEAN DESIGN notation, which includes an advanced bilge water cleaning system, an onboard sewage treatment system, and a ballast water treatment system to prevent the spread of invasive species (DNV, 2011).
4. Survey activities would comply with the Marine Mammal Monitoring and Mitigation Plan (4MP) submitted as part of HAK's application for incidental take authorization under the Marine Mammal Protection Act (MMPA); (see Appendix A). Examples of mitigation measures in Appendix A include, but are not limited to, the following types of actions:
    - use of Protected Species Observers (PSOs) to visually scan the area during the survey and communicate with survey personnel if marine mammals enter waters where they could potentially be affected;
    - use of exclusion zones (EZ – area in which all operations are shut down if entered by a marine mammals) and safety zones (SZ – an area larger than an EZ which can be monitored for presence of marine mammals); and
    - use of ramp up procedures at the beginning of a survey line or after a shut down where airgun volume is gradually increased, etc.

The impacts analysis in Chapter 3 assumes all of the provisions described above.

2.2 No Action Alternative

Under this alternative, BOEM would not approve HAK's G&G Exploration Permit Application and the proposed 2019 seismic survey would not occur. HAK would not be able to identify and map potential hydrocarbon-bearing formations and the geologic structures that surround them, which could slow or prevent future development of these formations. The environmental impacts identified in Chapter 3 would not occur.

No other alternatives were identified that meet the purpose and need of the Proposed Survey, i.e., to gather information on these lease blocks to inform strategies for potential exploration development of the OCS.

CHAPTER 3. AFFECTED ENVIRONMENT AND IMPACTS

This chapter describes the relevant marine, coastal, and human environment, and analyzes the potential effects to that environment resulting from the Proposed Action and the No Action Alternative. BOEM incorporates by reference portions of Chapters 3, 4, and 5 of the LS 244 FEIS where relevant to its consideration of the Proposed Survey.

The analyses in this chapter apply a scale to categorize the potential impacts to specific resources and evaluate the significance of those impacts. The scale takes into account 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).

Subject matter experts 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." Impacts that fall in the category of "major" are considered to be significant under NEPA. For biological resources, impacts were determined based on changes to the stock or population

The impacts scale 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
- Major: impacts are severe

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

3.1 The Cook Inlet Environment

3.1.1 Meteorology and Climate

Weather and oceanic conditions of the lower Cook Inlet are influenced by three weather systems: the Continental High, the Aleutian Low, and the Pacific High (Shulski and Wendler, 2007). Climate classification is a maritime-continental gradient with a marine climate to the south and east, and a continental climate to the north and west. Eleven watersheds drain large amounts of freshwater and glacial runoff into the inlet.

The meteorological databases for Homer, Alaska are presumed to be representative of conditions that exist in the project area. Summer temperatures are in the upper 50s to lower 60s. Precipitation is most

likely to occur from September through January. Rain is least likely in April and May, and what rain does fall would more likely occur south of Homer (Shulski and Wendler, 2007). Wind speeds range generally from 7 to 14 miles per hour in Homer. While prevailing winds in Homer are easterly, this occurs mostly from October through March. During the time period of the proposed seismic survey, winds are predominantly from the west and southwest in Homer. Otherwise, winds would be from the north and east.

Sea ice is seasonal and most prevalent in the Proposed Survey area during late winter before the Proposed Action begins (Brower et al., 1988; LaBelle et al., 1983; Mulherin et al., 2001). On average, first ice occurs November 25 and average ice out is April 7. The project area is expected to be ice free for the duration of the Proposed Action.

In general, Cook Inlet surface currents in the project area are northward along the eastern side of the inlet and southward on the western side of the inlet (Johnson, 2008; Okkonen, Pegau and Saupe, 2009). Two unequal high and low tides per day overlay the general current patterns (Ezer et al., 2013) with tidal currents and range increasing northward. Tidal current velocities reach up to 4-5 knots in the project area with ranges of 16-19 feet. Survey activities would occur when tidal currents are moving parallel (north/south) to shoreline during ebb and flow tide in order to keep streamers straight (HAK, 2018).

3.2 Diesel Fuel Spill Assumptions

Refueling of the vessels, if needed, would take place at the Homer fuel dock. All fueling would occur in accordance with applicable USCG regulations and HAK spill prevention practices. If refueling takes place, historical OCS fuel spill data demonstrate that small spills are reasonably expected to occur although accidental spills are not part of the proposed project. If a spill were to occur during refueling, it is anticipated that cleanup and containment activities would immediately commence with dockside support. Therefore, any accidental fuel spills would be small, quickly cleaned up, and are not anticipated to escape the immediate area of the Homer dock.

3.3 Cumulative Impacts Scenario

The 2016 Cook Inlet Planning Area Lease Sale 244 Final EIS (LS 244 FEIS) identified past, present, and reasonably foreseeable future actions that may be relevant to cumulative impacts analyses for proposed actions on the Cook Inlet OCS (LS 244 FEIS p.5-1 to 5-25).

General categories of actions that could potentially impact the marine, coastal, and human environments are listed in Table 3-1.

Table 3-1 Relevant Past, Present, and Reasonably Foreseeable Future Categories

Category	Area	Type of Action
Oil and Gas Activities	Cook Inlet onshore, nearshore, and offshore	Geological and geophysical surveys; infrastructure construction (e.g., dock), expansion, and/or maintenance; energy exploration, development, and production; maintenance of existing facilities
Marine Vessel Traffic	Cook Inlet waters	Industry vessels, oil field support and transports; research vessels
Aircraft Traffic	Cook Inlet onshore, nearshore, and offshore	Industry crew transfers; commercial and private flights; expansion of airfields; research flights; wildlife viewings
Scientific Research Activities	Cook Inlet onshore, nearshore, and offshore	Studies and Surveys: oceanographic; biological; geophysical; archaeological; socioeconomic
Military/Homeland Security Activities	Cook Inlet onshore, nearshore, and offshore	Decommissioned Distant Early Warning (DEW) and North Warning System (NWS) sites; vessel and aircraft presence; training exercises, onshore infrastructure

Category	Area	Type of Action
Subsistence Harvest	Cook Inlet onshore, nearshore, and offshore	Marine mammal, terrestrial mammal, fish and avian harvest
Commercial and Recreational Activities	Cook Inlet onshore, nearshore and offshore	Commercial/sport fishing vessels; commercial/sport guiding or hunting; vessel and aircraft presence

Oil and gas exploration and production activities have occurred in Cook Inlet since the discovery of the Swanson River Field on the Kenai Peninsula in 1957, and it is considered a mature oil and gas field. Activities on existing oil and gas facilities can be year-round. Marine vessel traffic in the area may consist of large and small vessels engaged in a variety of activities such as subsistence activities, support of oil and gas activities, scientific research, military activity, and commercial/recreational fishing. Aircraft traffic could include both fixed-wing and helicopter flights. Purposes would vary widely and could include scientific programs such as marine mammal surveys; cargo and passenger flights; hunting/fishing/sightseeing; commercial flights to support oil and gas activities (such as crew changes and supply flights); air ambulance and search and rescue emergency flights; general aviation; and multi-governmental military flights.

The cumulative impacts analysis focuses on those past, present, and reasonably foreseeable future actions whose impacts may overlap in time and space with those of the Proposed Survey. For this Proposed Survey, the temporal scope generally equates to the time it takes to mobilize/demobilize equipment/ personnel and complete the survey, and a spatial scope that extends across lower Cook Inlet (south of the Forelands to the vicinity of Homer). That said, both the temporal and spatial scope of the cumulative impacts analysis can expand according to the resource/activity under consideration.

3.4 Air Quality

3.4.1 Affected Environment

The Environmental Protection Agency finds the air quality within the project area does not exceed Federal guidelines defining good air quality. The existing condition of air quality in the vicinity of the Proposed Survey is largely a function of the few emission sources existing on the east and west coastline of the lower Cook Inlet, and the complex interactions between meteorological conditions, mainly wind, and the topographical features of the basin. The waters of the lower Cook Inlet typically experience winds from the west and southwest averaging 5 to 10 miles per hour, with the highest average winds occurring in the early summer. Winds in this range have a tendency to disperse and mix air pollutants within the surrounding air. Thus, the wind conditions over the lower Cook Inlet, together with the relatively few pollutant sources onshore or offshore, cause the quality of the air over the affected area to be consistently better than required by Federal standards (EPA, 2014).

3.4.2 Impacts

Proposed Action

The operation of diesel-electric marine propulsion and auxiliary engines on vessels proposed for the seismic survey, including the support vessels, have the potential to emit pollutants into the air above lower Cook Inlet. The survey vessel, Polarcus Alima, is equipped with exhaust catalysts for all main engine exhaust lines (Polarcus, 2018). The emission mitigation system in place on the Alima has led to reductions in nitrous oxides (NO_x), hydrocarbon, and particulate matter emissions by 90 percent, 80 percent, and 20 percent, respectively. In order to mitigate sulfur oxides (SO_x) emissions, the operator has chosen to use cleaner bunker fuel – marine gas oil over heavy fuel oil. The mobile nature of the vessels

combined with the duration of the survey (45-60 days) would prevent/minimize transport of emissions to a single onshore location.

The lower Cook Inlet regularly has dozens of vessels transiting around every day throughout the summer season. Commercial and sport fishing vessels, barges, fuel tankers, and cruise liners are the types of vessels transiting in the area. Even with this high level of activity, onshore air quality adjacent to the project area has remained good. The amounts of emissions released as a part of this survey are expected to be similar to the everyday emissions from vessels regularly operating in the area. The resulting air quality impact would be localized to the immediate area and would last only for the duration of the survey. Within hours of the completion of the survey, the air quality would recover and return to pre-exercise levels. It is unlikely that during any point of the survey (before, during, or after), the amounts of air pollution in the area would result in an exceedance of national air quality standards. Therefore, the seismic survey would have a negligible effect on air quality.

The estimated emissions of greenhouse gases (GHG) from the Proposed Survey are 1,945 tons of carbon dioxide (CO_{2e}). The GHG analysis focuses on gross tonnage of emissions, not concentrations of pollutants onshore. Because some GHG such as CO_2 may persist in the atmosphere for up to a century, the potential impacts of any source may extend well beyond the active lifetime of the Proposed Survey. How these emissions would impact the Proposed Survey Area would depend on emissions from the Proposed Survey together with emissions on a national and global scale. According to the U.S. Environmental Protection Agency's (EPA's) Greenhouse Gas Reporting Program, in 2017 the U.S. oil and gas industry as a whole released 284 million metric tons (MMT) of CO_{2e} (EPA, 2018), of which 7 MMT (or 0.03%) was from offshore production and only 0.25% of those offshore emissions originated from Alaskan waters.

No Action Alternative

Under the No Action Alternative, BOEM would not approve Hilcorp's 2019 G&G Seismic Survey Permit Application and the Proposed Survey would not occur. There would be no effects on air quality and no contributions of GHGs attributable to the Proposed Survey.

Cumulative Effects

Because of the mobile nature of the vessels used for the seismic survey and the temporary conditions under which the survey and support ships operate, the incremental air quality impact to the lower Cook Inlet and surrounding areas within the Kenai Peninsula Borough would be negligible. When this impact is combined with the cumulative impacts associated with past, present, and reasonably foreseeable future emission sources summarized in Section 3.3, the overall impact is negligible.

3.5 Water Quality

3.5.1 Affected Environment

The water quality of lower Cook Inlet is rated as good based on the Alaska Department of Environmental Conservation's (ADEC) Southcentral Alaska Coastal Survey (ADEC, 2010). There are no waterbodies identified by ADEC as impaired per Section 303 of the Clean Water Act that directly drain into the Proposed Survey area (ADEC, 2010). Data collected at approximately 20 locations in Cook Inlet assessed a wide variety of parameters including hydrographic properties, dissolved oxygen, nutrients, chlorophyll, suspended sediment, trace metals, and hydrocarbon components. All samples met Alaska Water Quality Standards (AWQS) criteria for all marine water uses including aquaculture; growth and propagation of fish, shellfish, and other aquatic life and wildlife; and harvesting mollusks or other raw aquatic life (Saupe, Gendron, and Dasher, 2005). Water with a large variety of naturally occurring inorganic and

organic compounds is transported into Cook Inlet by surrounding streams and rivers, and by currents from the Gulf of Alaska. Substances suspended or dissolved in the water column are rapidly dispersed by strong tidal currents and winds. While contaminants have been reported, many are attributed to erosion of local soils, rocks, and ores and few can be unambiguously linked to human activities (Glass et al. 2004). However, anthropogenic input of pollutants at urban centers surrounding Cook Inlet has deleteriously impacted sections of local streams and lakes (e.g. Chester Creek; Brabets and Whitman, 2004).

For a more detailed examination of nutrients, streamload and suspended sediment, sedimentary and dissolved trace metals, hydrocarbon constituents, persistent organic compounds, and toxicity studies in Cook Inlet, see Cook Inlet Planning Area, Final Environmental Impact Statement, Volume 1 (BOEM, 2016).

3.5.2 Impacts

Proposed Action

The Proposed Survey could affect offshore marine water quality via operational discharges from vessels. Local water quality could be impacted by the introduction of total suspended solids, nutrients, organics, oil and grease, and waters with higher temperatures and salinity than ambient waters. Degradation of localized surface and near-surface water quality would be highest at the point of discharge near the vessel.

Cook Inlet is a high-energy environment with strong tidal currents and mixing that produces a rapid dispersion of soluble and particulate pollutants. The opportunity for impacts from temporary increases of suspended sediment, turbidity, and vessel discharges would be localized, brief, and fleeting. Compliance with applicable permitting requirements for vessel discharges by the State of Alaska (SOA), USCG, EPA, and the stringent DNV CLEAN DESIGN notation serves to minimize and mitigate discharges with no lasting impacts to water quality expected. Overall, the level of effects of the Proposed Survey on water quality would be negligible.

No Action Alternative

Under the No Action Alternative, BOEM would not approve Hilcorp's 2019 G&G Seismic Survey Permit Application and the Proposed Survey would not occur. There would be no effects attributable to the Proposed Survey on water quality.

Cumulative Effects

Impacts to water quality resulting from the Proposed Survey are negligible because vessel discharges over the 60-day operation are temporary, short-term, and of limited volume, and thus would not contribute appreciable levels of contaminants to Cook Inlet. Other past, present, and reasonably foreseeable future sources of discharges include additional oil and gas activities, effluent discharges from sewage treatment plants, vessel discharges from recreational and commercial vessels, industrial facilities, non-point source runoff, and power-generating plants. The requirements and conditions of the federal and SOA permits on past, present, and reasonably foreseeable future activities serve to limit discharges and other activities in Cook Inlet and prevent unreasonable degradation of water quality within the marine environment. When the incremental effects of the Proposed Survey are added to past, present, and reasonably foreseeable future activities, the overall impact would be negligible.

3.6 Fish and Invertebrates

3.6.1 Affected Environment

Cook Inlet has a rich and diverse flora and fauna of fish, invertebrates, and algae (Lees and Driskell, 2006). Generally, these communities live in the water column (pelagic) or are associated with the seafloor (benthic), which can include shallow intertidal or deeper subtidal areas. Lower trophic invertebrate communities occupy multiple habitat types from the intertidal zone to the open ocean and are an integral part of the food web. Fish also occupy both the pelagic and benthic zones, and certain species of fish travel between fresh and marine water depending on their stage of life. Some fish and invertebrates are commercially important, including salmon, shrimp, crabs, and clams (Trowbridge and Goldman, 2006). The Cook Inlet Lease Sale 244 EIS (USDOI, BOEM, 2016) provides more detailed information about fish and invertebrate species, their ecological roles, and discussions of the marine habitats and food webs in Cook Inlet.

The open water habitat of Cook Inlet, where the Proposed Survey would occur, has highly productive plankton blooms in the spring and summer (Piatt, 2002; Strom, Fredrickson, and Bright, 2016). Copepods, euphausiids, pteropods, and other pelagic species feed on plankton blooms (Cooney, 1987; Piatt, 2002), and in turn are often prey for higher-level predators such as fish and birds. Depth, substrate type, time of year, and nutrient supply from the pelagic realm heavily influence seafloor communities. Shallow and intertidal invertebrate communities include algae, herbivores (sea urchins, chitons, and limpets), suspension feeders (mussels, clams, polychaetes, bryozoans, and sponges), and predators/ scavengers (crustaceans, sea stars, snails, and crabs) (Lees et al., 1980; Foster et al., 2010; Pentec Environmental, Inc., 2011). Deeper invertebrate communities consist primarily of crabs (Tanner, snow, and king crabs), shrimps, and sea urchins (Feder and Jewett, 1987; Lees et al., 1980).

Cook Inlet is home to freshwater, anadromous, and marine species (Piatt et al., 1999) which include pelagic and groundfishes. Pelagic fish, such as salmon and herring, inhabit the water column while groundfish, which include Pacific cod, flatfish, sculpins, and pollock, inhabit the seafloor sometime during their life cycle (Nemeth et al., 2007). Some species are also forage fish, a term which applies to small schooling fishes that are prey to marine mammals, seabirds, and larger fishes (Springer and Speckman, 1997). Forage fish, which are widely distributed throughout Cook Inlet, play an important role linking trophic levels because they are nutritionally dense. Forage fish are key indicators of the health of the Cook Inlet/Northern Gulf of Alaska marine ecosystem by supporting the marine food web of the region (Fechhelm et al., 1999; Springer and Speckman, 1997). Common forage fish species in Cook Inlet are herring, pollock, sandlance, capelin, and eulachon. While abundance and distribution of these schooling fish vary, forage fish occur throughout Cook Inlet with fish densities greatest during early summer. Most groundfish species are present year-round (Rumble, Russ, and Russ, 2016). In contrast, anadromous fish, such as salmon, live in the marine environment while growing to maturity and then migrate to freshwater spawning grounds (Moulton, 1997). These migrations usually occur in Cook Inlet from May to November, depending on the species.

3.6.2 Impacts

Proposed Action

Impacts on lower trophic organisms and fish may result from the energy emitted by air guns during the Proposed Survey, vessel discharge, and possible introduction of invasive species from vessel operations.

Fish may be temporarily displaced from the area where vessels are operating and airguns are in use, and individuals who are in close proximity to airgun emissions may have reduced individual fitness (Fewtrell

and McCauley, 2012; McCauley, Fewtrell, and Popper, 2003). If seismic activity occurs in areas where spawning migrations are occurring, some fish may have to swim farther to avoid the noise on the way to their spawning grounds. Although individual fish may be damaged by the seismic activity, it is unlikely to affect the timing or success of the runs or to have population level impacts. The most intense seismic activity will be occurring away from spawning streams and will be in an area where fish can divert around the source of disturbance.

The severity of the impact to organisms is dependent on a variety of factors, including distance from the source and the bathymetry of the area. Cook Inlet ambient noise levels are high (NMFS, 2003), and most of the detectable impacts would be limited to the time and space around the vessels and survey activity. Seismic surveys may cause physical damage and death to zooplankton and benthic invertebrates at close range (Day et al., 2017; McCauley et al., 2017), but impacts are decreased with distance from the source. Impacts to lower trophic communities would be smaller if seismic surveys do not occur during high spring bloom activity, although the timing of the spring bloom can be variable. Planktonic communities can recolonize from adjacent areas through water currents and have short lifecycles coupled with high reproductive potential (Abbriano et al., 2011). Impacts to fish and invertebrates from seismic operations, even if repeated, would likely be undetectable once survey vessels have left the area, currents have recolonized the area with plankton, and fish have resumed use of the area.

Vessel operations in the area may result in temporary, localized decreases in water quality from discharges and deck runoff (see Section 3.5.2). Impacts from this would not likely be detectable for fish or invertebrates because the area of impact would be extremely limited. Vessels used in the Proposed Survey from outside the Cook Inlet area may be potential vectors for introducing aquatic invasive species through fouled vessel hulls, ballast water discharge, and equipment placed overboard (e.g., anchors, seismic airguns, hydrophone arrays, ocean bottom equipment). Aquatic invasive species can impact resident communities through competition for resources or habitat, predation, or introduction of pathogens. However, the probability that the Proposed Survey would introduce invasive species is small given HAK's commitment that the Polarcus Alima would comply with the stringent DNV CLEAN DESIGN notation, which includes an advanced bilge water cleaning system, an onboard sewage treatment system, and a ballast water treatment system. HAK's stated adherence to the requirements regarding vessel discharges (i.e., National Pollution Discharge Elimination System (NPDES) and the International Convention for the Prevention of Pollution from Ships MARPOL) would serve to further minimize the risk of any vessel transporting invasive species to the project.

Effects of the Proposed Survey on fish and invertebrates would be limited to the areas surrounding the vessel activity and would likely not be detectable once the vessels have left the area. Population level impacts are not expected. The effects described above, because they are limited to discrete locations and times and would not persist, and are not additive. Therefore, the level of effects for the Proposed Survey with respect to fish and invertebrate species is negligible.

No Action Alternative

Under the No Action Alternative, BOEM would not approve the Application Permit and the Proposed Survey would not occur. There would be no effects attributable to the Proposed Survey on fish and invertebrate species.

Cumulative Effects

The level of effects for the Proposed Survey with respect to fish and invertebrate species is negligible. Past, present, and reasonably foreseeable future projects include marine seismic surveys, oil and gas exploration, development and production, commercial fishing, recreation, shipping, and scientific

activities. The effects of the Proposed Survey would not appreciably add to the past, present, and reasonably foreseeable future effects because the impacts would be extremely short-term and are unlikely to overlap in space and time with other actions from the cumulative scenario. Cumulative impacts from these activities, both on and offshore, would have negligible impacts to fish and invertebrate species over the timespan of the Proposed Survey.

3.7 Birds

3.7.1 Affected Environment

Lower Cook Inlet is one of the most productive areas for seabirds in Alaska with over 2 million seabirds foraging in the area in summer seasons (Piatt 1994). A variety of birds use the Cook Inlet Project Area, with overall marine bird densities generally high throughout the year (Renner, Kuletz, and Labunski, 2017). Seabirds are the most common bird type in the Project Area. Seabirds likely to be found foraging throughout the time period of the Proposed Survey include black-legged kittiwake, common murre, glaucous-winged gull, northern fulmar, sooty and short-tailed shearwaters, fork-tailed storm petrel, tufted and horned puffins, and marbled and Kittlitz's murrelets (Renner, Kuletz, and Labunski, 2017; Kuletz et al., 2011). Collectively, many of these seabirds are highly dependent on small or "forage" fish such as capelin, Pacific sand lance, or young-of-the-year walleye pollock (see Section 3.6.1). This includes the surface-feeding kittiwake and gulls, and the diving murre, puffins, and murrelets (Kuletz et al., 2015). The surface-feeding or shallow-diving fulmar, shearwaters, and storm-petrel exhibit varying levels of omnivory foraging on zooplankton as well as small fish (Dragoo, Renner, and Irons, 2009). Glaucous-winged gull and northern fulmar are known to be attracted to ships in search of fish or fish-based waste. Several species of seabirds are also nocturnally active, and are attracted to bright lights of vessels and other facilities. Northern fulmar, shearwaters, and storm petrel particularly exhibit this trait (Greer, Day, and Bergman, 2010).

Waterfowl species, primarily sea ducks, also are abundant in the waters of the Project Area. Seaducks are diving ducks that move onto land in the summer only to nest, but depend on marine waters most of their lives. White-winged scoter and harlequin duck are among the seaducks most likely to be observed in offshore waters (Renner, Kuletz, and Labunski, 2017). Scoters in particular are often observed in flocks or "rafts" of up to a few hundred birds. In April and May waterfowl move to surrounding land or beyond the Cook Inlet vicinity to breed (USFWS 2011, Safine 2005). However, some non-breeders or failed breeders may remain in marine waters year-round.

Another common seaduck in Cook Inlet is Steller's eider. These birds begin a 3-week flightless molt in late July in southwestern and central Alaska. Then from late August to late April or early May they will winter over in Cook Inlet. A few thousand, the Alaska breeding population, are listed as threatened under the Endangered Species Act (ESA) (62 FR 31748), and these mingle with many more thousands of other non-listed Steller's eiders from Russia. The birds occur most typically in flocks in shallow, nearshore marine waters, with the largest numbers concentrated along the north side of the Alaska Peninsula and in smaller numbers along the eastern Aleutian Islands, the Kodiak Archipelago, and lower Cook Inlet (USFWS, 2002). Numbers typically peak in January through February. The eiders breed in the Arctic and subarctic tundra beyond the Project Area.

Besides seabirds and waterfowl, loons and red-necked phalarope are typically among the most common birds using the Project Area waters. Pacific and common loons (Renner, Kuletz, and Labunski, 2017) are relatively large birds that breed in territorial pairs on freshwater lakes all around the Cook Inlet area in the summer months. They winter in Cook Inlet marine waters where they are typically found singly or in small groups diving for forage fish. Phalaropes are unique among most shorebirds in that they depend on open water for foraging, where they are often seen paddling in a tight circle to concentrate planktonic

food at the surface. In the spring months (March to May) red-necked phalarope is among the most common lower Cook Inlet marine bird species (Renner, Kuletz, and Labunski, 2017), although a few may stay in Cook Inlet year-round.

Cook Inlet is part of a migratory flyway for most of these marine species plus other shorebirds, geese, swans, and landbirds like passerines ("songbirds"), raptors (e.g., peregrine falcon, northern goshawk), and sandhill crane (Erickson 1977; Day, et al., 2005). Thousands of birds fly over Cook Inlet between March and May in migration to Alaskan breeding grounds, and then again for the southward migration over a longer period between approximately July and November. Many birds, including most passerines like numerous species of sparrows, warblers, thrushes, blackbirds, and other small songbirds, make this migration nocturnally.

3.7.2 Impacts

Proposed Action

Primary sources of potential impacts of the Proposed Survey on birds would be underwater seismic survey noise, vessel traffic, and light attraction and collision hazards.

Seismic Survey Noise. During the course of normal feeding or escape behavior, some diving seabirds, seaducks, or loons could be harmed or disturbed by underwater airgun noise. Diving birds are able to hear underwater (Hansen et al., 2017). Airgun pulses are directional, with the majority of the sound energy directed towards the seafloor and lower levels of sound energy projected laterally from the airgun array; birds could potentially be affected by these laterally projected sounds. There is potential for noise from seismic surveys to impact seabirds and waterfowl that dive below the water surface (Turnpenny and Nedwell, 1994). Some seabirds (e.g., common murre) and seaducks (e.g., scoters) routinely dive to 10 or more meters in depth and/or spend more of their foraging time submerged than on the surface. Such diving seabird and waterfowl species could be susceptible to acoustic sounds generated by active acoustic sound sources, as would those birds that would dive rather than fly away from a vessel (e.g., loons, murres and puffins, and sea ducks). A few individual birds could conceivably dive near enough to a firing airgun to receive a pulse strong enough to cause injury. This would affect a low number of individual birds in the short single survey season of the Proposed Survey.

Besides impacts from injury, foraging or molting birds may experience disturbance impacts from underwater survey noise as well. Birds may be directly displaced from an area either when they detect underwater surveys, or in response to any survey impacts to prey abundance. Given the continual movement of the vessels to relatively new areas, no more than short-term disturbance to the same birds would be expected, however. Changes to prey abundance or distribution would be similarly limited to the time period of the Proposed Survey's presence, so subsequent related impacts to foraging birds would be limited spatially and temporally.

Vessel Traffic. The operation of vessels could disturb birds at sea. Individual and flocks of birds generally move away from vessel activity (Hentze, 2006). Many species, including flight-capable eiders and scoters, typically take flight to avoid a fast-approaching vessel, and the larger the flock of sea ducks, the greater the distance at which they flush on vessel approach (Kahlert, 2006; Schwemmer, et al., 2011). Many birds would return quickly; some murrelets, seaducks and loons, however, could be displaced from preferred foraging habitats for 6-8 hours or more (Agness et al., 2008; Lacroix et al., 2003; Schwemmer et al., 2011). Birds are most likely to move away from moving seismic vessels well in advance of the towed airgun array. Flightless (molting) birds at sea remain capable of paddling away from disturbances.

Most migrating birds would experience a one-time exposure to disturbances and would quickly recover without measureable impact as vessels moved through the area. The more abundant species would likely be affected in the greatest numbers. Species that molt locally and occur in high-density flocks of hundreds of birds (e.g., scoters, eiders) would be most susceptible to impacts. Molting flocks would likely be able to swim away from vessel-based seismic operations, as few confined conditions are expected. It is possible that vessel activity could trap a few molting flocks in a relatively confined area for a few hours or longer, but this is unlikely to be in large enough bird numbers, large enough percentage of any population, or for a long enough part of the feeding season to cause persistent harm or more than short-term disturbance. Furthermore, the convergence on a population of several specific disturbance events from only one survey is unlikely, so the effects of vessel disturbance on birds would not exceed short-term.

Light Attraction and Collisions. The bright artificial lighting of large vessels, including the seismic survey vessel and support and chase vessels, can attract and disorient migrating birds under certain environmental conditions. These lit vessels therefore become collision hazards to individuals or flocks during migration (Day, Prichard, and Rose, 2005; Ronconi, Allard, and Taylor, 2015; Montevecchi et al., 1999). Nocturnally migrating birds that have a greater attraction to light have a greater potential to collide with ships, especially under conditions of poor visibility such as fog, precipitation, and darkness (Bruinzeel, van Belle, and Davids, 2009; Merkel and Johansen, 2011).

Birds that would be expected to collide with the project's vessels based on flight patterns or history of light attraction and vessel collisions in Alaska include seabirds (e.g., gulls, fulmars, shearwaters, storm petrels, jaegers), waterfowl (e.g., eiders), shorebirds (e.g., phalaropes), and passerines (Day et al., 2017; Greer, Day and Bergman 2010; USFWS 2012). Collision events would involve both individuals and flocks of a few birds, and all collisions are assumed to be fatal. Several fatalities may be incurred from a single breeding population but most would be from disparate, widespread breeding populations.

An operating protocol that includes basic monitoring, lighting control, and adaptive management is commonly recognized as an appropriate strategy for tracking and reducing collision mortalities on vessels. Comprehensive monitoring, following scientifically approved protocols, of collisions and ultimate fates of grounded birds, improves assessments of the site-specific factors associated with vessel attraction (Wiese, et. al., 2001; Ellis, et. al., 2013). Reduced and shielded vessel lighting minimizes the deleterious impacts of lighting attraction to birds (Ronconi, Allard, and Taylor, 2015; Miles, et. al., 2010). Adaptive management may further reduce impacts if, for example, monitoring reveals light attractant problem areas on a structure or timing of heavy migration when lighting can be adjusted.

BOEM assumes that the project's vessels could cause one or two collisions, and in a few cases as many as five or ten, of each of several species of birds during the course of the survey season. Given the single season and few vessels, these impacts would be short-term and not expected to result in a population level effect. This level of effect is based on BOEM's assumption that a mitigation protocol of monitoring, and reduced and shielded lighting will be implemented on the primary Project Action vessels (i.e., the seismic survey vessel). Details of the assumed monitoring and lighting measures follow.

BOEM completed ESA consultation with the USFWS to assess potential effects to listed Steller's eiders (see Section 4.1) from certain exploration activities in lower Cook Inlet, including 3D seismic surveys. The USFWS Biological Opinion (BO, USFWS, 2017) provided BOEM with a non-jeopardy opinion and an incidental take statement for eiders. To avoid and minimize impacts to ESA-listed species managed by the USFWS, BOEM would require HAK to conduct the Proposed Survey in accordance with appropriate Reasonable and Prudent Measures (RPMs) / Terms and Conditions (T&Cs) of that BO. T&Cs 1.1–1.3 generally require that lighting protocols be developed and that a reporting/monitoring program be

implemented. The following recommendations would serve to implement the RPMs/T&Cs and mitigate adverse effects of the Proposed Survey listed species, as well as other birds.

1. All vessel operators shall be instructed that the use of high-intensity exterior lighting on, and the radiation outward of high-intensity lighting from, vessels shall be minimized. During periods of darkness or inclement weather, exterior lights shall be used only as necessary to illuminate active, on-deck work areas or safety; otherwise, they shall be turned off. Exterior-facing window coverings shall be closed in illuminated rooms during periods of darkness except as required for specific work or safety purposes. Interior and navigation lights may remain on as needed for safety.
2. HAK shall report to BOEM specific information about any birds found on vessels while at sea. An individual report entry shall be generated for each bird (i.e., downed bird that strikes the vessel and either found on board dead or apparently unable to depart on its own). This information shall be compiled and submitted to BOEM in electronic format (e.g., spreadsheet) each week and must include:
    - vessel name, and the date, time, and location (latitude/longitude) determined as closely as possible for actual or estimated time of strike;
    - bird species (if known), number, and condition (alive with no visible injury, injured, dead);
    - photograph (indicating size of bird if species not determined), including in situ if safety allows;
    - visibility and vessel lighting conditions (determined as closely as possible for actual or estimated time of strike); and
    - if known or speculated, notes on potential cause of strike.

In summary, the most common effect to birds from the Proposed Survey is expected to be disturbance caused by vessel operations, but most swimming birds would only be briefly displaced with no measurable impacts. Seismic survey noise and attractant and collision hazards can be lethal; however, exposures of most avian populations to such hazards associated with the Proposed Survey over the relatively short project duration (i.e., 45-60 days) would be brief and likely affecting too few individuals to have measurable population level impacts. Overall, Cook Inlet bird populations are not expected to experience more than temporary, localized, and therefore minor impacts. Inclusion of the above mitigation measures would serve to further reduce bird strike numbers, although overall impact level is not expected to be reduced to negligible.

No Action Alternative

Under the No Action Alternative, BOEM would not approve the Application Permit and the Proposed Survey would not occur. There would be no effects on birds attributable to the Proposed Survey.

Cumulative Effects

A variety of past, present, and reasonably foreseeable future actions affect bird populations in the Cook Inlet region. The majority of birds are migratory, spending much of each year in distant regions where they are subject to environmental impacts outside the scope of the present analysis.

Relevant local activities, however, include additional past, present, and reasonably foreseeable future oil and gas exploration and commercial development in Cook Inlet. These activities have increased, and will continue to increase, with the presence of humans and infrastructure and are associated with ongoing collision risk; disturbance and displacement from vessel and aircraft traffic; habitat alteration; and risk of encountering oil spills. Development, including oil and gas development, is generally the largest growing

source of these potential impacts in lower Cook Inlet. A very large oil spill, the Exxon Valdez oil spill, originated from vessel transit in adjacent Prince William Sound in 1989, and impacts to some Cook Inlet bird populations may linger.

The best available scientific evidence indicates that some combination of climate change, marine heatwaves, potential biotoxin events, and related rapid trophic regime changes or prey unavailability has recently led to periodic poor foraging conditions and seabird starvation. These conditions are strongly associated with several recent years of Cook Inlet (part of broader Gulf of Alaska or GOA) seabird die-offs and subsequent colony failures (Zador and Yasumisshi, eds., 2018; von Biela, et al., 2019). Piatt and Harding (2007) believe other ocean regime shifts in recent decades have substantial ongoing impacts on certain GOA seabird populations. The particular state of the birds from the die-offs and colony failures at the time of the Proposed Survey are unlikely to influence the analysis of the impacts from the Proposed Survey. This is because the potential Proposed Survey's impacts would be highly localized and brief (i.e., often measured in days), unlikely to contribute to population level impacts for the large seabird populations that are affected by the regime shift impacts and are widespread beyond the area. In the Cook Inlet area, potential cumulative impacts of rapid ocean regime shifts on birds dependent on patchy forage fish prey are anticipated to be relatively widespread and/or long-term.

In summary, the effects of the Proposed Survey on birds would be short-term or minor. The contribution of impacts from the Proposed Survey to the overall cumulative effects on bird populations is expected to be immeasurable and negligible, relative to larger ongoing impacts to marine birds from numerous sources of development and vessel activity in the area, as well as current periodic marine trophic regime shift effects.

3.8 Marine Mammals

3.8.1 Affected Environment

Marine mammals most likely to be found in lower Cook Inlet when the Proposed Survey would occur are the beluga, fin, humpback, minke, killer, and gray whales; Dall's and harbor porpoises; harbor seals; Steller sea lions; and northern sea otters (Muto et al., 2018). There are no marine mammal critical habitats within the Proposed Survey area.

The stock population estimates for marine mammals found in Cook Inlet are shown in Table 3-2. The LS 244 FEIS provided detailed species descriptions of marine mammals in the area, and are summarized and incorporated by reference (Section 3.2.3, pages 3-46 through 3-87). Where relevant, the species descriptions below reflect updated information and supersede and/or supplement the LS 244 materials where references are dated after 2016.

Table 3-2 Stock Size Estimates, Stock Designation, and ESA Status of Marine Mammals Inhabiting the Cook Inlet Action Area

Species	Stock Estimate	Comment
Beluga Whale (*Delphinapterus leucas*)	312	Cook Inlet Stock, ESA-listed as Endangered
Humpback Whale (*Megaptera novaeangliae*)	10,103	Central North Pacific Stock
Fin Whale (*Balaenoptera physalus*)	2,554*	Northeast Pacific
Gray Whale (*Eschrichtius robustus*)	20,990	Eastern North Pacific Stock
Minke Whale (*Balaenoptera acutorostra*)	1,233	Alaska Stock
Killer Whale (*Orcinus orca*)	587*	Gulf of Alaska, Aleutian Islands, and Bering Sea Transient Stock
	2,347	Alaska Resident Stock
Dall's Porpoise (*Phocoenoides dalli*)	83,400	Alaska Stock

Species	Stock Estimate	Comment
Harbor Porpoise (*Phocoena phocoena*)	31,046	Gulf of Alaska Stock
Steller Sea Lion (*Eumetopia jubatus*)	53,303*	Western U.S. Stock, ESA-listed as Endangered
Harbor Seal (*Phoca vitulina*)	27,386	Cook Inlet/Shelikof Stock
Northern Sea Otter (*Enhydra lutris kenyoni*)	14,661* 45,064*	Southcentral Alaska Stock Southwest Alaska Stock, ESA-listed as Threatened

* Minimum population estimate

Source: Muto et al. (2018), Carretta et al. (2018)

Beluga Whale

The Cook Inlet beluga whale Distinct Population Stock (DPS) is a small isolated population that largely remains within Cook Inlet (O'Corry-Crowe et al., 1997; Laidre et al., 2000; Speckman and Piatt, 2000; and Rugh et al., 2000; 2005). It was originally estimated at 1,300 whales in 1979 and has been the focus of management concerns after a dramatic decline in the 1990s (Calkins, 1989). Between 1994 and 1998, the stock declined 47 percent because of unrestrained subsistence hunting (Muto et al., 2018). In 2000, the NMFS declared the stock depleted, and in 2008 listed it as endangered under the ESA (73 FR 62919). Critical habitat for the stock was designated in April 2011 (76 FR 20179) (Figure 3-1).

During the summer and fall, belugas reside in upper Cook Inlet (Figure 3-1), particularly near the large river and stream mouths where they can feed on migrating eulachon and salmon (Nemeth et al., 2007; Moore et al., 2000). In winter, they shift southward to deeper waters in the mid- and lower-inlet below Kalgin Island, and in shallow areas along the western Cook Inlet shoreline down to Kamishak and Kachemak bays (Federal Register, 2011). The Proposed Survey would not occur in beluga whale Critical Habitat.

Humpback Whale

Humpback whales in lower Cook Inlet are most likely from the Central North Pacific stock, which migrates from Hawaii to Alaska in the summer to feed, then returns to Hawaii for winter (Calambokidis et al., 1997). Their use of Cook Inlet is largely confined to lower Cook Inlet, particularly near Kachemak Bay, and anecdotally near Anchor Point, and Cape Starichkof (Rugh et al., 2005). Several humpbacks could occur in the Proposed Survey area at any given time.

Fin Whale

Individual animals from the Northeast Pacific stock of fin whales sometimes enter lower Cook Inlet. Muto et al., (2018) assumes they number 652 between Kenai Fjords National Park and Preserve and the central Aleutian Islands, with most sightings in the Aleutians with a minimum population estimate of 2,554 individuals in the stock (Zerbini et al., 2006).

Gray Whale

Presently, the Eastern gray whale stock size has increased to approximately 20,990 individuals (Carretta et al., 2018). During spring, they migrate from the Sea of Cortez northward along the coast to shelf waters in the Bering, Chukchi, and to a lesser extent, Beaufort seas, and return in like manner to the Sea of Cortez to overwinter (Rice and Wolman, 1971). Some gray whales forgo making the full Baja-Chukchi migration, and remain in select coastal areas, including lower Cook Inlet, Alaska (Rice et al., 1984; Moore et al., 2007). During Buccaneer's Cosmopolitan drilling program in 2013, gray whales were seen in waters off Cape Starichkof (Owl Ridge, 2014).

Minke Whale

Minke whales are the smallest (lengths up to 35 feet), and most common baleen whales. Zerbini et al. (2006) estimated the coastal population between Kenai Fjords and the Aleutian Islands at 1,233 animals; however, no reliable population estimates for the Alaska stock have been produced. Most likely, small numbers of minke whales would be near the survey area in lower Cook Inlet during the Proposed Survey, particularly since the majority of the sightings described by Zerbini et al. (2006) occurred in the Aleutian Islands rather than in the Gulf of Alaska, and in waters less than 200 meters (m) deep.

Killer Whale

Two different stocks of killer whales use the Cook Inlet region of Alaska: the Alaska Resident Stock and the Transient Stock (Bering Sea, Gulf of Alaska, and Aleutian Islands) (Muto et al., 2019). The resident stock is estimated at 2,347 animals and occurs from Southeast Alaska to the Bering Sea (Muto et al., 2019). They feed exclusively on fish and are genetically distinct from the transient stock (Saulitis et al., 2000). Killer whales from the transient stock feed primarily on marine mammals (Saulitis et al., 2000). The transient killer whales in the Gulf of Alaska are genetically related to killer whales found along the Aleutian Islands and the Bering Sea linking them into a single population (Muto et al., 2018). Killer whales from both stocks are occasionally seen in lower Cook Inlet, especially near Homer and Port Graham (Shelden et al., 2003, Rugh et al., 2005). A concentration of sightings near Homer and inside Kachemak Bay may represent high use, or high observer-effort given most records are from a whale watching venture based in Homer. The few whales photographically identified in lower Cook Inlet belong to resident groups more commonly found in nearby Kenai Fjords and Prince William Sound (Shelden et al., 2003). Killer whales could occur in the survey area and might be encountered during the Proposed Survey.

Dall's Porpoise

Dall's porpoise are widely distributed throughout the North Pacific Ocean (Muto et al., 2018), preferring deep offshore and shelf slope waters, and are among the more numerous cetacean species found in Alaskan waters. They have been observed in lower Cook Inlet, particularly around Kachemak Bay and Anchor Point, and could occur in the Proposed Survey area.

Harbor Porpoise

Harbor porpoise are small (1.5 m in length), dark, and relatively inconspicuous. The Gulf of Alaska Stock occurs from Cape Suckling to Unimak Pass. They mostly occur in coastal waters less than 100 m (300 feet) deep, and feed on Pacific herring, eulachon, other schooling fishes, and cephalopods (Hobbs and Waite, 2010).

They are frequently observed in aerial marine mammal surveys of Cook Inlet, and most sightings have been concentrated around Chinitna and Tuxedni bays on the west side of lower Cook Inlet (Rugh et al., 2005). Dahlheim et al. (2000) estimated the 1991 Cook Inlet-wide sub-population was limited to 136 animals; however, they are among the most numerous marine mammals regularly seen in Cook Inlet (besides belugas and harbor seals) (Nemeth et al., 2007). They are likely to be present in the survey area during the Proposed Survey.

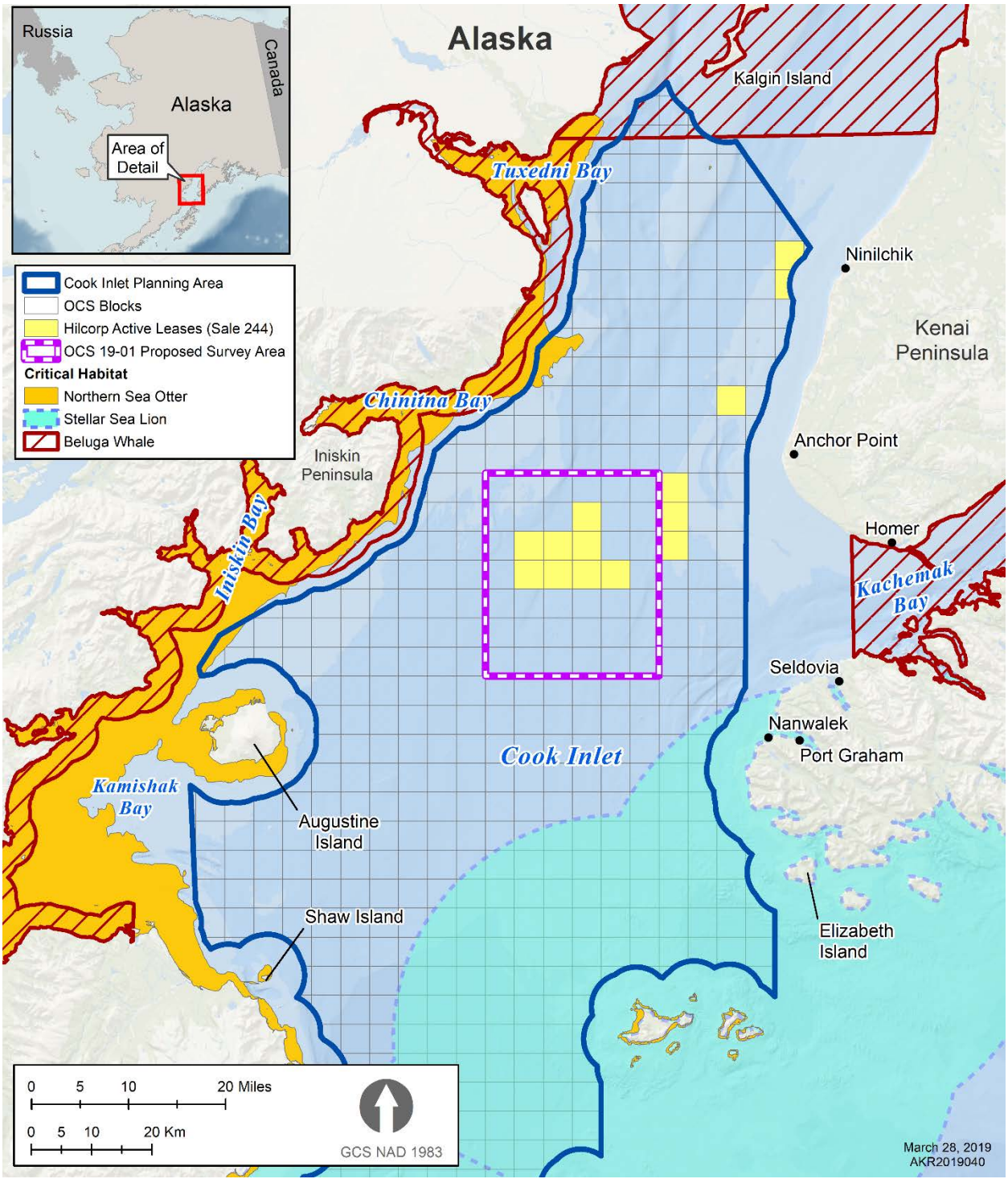

Figure 3-1 Cook Inlet Marine Mammal Critical Habitat

Steller Sea Lion

The Western DPS of the Steller sea lion is defined as all populations west of longitude 144°W to the western end of the Aleutian Islands. The stock was listed as threatened under the ESA in 1990 (55 FR 49204), and listed as endangered in 1997 (62 FR 24345). Critical habitat was designated in 1993 (58 FR 45269), and is defined as a 20 nautical mile radius around all major rookeries and haulout sites (Figure 3-1).

Steller sea lions inhabit lower Cook Inlet, especially in the vicinity of Shaw Island and Elizabeth Island (Nagahut Rocks) haulout sites (Rugh et al., 2005; Nemeth et al., 2007). Marine mammal observers associated with Buccaneer's drilling project off Cape Starichkof observed 7 Steller sea lions in 2013 (Owl Ridge, 2014) and they could be encountered in the survey area.

Harbor Seal

Harbor seals are commonly encountered in lower Cook Inlet, feeding on fishes such as Pacific cod, salmon, Pacific herring, and eulachon, and sometimes squid. The Cook Inlet/Shelikof Stock is estimated to number 22,900 (Muto et al., 2018), and is distributed from Anchorage into lower Cook Inlet during summer (Boveng et al., 2012). Large numbers concentrate at the river mouths and embayments of lower Cook Inlet, particularly Kachemak Bay and the Southern end of Kalgin Island (Rugh et al., 2005; Boveng et al., 2011).

Montgomery et al. (2007) recorded over 200 haulout sites in lower Cook Inlet and found seals move in response to local steelhead and salmon runs. Harbor seals would likely be encountered in the survey area.

Sea Otter

Two stocks of sea otters occur near the Proposed Survey area: the southcentral and southwest Alaska stocks (Muto et al., 2018; USFWS, 2014ab). The southwest Alaska sea otter stock is listed as depleted under the MMPA, and threatened under the ESA (79 FR 51584). The southcentral Alaska stock is not. Critical habitat for the southwest Alaska stock was designated in 2009 (74 FR 51988; see Figure 3-1).

Sea otters are year-round residents within Cook Inlet, including the Proposed Survey area. Sea otters generally inhabit nearshore waters <35 m (115 feet) deep. Sea otters forage in the nearshore benthos of rocky and soft-sediment communities. During summer (June - August), sea otters predominantly use areas within a distance of 40 m from shore where foraging opportunities are best (Bodkin et al., 2003; Riedman and Estes, 1990; Schneider, 1976). Sometimes they occur in offshore areas, rafting together while transiting through deeper waters (Schneider, 1976). Most of the survey area occurs in water too deep to serve as good sea otter habitat. Sea otters would most likely be encountered along the east and west peripheries of the survey area.

3.8.2 Impacts

The aspect of the Proposed Survey with the greatest potential to impact marine mammals is the introduction of noise into the marine environment. For noise to directly impact a marine mammal, an animal must first be able to hear the frequency. The generalized hearing ranges of marine mammals that could be present in the Proposed Survey area are provided below in Table 3-3. Noises outside of a particular marine mammal's hearing range are imperceptible to that animal and thus cannot result in direct impacts.

Table 3-3 Marine Mammal Hearing Groups

Hearing Group	Generalized Hearing Range*
Fin, humpback, gray, and minke whales	7 Hz to 35 kHz
Beluga and killer whales	150 Hz to 160 kHz
Dall's and Harbor porpoises	275 Hz to 160 kHz
Harbor seals	50 Hz to 86 kHz
Steller sea lions, and Northern sea otters	60 Hz to 39 kHz

Note: Frequency ranges follow those identified in NMFS (2016a).

Second, the noise must be loud enough to produce a response from, or injury to, the animal. In discussing the potential for injuries or behavioral responses from noise, BOEM references and/or applies many of the terms and/or concepts used in MMPA authorizations and in NMFS' guidance for assessing effects of anthropogenic sound on marine mammals (NMFS, 2018). For example, the potential effects of manmade noise on marine mammals depends on the level of noise exposure. Low noise exposure levels may fail to elicit any observable response, while at moderate exposure levels, noise may cause a change in behavior (referred to as Level B Harassment in the MMPA). At higher exposure levels, noise can induce injury (referred to as Level A Harassment in the MMPA). The dB is the unit used to measure the intensity of a sound. Noise expands outward from the source in all directions, and as it expands outward, energy levels (i.e., dB levels) decrease. NMFS uses three different dB metrics to gauge sound impacts on marine mammals: dB_{SEL} (sound exposure level); dB_{SPL} (sound pressure level); and dB_{RMS} (root mean square). More thorough descriptions of these metrics are found in NMFS, 2018. Briefly, SEL is the total noise energy produced from a single noise event and is the integration of all the acoustic energy contained within the event. For a seismic survey, the SEL can represent either all energy received at a particular location in the water column from a given seismic pulse, or a sequence of pulses as the seismic vessel passes. SPL is a measure of the sound pressure converted to dB, and RMS is the square root of the SPL value. In general terms, RMS can be considered to be an average sound pressure. The type and level of the impact also depends on whether the noise is impulsive (e.g., seismic airguns) or non-impulsive (e.g., vessel noise). For impulsive noise, the metric of interest is the distance to peak received sound pressure level (SPL_{peak}); for non-impulsive noise, the metric of interest is the 24-hour cumulative sound exposure level (SEL_{24}).

As noise travels through water (or air), its intensity dissipates, meaning it becomes less loud. Noise emitted at a high level often attenuates to a lower level by the time it reaches marine mammals located some distance away from the noise source. This "received" noise level is much more relevant to understanding potential impacts than "source" noise levels.

Injuries (referred to as Level A Harassment in the MMPA) to hearing could be temporary or permanent depending on the circumstances and severity of the exposure. Injuries can include shifts in the hearing thresholds of a marine mammal that could be temporary (TTS = Temporary Threshold Shifts), permanent (PTS = Permanent Threshold Shifts), or could include physical injuries to organs in extreme cases. Other impacts could involve the masking or blocking out of environmental noises by loud manmade noises, or by causing affected individuals to change their behavior. Behavioral responses to noise (referred to as Level B Harassment in the MMPA) include tolerance, inquisitiveness, avoidance, or changes in other behaviors such as feeding, courtship, mating, swimming, or breathing. Such changes are usually temporary and lack consequence, particularly if the disturbance is brief (Richardson, 1995). Exceptions could occur if individual animals are prevented from using key habitats at critical times in their life cycles. No such habitats are known to exist in the survey area.

Table 3-4 depicts the current in-water thresholds used by NMFS/USFWS to gauge the potential for noise impacts. For injury (Level A harassment), NMFS (2018) has established different thresholds for various marine mammal groups based on the best available science. Injuries could arise from impulsive or non-

impulsive noise, and result in PTS or TTS. For behavioral effects (Level B harassment), NMFS and USFWS consider 120 dB_{RMS} as the threshold at which continuous noise (e.g., vessels underway) could cause behavioral effects, and 160 dB_{RMS} for impulsive noise (airguns).

Table 3-4 NOAA Fisheries Current In-Water Acoustic Thresholds

	Level A Harassment				Level B Harassment	
Species	**PTS Impulsive**	**PTS Non-impulsive**	**TTS Impulsive**	**TTS Non-impulsive**	**Behavior Impulse**	**Behavior Non-impulse**
Humpback, Fin, Gray, and Minke Whales	219 dB SPL_{peak} 183 dB SEL_{24}	199 dB SEL_{24}	213 dB SPL_{peak} 168 dB SEL_{24}	179 dB SEL_{24}	160 dB_{RMS}	120 dB_{RMS}
Beluga and Killer Whales	230 dB SPL_{peak} 185 dB SEL_{24}	198 dB SEL_{24}	224 dB SPL_{peak} 170 dB SEL_{24}	178 dB SEL_{24}	160 dB_{RMS}	120 dB_{RMS}
Dall and Harbor Porpoises	202 dB SPL_{peak} 155 dB SEL_{24}	173 dB SEL_{24}	196 dB SPL_{peak} 140 dB SEL_{24}	153 dB SEL_{24}	160 dB_{RMS}	120 dB_{RMS}
Harbor Seals	218 dB SPL_{peak} 185 dB SEL_{24}	201 dB SEL_{24}	212 dB SPL_{peak} 170 dB SEL_{24}	181 dB SEL_{24}	160 dB_{RMS}	120 dB_{RMS}
Steller Sea Lions and Northern Sea Otters	203 dB SEL_{24} 232 dB SPL_{peak} *190 dB_{RMS}	219 dB SEL_{24} *190 dB_{RMS}	188 dB SEL_{24} 226 dB SPL_{peak} *180 dB_{RMS}	199 dB SEL_{24} *180 dB_{RMS}	*160 dB_{RMS}	*160 dB_{RMS}

SPL_{peak} = peak received sound pressure level

SEL_{24} = 24-hour cumulative sound exposure level

dB_{RMS} = dB root mean square; measurement of the intensity of sound

Source: NMFS, 2018.

Proposed Action

Anticipated impacts to marine mammals associated with the Proposed Survey would be from vessel noise and presence, and airgun noise. No impacts would result from other sources of noise associated with the Proposed Survey. The echosounder operates at frequencies above 200 kilohertz (kHz) making it inaudible to marine mammals in Cook Inlet (Table 3-3). The streamer positioning system emits a small pulse at frequencies between 50 kHz to 100 kHz. Consequently, the positioning system should be inaudible to fin, humpback, gray, and minke whales, sea otters, and Steller sea lions, but audible to beluga and killer whales, porpoises, and harbor seals (Table 3-3). Vessels produce low-frequency, low-intensity noise with limited effects on marine mammals since exposures to vessel presence are usually brief (Richardson et al., 1995; Richardson, 1995). Use of the airgun arrays would have the greatest impact on marine mammals in the survey area since the airguns produce the loudest noise. As described in Section 2.1.2, HAK has applied for incidental take authorization under the MMPA, and included the mitigation measures in their Marine Mammal Monitoring and Mitigation Plan (4MP) (see Appendix A) as part of the Proposed Survey.

Vessel Noise and Presence

Small ships (55-85 m) and boats (<55 m) generally emit noise in frequencies of 37–6,300 Hertz (Hz), with source noise levels of 170-180 dB_{RMS} for small vessels and 152-170 dB_{RMS} for boats; however, actual noise would vary with individual vessel characteristics (Greene and Moore, 1995). Typical responses of marine mammals to small vessel noise are behavioral reactions, or no visible reaction, depending upon circumstances.

The low speeds (4-5 knots per hour) used by seismic vessels should ensure no strikes to marine mammals occur from the Proposed Survey. Furthermore, HAK's 4MP includes use of Protected Species Observers (PSOs) to look for marine mammals in the water and avoid disturbing them with close approaches. For these reasons, no injuries to marine mammals should occur from vessel noise or operations in the

Proposed Survey area, and the most likely impacts would be a few instances where individual marine mammals are briefly displaced from the vicinity of vessels that are underway.

Airgun Noise

Noise frequencies produced by the proposed airguns and airgun arrays typically peak in the 10 to 120 Hz range before dropping off exponentially (Greene and Moore, 1995). This noise would be audible at the low end of the auditory bandwidth for marine mammals, particularly harbor porpoises, killer whales, and beluga whales (Table 3-3). Overall, their reactions to large arrays of airguns are variable and, at least for delphinids and some porpoises, seem to be confined to a smaller radius than has been observed for some mysticetes (SAE, 2014).

The current estimates for airgun source levels, noise injury, and disturbance radii (for both peak noise levels [SPL_{peak}] and for 24-hour continuous noise levels [SEL_{24}]) are listed in Table 3-5. The values in Table 3-5 suggest most marine mammals would have to be close to an airgun array in order to be injured, in most cases within 100 m. The exception to this is noise from the sub-bottom profiler where the zone of injury to a porpoise extends out to 1,000 m. However, the metric used to assess injury from a continuous noise such as this is SEL_{24}, which is the total noise accrued by an animal over a 24-hour period. This information indicates a porpoise would have to remain within 1,108 m of the operating sub-bottom profiler for 12 hours out of a 24-hour period in order to experience injury, which is unlikely). Table 3-5 also indicates that the zone for behavioral impacts can extend to 7,330 m.

Table 3-5 Source Levels for Hilcorp 1,945[3]-inch Airgun Array and Sub-Bottom Profiler with Noise Radii for Injury and Disturbance of Cook Inlet Marine Mammals

Equipment	Source Level at 1 meter	Approximate Zone of Injury (Level A Harassment)										Approx. Zone of Disturbance (Level B Harassment) for All Species
		Fin, Gray, Humpback, and Minke Whales		Beluga and Killer Whales		Dall's and Harbor Porpoises		Harbor Seals		Steller Sea Lions and Northern Sea Otters		
		SPL_{pk}	SEL_{24}	SPL_{pk}	SEL_{24}	SPL_{pk}	SEL_{24}	SPL_{pk}	SEL_{24}	SPL_{pk}	SEL_{24}	160 dB_{RMS}
1,945[3] inch Airgun Array	247 dB SPL_{peak}	74 m		14 m		1000 m		86 m		10 m		7,330 m
	215 dB SEL_{24}		399 m		0.31 m		45 m		66 m		1.32 m	
Sub-bottom Profiler	212 dB_{RMS}	< 1 m		< 1 m		5 m		< 1 m		< 1 m		2,929 m
	212 dB_{RMS}		76.48		4 m		1,108 m		48 m		< 1 m	

Notes: Zone of injury values are in meters.

In general, for noise injuries to occur from 24-hour cumulative sound exposure level (SEL_{24}) most species would have to remain within 66 m of the operating array for 12 hours or more (except for mysticete whales (fin/gray/humpback/minke), which would have to remain within 400 m of the array). Injury from peak noise levels (SPL_{peak}) could occur if marine mammals are within 85 m of the operating airgun (except porpoises, where injuries could occur out to 1,000 m). The zone for behavioral impacts can extend to 7,330 m.

A few fin, gray, humpback, and minke whales should be present in lower Cook Inlet during the Proposed Survey. To be injured, these whales would need to be within about 75 m of the firing airgun array. This is unlikely because they can detect and avoid noise that could cause injury. These whales tend to react to airgun noise by deviating from their travel routes, interrupting their feeding, and avoiding the area

(Johnson et. al 2007; Gordon et al. 2004). Based upon information regarding baleen whale disturbance reactions to seismic activity, baleen whales may exhibit minor, short-term disturbance responses to underwater sounds from seismic activities (NMFS 2019). Thus, the survey would most likely have behavioral impacts on these whales. Impacts would remain localized within the Proposed Survey area with no population-level effects. Additionally, Hilcorp will implement mitigation measures to avoid and minimize impacts (Appendix A).

Beluga and killer whales are in the same mid-frequency functional hearing group. While noise from the Proposed Survey would be audible to them, they would need to be within about 15 m of the firing airgun array to be injured. This is unlikely because they can detect and avoid noise that could cause injury, and 15 m is well within the distance where PSOs should be able to detect the presence of marine mammals and pause airgun operations if necessary. This is consistent with NMFS' estimation that very few beluga or killer whales (i.e., <1 of either species) would be injured from the Proposed Survey (NMFS 2019; Table 26). Thus, injury to beluga or killer whales is unlikely.

Potential for behavioral impacts to killer/beluga whales species could occur as far as 7,330 m from the noise source. Behavioral impacts to both killer and beluga whales would be unlikely primarily because neither species is common in the Proposed Survey area. Killer whales are occasionally seen in lower Cook Inlet, and beluga whales are found in upper Cook Inlet during ice-free months. Critical habitat for beluga whales has been designated in upper Cook Inlet, and almost the entire population of beluga whales is found there from late spring into the fall (i.e., more than 7,330 m from the Proposed Survey area). Thus, few killer and beluga whales would exhibit behavioral impacts from the Proposed Survey, and beluga whale critical habitat would not be affected.

Harbor and Dall's porpoises hear in high-frequency bands. Porpoises show variable reactions to seismic operations. Available data suggest that harbor porpoise show stronger avoidance of seismic operation than Dall's porpoises (Bain and Williams 2006), with Dall's porpoises being relatively tolerant of airgun operations. Effects of the Proposed Survey on these species are anticipated to be primarily avoidance behavior.

Steller sea lion, harbor seals, and northern sea otters are found in the vicinity of the Proposed Survey area. While there is little published data on seismic effect on these species, anecdotal data and data on arctic seals indicate that sea lions and other pinnipeds (likely including fissipeds (sea otter)) generally tolerate strong noise pulses (Richardson et al. 1995). These species would need to be underwater and near the vessel/airguns to be injured (i.e., ~90 m). Although sea lion rookeries and haul-outs are found in lower Cook Inlet, no rookeries or haul-outs are found in or adjacent to the Proposed Survey area. No sea otter critical habitat would be affected by the Proposed Survey. NMFS estimates that no sea lions or seals would be injured (NMFS 2019), and the USFWS estimates that up to 1 sea otter may be injured. Overall, it is anticipated that impacts to these species would include displacement and behavioral effects.

HAK's 4MP includes mitigation measures (see Appendix A) that would serve to minimize exposure of marine mammals to seismic noise. Such measures include, but are not limited, to:

- placement of PSOs on two vessels (the source vessel and chase vessel) to constantly scan the area for the presence of marine mammals during the survey;
- use of EZs and SZs to shut operations down if a marine mammals is too close and could be injured, or to power down in the event an animal is about to enter an injury zone;
- conduct aerial surveys once per day (weather permitting) to visually inspect the areas around vessels for marine mammals;

- use appropriate means to avoid/minimize impacts if marine mammals are sighted, including power down (decrease the number of airguns firing), shut down (shut down airguns or sub-bottom profilers), ramp up (gradually increase noise volume); and
- speed course or alteration (maneuver a vessel speed and/or change course).

In summary, seismic activities have the potential to affect marine mammal species found in Cook Inlet. Although some individuals could be injured, the most reasonably foreseeable future impacts would be short-term, non-injurious behavioral response. Behavioral responses would include avoidance of areas near vessels and operating airgun arrays. In addition, the proposed seismic activity will be short-term and localized and is not located near areas of elevated importance to any ESA-listed species. Furthermore, Hilcorp will implement mitigation measures to reduce effects from noise associated with the seismic surveys (Appendix A). Overall, effects from the Proposed Survey on marine mammals would range from negligible to minor.

No Action Alternative

Under the No Action Alternative, BOEM would not approve the Permit Application and the Proposed Survey would not occur. There would be no effects attributable to the Proposed Survey on marine mammals.

Cumulative Effects

Past, present, and reasonably foreseeable future activities that have affected, and will continue to affect, marine mammals include oil and gas exploration, development and production; marine vessel traffic, including shipping; aircraft traffic; subsistence harvest; commercial and recreational activities; and scientific activities. Effects from these activities include exposure of marine mammals to increased noise and pollution from coastal development and/or oil and gas activities; increased risk of strikes, noise disturbance, and/or pollution from vessel and aircraft traffic; competition for prey with, and potential entanglement from, commercial, recreational, and subsistence fisheries; mortality from subsistence hunting (a moratorium was placed on hunting beluga whales in 2005, but subsistence hunting of other marine mammals, especially seals and sea otters, still occurs); and disturbance or mortality associated with scientific studies. Despite the continued exposure to these activities, most marine mammal populations remain stable to increasing in Cook Inlet. This includes the listed population of fin whales, humpback whales, and Steller sea lions, but does not include beluga whales, whose population continues to decline.

The level of effects of the Proposed Survey on marine mammals would be negligible to minor. The Proposed Survey would overlap both spatially and temporally with current activities that potentially affect marine mammals. However, while seismic activities have the potential to affect individual marine mammals in Cook Inlet, impacts would be short-term (45-60 days), localized, and non-injurious. This includes the endangered beluga whale, which would be in upper Cook Inlet when the Proposed Survey would occur, and would most likely remain unaffected by noise and disturbances. Thus, the contribution of effects from the Proposed Survey to the overall cumulative effects on Cook Inlet marine mammals is expected to be negligible. In addition, the Proposed Survey would adhere to the mitigation measures described in the 4MP, which would serve to avoid and minimize potential adverse effects.

3.9 Subsistence Activities

3.9.1 Affected Environment

Residents of Seldovia, Port Graham, and Nanwalek are the primary subsistence harvesters in the lower Kenai Peninsula and lower Cook Inlet. Five species of Pacific Salmon, Pacific halibut, and invertebrates (e.g., clams, chitons, octopuses) are the most important marine resources used for subsistence purposes by households in the four communities (Jones and Kostick, 2016). Some halibut and cod are harvested using subsistence longlines, and residents who fish commercially often remove salmon and halibut from their commercial catches for subsistence purposes (Fall and Koster, 2017; Jones and Kostick, 2016). A substantial amount of subsistence fishing occurs 20 to 40 miles offshore inside the lower Cook Inlet.

During mid-June and extending through September, residents of Seldovia fish for salmon in marine waters using a variety of methods. Residents of Seldovia harvest halibut and Pacific cod offshore with rod and reel, and they harvest clams and mussels in near shore areas (Jones and Kostick, 2016). Residents of Seldovia travelled up to 40 miles from town in search of salmon and reported focusing search efforts in marine waters to the west of Seldovia (Jones and Kostick, 2016).

Residents of Nikiski travel to the waters of lower Cook Inlet to participate in offshore salmon and halibut fisheries and to Chinitna Bay to harvest clams (Jones and Kostick, 2016).

Harvesters in Nanwalek and Port Graham primarily search for salmon, halibut, harbor seals (and sometimes sea lions), and marine invertebrates in near shore waters. Residents of Port Graham practice some halibut fishing farther offshore to the north and west of town (Jones and Kostick, 2016).

3.9.2 Impacts

Proposed Action

For Nanwalek, there would be no spatial overlap of the Proposed Survey with subsistence use areas. There is potential for overlap in time and space of the Proposed Survey with offshore salmon, halibut, and cod subsistence fishing for residents of Nikiski and Seldovia. There is some potential overlap of the Proposed Survey with subsistence halibut fishing for Port Graham. This is especially the case for use of subsistence longlines that could entangle with seismic survey equipment if fishing and survey vessels approach too close. When harvesters travel to and from fishing and clamming grounds and while fishing, there could be short-term and localized space-use conflicts and interferences between survey and subsistence fishing vessels.

BOEM estimates short-term and localized adverse impacts to offshore subsistence fishing. The impacts would be temporary and occur in specific places in or near the survey area. Interference from space-use conflicts could delay subsistence fishers and they could miss some potential harvest. They would most likely have time to fish at other locations during any single trip and at other times and places during the season.

For nearshore subsistence fishing and harvest of seals and marine invertebrates near the communities, BOEM estimates little to no adverse impacts from the Proposed Survey because there would be no space-use conflicts.

HAK has begun a stakeholder engagement program to enable survey operators and subsistence harvesters to clearly communicate schedules and timing of their spring and summer activities to minimize or avoid space-use conflicts and vessel interference. HAK has met with and provided presentations on the

Proposed Survey to local authorities, representatives from the state, fishing guides, and angler's associations. HAK has contacted tribes and Native associations in the KPB to introduce the Proposed Survey.

Most subsistence fishing occurs mid-June through September. HAK proposes to complete the survey late summer / early fall of 2019. Consequently, there would be overlap between the project and subsistence fishing to some degree, depending on when the survey vessel and agency permits are issued.

However, it is possible the operator could extend the survey into the peak subsistence season and through the end of October. If the survey and the peak subsistence fishing season overlap, the primary impact would be from short-term and localized displacement or exclusion of subsistence fishing boats from fishing grounds during survey operations. Subsistence salmon and groundfish fisheries could be temporarily impacted by exclusion from the area of active seismic operations.

In conclusion, there is potential for space-use conflicts between subsistence fishing vessels and survey vessels used in the Proposed Survey. Overall, BOEM estimates negligible to minor impacts to subsistence activities from the Proposed Survey.

No Action Alternative

Under the No Action Alternative, BOEM would not approve HAK's Permit Application and the Proposed Survey would not occur. There would be no adverse impacts to subsistence activities as a result of the Proposed Survey.

Cumulative Effects

Past, present, and reasonably foreseeable future activities (i.e., all other activities) that may have impacts on subsistence activities for the lower Cook Inlet include offshore oil and gas exploration, development, production, and decommissioning activities (Section 3.1). Future activities also include small increases in vessel and aircraft traffic, offshore shipping and national security/military activities, scientific research, sport and commercial fishing, and regional recreation and tourism.

The minor effects described above for the Proposed Survey are limited to space-use conflicts that would last for less than one year. Effects from all other activities during this timeframe could include short-term and localized disruptions to subsistence fisheries, and temporary changes in how people access fish and wildlife for subsistence purposes. Additional vessel traffic, especially cruise ships, small aircraft, and local barge and boat traffic, could temporarily impede subsistence harvests because most traffic would occur during prime harvest seasons for fish, marine mammals, and marine invertebrates. Pressure from small increases in sport and commercial fishing, and recreation and tourism, could have short-term and localized impacts to subsistence practices. In terms of a cumulative baseline, all other activities could have minor effects to subsistence activities and harvest patterns during this one-year timeframe.

Effects from all other activities could be exacerbated by impacts from climate change. The lower Cook Inlet communities are vulnerable to climate change through impacts to hunting, fishing, and cultural connections to lands and waters. Climate change could affect timing of fish and animal migrations and access to subsistence resources. Subsistence harvest opportunities could be adversely affected by shifts in fishing and hunting seasons due to shifts in distribution or abundance of species used for subsistence purposes. Shellfish harvested for subsistence could decline due to ocean acidification, invasive species, and/or other changing conditions in benthic habitats. Economic losses to communities due to increased travel times, fuel expenditures, and increased reliance on store-bought foods have occurred as fish and wildlife change their relative location and abundance due to changing environmental conditions.

The effects of climate change could be long-lasting and widespread and will continue much longer than the potential effects from the Proposed Survey. The short-lived Proposed Survey would not substantially increase the effects of climate change or combine with climate change to produce any synergistic effects (see Section 3.4.2).

The Proposed Survey, similar to many of the other past, present, and reasonably foreseeable future activities listed above, would create some space-use conflicts that make it harder for subsistence users to harvest the resources they need. However, there will still be alternative fishing grounds and other days in which to fish or harvest subsistence resources in Cook Inlet, even when the conflicts contributed by the Proposed Survey are considered. While the Proposed Survey could make harvesting more difficult or time consuming, BOEM expects that subsistence harvesters will still have ample opportunities to obtain the resources they need.

In conclusion, all other actions could have a minor impact on subsistence activities. When added to all other actions, the incremental impact or contribution of the Proposed Survey would be too small to raise the baseline effect above minor. This is because the Proposed Survey is short-term (i.e., 45 -60 days) and would only affect a small part of one subsistence fishing season.

3.10 Economy

3.10.1 Affected Environment

Economic activity for the Proposed Survey is measured in the form of employment, income, and revenues. The Kenai Peninsula Borough (KPB) economy is diverse. In 2016, the Alaska Department of Labor and Workforce Development (ADOLWD) estimated that 23,214 Borough residents were employed, with an annual average unemployment rate of 8.6 percent. Industries employing the most workers include: trade, transportation, and utilities (20.0 percent of total employment); educational and health services (15.2 percent); local government (15.4 percent); leisure and hospitality (10.8 percent); and natural resources and mining (10.3 percent) (ADOLWD, 2016). According to the U.S. Bureau of Economic Analysis, per capita income in the Borough was $49,800 in 2017 (BEA, 2018). The main sources of revenue in 2016 for the Borough are from real and personal property taxes ($50,520,180), sales tax ($30,103,266), and oil and gas property taxes ($11,558,662) (ADOLWD, 2016).

The study area also supports important commercial fisheries. In 2016, for all commercial fisheries in the KPB combined, there were 1,418 permit holders and gross earnings of $98,329,046 (CFEC, 2016).

3.10.2 Impacts

Proposed Action

The Proposed Survey would have negligible effects on the KPB economy. While there may be some employment opportunities and some increased revenues accruing from lodging, food, and sales taxes, the proposed activities are short-term, temporary, and localized. Overall, there would be little to no positive or adverse effects on employment, income, revenues, population, infrastructure, or other economic drivers of the KPB and its communities.

No Action Alternative

Selection of the No Action Alternative would result in no positive or adverse effects attributable to the Proposed Survey on the KPB economy.

Cumulative Effects

The proposed activities are short-term, temporary, and localized involving negligible levels of new employment and associated income and negligible generation of tax revenues accruing to the KPB and its communities. Therefore, the incremental contribution of the Proposed Survey, when added to past, present, and reasonably foreseeable future activities, would be negligible.

3.11 Sport Fishing

3.11.1 Affected Environment

There are a number of saltwater sport fishing opportunities in the lower Cook Inlet fisheries management area, including fishing for halibut and rockfish in Kachemak Bay and lower Cook Inlet, trolling for salmon during seasonal migrations, trolling for Chinook salmon year-round in these waters, and harvesting clams from beaches in Cook Inlet and the south side of Kachemak Bay.

In the lower Cook Inlet management area, saltwater king salmon fishing occurs year-round in the nearshore waters of Kachemak Bay and east Cook Inlet. The sport fishery targets a mixture of Chinook salmon stocks. Mature (spawning) king salmon are caught April through August in the summer fishery, while immature king salmon are caught year-round.

Sport fishers access the sport fisheries in the lower Cook Inlet via the Sterling Highway. Ninilchik, Deep Creek, Anchor Point, and Homer have many services to support fishing charter boats and individual sport fishers. Daily air charter services are available from Anchorage to Homer. Access to sport fisheries is possible via boat, water taxi, and private charter. Some sport fishing charters launch from the beach.

3.11.2 Impacts

Proposed Action

Most sport fishing occurs mid-June through September. HAK plans to complete the Proposed Survey in late summer / early fall (likely September 1-October 31, 2019). Thus, there would be some overlap with the peak sport fishing season. The primary impact would be from short-term and localized displacement of fishing boats and charters from fishing grounds during survey operations. Pacific halibut, rockfish, and salmon sport fisheries could be impacted by exclusion from the area of active seismic operations (HAK, 2018). This is because a Notice to Mariners placed by the USCG would require temporary restricted access to specific areas in the lower Cook Inlet to avoid conflicts and interferences between sport fishers and survey operators.

Survey operators would maintain a stand-off safety exclusion zone around the source vessel when it is towing a streamer array; establishment of this zone would result in temporary and localized space-use conflicts with sport fishing boats. The size of the exclusion area would vary depending on the array configuration. The length of time that any particular point would be within the stand-off distance would be approximately 1 hour.

Increased vessel traffic from the Proposed Survey could have temporary and localized adverse effects to sport fishing in the offshore waters of lower Cook Inlet. HAK has implemented a stakeholder engagement program to enable survey operators and sport fishers to clearly communicate schedules and timing of their spring and summer activities, to minimize or avoid space-use conflicts and vessel interference. Since August 2018, HAK has sought input from stakeholders. HAK has been in regular communication with

stakeholder groups via email and meetings, and provided presentations to tribal groups, fisherman/guide groups, the Cook Inlet Regional Citizens Advisory Council, and relevant city managers.

HAK would also issue a Local Notice to Mariners, which would specify the survey dates and locations and the recommended avoidance requirements for sport fishing boats.

For sport king salmon fishing that occurs in April to mid-June and October, there would be little to no adverse impacts because it occurs in nearshore waters outside the survey area. There will be little to no impacts to people clamming on beaches because there would be no space-use conflicts with the Proposed Survey.

Seismic activity could occur in areas where spawning migrations are occurring, and some fish may have to swim farther to avoid the noise on the way to their spawning grounds; however, it is unlikely to affect the timing or success of the runs or to have population level impacts (Section 3.6.2). Some fish may divert around the source of the sound. This could cause sport anglers to temporarily miss opportunities to catch the diverted fish. There could be short-term and localized effects to sport fishing.

In conclusion, BOEM estimates negligible to minor adverse impacts to sport fisheries from the Proposed Survey.

No Action Alternative

Under the No Action Alternative, BOEM would not approve HAK's 2019 Permit Application and the Proposed Survey would not occur. There would be no adverse impacts to sport fishing activities as a result of the Proposed Survey.

Cumulative Effects

Past, present, and reasonably foreseeable future activities (i.e., all other activities) that may have impacts on sport fisheries in the lower Cook Inlet include offshore oil and gas exploration, development, production, and decommissioning activities (Section 3.1). Future activities also include small increases in vessel and aircraft traffic, offshore shipping and national security/military activities, scientific research, commercial fishing, and regional recreation and tourism.

Effects from all other activities could include short-term and localized disruptions to sport fisheries, temporary displacement of some sport fishers, and temporary changes in how people access sport fisheries. Additional vessel traffic could temporarily impede sport fish harvests because most traffic would occur during prime sport fishing seasons. Pressure from small increases in commercial fishing and recreation and tourism could have short-term and localized impacts to sport fishing. In terms of a cumulative baseline, all other activities could have minor effects to sport fishing during this one-year timeframe.

Effects from all other activities could be exacerbated by impacts from climate change. Climate change could affect timing of fish migrations and spawning events. Changing environmental conditions could affect access to sport fishery resources. Sport fishing opportunities could be adversely affected by shifts in fishing seasons due to shifts in distribution or abundance of species caught in sport fisheries. Coastal communities of the lower Kenai Peninsula could experience economic losses due to decreased sport fishing in the area.

The effects of climate change could be long-lasting and widespread and will continue much longer than the potential effects from the Proposed Survey. The short-lived Proposed Survey would not substantially

increase the effects of climate change or combine with climate change to produce any synergistic effects (Section 3.4.2).

The Proposed Survey, similar to many of the other past, present, and reasonably foreseeable future activities listed above, would create some space-use conflicts that make it harder for sport fishers to harvest the resources they desire. However, there will still be alternative fishing grounds and other days in which to sport fish in Cook Inlet, even when the conflicts contributed by the Proposed Survey are considered. While the Proposed Survey could make sport fishing more difficult or time-consuming, BOEM expects that sport fishers will still have ample opportunities to obtain the fish they desire.

In conclusion, all other actions could have a minor impact to sport fishing activities. When added to all other actions, the incremental impact or contribution of the Proposed Survey would be too small to raise the baseline effect above minor. This is because the Proposed Survey is short-term and would only affect part of one sport fishing season.

3.12 Commercial Fishing

3.12.1 Affected Environment

All five species of Pacific salmon, Pacific herring, and smelt are commercially harvested in the Cook Inlet area. Commercial fishers harvest numerous groundfish species including Pacific halibut, Pacific cod, sablefish, lingcod, and black rockfish (BOEM, 2016; ADF&G, 2018a). Species commercially harvested in the Cook Inlet area are octopus, razor clams, and scallops. Managers have divided commercial fisheries in Cook Inlet into two distinct management areas: the Upper Cook Inlet Management Area and the Lower Cook Inlet Management Area (ADF&G, 2018b). The Upper Cook Inlet Management Area is outside the Proposed Survey area and would not be impacted by the Proposed Survey.

The Lower Cook Inlet Management Area is located within the Proposed Survey area. It is comprised of all waters west of the longitude of Cape Fairfield, north of the latitude of Cape Douglas, and south of the latitude of Anchor Point. Commercially harvested chum and sockeye are the most economically valuable salmon in lower Cook Inlet. Commercial salmon fishing occurs in early June through mid-September. The estimated commercial salmon harvest for 2018 was 2.0 million salmon, including 381 Chinook, 370,460 sockeye, 15,387 silver, 1.6 million pink, and 48,729 chum salmon (ADF&G, 2018c).

Cook Inlet provides opportunity for commercial harvest of halibut, rockfish, and other groundfish. Authorities manage the Pacific Halibut Stock under the Pacific Halibut treaty between Canada and the United States. The lower Cook Inlet is within Pacific Halibut Regulatory Area 3A, which includes the ports of Homer, Kodiak, and Seward (IPHC, 2018). The commercial halibut season usually occurs from late March to early November.

Important stakeholders in these fisheries include two commercial fishing associations with oversight of activities in Cook Inlet. The Kenai Peninsula Fishermen’s Association and the United Cook Inlet Drift Association focus on activities in Cook Inlet and get involved with local issues and projects.

3.12.2 Impacts

Proposed Action

Seismic exploration activities utilizing vessels could have space-use conflicts with commercial fishing activities (BOEM, 2016). Seismic surveys can entangle buoy lines and longlines with consequent loss. The Proposed Survey would likely require temporary restricted access to specific areas in lower Cook

Inlet for commercial fishers. For safety, survey operators would attempt to maintain a standoff distance around the source vessel and its towed-streamer array and clear of other vessel traffic. This could result in short-term and localized space-use conflicts with commercial fishing vessels.

These effects could be readily mitigated with careful planning and timing with commercial fishery openings (Impact Assessment, Inc., 2004, p. 56). The majority of the seismic survey program occurs south of the gillnet area, thereby mitigating impacts to the commercial salmon fishery (HAK, 2018). If the Proposed Survey and the peak commercial fishing season overlap (for salmon, June to September), the primary impact would be from short-term and localized displacement or exclusion of commercial fishing boats from fishing grounds during survey operations. Commercial salmon and groundfish fisheries could be temporarily impacted by exclusion from the area of active seismic operations.

To further mitigate these impacts, the applicant has convened a stakeholder engagement program to enable survey operators and commercial fishers to clearly communicate schedules and timing of their activities, which would minimize or avoid space-use conflicts and vessel interference. The operator would also issue a Local Notice to Mariners, which would specify the survey dates and locations and recommended avoidance requirements for commercial fishers. Additionally, HAK has postponed their project to accommodate, to the extent practicable, the commercial fishing schedule.

Commercial salmon fishing occurs in early June through mid-September. Commercial halibut fishing opens much earlier in March. It is not possible to avoid overlap in timing of the Proposed Survey and the beginning of the commercial halibut and salmon seasons, so it would be paramount for the survey operators to coordinate early and often with the commercial fishers to minimize or avoid space-use conflicts.

Seismic activity could occur in areas where spawning migrations are occurring, and some fish may have to swim farther to avoid the noise on the way to their spawning grounds; however, it is unlikely to affect the timing or success of the runs or to have population level impacts (Section 3.6.2). Some fish may divert around the source of the sound. This could cause commercial fishers to temporarily miss opportunities to catch the diverted fish. There could be short-term and localized effects to commercial fishing.

BOEM estimates the increase in vessel activity and small changes in fish movement patterns from the Proposed Survey could result in spatially localized and short-term, thus minor, adverse impacts to commercial fishing.

No Action Alternative

Under the No Action Alternative, BOEM would not approve HAK's 2019 Permit Application and the Proposed Survey would not occur. There would be no adverse impacts to commercial fishing activities as a result of the Proposed Survey.

Cumulative Effects

Past, present, and reasonably foreseeable future activities (i.e., all other activities) that may have impacts on commercial fisheries in the lower Cook Inlet include offshore oil and gas exploration, development, production, and decommissioning activities (Section 3.1). Future activities also include small increases in vessel and aircraft traffic, offshore shipping and national security/military activities, scientific research, sport fishing, and regional recreation and tourism.

Effects from all other activities could include short-term and localized disruptions to commercial fisheries, temporary displacement of some commercial fishers, and temporary changes in how people

access commercial fisheries. Additional vessel traffic could temporarily impede commercial fish harvest because most traffic would occur during prime commercial fishing seasons. Pressure from small increases in sport fishing and recreation and tourism could have short-term and localized impacts to commercial fishing. In terms of a cumulative baseline, all other activities could have minor effects to commercial fishing during this one-year timeframe.

Effects from these activities could be exacerbated by impacts from climate change. Climate change could affect timing of fish migrations and spawning events. Changing environmental conditions could affect access to fishery resources and the timing of the commercial fishing season. A change in the timing of the fishing season and a shift in distribution or abundance of commercial species in lower Cook Inlet could adversely affect commercial fishing opportunities. Communities in the KPB could experience economic losses due to decreased or altered commercial fishing in the area.

The effects of climate change could be long-lasting and widespread and will continue much longer than the potential effects from the Proposed Survey. However, the short-lived Proposed Survey would not substantially increase the effects of climate change or combine with climate change to produce any synergistic effects (Section 3.4.2).

The Proposed Survey, similar to many of the other past, present, and reasonably foreseeable future activities listed above, would create some space-use conflicts that make it harder for commercial fishers to harvest the resources they need. However, there will still be alternative fishing grounds and other days in which to fish commercially in Cook Inlet, even when the conflicts contributed by the Proposed Survey are considered. While the Proposed Survey could make commercial fishing more difficult or time-consuming, BOEM expects that commercial fishers will still have ample opportunities to obtain the fish they need.

In conclusion, all other actions could have a minor impact on commercial fishing activities. When added to all other actions, the incremental impact or contribution of the Proposed Survey would be too small to raise the baseline effect above minor. This is because the Proposed Survey is short-term and would only affect part of one commercial fishing season.

3.13 Archaeological Resources

3.13.1 Affected Environment

Archaeological resources are any material remains of human life or activities that are at least 50 years of age and that are of archaeological interest (30 CFR 551.1). Historic resources include manmade objects or structures older than 50 years such as shipwrecks, submerged structures, and aircraft. There are 68 known wrecks, obstructions, or archaeological sites within Cook Inlet. Some losses may not have been reported if there were no survivors to report the loss, and no witnesses from nearby vessels or shore. BOEM prohibits disturbing archaeological resources while conducting survey activities.

3.13.2 Impacts

Proposed Action

The Proposed Survey by its design would not make contact with the seafloor. For that reason, the Proposed Survey would not have the potential to cause effects on historic properties. Thus, impacts to archaeological resources from the Proposed Survey are expected to be negligible.

No Action Alternative

Under the No Action Alternative, BOEM would not approve HAK's 2019 Seismic Survey Permit Application and the Proposed Survey would not occur. There would be no disturbance attributable to the Proposed Survey and no effects on archaeological resources.

Cumulative Effects

Due to the timing, type, and duration of this survey, the Proposed Survey would not be likely to add incremental effects on archaeological resources to those produced by past, present, or reasonably foreseeable future activities in the Proposed Survey area.

3.14 Environmental Justice

There is an important nexus between a subsistence way of life and environmental justice communities. The Council on Environmental Quality (CEQ) directs Federal agencies to consider populations with differential patterns of subsistence consumption of fish and wildlife. BOEM focused this environmental justice analysis on Section 4-4 of Executive Order 12898, entitled Subsistence Consumption of Fish and Wildlife, to address human populations with differential patterns of subsistence. Any high and adverse environmental effects to subsistence activities or resources from the Proposed Survey could disproportionately affect those communities or populations that depend most on subsistence resources (CEQ, 1997). Nikiski, Seldovia, Nanwalek, and Port Graham have disproportionately high consumption patterns of fish and wildlife and other subsistence resources compared to the Kenai Peninsula as a whole.

Overall, BOEM estimates that impacts to the following resources would range from negligible to minor: air quality, water quality; fish and invertebrates; birds; marine mammals; economy, subsistence activities, and harvest patterns. These effects do not constitute disproportionately high and adverse impacts to Nikiski, Seldovia, Nanwalek, and Port Graham. In conclusion, there would be no disproportionately high and adverse impacts to environmental justice communities from the Proposed Survey.

CHAPTER 4. CONSULTATION AND COORDINATION

4.1 Endangered Species Act Consultation

Section 7(a)(2) of the ESA requires Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the adverse modification of designated critical habitat. BOEM recently consulted with both USFWS and NMFS concerning the effects of oil and gas exploration activities in Cook Inlet (NMFS, 2017; USFWS, 2017). These consultations resulted in BOs that considered effects from, among other things, marine seismic surveys such as the one proposed here.

BOEM has determined that HAK's Proposed Survey is within the scope of activities analyzed in the USFWS BO (USFWS, 2017) and in the NMFS BO (NMFS, 2017) for oil and gas leasing and exploration activities in Cook Inlet. The USFWS BO provided BOEM with a non-jeopardy opinion, an incidental take statement, and non-discretionary RPMs and T&Cs. In a letter dated August 25, 2017, the USFWS provided revised RPMs and T&Cs. Upon review of the revised RPMs/T&Cs, BOEM determined that HAK's Proposed Survey could not comply with T&C 3.2. T&C 3.2 stated that no work could begin if sea otters were present within 2,154 m (1.3 miles) of the survey vessel, but it also included distances (radii) from the vessel in which could begin if noise levels were at or below certain thresholds. To clarify the acoustic thresholds and distances from the vessel that are necessary to avoid/minimize take of sea otters, BOEM reinitiated consultation on March 11, 2019. On May 22, 2019, the USFWS provided revised RPMs/T&Cs.

The NMFS BO provided BOEM with a non-jeopardy opinion, but deferred the issuance of an incidental take statement until a specific project(s) was (are) proposed. In 2018, HAK and Harvest applied to NMFS for an ITR to authorize take of listed and non-listed marine mammals associated with oil and gas activities in Cook Inlet. In a letter dated December 13, 2018, BOEM requested to be a co-action agency on NMFS' ESA consultation for listed marine mammals potentially affected by issuance of an MMPA authorization. NMFS completed the BO for the ITRs on June 18, 2019 (Hilcorp Alaska and Harvest Alaska Oil and Gas Activities, Cook Inlet, Alaska Incidental Take Regulations AKRO-2018-00381) (NMFS 2019).

4.2 Essential Fish Habitat Consultation

The Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801-1884) mandates the identification of Essential Fish Habitat (EFH) for managed species and requires Federal agencies to consult with NMFS on actions that may adversely affect EFH. The North Pacific Fishery Management Council (NPFMC) has produced several Fishery Management Plans (FMPs) that identify EFH for Alaska waters. Those FMPs relevant to the Proposed Survey area are for salmonids (NPFMC, 2012), GOA groundfish (NPFMC, 2015), and scallops (NPFMC, 2014). BOEM provided an EFH assessment to NMFS regarding the potential effects on EFH for Pacific salmon, groundfish, and scallops for Cook Inlet Lease Sale 244. The EFH consultation included the area of the current Proposed Survey and was completed on November 21, 2016. That consultation also included potential seismic activities of the type proposed here. NMFS did not provide any conservation recommendations. Therefore, BOEM considers its consultation obligations to be complete with respect to HAK's Proposed Survey.

4.3 National Historic Preservation Act (Section 106) Consultation

In accordance with the National Historic Preservation Act (NHPA) (54 USC § 300101 et seq.), Federal agencies are required to consider the effects of their undertakings on historic properties. The

implementing regulations for Section 106 of the NHPA, issued by the Advisory Council on Historic Preservation (36 CFR Part 800), specify the required review process. Based on the nature of HAK's Proposed Survey, the lack of potential impacts identified in Section 3.13, and previous communications with the State Historic Preservation Office (SHPO) (e.g., SHPO's concurrence that SAE's proposed 2014 seismic survey in lower Cook Inlet had no potential to cause effects to historic properties), BOEM has determined that HAK's Proposed Survey is not an undertaking that has the potential to cause effects on historic properties.

4.4 Public Involvement

BOEM notified the public of its receipt of the HAK 2018 G&G Seismic Survey Application on October 18, 2018 through its website. BOEM then commenced a review of the Permit Application to verify its completeness. A notice of preparation of an EA to evaluate the environmental impacts of the Proposed Action was published on January 28, 2019, on *https://www.reglations.gov* (docket BOEM-2910-0002), and posted on the Alaska OCS Region website. The notice stated that BOEM was seeking public involvement for preparing an EA of a G&G 3D seismic survey in Cook Inlet. Comments were accepted through February 7, 2019. BOEM received no public comments, but the USFWS agreed to be a cooperating agency.

Other agencies also provided opportunities for public involvement in their processes. On October 26, 2018, NMFS published a federal register notice (83 FR 54088) seeking public comments on HAK's request for development of ITRs in Cook Inlet for oil and gas activities. Similarly, on March 19, 2019, the USFWS published a notice (84 FR 10224) seeking public comments on HAK's request for ITRs.

4.5 Preparers

The individuals responsible for preparing this EA are listed below:

Name	**Role in NEPA Process**
Jeff Brooks	Subsistence, Fishing, Environmental Justice
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Maureen deZeeuw	Birds
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Virgilio Maisonet-Montanez	Air Quality, NEPA Coordinator
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Shannon Vivian	Technical Writer/Editor

CHAPTER 5. REFERENCES

Abbriano, R.M., M.M. Carranza, K.L. Sero, S.M. Snyder, and P.J. Franks. 2011. Deepwater Horizon Oil Spill. *Oceanography* 24(3): 294.

Agness, A.M, J.F. Piatt, J.C. Ha and G.R. Vanblaricom. 2008. Effects of Vessel Activity on the Near-Shore Ecology of Kittlitz's Murrelets (*Brachyramphus brevirostris*) in Glacier Bay, Alaska. *Auk* 125: 346–353.

Alaska Commercial Fisheries Entry Commission (CFEC). 2016. Permit and Fishing Activity by Year, State, Census Area, or City. http://www.cfec.state.ak.us/gpbycen/2016/122.htm.

Alaska Department of Environmental Conservation (ADEC). 2010. Alaska's Final 2010 Integrated Water Quality Monitoring and Assessment Report, July 15, 2010.

ADF&G. 2018a. Commercial Fisheries Overview, Cook Inlet Management Area. 2017. http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareacookinlet.main. Accessed on August 16, 2018.

ADF&G. 2018b. Commercial Fisheries. Information by Area. Upper Cook Inlet Management Area. http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareauci.main. Accessed on August 16, 2018.

ADF&G, 2018c. Lower Cook Inlet Salmon Season Summary. Juneau, AK: Division of Commercial Fisheries, Alaska Department of Fish and Game.

Alaska Department of Labor and Workforce Development (ADOLWD). 2016. Alaska Local and Regional Information: Kenai Peninsula Borough. State of Alaska, Department of Labor and Workforce Development, Research and Analysis. http://live.laborstats.alaska.gov/alari/details.cfm?yr=2016&dst=01&dst=03&dst=04&dst=02&dst=06&dst=08&dst=09&dst=11&dst=07&dst=13&r=2&b=12&p=0.

Bain, D.E. and R.W. Williams. 2006. Long-Range Effects of Airgun Noise on Marine Mammals: Responses as a Function of Received Sound Level and Distance. Paper presented to the International Whaling Commission Scientific Committee, SC/58/E35.

Bodkin, J.L., D.H. Monson, and G.E. Esslinger. 2003. A Report on the Results of the 2002 Kenai Peninsula and Lower Cook Inlet Aerial Sea Otter Survey. USGS Report. 10pp.

Boveng, P.L., J.M. London, R.A. Montgomery, and J.M. Ver Hoef. 2011. Distribution and abundance of harbor seals in Cook Inlet, Alaska. Task I: Aerial surveys of seals ashore, 2003-2007. Final Report. BOEM Report 2011-063. Bureau of Ocean Energy Management, Alaska Outer Continental Shelf Region, Anchorage, Alaska, USA. 46 pp.

Boveng, P.L., J.M. London, and J.M. VerHoef. 2012. Distribution and Abundance of Harbor Seals in Cook Inlet, Alaska. Task III: Movements, Marine Habitat use, Diving Behavior and Population Structure, 2004-2006. Final Report BOEM Report 2012-065. Anchorage, Alaska: Bureau of Ocean Energy Management, Alaska Outer Continental Shelf Region.

Brabets, T.P. and M.S. Whitman. 2004. Water-Quality, Biological, and Physical-Habitat Conditions at Fixed Sites in the Cook Inlet Basin, Alaska, National Water – Quality Assessment Study Unit,

October 1998-September 2001. U.S. Geological Survey Scientific Investigations Report 2004-5021. 101 pp.

Brower, W.A., Jr., R.G. Baldwin, Jr., C.N. Williams, J.L. Wise, and L.D. Leslie. 1988. Climatic Atlas of the Outer Continental Shelf Waters and Coastal Regions of Alaska, Vol. I, Gulf of Alaska. OCS Report, MMS 87-0013 and NAVAIR 50-1C-553. Asheville, NC and Anchorage, AK: USDOD, NOCD; USDOI, MMS, Alaska OCS Region; and USDOC, NOAA, NOS, 530 pp.

Bruinzeel, L.W., J. van Belle, and L. Davids. 2009. The Impact of Conventional Illumination of Offshore Platforms in the North Sea on Migratory Bird Populations. A&W-rapport 1227. Altenburg & Wymenga Ecologisch Onderzoek, Feanwalden. 49 pp.

Calambokidis, J., G.H. Steiger, J.M. Straley, T. Quinn, L.M. Herman, S. Cerchio, D.R. Salden et al. 1997. Abundance and Population Structure of Humpback Whales in the North Pacific Basin. Final Contract Report 50ABNF500113 to Southwest Fisheries Science Center, La Jolla, CA.

Carretta, James V., Karin. A. Forney, Erin M. Oleson, David W. Weller, Aimee R. Lang, Jason Baker, Marcia M. Muto, Brad Hanson, Anthony J. Orr, Harriet Huber, Mark S. Lowry, Jay Barlow, Jeffrey E. Moore, Deanna Lynch, Lilian Carswell, and Robert L. Brownell Jr. 2018. U.S. Pacific Marine Mammal Stock Assessments: 2017. US Department of Commerce. NOAA Technical Memorandum NMFS-SWFSC-602. https://doi.org/10.7289/V5/TM-SWFSC-602

Calkins, D.G. 1989. Status of Beluga Whales in Cook Inlet. Chp. Anchorage, AK, February 7-8.

Cooney, R.T. 1987. Zooplankton. *In* The Gulf of Alaska: Physical Environment and Biological Resources D.W. Hood, and S.T. Zimmerman (eds.). OCS study, MMS 86-0095. Anchorage, AK: USDOI, BOEM, Alaska OCS Region. pp. 284-303.

Council on Environmental Quality (CEQ). 1997. Environmental Justice: Guidance under the National Environmental Policy Act. Washington, DC: CEQ, Executive Office of the President of the United States, 34 pp.

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

Day, R.D., R.D. McCauley, Q.P. Fitzgibbon, K. Hartmann and J.M. Semmens. 2017. Exposure to seismic air gun signals causes physiological harm and alters behavior in the scallop *Pecten fumatus*. Proceedings of the National Academy of Sciences. 114(40), pp.E8537-E8546.

Day, R.H., A.K. Prichard, and J.R. Rose. 2005. Migration and collision avoidance of eiders and other birds at Northstar Island, Alaska, 2001 – 2004: Final report. Prepared for BP Exploration (Alaska), Inc., Anchorage, Alaska, by ABR, Inc.—Environmental Research and Services, Fairbanks, Alaska. http://www.arlis.org/docs/vol1/H/887766891.pdf

Day, R.H., A.K. Prichard., J.R. Rose, B. Streever, and T. Swem. 2017. Effects of a Hazing-Light System on Migration and collision Avoidance of Eiders at an Artificial Oil-Production Island, Arctic Alaska. Arctic 70(1) 13-24.

Det Norske Veritas (DNV). 2011. Guidance for the environmental class notations clean and clean design. Det Norske Veritas, Høvik, Norway.

Dragoo, D.E., H.M. Renner, and D.B. Irons. Breeding Status, Population Trends and Diets of Seabirds in Alaska, 2009. Unpublished Report by Alaska Maritime National Wildlife Refuge, U.S. Fish and Wildlife Service. 116 pp.

Ellis, J.I., S.I. Wilhelm, A. Hedd, G.S. Fraser, G.J. Robertson, J.F. Rail, M. Fowler and K.H. Morgan. 2013. Mortality of Migratory Birds from Marine Commercial Fisheries and Offshore Oil and Gas Production in Canada. Avian Conserv. Ecol. 8(2): 4.

Erikson, D. 1977. Distribution, abundance, migration and breeding locations of marine birds – Lower Cook Inlet, Alaska, 1976. Vol. VIII in L.L. Trasky, L.B. Flagg, and D.C. Burbank, eds. Environmental studies of Kachemak Bay and Lower Cook Inlet. *Unpublished report*, Alaska Dept. of Fish and Game, Anchorage, AK. XII vols.

Estes, J.A., M.T. Tinker, T.M. Williams, and D.F. Doak. 1998. Killer Whale Predation on Sea Otters Linking Oceanic and Nearshore Ecosystems. Science. 282:473-476.

Ezer, T., J.R. Ashford, C.M. Jones, B.A. Mahoney, and R.C. Hobbs. 2013. Physical–biological Interactions in a Subarctic Estuary: How do Environmental and Physical Factors Impact the Movement and Survival of Beluga Whales in Cook Inlet, Alaska? *Journal of Marine Systems*. 111–112(0): 120-129.

Fall, J. A., and D. Koster. 2017. Subsistence Harvest of Pacific Halibut in Alaska, 2016. Draft Technical Paper No. 436. Anchorage, AK: ADF&G, Division of Subsistence, 118 pp.

Fechhelm, R.G., W.J. Wilson, W.B. Griffiths, T.B. Stables, and D.A. Marino. 1999. Forage Fish Assessment in Cook Inlet Oil and Gas Development Areas, 1997-1998. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, and BioSonics, Inc., Seattle, WA, for USDOI, Minerals Management Service, Anchorage, AK.

Feder, H.M. and S.C. Jewett. 1987. The Subtidal Benthos. *In* The Gulf of Alaska: Physical Environment and Biological Resources, D.W. Hood and S.T. Zimmerman (eds.). USDOC. Pp. 347-396.

Fewtrell, J.L. and R.D. McCauley. 2012. Impact of Air Gun Noise on the Behaviour of Marine Fish and Squid. *Marine Pollution Bulletin* 64(5), pp.984-993.

Foster, N.R, D. Lees, S.C. Lindstrom, and S. Saupe. 2010. Evaluating a Potential Relict Arctic Invertebrate and Algal Community on the West Side of Cook Inlet. Prepared by MMS and UAF School of Fisheries & Ocean Sciences. Final Report OCS Study MMS 2010-005. Anchorage, AK. USDOI, BOEM. Alaska OCS Region.79 pp. www.data.boem.gov/PI/PDFImages/ESPIS/4/5049.pdf.

Glass, R.L., T.P., Brabets, S.A. Franzel, M.S. Whitman, and T. Ourso. 2004. Water Quality in the Cook Inlet Basin, Alaska, 1998-2001. U.S. Dept. of the Interior, U.S. Geological Survey (USDOI, USGS). Circular 1240. 26 pp.+app.

Greene, C.R. and S.E. Moore. 1995. Man-made Noise. In Marine Mammals and Noise. Edited by J. W. Richardson, C. R. Jr Greene, C. I. Malme and D. Thomson. pp. 101-158. San Diego, CA: Academic Press, Inc.

Greer, R.D., R.H. Day, and R.S. Bergman. 2010. Literature Review, Synthesis, and Design of Monitoring of Ambient Artificial Light Intensity on the OCS Regarding Potential Effects on Resident Marine

Fauna. Prepared for U.S. Minerals Management Service, Anchorage, Alaska, by Golder Associates, Mount Laurel, New Jersey, ABR, Inc.—Environmental Research & Services, Fairbanks, Alaska, and Rolf Bergman Consulting, Cleveland Heights, Ohio. Contract No. 1435-01-05-CT-39072. http://www.boem.gov/uploadedFiles/BOEM/BOEM_Newsroom/Library/Publications/MMS_2007-055.pdf

Hansen, K.A., A. Maxwell, U. Siebert, O.N. Larsen and M. Wahlberg. 2017. Great Cormorants (*Phalacrocorax carbo*) can Detect Auditory Cues While Diving. Sci Nat 104:45.

Hentze, N.T. 2006. The Effects of Boat Disturbance on Seabirds off Southwestern Vancouver Island, British Columbia. *Unpublished* Bachelor of Science Thesis, University of Victoria. 54 pp.

Hilcorp Alaska, LLC (HAK). 2018. Lower Cook Inlet 3D Seismic Survey, 2019. Anchorage, AK: Hilcorp Alaska, LLC, 81 pp.

Hobbs, R.C. and J.M. Waite. 2010. Abundance of Harbor Porpoise (*Phocoena Phocoena*) in Three Alaskan Regions, Corrected for Observer Errors due to Perception Bias and Species Misidentification, and Corrected for Animals Submerged from View. Fishery Bulletin. 108(3): 251-267.

Impact Assessment, Inc. 2004. A Study of the Drift Gillnet Fishery and Oil/Gas Industry Interactions and Mitigation Possibilities in Cook Inlet. OCS Study MMS 2004-038. La Jolla, CA: Impact Assessment, Inc., 105 pp.

International Pacific Halibut Commission (IPHC). 2018. Directed – IPHC Regulatory Areas 2C, 3, 4. https://iphc.int/management/fisheries/directed-commercial-fisheries/directed-iphc-regulatory-area-2c-3-and-4. Accessed on February 6, 2019.

Johnson, M.A. 2008. Water and Ice Dynamics in Cook Inlet. OCS Study MMS 2008-061. Fairbanks, AK: University of Alaska Coastal Marine Institute and USDOI, MMS, Alaska OCS Region. 106 pp.

Jones, B., and M. L. Kostick (Eds.). 2016. The Harvest and Use of Wild Resources in Nikiski, Seldovia, Nanwalek, and Port Graham, Alaska, 2014. Technical Paper No. 420. Anchorage, AK: ADF&G, Division of Subsistence, 493 pp.

Kahlert, J. 2006. Factors Affecting Escape Behaviour of Moulting Greylag Geese (*Anser anser*). Journal of Ornith 147(4) 569.

Kuletz, K. J., M.C. Ferguson, B. Hurley, A.E. Gall, E.A. Labunski, and T.C. Morgan. 2015. Seasonal Spatial Patterns in Seabird and Marine Mammal Distribution in the Eastern Chukchi and Western Beaufort Seas: Identifying Biologically Important Pelagic Areas. Progress in Oceanography 136: 175-200.

Kuletz, K.J., S.G. Speckman, J.F. Piatt, and E.A. Labunski. 2011. Distribution, Population Status and Trends of Kittlitz's Murrelet *Brachyramphus brevirostris* in Lower Cook Inlet and Kachemak Bay, Alaska. Marine Ornithology 39: 85-95.

LaBelle, J.C., J.L. Wise, R.F. Voelker, R.H. Shulze, and G.G. Wohl. 1983. Alaska Marine Ice Atlas. Anchorage, AK: University of Alaska, Arctic Environmental Information and Data Center, 302pp.

Lacroix, D.L., R.B. Lanctot, J.A. Reed, and T.L. McDonald. 2003. Effect of Underwater Seismic Surveys on Molting Male Long-Tailed Ducks in the Beaufort Sea, Alaska. Can J Zool 81: 1862-1875.

Laidre, K.L., K.E. Shelden, D.J. Rugh, and B.A. Mahoney. 2000. Beluga, Delphinapterus Leucas, Distribution and Survey Effort in the Gulf of Alaska. Marine Fisheries Review. 62(3): 27-36.

Lees, D.C., and W.B. Driskell. 2006. Intertidal Reconnaissance Survey to Assess Composition, Distribution, and Habitat of Marine/Estuarine Infauna in Soft Sediments in the Southwest Alaska Network: Natural Resource Technical Report, National Park Service. Anchorage: National Park Service, NPS/AKRSWAN/NRTR-2006/01.

Lees, D.C., J.P. Houghton, D.E. Erickson, W.B. Driskell, and D.E. Boettcher. 1980. Ecological Studies of Intertidal and Shallow Subtidal Habitats in Lower Cook Inlet, Alaska. USDOC, NOAA, OCSEAP, Final Rep. 44(1986):1-436.

Lensink, C.J. 1962. The History and Status of Sea Otters in Alaska. Ph.D. Dissertation. Purdue, IN: Purdue University, 188 pp.

McCauley R.D., R.D. Day, K.M. Swadling, Q.P. Fitzgibbon, R.A. Watson, and J.M. Semmens. 2017. Widely used marine seismic survey air gun operations negatively impact zooplankton. *Nature Ecology & Evolution* 1(7): 0195.

McCauley, R.D., J. Fewtrell, and A.N. Popper. 2003. High Intensity Anthropogenic Sound Damages Fish Ears. The Journal of the Acoustical Society of America. 113(1): 638-642.

Merkel, F.R. and K.L. Johansen. 2011. Light-Induced Bird Strikes on Vessels in Southwest Greenland. Marine Pollution Bulletin 62: 2330-2336.

Miles, W., S. Money, R. Luxmoore, and R.W. Furness. 2010. Effects of Artificial Lights and Moonlight on Petrels at St Kilda. Bird Study, 57:2, 244-251.

Montevecchi, W.A., F.K. Wiese, G. Davoren, A.W. Diamond, F. Huettmann and J. Linke. 1999. Seabird attraction to offshore platforms and seabird monitoring from offshore support vessels and other ships: Literature review and monitoring designs. Report prepared for Canadian Association of Petroleum Producers, Calgary, AB. 52 pp.

Montgomery, R., J. Ver Hoef, and P. Boveng. 2007. Spatial Modeling of Haul-Out Site use by Harbor Seals in Cook Inlet, Alaska. Marine Ecology Progress Series. 341: 257-264.

Moore, S.E., K.M. Wynne, J.C. Kinney, and J.M. Grebmeier. 2007. Gray Whale Occurrence and Forage Southeast of Kodiak, Island, Alaska. Marine Mammal Science. 23(2): 419-428.

Moulton. 1997. Early Marine Residence, Growth, and Feeding by Juvenile Salmon in Northern Cook Inlet, Alaska. Alaska Fishery Research Bulletin 4(2): 154-177.

Mulherin, N.D., III W.B. Tucker, O.P. Smith, and W.J. Lee. 2001. Marine Ice Atlas for Cook Inlet, Alaska. ERDC/CRREL Technical Report 01-10. Hanover, NH: U.S. Army Corps of Engineers, CRREL and USDOC, NOAA, 155 pp.

Muto, M.M., V.T. Helker, R.P. Angliss, B.A. Allen, P.L. Boveng, J.M. Breiwick, M.F. Cameron, P.J. Clapham, S.P. Dahle, M.E. Dahlheim, B.S. Fadely, M.C. Ferguson, L.W. Fritz, R.C. Hobbs, Y.V.

Ivashchenko, A.S. Kennedy, J.M. London, S.A. Mizroch, R.R. Ream, E.L. Richmond, K.E.W. Shelden, R.G. Towell, P.R. Wade, J.M. Waite, and A.N. Zerbini. 2018. Alaska Marine Mammal Stock Assessments, 2017. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-AFSC-378, 382 p.

National Marine Fisheries Service (NMFS). 2003. Acoustic Measurements in Cook Inlet, Alaska during August 2001. Greeneridge Report 271-2.

NMFS. 2017. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion for Lease Sale 244, Cook Inlet, Alaska 2017-2022. NMFS Consultation Number AKR/2016/9580. 302pp.

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

NMFS. 2019. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion for Hilcorp Alaska and Harvest Alaska Oil and Gas Activities, Cook Inlet, Alaska. NMFS Consultation Number AKRO/2018/00381. 261 p.

Nemeth, M.J., C.C. Kaplan, A. Prevel-Ramos, G.D. Wade, D.M. Savarese, and C.D. Lyons. 2007. Baseline Studies of Marine Fish and Mammals in Upper Cook Inlet, April through October 2006. LGL Final Report P887. Prepared by LGL Alaska Research Associates, Inc., for DRven Corporation. 191 pp.

North Pacific Fishery Management Council (NPFMC). 2012. Fishery Management Plan for the Salmon Fisheries in the EEZ off Alaska. North Pacific Fishery Management Council, Anchorage, AK. 59 pp. + app.

NPFMC. 2014. Fishery Management Plan for the Scallop Fishery off Alaska. North Pacific Fishery Management Council, Anchorage, AK. 52 pp. + app.

NPFMC. 2015. Fishery Management Plan for Groundfish of the GoA. North Pacific Fishery Management Council, Anchorage, AK. 129 pp. + app.

O'Corry-Crowe, G., R. Suydam, A. Rosenberg, K. Frost, and A. Dizon. 1997. Phylogeography, Population Structure and Dispersal Patterns of the Beluga Whale, *Delphinapterus Leucas,* in the Western Nearctic Revealed by Mitochondrial DNA. Molecular Ecology. 6(10): 955-970.

Okkonen, S., S. Pegau, and S. Saupe. 2009. Seasonality of Boundary Conditions for Cook Inlet, Alaska. OCS Study MMS 2009-041. Fairbanks, AK: Department of the Interior, MMS, Alaska OCS Region and Coastal Marine Institute, University of Alaska Fairbanks. 64 pp.

Owl Ridge. 2014. BOEM Environmental Monitoring of Marine Mammals in Conjunction with SAE's Proposed 3D Seismic Surveys in Cook Inlet, Alaska, 2015. Owl Ridge Natural Resource Consultants, Inc. for SAExploration, Inc. Anchorage, AK.

Pentec Environmental, Inc. 2011. Pebble Project Environmental Baseline Document 2004 through 2008. Chapter 42. Marine Benthos: Cook Inlet Drainages. 151 pp. https://pebbleresearch.files.wordpress.com/2014/03/ch_42_marine_benthos_ci.pdf.

Piatt, J.F. 2002. Response of Seabirds to Fluctuations in Forage Fish Density. Final Report to Exxon Valdez Oil Spill Trustee Council (Restoration Project 00163M) and Minerals Management Service (Alaska OCS Region). Alaska Science Center. OCS Study MMS 2002-068. Anchorage, Alaska: U.S. Dept. Interior, USGS, Alaska Science Center for Minerals Management Service, Alaska OCS.

Piatt, J.F. 1994. Monitoring Seabird Populations in Areas of Oil and Gas Development on the Alaskan Continental Shelf: Oceanic, Shelf and Coastal Seabird Assemblages at the Mouth of a Tidally Mixed Estuary (Cook Inlet, Alaska). Final Report for Minerals Management Service (OCS Study MMS 93-0072), National Biological Service, USGS, Anchorage, AK. 69 pp.

Piatt, J.F., G. Drew, T. Van Pelt, A. Abookire, A. Nielsen, M. Shultz, and A. Kitaysky. 1999. Biological effects of the 1997/1998 ENSO in Cook Inlet, AK. PICES Scientific Report 10:93-99.

Piatt, J.F. and A.M.A. Harding. 2007. Population Ecology of Seabirds in Cook Inlet. Pp. 335-352 in: Robert Spies (ed.), Long-term Ecological Change in the Northern Gulf of Alaska. Elsevier, Amsterdam.

Polarcus. 2018. Polarcus Limited 2018 Prospectus. ABG Sundal Collier, ASA and DMB Markets, Managers. March 21, 2018.

Renner, H. 2016. Personal Communication (telephone conversation) between Heather Renner, Alaska Maritime National Wildlife Refuge, USFWS, and Maureen de Zeeuw, BOEM, Anchorage, Alaska, on October 13, 2016.

Renner, M., K.J. Kuletz, and E.A. Labunski. 2017. Seasonality of Seabird Distribution in Lower Cook Inlet: Final Report. *Unpublished report prepared by* Tern Again Consulting and Migratory Bird Management, U.S. Fish and Wildlife Service, Anchorage, Alaska. OCS Study BOEM 2017-011. 38pp.

Rice, D.W. and A.A. Wolman. 1971. The Life History and Ecology of the Gray Whale (*Eschrichtius Robustus*). American Society of Mammology Special Publication. 3:1-142.

Rice, D.W., A.A. Wolman, and H.W. Braham. 1984. The Gray Whale, *Eschrichtius Robustus*. Marine Fisheries Review. 46(4):7-14.

Richardson, W.J., C.R.J. Greene, J.S. Hanna, W.R. Koski, G.W. Miller, N.J. Patenaude, M.A. Smultea, R. Blaylock, R. Elliott, and B. Würsig. 1995. Acoustic Effects of Oil Production Activities on Bowhead and White Whales Visible during Spring Migration Near Pt. Barrow, Alaska – 1991 and 1994 Phases. MMS 95-0051 / LGL Rep. TA954 / NTIS PB98-107667. King City, Ontario: LGL Ltd. for U.S. Minerals Management Service.

Richardson, W.J. 1995. Chapter 9 - Documented Disturbance Reactions. In Marine Mammals and Noise. Edited by W.J. Richardson, C.R. Jr. Greene, C.I. Malme, and D.H. Thomson. pp. 241- 324. San Diego, CA: Academic Press.

Riedman, M.L. and J.A. Estes. 1990. The Sea Otter (*Enhydra lutris*): Behavior, Ecology and Natural History. Biological Report 90(14). Anchorage, AK: USDOI, Fish and Wildlife Service, 127 pp.

Ronconi, R.A., K.A. Allard, and P.D. Taylor. 2015. Bird Interactions with Offshore Oil and Gas Platforms: Review of Impacts and Monitoring Techniques. Journal of Environmental Management. 147: 34-45.

Rugh, D.J., K.E. Shelden, and B.A. Mahoney. 2000. Distribution of Belugas, *Delphinapterus Leucas*, in Cook Inlet, Alaska, during June/July 1993–2000. Marine Fisheries Review. 62(3): 6-21.

Rugh, D.J., K.E. Shelden, C.L. Sims, B.A. Mahoney, B.K. Smith, L. Litzky, and R.C. Hobbs. 2005. Aerial Surveys of Belugas in Cook Inlet, Alaska, June 2001, 2002, 2003, and 2004. NOAA Technical Memorandum NMFS-AFSC-149. Anchorage, AK: US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, National Marine Mammal Laboratory, Alaska Fisheries Science Center.

Rumble, J., E. Russ, and C. Russ. 2016. Cook Inlet Area groundfish management report, 2012-2015. Alaska Department of Fish and Game, Fishery Management Report No. 16-29, Anchorage.

SAE. 2014. BOEM Environmental Monitoring of Marine Mammals in Conjunction with SAE's Proposed 3D Seismic Surveys in Cook Inlet, Alaska, 2015. Prepared for SAExploration, Anchorage, Alaska. October 2014.

Safine, D.E. 2005. Breeding Ecology of White-Winged Scoters on the Yukon Flats, Alaska. *Unpublished* Master of Science Thesis, University of Alaska Fairbanks. 114 pages.

Schwemmer, P., B. Mendel, N. Sonntag, V. Dierschke, and S. Garthe. 2011. Effects of Ship Traffic on Seabirds in Offshore Waters: Implications for Marine Conservation and Spatial Planning. *Ecological Applications.* 21(5):1851-1860.

Saulitis, E., C. Matkin, L. Barrett-Lennard, K. Heise, and G. Ellis. 2000. Foraging Strategies of Sympatric Killer Whale (*Orcinus Orca*) Populations in Prince William Sound, Alaska. Marine Mammal Science. 16(1): 94-109.

Saupe, S.M., J. Gendron, and D. Dasher. 2005. National Coastal Assessment Program: The Condition of Southcentral Alaska Coastal Bays and Estuaries. Juneau, AK: ADEC. 136 pp.

Schneider, K.B. 1976. Assessment of the Abundance and Distribution of Sea Otters along the Kenai Peninsula, Kamishak Bay and the Kodiak Archipelago. OCSEAP Final Reports of Principal Investigators, Vol. 37. Boulder, CO and Anchorage, AK: USDOC, NOAA and USDOI, BLM.

Shelden, K.E., D.J. Rugh, B. Mahoney, and M.E. Dahlheim. 2003. Killer Whale Predation on Belugas in Cook Inlet, Alaska: Implications for a Depleted Population. Marine Mammal Science. 19(3): 529-544.

Shulski, M. and G. Wendler. 2007. The Climate of Alaska. University of Alaska Press: Fairbanks, Alaska.

Speckman, S.G. and J.F. Piatt. 2000. Historic and Current use of Lower Cook Inlet, Alaska, by Belugas, *Delphinapterus Leucas*. Marine Fisheries Review. 62(3): 22-26.

Springer, A.M. and S.G. Speckman. 1997. A Forage Fish is What? Summary of the Symposium. In: Baxter B, Mecklenberg CW (eds) Forage fishes in Marine Ecosystems. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems. Alaska Sea Grant College Program Report No. 97-01. University of Alaska Fairbanks, AK, p 773–805.

Strom, S.L., K.A. Fredrickson, and K.J. Bright. 2016. Spring Phytoplankton in the Eastern Coastal Gulf of Alaska: Photosynthesis and Production during High and Low Bloom Years. Deep-Sea Research II 132:107-121.

Trowbridge, C. E., and K. J. Goldman. 2006. 2006 review of Cook Inlet Area Commercial Fisheries for Dungeness Crab, Shrimp and Miscellaneous Shellfish Fisheries: A Report to the Alaska Board of Fisheries. Vol. Special Publication Number 06-09. Anchorage, AK: Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services.

Turnpenny, A.W.H. and J.R. Nedwell. 1994. The Effects on Marine Fish, Diving Mammals and Birds of Underwater Sound Generated by Seismic Surveys. Consultancy Report, FCR 089/94. Fawley Aquatic Research Laboratories Ltd.

U.S. Department of Commerce, Bureau of Economic Analysis (BEA). 2018. Regional Data, GDP and Personal Income Interactive Data Tables. https://apps.bea.gov/itable/iTable.cfm?ReqID=70&step=1 Accessed: Feb. 4, 2019.

U.S. Department of the Interior, Bureau of Ocean Energy Management (BOEM). 2016. Final Environmental Impact Statement. OCS EIS/EA BOEM 2016-069. Outer Continental Shelf, Cook Inlet Planning Area, Oil and Gas Lease Sale 244 in the Cook Inlet, Alaska. Anchorage, AK: USDOI, BOEM, Alaska OCS Region.

U.S. Environmental Protection Agency (EPA). 2018. EPA Greenhouse Gas Reporting Program (GHGRP) https://www.epa.gov/ghgreporting Accessed March 14, 2019.

USDOI, Fish and Wildlife Service (USFWS). 2002. Steller's Eider Recovery Plan. Fairbanks, AK: USFWS. 29 pp.

USFWS. 2011. Action plan for White-Winged Scoter. U.S. Fish and Wildlife Service, Anchorage, Alaska. *Unpublished report*. 43 pp. + appendices.

USFWS. 2012. Biological Opinion for Diamond Point Granite Rock Quarry. Prepared by: Anchorage Fish and Wildlife Field Office and the United States Fish and Wildlife Service. 93pp. +App.

USFWS. 2014a. Alaska Marine Mammal Stock Assessments, 2013. Northern Sea Otter (*Enhydra lutris kenyoni*), Revised April 2014. U.S. Department of Commerce, NOAA Technical Memorandum. http://www.fws.gov/alaska/fisheries/mmm/stock/stock.htm

USFWS, 2014b. Environmental Assessment for Issuance of an Incidental Harassment Authorization to SAExploration, Inc., for the Take of Sea Otters Incidental to a 3D Seismic Survey in Cook Inlet, Alaska. Prepared by U.S. Fish and Wildlife Service, Alaska Region, Marine Mammal Management, Anchorage, AK. July 2014.

USFWS. 2017. Biological Opinion for the Oil and Gas Activities associated with Lease Sale 244. Anchorage, AK: Anchorage Fish and Wildlife Conservation Office. 165pp.

Wiese, F.K., W.A. Montevecchi, G.K. Davoren, F. Huettmann, A.W. Diamond, and J. Linke. 2001. Seabirds at Risk Around Offshore Oil Platforms in the North-West Atlantic. Marine Pollution Bulletin 42(12) 1285-1290.

Zador, S. and Yasumisshi, E., eds. 2018. Ecosystem Status Report 2018: Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK. 194 pp.

Von Biela, V.R., M.L. Arimitsu, J.F. Piatt, B. Heflin, S.K. Schoen, J.L. Trowbridge, and C.M. Clawson. 2019. Extreme Reduction in Nutritional Value of a Key Forage Fish during the Pacific Marine Heatwave of 2014-2016. Mar Ecol Prog Ser 613:171-182.

Zerbini, A.N., J.M. Waite, J.L. Laake, and P.R. Wade. 2006. Abundance, Trends and Distribution of Baleen Whales Off Western Alaska and the Central Aleutian Islands. Deep Sea Research Part I: Oceanographic Research Papers. 53(11): 1772-1790.

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APPENDIX A

Marine Mammal Monitoring and Mitigation Plan

MARINE MAMMAL MONITORING AND MITIGATION PLAN
FOR
HILCORP ALASKA AND HARVEST ALASKA
OIL AND GAS ACTVITIES
COOK INLET, ALASKA
YEAR 1: APRIL 1, 2019-MARCH 31, 2020

Prepared for

Hilcorp Alaska, LLC

and

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January 28, 2019

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

2D	two-dimensional
3D	three-dimensional
4MP	Marine Mammal Monitoring and Mitigation Plan
AGL	above ground level
AOGCC	Alaska Oil and Gas Conservation Commission
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety Environment and Enforcement
cui	cubic inches
dB re 1 µPa	decibels referenced to one microPascal
EZ	Exclusion Zone
ft	feet
Harvest Alaska	Harvest Alaska, LLC
Hilcorp Alaska	Hilcorp Alaska, LLC
hrs	hours
IHA	Incidental Harassment Authorizations
ITR	Incidental Take Regulations
kg	kilograms
km	kilometers
lbs	pounds
L_{pk}	peak level
LOA	Letters of Authorization
m	meters
MMPA	Marine Mammal Protection Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
PAM	passive acoustic monitoring
PSO	Protected Species Observer
PTS	permanent threshold shift
rms	root-mean-square
s	seconds
SEL	sound exposure level
SPL	sound pressure level
SSV	sound source verification
SZ	Safety Zone
TTS	temporary threshold shift
UAS	Unmanned Aerial System
VHF	very high frequency

1.0 INTRODUCTION

Hilcorp Alaska, LLC (Hilcorp Alaska) and Harvest Alaska, LLC (Harvest Alaska) hereinafter referred to jointly as the "Applicant" hereby petitioned the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS) to promulgate regulations pursuant to Section 101(a)(5) of the Marine Mammal Protection Act (MMPA) for the non-lethal unintentional taking of small numbers of marine mammals incidental to oil and gas exploration, development, and production activities in Cook Inlet, Alaska for the period of five years beginning April 1, 2019 extending through April 1, 2024. The Applicant hereby requests a Letter of Authorization (LOA) for activities in the first year (Year 1) under the promulgated incidental take regulations (ITRs) for the period of April 1, 2019 through March 31, 2020.

The geographic area of activity covers a total of approximately 2.7 million acres (10,926 square kilometers [km^2]) in Cook Inlet. It includes land and adjacent waters in Cook Inlet including both State of Alaska and Federal Bureau of Ocean Energy Management (BOEM) Outer Continental Shelf (OCS) waters (Figure 1). The area extends from the north at the Susitna Delta on the west side and Point Possession on the east side of Cook Inlet to southwest of Homer in lower Cook Inlet.

This document summarizes the marine mammal monitoring and mitigation plan (4MP) for activities planned for the period of April 1, 2019 through March 31, 2020. Marine mammal monitoring and mitigation methods have been designed to meet the requirements and objectives which will be specified in the Year 1 Letter of Authorization (LOA). As this current 4MP is submitted prior to the promulgation of the incidental take regulations (ITR), the Applicant recognizes some details of the 4MP may change upon receipt of the LOAs.

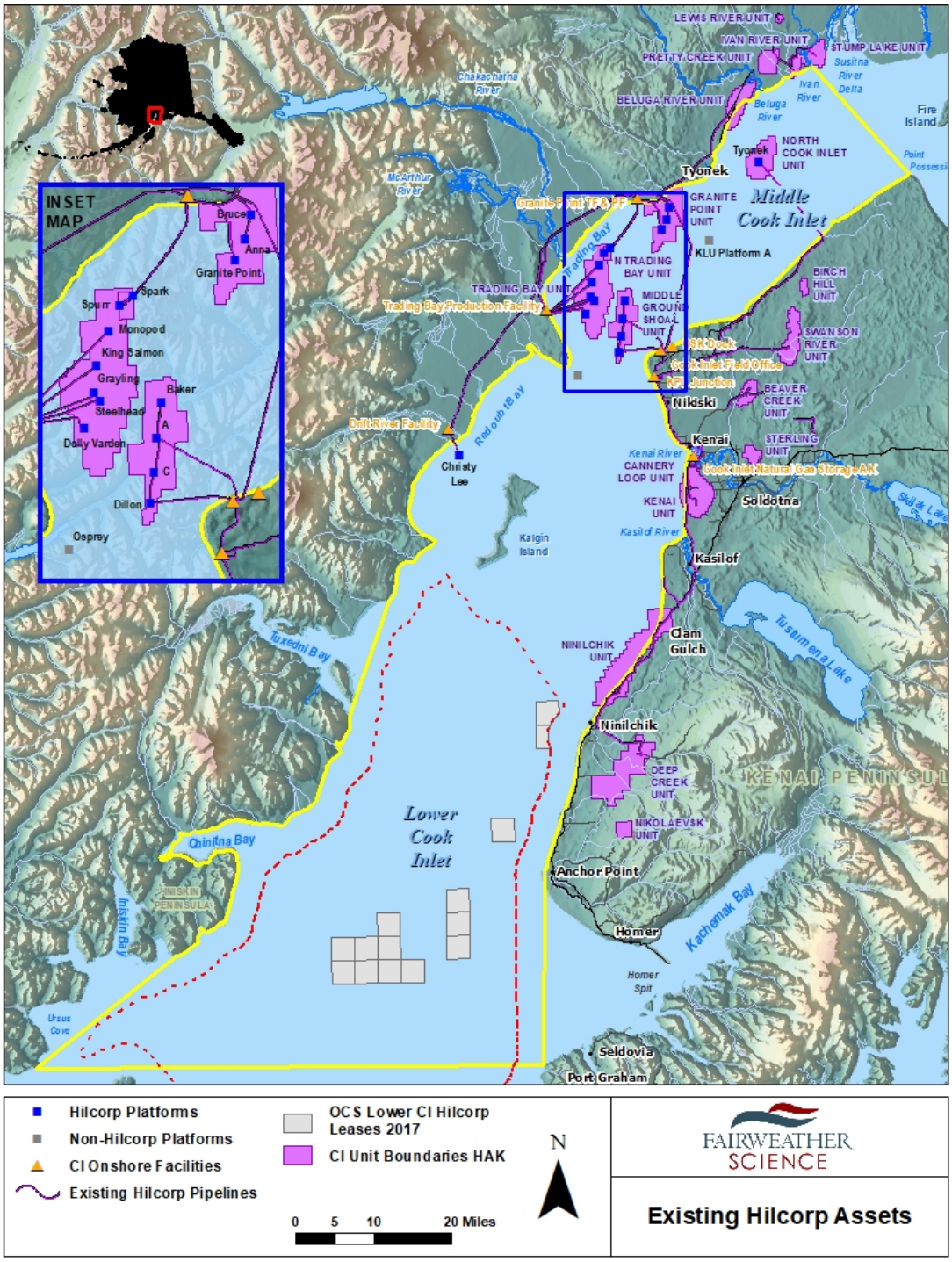


Figure 1. Map showing existing Hilcorp Alaska assets in Cook Inlet.

2.0 DESCRIPTION OF ACTIVITIES

The scope of this LOA request for Year 1 includes three of the four stages of activity described in the ITR Petition, including exploration, development, and production activities within the Applicant's area of operations in and adjacent to Cook Inlet within the Petition's geographic area (Figure 2). Table 1 summarizes the planned activities within the geographic scope of this LOA and the following text describes these activities in more detail. This section is organized into two primary areas within Cook Inlet: lower Cook Inlet (south of the Forelands to Homer) and middle Cook Inlet (north of the Forelands to Susitna/Point Possession).

Table 1. Summary of planned activities included the Year 1 LOA request.

Project Name	Cook Inlet Region	Seasonal Timing	Anticipated Duration	Anticipated Noise Sources
OCS 3D seismic survey	Lower Cook Inlet OCS	April-October	45-60 days	1 source vessel with airguns, 1 support vessel, 1-2 chase vessels
Platform & pipeline maintenance	Middle Cook Inlet	April-October	180 days	Vessels, water jets, hydraulic grinders, pingers, helicopters, and/or sub-bottom profilers
Granite Point Platform Development Drilling (and associated geohazard survey)	Middle Cook Inlet	May-November	120-150 days	1 jack-up rig, tugs towing rig, support vessel, helicopters, and 1 vessel with echosounders and/or sub-bottom profilers

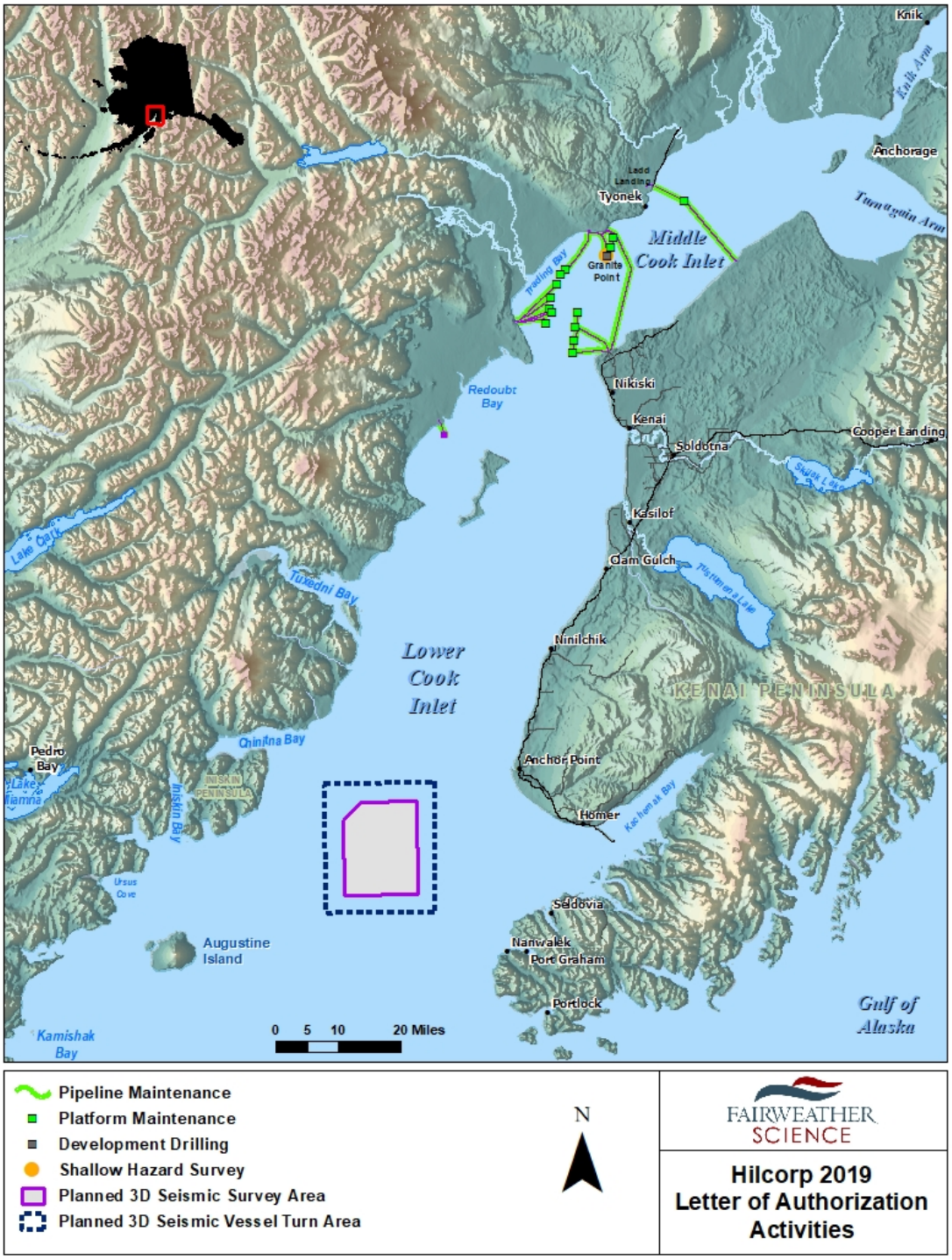


Figure 2. Map showing planned activities Year 1 LOA.

2.1 3D SEISMIC SURVEY

Hilcorp Alaska plans to collect 3D seismic data for approximately 45-60 days starting April 1, 2019 over 11 of the 14 OCS lease blocks in lower Cook (Figure 2). The 3D seismic survey is comprised of an area of approximately 969 km^2 (375 mi^2), which includes a 3D survey area of 451 km^2 (174 mi^2) through 8 blocks (6357, 6405, 6406, 6407, 6455, 6456, 6457, 6458). The survey program target start date is April 1, 2019 but the actual start date will depend on arrival of the seismic source vessel. The survey is planned to last for approximately 45-60 days. The length of the survey will depend on weather, equipment, and marine mammal delays.

Polarcus is the seismic contractor and the general seismic survey design is provided below. The 3D seismic data will be acquired using a specially designed marine seismic vessel towing 8-10 x ~2,400-meters (m; 1.5 miles [mi]) recording cables (i.e., streamers) with a dual air gun array. The survey will involve one source vessel, one support vessel, and one or two chase vessels. Crew changes are expected to occur every four to six weeks using a helicopter or support vessel from shore bases in lower Cook Inlet.

The proposed seismic survey will be active 24 hours (hrs) per day. The array will be towed at a speed of approximately 7.41 km/hr (4 knots), with seismic data collected continuously. Data acquisition will occur for approximately 3-5 hrs, followed by a 1.5-hr period to turn and reposition the vessel for another pass. The turn radius on the seismic vessel is approximately 4,828 m (3 mi), which includes a run-out area where guns are active, but outside the full-fold data acquisition area. The total area of airgun operations will be approximately 528 km^2 (204 mi^2).

The data will be shot parallel to the Cook Inlet shorelines in a north/south direction. This operational direction will keep recording equipment/streamers in line with Cook Inlet currents and tides and keep the equipment away from shallow waters on the east and west sides. The program may be modified if the survey cannot be conducted as a result of noise conditions onsite (i.e., ambient noise). The airguns will typically be turned off during the turns, however, depending on the daylight hours and length of the turn, Hilcorp Alaska may use the smallest gun in the array (45 cubic inch [cui]) as a mitigation airgun where needed. The vessel will turn into the tides to ensure the recording cables/streamers remain in line behind the vessel.

The survey will involve one source vessel, one support vessel, one or two chase vessels, and potentially one mitigation vessel. The source vessel tows the airgun array and the streamers. The support vessel provides general support for the source vessel, including supplies, crew changes, etc. The chase vessel(s) monitors the in-water equipment and maintains a security perimeter around the streamers. Details of anticipated vessels are provided in Table 2. Figure 3 and Figure 4 show a picture of a typical, modern source vessel.

Table 2. Description of the vessels for 3D seismic survey.

Name	Primary Activity	Specifications
M/V *Naila, Asima, Adira, or Alima* (or similar)	Source /Streamer/Recording vessel	92 m length x 21 m breadth 7.5 m draft 7,420 to 7,894 gross tonnage Built in 2010 Bahamas flag
M/V *Maria G or Victory G* (or similar)	Support vessel Supports crew changes, supplies, etc.	53.8 m length x 13.8 m breadth 3.8 m draft 1,081 gross tonnage Built in 2009 Panama flag
TBD (1 or 2)	Chase vessel Maintains security around streamers	TBD

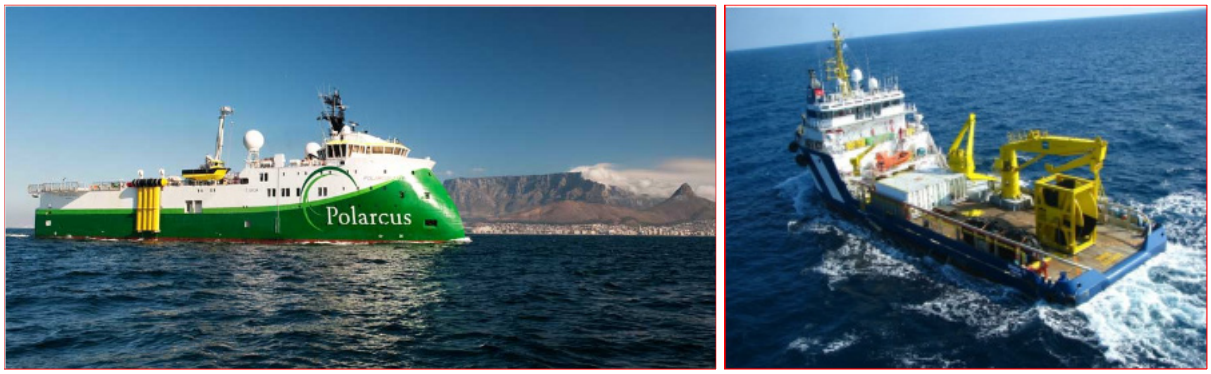


Figure 3. Photos of typical marine source / streamer vessel (left) and support vessel (right).

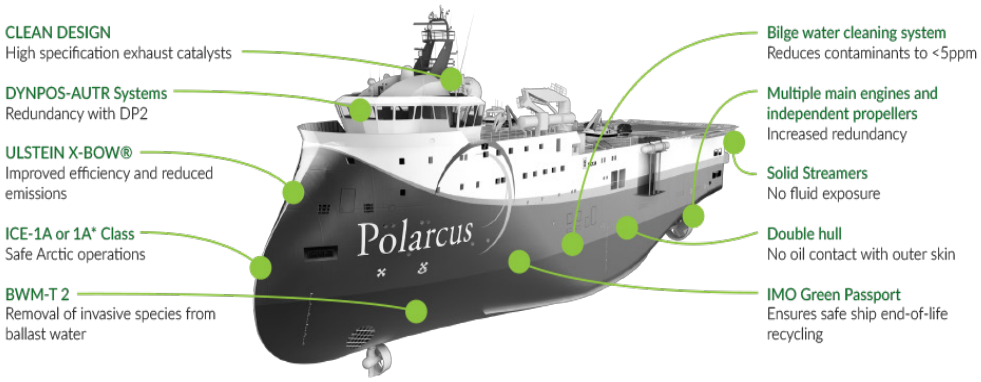


Figure 4. Polarcus source vessel environmental capabilities.

2.2 GEOHAZARD AND GEOTECHNICAL SURVEYS

Hilcorp Alaska plans to conduct a geohazard survey on site-specific regions within the area of interest prior to conducting development drilling at the Granite Point Platform, as well as part of the routine maintenance on pipelines and platforms. The actual survey duration will take approximately 30 days.

The suite of equipment used during a typical geohazards survey consists of single beam and multi-beam echosounders, which provide water depths and seafloor morphology; a side scan sonar that provides acoustic images of the seafloor; a sub-bottom profiler which provides 20 to 200 m (66 to 656 ft) sub-seafloor penetration with a 6- to 20-centimeter (cm, 2.4-7.9-inch [in]) resolution. Magnetometers, to detect ferrous items, may also be used. Geotechnical surveys are conducted to collect bottom samples to obtain physical and chemical data on surface and near sub-surface sediments. Sediment samples typically are collected using a gravity/piston corer or grab sampler.

2.3 ROUTINE MAINTENANCE

Each year, Hilcorp Alaska must verify the structural integrity of their platforms and pipelines located within Cook Inlet. Routine maintenance activities include: subsea pipeline inspections, stabilizations, and repairs; platform leg inspections and repairs; and anode sled installations and/or replacement.

Natural gas and oil pipelines located on the seafloor of the Cook Inlet are inspected on an annual basis using ultrasonic testing (UT), cathodic protection surveys, multi-beam sonar surveys, and sub-bottom profilers. In some cases, a water jet may be required to remove sand and gravel from under or around the pipeline to allow access for assessment and repair. The pipeline surface may also require cleaning using a hydraulic grinder to ensure adequate repair. If pipeline replacement is required, an underwater pipe cutter such as a diamond wire saw or hydraulically-powered Guillotine saw may be used.

Per NMFS guidance, the water jets are the only activity that requires authorization for Level B take. Therefore, monitoring and mitigation measures are only included for this activity.

2.4 PINGERS

Several types of moorings are deployed in support of Hilcorp Alaska operations; all of which require an acoustic pinger for location or release. The pinger is deployed over the side a vessel and a short signal is emitted to the mooring device. The mooring device responds with a short signal to indicate that the device is working, to indicate range and bearing data, or to illicit a release of the unit from the anchor. These are used for very short periods of time when needed.

The types of moorings requiring the use of pingers anticipated to be used in the Year 1 LOA period include acoustic moorings during the 3D seismic survey (assumed 2-4 moorings) and potential current profilers deployed each season (assumed 2-4 moorings). The total amount of time per mooring device is less than 10 minutes during deployment and retrieval. To avoid disturbance, the pinger would not be deployed if marine mammals have been observed within 135 m (443 ft) of the vessel.

3.0 MITIGATION AND MONITORING

The Applicant will implement a robust monitoring and mitigation program for the protection of marine mammals using NMFS/USFWS-approved Protected Species Observers (PSOs)for LOA activities. Marine mammal monitoring and mitigation methods have been designed to meet the requirements and objectives which will be specified in the ITRs promulgated by NMFS and USFWS. The Applicant recognizes some

details of the monitoring and mitigation may change upon receipt of the LOA issued by NMFS and USFWS each year. Specific mitigation measures will depend on the specific project.

3.1 MITIGATION MEASURES

3.1.1 Applicable Noise Criteria

Under the MMPA, NMFS and USFWS have defined levels of harassment for marine mammals. Level A harassment is defined as "…any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is defined as "…any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering."

For Level A, the NOAA Technical Memorandum NMFS-OPR provides guidelines for assessing the onset of permanent threshold shifts (PTS) from anthropogenic sound. Under this guideline, marine mammals are separated into five functional hearing groups; source types are separated into impulsive (e.g., seismic, pipe driving, sub-bottom profiler) and non-impulsive (tugs towing rigs, drilling, water jet, hydraulic grinder); and require analyses of the distance to the peak received sound pressure level (SPL, L_{pk}) and 24-hr cumulative sound exposure level (SEL_{24h}).

The current NMFS Level B (disturbance) threshold for assessing the onset of temporary threshold shifts (TTS) for impulsive sound is 160 decibels referenced to one microPascal (dB re 1 µPa) root mean square (rms) for impulsive and 120 dB re 1 µPa rms for non-impulsive sound for all marine mammals.

Under current USFWS guidelines, Level A (injury) threshold for impulsive sound is considered to be 190 dB re 1 µPa rms and 180 dB re 1 µPa rms for non-impulsive sound. The Level A thresholds for otariid pinnipeds are considered a proxy for sea otters. The current USFWS Level B (disturbance) threshold for both impulsive and non-impulsive sounds is 160 dB re 1 µPa rms.

Table 3 provides a summary of the disturbance guidelines. For purposes of this section, all underwater SPLs are reported as dB re 1 µPa.

Table 3. Summary of NMFS acoustic thresholds.

Marine Mammals	Injury (Level A) Threshold		Disturbance (Level B) Threshold	
	Impulsive	Non-Impulsive	Impulsive	Non-Impulsive
Low-Frequency Cetaceans	219 dB L_{pk} 183 dB SEL	199 dB SEL	160 dB rms	120 dB rms
Mid-Frequency Cetaceans	230 dB L_{pk} 185 dB SEL	198 dB SEL	160 dB rms	120 dB rms
High-Frequency Cetaceans	202 dB L_{pk} 155 dB SEL	173 dB SEL	160 dB rms	120 dB rms
Phocid Pinnipeds/Sea Otters	218 dB L_{pk} 185 dB SEL	201 dB SEL	160 dB rms	120 dB rms
Otariid Pinnipeds	232 dB L_{pk} 203 dB SEL	219 dB SEL	160 dB rms	120 dB rms
Sea Otters	190 dB rms	180 dB rms	160 dB rms	

3.1.2 Description of Exclusion and Safety Zones

The Exclusion Zone (EZ) is defined as the area in which all operations are **shut down** in the event a marine mammal enters or is about to enter this zone. For activities included in this Petition, there are different EZs depending on the species and sound source. The EZ for sea otters is based on USFWS requirements which are different than NMFS for Level A. The EZ for beluga whales is based on the NMFS Level B zone instead of the Level A zone because of the low numbers of allowable Level B "takes" by harassment due to their critically endangered status.

The Safety Zone (SZ) is an area larger than the EZ and is defined as the area within which operations may power down in the event a marine mammal enters, is about to enter or may be considered a Level B harassment. There is no SZ for beluga whales, as the Level B zone is considered the Level A zone because of the low numbers of allowable Level B "takes" by harassment due to their critically endangered status.

The distances for the EZ and SZ for the activities are summarized in Table 4 and described in the following text.

1) The distances to the Level A thresholds for the 3D seismic activity were calculated using the methods described in Section 6 of the ITR Petition and the Level B is based on Apache field-verified distance (81 FR 47239).
   a) The EZ for sea otters is 50 m.
   b) The EZ for all other marine mammals is rounded up to 500 m, similar to what has been implemented by NMFS for the Atlantic Sea seismic programmatic MMPA authorization (82 FR 26244).
   c) The SZ for all marine mammals is 7,300 m. *Hilcorp Alaska endeavors to implement this as a shut down zone for beluga whales to manage for the low number of allowable Level B takes*.
2) The distances to the thresholds for the sub-bottom profiler were calculated using the methods described in Section 6 of the ITR Petition.
   a) The EZ for sea otters is 50 m.
   b) The EZ for all other marine mammals is 100 m.

c) The distance to the SZ for all marine mammals is 3,000 m. *Hilcorp Alaska endeavors to implement this as a shut down zone for beluga whales to manage for the low number of allowable Level B takes.*

3) The distances to the Level A thresholds for the water jet were calculated using methods described in Section 6 of the ITR Petition and the distance to the Level B is based on Austin (2017) measurements of 860 m to the 120 dB zone.
   a) The EZ for all marine mammals is 15 m.
   b) The SZ for all marine mammals is 860 m. *Hilcorp Alaska endeavors to implement this as a shut down zone for beluga whales to manage for the low number of allowable Level B takes.*

4) To avoid disturbance, the pinger would not be deployed if marine mammals have been observed within 135 m (443 ft) of the vessel.

Table 4. Radii of exclusion zone (EZ) and safety zone (SZ) for Petition activities.

Source	Exclusion Zone (EZ) Radius (m)						SZ Radius
	LF Cetaceans	MF Cetaceans	HF Cetaceans	Pinnipeds	Beluga whales	Sea otters	All marine mammals (other than beluga whales)
3D seismic survey[1]	500 m	500 m	500 m	500 m	7,300 m	50 m	7,300 m
Sub-bottom profiler	100 m	100 m	500 m	100 m	3,000 m	50 m	3,000 m
Water jet	15 m	15 m	15 m	15 m	860 m	15 m	860 m

3.1.3 Sound Source Verification Survey

When site-specific measurements are not available for noise sources of concern for acoustic exposure, NMFS often requires a sound source verification (SSV) to characterize the sound levels, propagation, and to verify the monitoring zones (EZ and SZ). Hilcorp Alaska plans to perform an SSV for the 3D seismic survey in lower Cook Inlet. Hilcorp Alaska will work with NMFS to determine if an SSV is needed for other activities occurring in the LOA area.

3.1.4 Aircraft Mitigation Measures

To minimize the possibility of adverse effects from aircraft noise on marine mammals, Hilcorp Alaska will ensure that helicopters used to transport equipment and personnel will maintain an altitude of 304 m (1,000 ft) as practicable and safe when transiting over Cook Inlet waters. Practicability and safety risk is determined by the pilot in command. Conditions that will make it impracticable to maintain this altitude may include: adverse weather conditions, safety considerations, and reduced flight time (e.g., very short platform to platform flights do not have the time to reach 1,000 ft).

3.1.5 Seismic and Geohazard Survey Mitigation Measures

For the 3D survey, PSOs will be stationed on two of the project vessels, the source vessel and the chase vessel. At NMFS request, an aerial survey with two PSOs will be conducted each day to monitor the Level B zone. Alternatives to the aerial survey are presented in text below.

For geohazard surveys when the sub-bottom profiler is being used, PSOs will be stationed on the survey vessel. PSOs will implement the following mitigation measures.

3.1.5.1 Clearing the Exclusion Zone

Prior to the start of daily seismic, use of sub-bottom profiler, or when activities have been stopped for longer than a 30 minute period, the PSOs will clear the EZ for a period of 30 minutes. Clearing the EZ means no marine mammals have been observed within the EZ for that 30-minute period. If any marine mammals have been observed within the EZ, ramp up cannot start until the marine mammal has left the EZ or has not been observed for a 30-minute period.

3.1.5.2 Power Down Procedure

A power down procedure involves reducing the number of airguns in use, which reduces the EZ or SZ radius. In contrast, a shut down procedure occurs when all airgun activity is suspended immediately. During a power down, a mitigation airgun is operated. Operation of the mitigation gun allows the size of the EZ to decrease to the size of the SZ for marine mammals other than beluga whales. If a marine mammal is detected outside the safety radius (either SZ or EZ) but is likely to enter that zone, the airguns may be powered down before the animal is within the safety radius, as an alternative to a complete shutdown. Likewise, if a marine mammal is already within the SZ when first detected, the airguns will be powered down if this is a reasonable alternative to an immediate shutdown. If a marine mammal is already within the EZ when first detected, the airguns will be shut down immediately.

Following a power down, airgun activity will not resume until the marine mammal has cleared the SZ. The animal will be considered to have cleared the SZ if it:

- Is visually observed to have left the SZ, or
- Has not been seen within the SZ for 15 min in the case of pinnipeds, sea otters, and harbor porpoise, or
- Has not been seen within the SZ for 30 min in the case of cetaceans.

3.1.5.3 Shut Down Procedure

A shut down occurs when all airgun or sub-bottom profiler's activity is suspended. The operating airguns or profiler will be shut down completely if a marine mammal approaches the EZ. The shut down procedure will be accomplished within several seconds (of a "one shot" period) of the determination that a marine mammal is either in or about to enter the EZ.

Following a shut down, airgun or sub-bottom profiler activity will not resume until the marine mammal has cleared the EZ. The animal will be considered to have cleared the EZ if it:

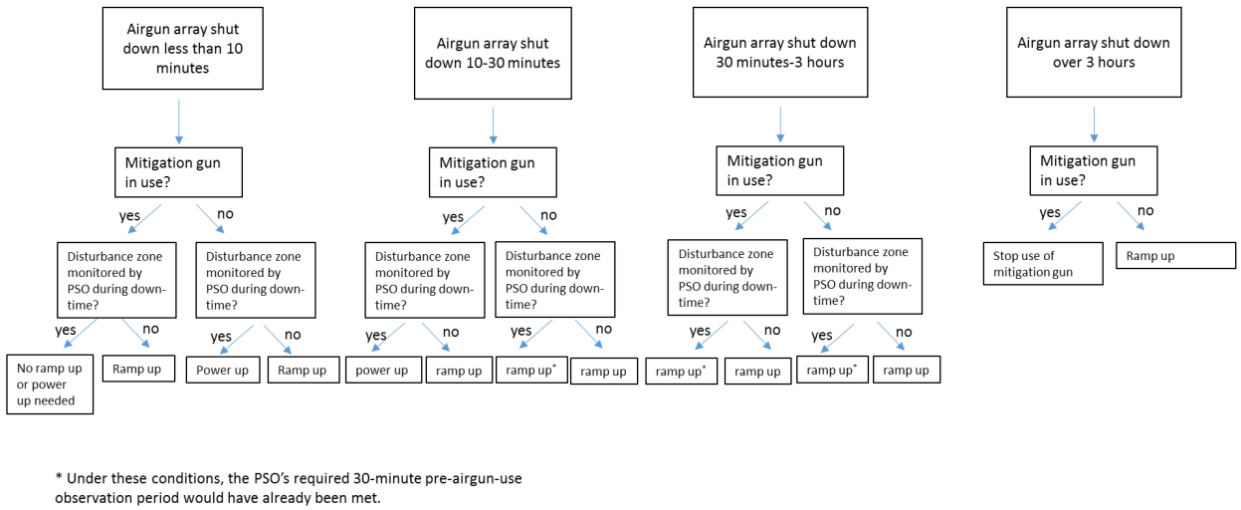
- Is visually observed to have left the EZ, or
- Has not been seen within the EZ for 15 min in the case of pinnipeds, sea otters, and harbor porpoise, or
- Has not been seen within the EZ for 30 min in the case of cetaceans.

3.1.5.4 Ramp Up and Power Up Procedures

A "ramp up" procedure gradually increases airgun volume at a specified rate. Ramp up is used at the start of airgun operations, including after a power down, shut down, and after any period greater than 10 minutes in duration without airgun operations. NMFS normally requires that the rate of ramp up be no more than 6 dB per 5-minute period. Ramp up will begin with the smallest gun in the array that is being used for all airgun array configurations. During the ramp up, the EZ for the full airgun array will be maintained.

If the complete EZ has not been visible for at least 30 minutes prior to the start of operations, ramp up will not commence unless the mitigation gun has been operating during the interruption of seismic survey operations. This means that it will not be permissible to ramp up the 24-gun source from a complete shut down in thick fog or at other times when the outer part of the EZ is not visible. Ramp up of the airguns will not be initiated if a marine mammal is sighted within or near the EZ at any time.

The following information has been included from NMFS' Biological Opinion to Lease Sale 244. Figure 5 shows a flow diagram indicating some seismic exploration mitigation measures under various scenarios described in mitigation measures 2c-2j in the NMFS Biological Opinion to Lease Sale 244.



* Under these conditions, the PSO's required 30-minute pre-airgun-use observation period would have already been met.

Figure 5. A flow diagram of suggested mitigation gun procedures in the NMFS Biological Opinion to Lease Sale 244.

3.1.5.5 Speed or Course Alteration

If a marine mammal is detected outside the EZ and, based on its position and relative motion, is likely to enter the EZ, the vessel's speed and/or direct course may, when practical and safe, be changed. This technique also minimizes the effect on the seismic program. This technique can be used in coordination with a power down procedure. The marine mammal activities and movements relative to the seismic and support vessels will be closely monitored to ensure that the marine mammal does not approach within the EZ. If the mammal appears likely to enter the EZ, further mitigative actions will be taken, i.e., either further course alterations, power down, or shut down of the airguns.

3.1.6 Water Jet Measures

A diver trained as a PSO will be present on the dive support vessel when divers are using the water jet. Prior to in-water use of the water jet, an EZ of 860 m around the DSV will be established. The water jet will be shut down if marine mammals are observed within the EZ.

3.1.7 Pingers

To avoid disturbance, the pinger would not be deployed if marine mammals have been observed within 135 m (443 ft) of the vessel by a trained observer.

3.2 MONITORING

3.2.1 Protected Species Observers

The Applicant will implement a robust monitoring and mitigation program for the protection of marine mammals using NMFS/USFWS-approved PSOs for LOA activities such as seismic and sub-bottom profilers. The use of water jets and pingers do not require the same level of monitoring (see text below). Marine mammal monitoring and mitigation methods have been designed to meet the requirements and objectives which will be specified in the ITRs promulgated by NMFS and USFWS. The Applicant recognizes some details of the monitoring and mitigation program may change upon receipt of the LOAs issued by NMFS and USFWS.

The specific objectives of the monitoring and mitigation program provide:

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

PSOs will be on watch during all daylight periods for project-specific activities. The observer(s) will watch for marine mammals from the best available vantage point on the vessel or station. Ideally this vantage point is an elevated stable platform from which the PSO has an unobstructed 360° view of the water. The PSOs will scan systematically with the naked eye and with binoculars. When a mammal sighting is made, the following information about the sighting will be carefully and accurately recorded:

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

An electronic database or paper form will be used to record and collate data obtained from visual observations. The PSOs will enter the data into the data entry program installed on field laptops. The program automates the data entry process, reduces data entry errors, and maximizes PSO time spent looking at the water.

3.2.2 Seismic Survey Monitoring Methods

The seismic survey involves one source vessel, one support vessel, and one chase vessel. The source vessel will tow the airgun array and the streamers. The support vessel will provide general support for the source vessel, including supplies, crew changes, etc. The chase vessel will monitor the in-water equipment and maintain a security perimeter around the streamers.

After discussions with the project operations team and NMFS/USFWS, we determined that four PSOs will be stationed on the source vessel with two on watch during daylight hours, and three PSOs will be on either the support vessel or the chase vessel. Additionally, two PSOs will provide aerial survey support. This section suggests routine aerial survey methods as well as potential options for survey coverage when aerial flights are restricted due to weather or other limiting factors.

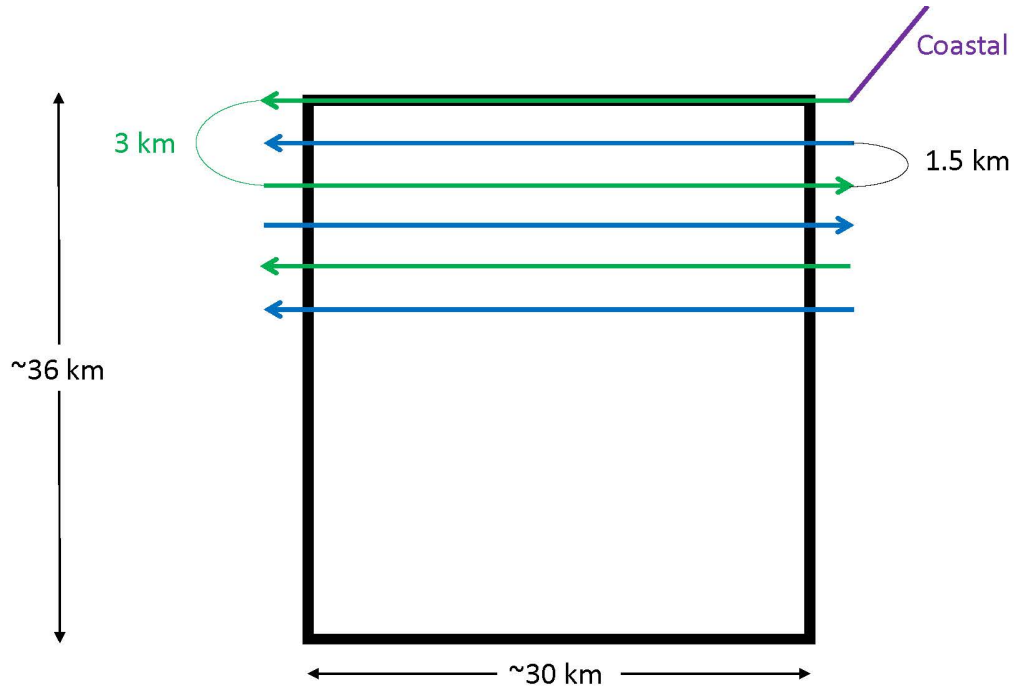
NMFS conducted annual aerial surveys in Cook Inlet, Alaska for beluga whales from 1993 to 2012, and began biennial surveys in 2014. Surveys were flown in a fixed-wing, high-wing aircraft at a target altitude of 244 m (800 ft) and speed of 185 km/hr (100 kts). Coastal surveys were conducted approximately 1.4 km from the shoreline or exposed mudflats, as beluga sightings more than 3 km from the coast are infrequent.

3.2.3 Routine Aerial Survey Methods

We propose similar survey methodology, conditions permitting. A fixed-wing, high-wing aircraft will be flown at a target speed of 185 km/hr (100 kts) and a target altitude of 457 m (1,500 ft). The aircraft will depart Kenai and transit south to the project area, where survey effort will commence. A coastal transect offset approximately 1.4 km from the shoreline or exposed mudflats will be surveyed south to the Anchor Point area, where the aircraft will head offshore to the area of activity. The coastal transect will also be reflown *en route* to Kenai, after completing survey effort of the monitoring zone. The transit distance is estimated to be 106 km total and the coastal transect is estimated to be 106 km total.

The monitoring zone is approximately 36 km x 30 km, and we propose 25 transects spaced 1.5 km apart aligned in an east-west direction. The aircraft will survey 13 transects spaced 3 km apart traveling north to south. At the southern end of the monitoring zone, the aircraft will turn around and survey 12 transects spaced 3 km apart traveling south to north (Figure 6). Ferguson and Clarke (2013) estimated the effective strip width (ESW) for aerial detection of beluga whales to be 614 m. This was based on surveys conducted in an Aero Commander (used during Cook Inlet aerial beluga whale surveys) flown at a target speed of 204-259 km/hr (110-140 kts) and target altitude of 305 to 457 m (1,000-1,500 ft).

The transect length is ~1,000 km and flight duration will be ~6 hrs (survey and transit). Depending on the survey aircraft, a refuel may be necessary. Most small aircraft are capable of 4-5 hours of flight time. Transect spacing could be increased to 2 km or 3 km to reduce flight time to 5 or 4 hours, respectively. Beluga whale sighting rates have been consistently low in lower Cook Inlet (south of the Forelands), and increased transect spacing will likely still provide adequate coverage of the activity area. In areas of high narwhal abundance off of northwest Greenland, aerial survey transects were spaced 5.5 km apart (Heide-Jørgensen et al. 2010).



- Coastal transect will be flown to/from the prospect to/from the Forelands offset 1.4 km from the shoreline (or exposed mudflat)
- East-West Green transects spaced 3 km apart and flown north to south
- East-West Blue transects spaced 3 km apart and flown south to north
- 1.5 km spacing between Green and Blue transects

Figure 6. Monitoring zone with partial outline of survey transects spaced 1.5 km apart.

Option 1 – Aerial surveys at lower altitudes

When low ceilings prevent the aircraft from flying at 457 m (1,500 ft), we propose reducing the target altitude as necessary, within the range of 244-457 m (800-1,500 ft). The most conservative survey altitude available within aircraft safety parameters will be flown. Lower survey altitude, however, increases the likelihood of disturbance and potential takes.

Option 2 – Land-based observations

A go, no-go time will be established for aerial survey effort. If the aircraft is unable to survey, aerial PSOs could be mobilized from Kenai to a shore-based location near Anchor Point. Observations will be limited to coastal waters, and will not cover the monitoring zone. However, beluga whales are typically observed in nearshore waters rather than farther offshore.

Option 3 – Additional vessel-based observations from a project vessel

If the aircraft is unable to survey, aerial PSOs could be mobilized from Kenai to the offshore project vessel (chase or support) without PSOs. This will be dependent on the vessel ceasing routine duties and being re-tasked with marine mammal monitoring and mitigation support. Additionally, this supplemental vessel-based PSO coverage will be limited in comparison to the typical area covered by aerial monitoring. PSOs on the source vessel will have an estimated monitoring radius of ~4.5 km around of the vessel. The Level

B harassment zone has been estimated to be 7.3 km. We propose directing the supplemental monitoring vessel to the northeast quadrant of the monitoring zone, where the vessel will travel ahead of the source vessel the on coastal side as opposed to the offshore side. The supplemental monitoring vessel will travel in a sawtooth pattern and focus monitoring effort on the Level B harassment zone not otherwise covered (the area outside of the 4.5 km radius covered by the source vessel PSOs out to ~ 7 km), as the source vessel operates.

Option 4 - Additional vessel-based observations on vessel of opportunity (contracted standby vessel)

Same as Option 3, however, a contracted vessel of opportunity will be deployed to act as the supplemental monitoring vessel, rather than re-tasking a project vessel (chase or support).

3.2.4 Geohazard Survey Monitoring Methods

When sub-bottom profilers are utilized as part of the geohazard surveys, NMFS/USFWS-approved PSOs will be stationed on the survey vessel. PSOs will implement similar monitoring strategies as those for the seismic survey.

3.2.5 Water Jet Monitoring Methods

A diver trained who has been specifically trained as a PSO will be present on the dive support vessel when divers are using the water jet to observe the SZ. Reporting will be on paper forms, as approved as part of the 5-year Letter of Concurrence (LOC) consultation.

3.2.6 Pingers

To avoid disturbance, the pinger would not be deployed if marine mammals have been observed within 135 m (443 ft) of the vessel by a trained observer. There are no further monitoring or reporting associated with this activity.

4.0 REPORTING

The results of PSO monitoring for the seismic and sub-bottom profiler activities, including estimates of exposure to key sound levels, will be presented in weekly, monthly, and 90-day reports. Reporting will address the requirements established by NMFS and USFWS in the LOAs. The technical report(s) will include the list below.

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

- Numbers of sightings/individuals seen versus project activity,
- Distribution around the vessels versus project activity,
- Summary of implemented mitigation measures, and
- Estimates of "take by harassment".

Reporting for the water jets will be in accordance with the LOC. No further reporting is required for the pingers.

5.0 REFERENCES

Ferguson, M.C. and T.J. Clarke. 2013. Estimates of detection probability for BWASP Bowhead whale, Grey whale, and Beluga sightings collected from Twin Otter and Aero Commander Aircraft, 1989 to 2007 and 2008 to 2011.

Heide-Jørgensen, M.P., K.L. Laidre, M.L. Burt, D.L. Borchers, T.A. Marques, R.G. Hansen, M. Rasmussen, and S. Fossette. 2010. Abundance of narwhals (*Monodon monoceros*) on the hunting grounds in Greenland. Journal of Mammalogy. 91. 1135-1151. 10.2307/40925720.

Shelden, K. E. W., R. C. Hobbs, C. L. Sims, L. Vate Brattström, J. A. Mocklin, C. Boyd, and B. A. Mahoney. 2017. Aerial surveys of beluga whales (*Delphinapterus leucas*) in Cook Inlet, Alaska, June 2016. AFSC Processed Rep.2017-09, 62 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.