Alaska Outer Continental Shelf

OCS EIS/EA
BOEM 2015-007

# SAExploration, Inc.

3D Cook Inlet 2015 Geological and Geophysical Seismic Survey
Lower Cook Inlet, Alaska

**Environmental Assessment**

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

February 2015

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# Acronyms and Abbreviations

~ .....Approximately
ADEC .....Alaska Department of Environmental Conservation
ADF&G .....Alaska Department of Fish and Game
bbl.....Barrel/Barrels
BOEM .....Bureau of Ocean Energy Management
BOEMRE .....Bureau of Ocean Energy Management, Regulation and Enforcement
CEQ .....Council on Environmental Quality
CFM .....Cubic feet per minute
CFR .....Code of Federal Regulations
CO .....carbon monoxide
CWA.....Clean Water Act
dB re 1 μPa .....Decibels in Relation to a Reference Pressure of 1 Micropascal
DGPS.....Differential Global Positioning System
DPS.....Distinct Population Segment
EA.....Environmental Assessment
EIS .....Environmental Impact Statement
EJ .....Environmental Justice
EPA .....U.S. Environmental Protection Agency
ESA .....Endangered Species Act
FONSI .....Finding of No Significant Impact
FR .....Federal Register
G&G .....Geological and Geophysical
GOM.....Gulf of Mexico
hr.....Hour
Hz .....Hertz
IHA .....Incidental Harassment Authorization
in.....Inch
ION.....ION Geophysical, Inc.
KPB .....Kenai Peninsula Borough
kt.....Nautical Mile Per Hour (1 Knot = 1.853 Km/H)
kW .....Kilowatt
Lease Sale 193 .....Chukchi Sea OCS Oil and Gas Lease Sale 193
m.....Meter
min.....Minute
MMPA.....Marine Mammal Protection Act
MMS.....Minerals Management Service
M/V .....Marine Vessel
NEPA .....National Environmental Policy Act
NMFS .....National Marine Fisheries Service
nmi.....Nautical mile
$NO_2$ .....Nitrogen Dioxide
NOAA .....National Oceanic and Atmospheric Administration
$NO_x$.....Nitrogen Oxides
NPDES .....National Pollutant Discharge Elimination System
OBN .....Ocean-bottom Node
OCSLA.....Outer Continental Shelf Lands Act
OCS .....Outer Continental Shelf
PM .....Particulate Matter
psi .....Pounds Per Square Inch
PSO.....Protected Species Observer
s .....Second
TTS.....Temporary Threshold Shift
U.S. .....United States of America
USC. .....United States Code

USCG ..... United States Coast Guard
USDOC..... U.S. Department of Commerce
USDOI..... U.S. Department of the Interior
USFWS..... U.S. Fish and Wildlife Service
USGS..... United States Geological Survey
USW ..... Ultra Shallow Water

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# 1.0 PURPOSE AND NEED

SAExploration, Inc. (SAE) submitted Geological and Geophysical (G&G) Exploration Permit 15-01 application to the Bureau of Ocean Energy Management (BOEM) on October 21, 2014. The application was deemed complete on October 29, 2014 to conduct a three-dimensional (3D) cable-free nodal or ocean-bottom node (OBN) seismic survey in the U.S. lower Cook Inlet (Proposed Action). The Proposed Action would acquire data on approximately 697.9 square miles (SAE, Inc., 2014a). Approximately 159 $mi^2$ (413 $km^2$) is located in Outer Continental Shelf (OCS) waters under BOEM jurisdiction. The Proposed Action would take place between March 1, 2015 and December 15, 2015 and would occur in both Federal and State waters (see Figure 1). BOEM has jurisdiction to permit only those portions of geological and geophysical explorations (30 CFR part 551) occurring in the U.S. waters seaward of the Federal-State Boundary (see Figure 1).

BOEM assumes that the survey activities in the area under State jurisdiction are an interdependent part of the larger action, and depend on the larger action for their justification. Accordingly, the portion of the Proposed Action under State jurisdiction is treated as a connected action for purposes of National Environmental Policy Act (NEPA) analysis. However, any permits and associated restrictions issued by BOEM subsequent and pursuant to this analysis apply only to activities in the U.S. waters seaward of the Federal-State Boundary (see Figure 1).

## 1.1. Purpose of the Proposed Action

The Outer Continental Shelf Lands Act (OCSLA) (43 USC §1332) requires resources on the OCS to be made available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs. The purpose of the proposed seismic program is to gather geophysical data that will be used to identify and map potential hydrocarbon-bearing formations and the geologic structures that surround them. This information will provide critical insight into the geologic evolution, basin architecture, and depositional and structural history of the petroleum system.

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 the Proposed Action in accordance with the following:

- National Environmental Policy Act (NEPA) (42 USC 4231 et seq).
- Council on Environmental Quality (CEQ) regulations at 40 CFR 1500 (specifically 1501.3(b) and 1508.27).
- Department of the Interior (DOI) regulations at 43 CFR Part 46.
- DOI policy in Section 516, Chapter 15 of the Department of the Interior Manual (DM) (516 DM 15).

Permit applications to conduct such seismic survey activities are submitted pursuant to Federal regulations for Geological and Geophysical (G&G) Explorations of the OCS at 30 CFR 551.

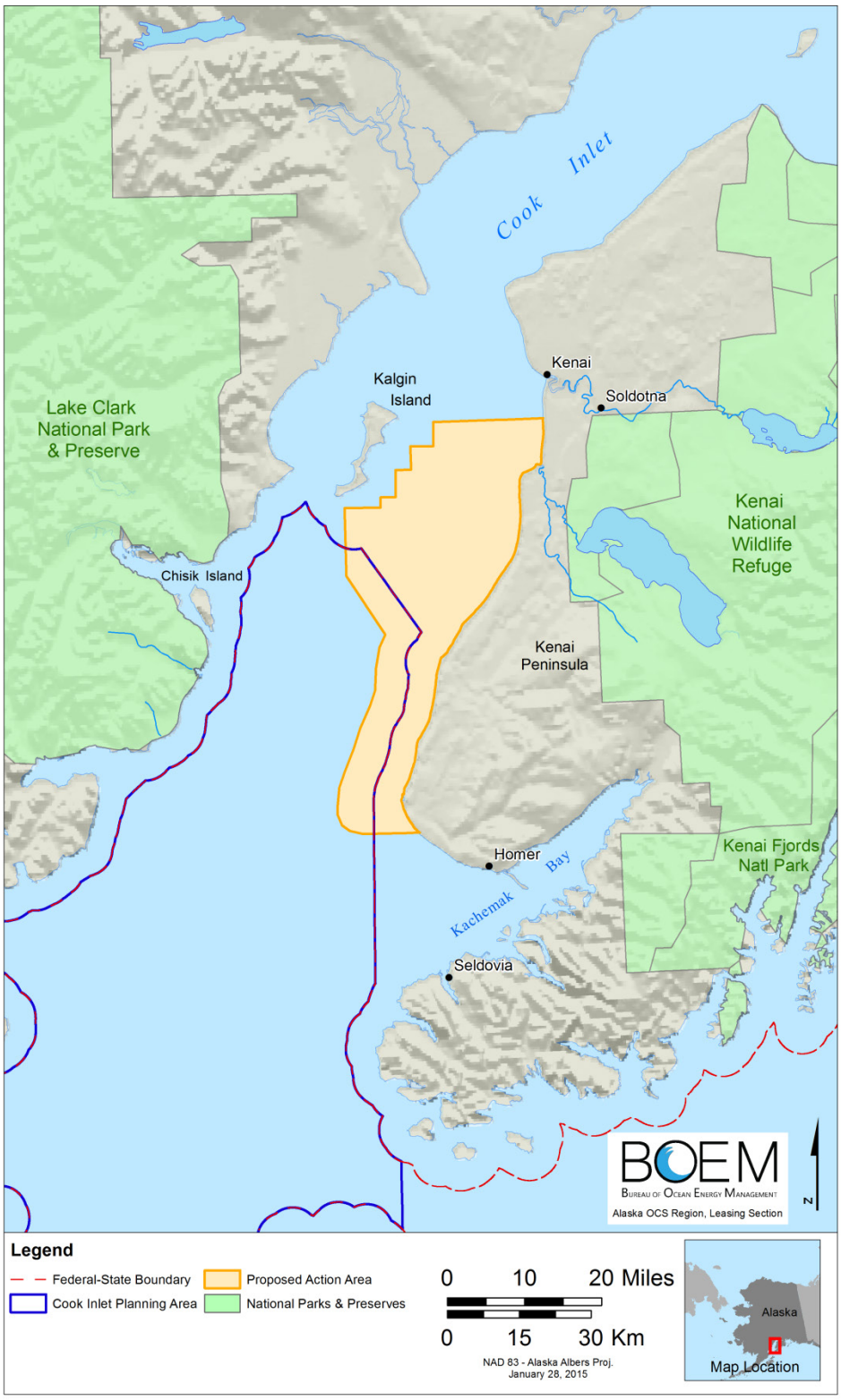



**Figure 1. Proposed Action Area: Lower Cook Inlet Seismic Survey Area.** *The Proposed Action area is entirely offshore and includes both State and Federal jurisdictional waters. BOEM's jurisdictional area for the Proposed Action is shown by the brown area seaward of the blue line.*

## 1.2. Previous Applicable Analyses

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

- Final Environmental Impact Statement, Cook Inlet Planning Area Oil and Gas Lease Sales 191 and 199 (Alaska Outer Continental Shelf OCS EIS/EA MMS 2003-055) November 2003 (USDOI, MMS, 2003) (hereafter Cook Inlet Lease Sales 191 and 199).
- Environmental Assessment, Proposed Geophysical Survey Cosmopolitan Unit, Cook Inlet (OCS EIS/EA MMS 2005-045) July 2005 (USDOI, MMS, 2005).

The EA and EIS documents above, and others, are available on the BOEM Alaska Region website at: http://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 from recent scientific studies.

Further, public comments were received on the Proposed Action and the issues raised were considered in the development of resource analyses. Finally, this EA considers information and analysis submitted by the project applicant. BOEM reviewed SAE's submitted documents and, consistent with 40 CFR 1506.5(a), BOEM independently evaluated the applicant's analysis and supplemented the applicant's analysis where necessary.

Further information is available at Section 5.5, Public Involvement.

The notice of preparation of an EA on the Proposed Action was published on November 18, 2014, on Regulations.gov (Docket No. BOEM-2014-0099). The notice stated that "BOEM seeks public involvement in preparing an environmental assessment for a 2015 geophysical 3D Ocean Bottom Seismic Survey in Cook Inlet." The comment period was held from November 18, 2014 through December 12, 2014. One comment was received. The commenter asked that sound science be used and that all legitimate stakeholders be engaged.

# 2.0 PROPOSED ACTION AND ALTERNATIVES

## 2.1. Description of the Alternatives

### 2.1.1. Alternative 1 – No Action

Under this alternative, BOEM would not approve the application for 2015 SAE Geophysical Exploration Permit 15-01 and the proposed seismic survey would not occur in waters under jurisdiction of the Federal government. SAE would not be able to identify and map potential hydrocarbon-bearing formations and the geologic structures that surround them. Not issuing the permit for the survey could result in delay in understanding of the geophysical makeup of the lower Cook Inlet, and a loss or delay of opportunities for discovery and extraction of natural resources, including any associated economic benefits.

### 2.1.2. Alternative 2 – Proposed Action

Under this alternative, BOEM would approve the application for 2015 SAE Geophysical Exploration Permit 15-01 for activities in the approximately 159 square mile ($mi^2$) area of SAE's Proposed Action under Federal jurisdiction and located in OCS waters of the lower Cook Inlet. The Proposed Action would occur during the open water season of 2015, beginning no sooner than March 1, 2015 and concluding no later than December 15, 2015.

#### 2.1.2.1. Overview

SAE's Proposed Action would acquire three dimensional (3-D) geophysical data in open waters in the lower Cook Inlet generally from south of the Kenai River, east of Kalgin Island and down to the Anchor Point area (Figure 1). The program is intended to obtain marine offshore data by mapping the subsurface and its geological structure for potential oil and gas prospects. The survey area encompasses approximately 698 $mi^2$ (1,808 $km^2$). Approximately 159 $mi^2$ (413 $km^2$) of the Proposed Action area is located in Federal waters of the lower Cook Inlet. SAE will use autonomous nodal seismic recording equipment and airguns as the source. SAE is proposing a multi-year project (2015-2016). BOEM issues geophysical exploration permits on a single calendar year basis. SAE will be required to submit a new application for activities proposed in 2016. BOEM will evaluate any new permit applications submitted for 2016 activities under the NEPA.

#### 2.1.2.2. Seismic Survey and Support Vessels

Equipment for the Proposed Action will include geophysical equipment such as airguns, nodes, compressors, sleds, firing lines, timing lines, and vessels. Vessels anticipated for use in data acquisition are shown in Table 1. A total of two source vessels and a variety of associated vessels will be in operation to support seismic activities. SAE proposes to operate nine vessels for the duration of the Proposed Action; of these, six would be in operation 24 hours per day while the remaining three would be in operation intermittently, transporting crews or deploying and retrieving nodes.

Seismic data acquisition will occur on a 24 hour per day schedule with intermittent crew transport. Vessel crews and offshore staff will be housed on the vessels which are capable of housing 24 hour crews. A total of 111 berths are available on nine vessels. Receiver retrieval and demobilization of equipment and support crew will be completed by the middle of December, 2015.

SAE reports that it will follow a waste management plan as required by the U.S. Coast Guard (USCG) and other applicable governmental regulations. Waste will be stored and hauled to shore for treatment, or disposal in existing approved facilities. Vessels will have USCG approved marine sanitation devices for handling sewage. Vessel fluids will be managed in accordance with applicable governmental regulations. Solid wastes from vessels will be transferred to shore for handling at existing facilities. There will be no incineration of waste aboard vessels.

**Table 1. Summary of Number and Type of Vessels to be Operated.**

| Vessel | Operation | Size (feet) | Gross Tons | Berths | Main Activity/Frequency | Source Levels* (dB) |
|---|---|---|---|---|---|---|
| **M/V *Arctic Wolf* (or similar)** | Source Vessel | 135 x 38 | 251 | 22 | Seismic data acquisition<br>24 hour operation | 200.1 |
| **M/V *Peregrine Falcon* (or similar)** | Source Vessel | 99 x 24 | 100 | 18 | Seismic data acquisition<br>24 hour operation | 179 |
| **M/V *Miss Diane I* (or similar)** | Node equipment deployment and retrieval | 85 x 20 | 80 | 6 | Deploying and retrieving nodes<br>24 hour operation | 165.3 |
| **M/V *Mark Stevens* (or similar)** | Node equipment deployment and retrieval | 85x24 | 80 | 16 | Deploying and retrieving nodes<br>24 hour operation | 165.3 |
| **M/V *Maxime* (or similar)** | Node equipment deployment and retrieval | 70 x 16 | 48 | 10 | Deploying and retrieving nodes<br>24 hour operation | 165.3 |
| **M/V *Dreamcatcher* (or similar)** | Mitigation/Housing Vessel | 85 x 23 | 100 | 32 | House crew<br>24 hour operation | 200.1 |
| ***Gwyder Bay (or similar)*** | Crew Transport Vessel | 30 x 20 | 20-30 | 3 | Transport crew intermittent<br>8 hours | 191.8 |
| ***M/V Sleep Robber (or similar)*** | Bow Picker | 32 x 14 | 48 | 1 | Deploying and retrieving nodes<br>Intermittent operation | 171.8 |
| ***TBD*** | Bow Picker | 30 x 20 | 20-30 | 3 | Deploying and retrieving nodes<br>Intermittent operation | 171.8 |

*Sound source levels from Aerts et al. (2008) based on empirical measurements of the same vessels expected to be used during this survey.
Note: All vessels are rated at EPA standards of type Tier II.

Marine seismic operations would be based on a "recording patch" approach. Recording patches are groups of 6 receiver lines and 32 source lines (Figure 2). Receiver lines have submersible marine sensor nodes tethered (with non-kinking line) equidistant along the length of the line at approximately 165 ft (50 m) intervals. Each node is a multicomponent system containing three velocity sensors and a hydrophone. Each receiver line is approximately 5 miles (8 km) in length, and lines are spaced approximately 1,650 ft (503 m) apart.

Source lines, 7.5 mi (12 km) long and spaced 1,650 ft (503 m) apart, run perpendicular to the receiver lines (and perpendicular to the coast). Where possible, source lines will extend approximately 2.5 mi (4 km) beyond the ends of the receiver lines. The outside dimensions of a recording patch could be 7.5 mi x 10 mi (12 km x 16 km) and may take a period of 3-5 days to deploy, shoot, and record an area encompassing 75 $mi^2$ (194 $km^2$). Shot intervals along each source line will be 165 ft (50 m).

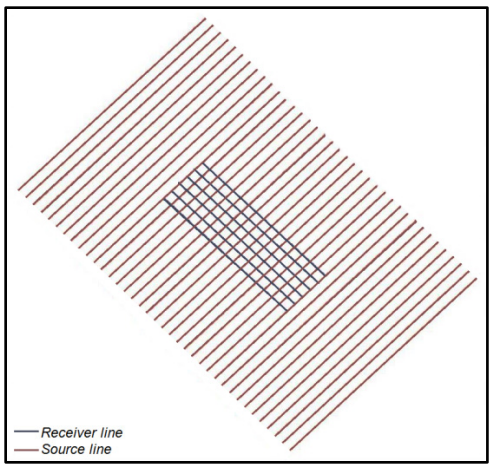



**Figure 2. Recording Patch.**

On average, approximately 18.75 $mi^2$ (49 $km^2$) of patch will be shot daily. During recording of one patch, nodes from the previously surveyed patch will be retrieved, recharged, and data downloaded prior to redeployment. As patches are recorded, receiver lines are moved to the next patch location to provide continuous coverage of the recording area.

The energy sources for offshore recording consist of 2 x 880- cui tri-cluster arrays for a total of 1,760-cui array. Two source vessels will be equipped with 1,760-cui arrays. Source activities only occur during low and high slack tides or when vessels can operate safely to acquire quality data. Source activities will typically occur for two to three hours at each slack tide. Additional source equipment identified by SAE is found in Table 2.

**Table 2. Source Equipment Other than Vessels.**

| Equipment Type | Quantity | Location |
|---|---|---|
| 880-cubic-inch airgun arrays | 2 | On each source vessel |
| 440-cubic-inch USW[1] airgun array | 1 | Source vessel[2] |

[1] USW = Ultra Shallow Water
[2] The array will be on one of the two source vessels, but is not specified as to which one.

Navigation will be accomplished with the use of a Differential Global Positioning System (DGPS). This navigation system remotely links the operating systems located on each vessel to a land based known point of reference. Prior to commencement of the Proposed Action, two DGPS base stations may be deployed onshore to provide corrections to the rover units aboard both the source and layout vessels offshore. The DGPS gives all systems a common known error to correct to real world coordinates.

Prior to the start of water operations, the source and receiver grids are mapped. In addition, known obstructions are mapped and refined as the survey progresses.

Autonomous recording nodes lack cables but will be tethered together using a thin rope for ease of retrieval. This rope will lay on the seabed surface, as will the nodes, and will have no effect on marine traffic. Primary vessel positioning will be achieved using GPS with the antenna attached to the airgun array. Pingers deployed from the node vessels will be used for positioning of nodes. The geometry/patch could be modified as operations progress to improve sampling and operational efficiency.

### 2.1.2.3. Schedule

The Proposed Action will start on or around March 1, 2015 with a projected end date on or before December 15, 2015. SAE is expected to begin operations as soon as the Cook Inlet is free of ice and conditions allow. Project timelines are dependent upon weather, commercial fishing, tourist activities, subsistence activities, other simultaneous operations in the area, and permit authorizations. Seismic operations can typically cover 200 to 300 square miles in a season.

### 2.1.2.4. Sound Generation

Airguns are the primary acoustic source and will be deployed from the seismic vessels described above. Other noise sources resulting from this activity include pingers and transponders associated with locating receiver nodes and propeller noise from the vessel fleet.

The primary seismic source for offshore recording consists of a 2 x 880-cubic-inch tri-cluster array for a total of 1,760-cubic-inches. A 440-cubic-inch array may be used in very shallow water locations. The arrays will be centered approximately 15 m (50 ft) behind the source vessel stern, at a depth of 12 ft (4 m), and towed along predetermined source lines at speeds between 4 – 5 knots/hr (7.4-9.3 km/hr). Two vessels with full arrays will be operating simultaneously in an alternating shot mode; one vessel shooting while the other recharges. Shot intervals are expected to be about 16 seconds for each array, resulting in an overall shot interval of 8 seconds considering the two alternating arrays. Operations are expected to occur 24 hours a day, with actual daily shooting totaling about half that time.

Based on the manufacturer's specifications, the 1,760-cubic-inch array has a peak estimated sound source of 254.55 dB (decibels) re 1 micropascals (μPa) @ 1 m (53.5 bar-m; Far-field Signature), with a root mean square (RMS) sound source of 236.55 dB re 1 μPa. The acoustical broadband energy of these airguns provided by the manufacturer indicates that energy is focused along the vertical axis with little energy focused horizontally.

An acoustical positioning (or pinger) system will be used to position and interpolate the location of the nodes. A vessel-mounted transceiver calculates the position of the nodes by measuring the range and bearing from the transceiver to a small acoustic transponder fitted to every third node. The transceiver uses sonar to interrogate the transponders, which respond with short pulses that are used in measuring the range and bearing. The transceiver to be used is the Sonardyne Scout USBL, while transponders will be the Sonardyne TZ/OBC Type 7815-000-06. Because the transceiver and transponder communicate via sonar, they produce underwater sound levels. The Scout USBL transceiver has a transmission source level of 197 dB re 1 μPa @ 1 m and operates at frequencies between 35 and 55 kilohertz. The transponder produces short pulses of 184 to 187 dB re 1μPa @ 1 m at frequencies also between 35 and 55 kilohertz.

Several offshore vessels will be required to support recording, shooting, and housing in the marine and transition zone environments. Source vessels will have the ability to deploy two arrays off the stern using large A-frames and winches, and have a draft shallow enough to operate in waters less than 5 ft (1.5 m) deep. On the source vessels, the airgun arrays are typically mounted on the stern deck with an umbilical that allows the arrays to be deployed and towed from the stern without having to re-rig or move arrays. The two marine vessels that have been used in the past are the marine vessel (M/V) Peregrine Falcon and the M/V Arctic Wolf. Both vessels' "acoustic signatures" were measured to have source levels of 179.0 dB re 1 μPa and 200.1 dB re μPa, respectively.

Jet-driven shallow draft vessels and bow-pickers will be used for the deployment and retrieval of the offshore recording equipment. These vessels will be rigged with hydraulically driven deployment and retrieval equipment allowing for automated deployment and retrieval from the bow or stern of the vessel. Recording and deployment vessels have been found to have source noise levels of

approximately 165.3 dB re 1 μPa, while the smaller bow pickers produce more cavitation resulting in source levels of 171.8 dB re 1 μPa.

Housing vessel(s) will be larger with sufficient berthing to house crews and management. Crews will be mainly housed aboard the source vessel M/V Arctic Wolf and the mitigation vessel M/V Dreamcatcher (or similar vessels), both with large numbers of berths. The crew transfer vessels (Gwyder Bay or similar) will be used to transfer crews between vessels as needed. The crew transfer vessel travels infrequently relative to other vessels and is operated at different speeds. During high-speed runs to shore, the Gwyder Bay was found to produce source noise levels of about 191.8 dB re 1 μPa, while during slower on-site movements the vessel source levels were 166.4 dB re 1 μPa (Aerts et al., 2008).

To facilitate marine mammal monitoring, one dedicated vessel will be deployed a few kilometers from the active seismic source vessels to provide a survey platform for two or three Protected Species Observers (PSO) who will provide an early warning of the approach of any marine mammals. The M/V Dreamcatcher or a similar boat will fulfill this role. There is no available acoustic signature for the M/V Dreamcatcher, but it is similar in size to the M/V Peregrine Falcon and therefore is expected to have a similar source sound level (179.0 dB re 1 μPa) (Aerts et al., 2008).

### 2.1.2.5. Fuel Storage

Fuel storage is maintained within the vessels fuel storage tanks. All vessels will comply with SAE fueling procedures, which is a two person fueling process. SAE reported that it will conduct fueling operations in full compliance with all Federal, state, and local regulations. The “mother ship” will refuel once every 10 days at dock and will supply fuel to smaller vessels at times. Supply vessels will fuel at dock locations. Procedures would be in place to ensure that the risk of accidental discharge, or spill of any foreign fluids into water, is minimized. Holding tanks are available on the vessels for waste oils, and other fluids are contained onboard in the appropriate containers for disposal onshore.

### 2.1.2.6. Monitoring and Mitigation

To ensure compliance with the Marine Mammal Protection Act (MMPA), SAE has applied to National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) for incidental harassment authorizations (IHA). Mitigation and monitoring requirements in the IHA are intended to ensure that potential impacts to marine mammals would be negligible and that there would be no unmitigable impacts to the availability of subsistence resources. Therefore, SAE will be required to receive the IHAs before commencing BOEM-permitted seismic-survey activities. SAE has committed to a suite of typical monitoring and mitigation measures as part of their Plan of Operations and IHA applications. These measures are described in the sections below, and are considered part of SAE’s Proposed Action for the purpose of this environmental assessment.

#### Monitoring

##### *Vessel-Based Visual Monitoring*

SAE will work with the NMFS and USFWS to design monitoring protocols that will meet the requirements of the MMPA. Required monitoring protocols will be established in the IHA which SAE would obtain prior to initiating seismic survey activities. The objectives of the vessel-based monitoring are to:

- ensure disturbance to marine mammals is minimized and all permit stipulations are satisfied
- document the effects of the proposed seismic activities on marine mammals; and
- collect data on the occurrence and distribution of marine mammals in the Proposed Action area

The monitoring and mitigation plan will be implemented by a team of experienced PSOs. The main roles of the PSO and the monitoring program are to ensure compliance with regulations set in place by the NMFS and USFWS to ensure the disturbance of marine mammals is minimized, and potential effects on marine mammals are documented. PSOs will implement the monitoring and mitigation measures specified in any NMFS issued IHA and in the Marine Mammal Monitoring and Mitigation Plan (4MP), unless the IHA and/or 4MP designate a different person to implement a given measure. PSOs on board the source vessels play a key role in monitoring the 160 dB threshold area for potential Level B harassment, and will monitor and implement mitigation measures in the 190 and 180 dB safety zones to mitigate Level A Harassment. PSOs will be stationed aboard vessels to monitor and implement mitigation measures during all seismic operations. SAE intends to work with experienced PSOs. The observers will monitor the occurrence and behavior of marine mammals near the source vessels.

### *Protected Species Observers*

Protected Species Observers will be stationed at the best available vantage point on the source and mitigation vessels (flying bridge or bridge) which allows an unobstructed 360 degree view of the water. PSO duties will include watching for and identifying marine mammals, recording their numbers, distances, and reactions to the seismic acquisition operations, and documenting exposures of animals to sound levels that may constitute harassment as defined by NFMS. PSOs will scan systematically with the unaided eye, 7x50 reticule binoculars and supplemented with 40x80 long-range binoculars. Monitoring activities will be scheduled to maximize marine mammal observations on/near the seismic vessels during all ongoing operations, including airgun ramp-up activities. PSOs will conduct continuous monitoring during all daylight periods (weather permitting) during seismic operations, for a minimum of 30 minutes prior to the planned start of airgun or pinger operations and after an extended shut down; PSOs will also conduct monitoring during most daylight periods when seismic operations are not occurring. When marine mammals are observed within, or about to enter, designated safety zones, PSOs have the authority to call for immediate power down (or shutdown) of airgun operations as required by the situation.

### *Shore-based Monitoring*

Shore-based monitoring for beluga whales will occur during any summer seismic surveys occurring nearshore within Cook Inlet beluga whale designated critical habitat areas. The standard operating procedures will be virtually identical to vessel-based monitoring, other than that the PSO will be stationed at promontory land locations near the seismic activity.

## Mitigation Measures

### *Proposed Safety and Harassment Monitoring Radii*

The IHA issued by NMFS will establish harassment and safety zones appropriate for cetaceans and pinnipeds in reference to Zones of Influence (ZOI) surrounding the airgun array on the source vessel. PSOs will be tasked with monitoring ZOIs relative to received levels of 180 dB and 190 dB. Harassment zones for cetaceans are based on the estimated area of ensonification relative to the sound source.

Preliminary monitoring zones for the 190, 180 and 160 dB with the various airgun configurations were estimated. These estimates are provided in Table 3. SAE PSOs will monitor these zones for marine mammals before, during, and after the operation of the airguns. Monitoring will be conducted using qualified PSOs on vessels. Preliminary monitoring zones will be adjusted as needed based on the results of the sound source verification test.

**Table 3. Summary of Distance to NMFS Sound Level Thresholds.**

| Source | Source Level | 190 dB | 180 dB | 160 dB |
|---|---|---|---|---|
| 440-cubic-inch airgun array | 221.08 dB re 1 μPa (rms) | 50 m | 182 m | 3.05 km |
| 1,760-cubic-inch airgun array | 236.55 dB re 1 μPa (rms) | 880 m | 1.84 km | 6.83 km |

While the pingers and transponders that will be used to relocate nodes generate source sound levels (185 to 193 dB) that exceed Level A criteria, the associated ZOIs are small (radii of 0 to 6 meters) making marine mammal monitoring impractical. PSOs and operators will, however, ensure that no marine mammals are in the immediate vicinity before deploying active pingers and transponders.

Housing and crew transfer vessels can produce noises exceeding 190 or 180 dB re 1 μPa when traveling at higher speeds. However, ZOIs only extend to 2 to 4 meters from the vessel and impractical to monitor.

### *Sound Source Verification*

Sound source verification (SSV) tests on the same airgun arrays proposed for 2015 surveys were conducted by Heath et al. (2014) during SAE's Cook Inlet operation for Apache. The results of the SSV were used to estimate distances to the NMFS noise thresholds. SSVs for the vessels proposed to be used during the Cook Inlet operations were also conducted by Aerts et al. in 2008. No additional SSVs are planned.

### *Shut-Down Procedure*

A shut-down procedure occurs when all airgun activity is suspended. PSOs may call for the seismic operations to implement a shut-down procedure when a marine mammal approaches (or is observed within) the applicable safety zone. The shutdown 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 applicable ZOI.

Airgun activity will not proceed until the marine mammal has cleared the zone and the PSOs on duty are confident that no marine mammals remain within the appropriate ZOI. The animal will be considered to have cleared the zone if it:

- is visually observed to have left the applicable zone of influence
- has not been seen within the zone for 15 minutes in the case of pinnipeds; or
- has not been seen within the zone for 30 minutes in the case of cetaceans

### *Power-Down Procedure*

A power-down procedure involves reducing the number of airguns in use such that the radius of the 180 dB (or 190 dB) zone is decreased to the extent that marine mammals are not in the zone of influence. Whenever a marine mammal is detected outside the safety radius and, based on its position and motion relative to the ship track is likely to enter the zone, PSOs may call for the seismic operations to implement a power-down procedure (de-energize the airgun array). If a marine mammal is detected outside the ZOI (either injury or harassment) but is likely to enter that zone, airguns may be powered down before the animal is within the safety radius, as an alternative to complete shutdown.

Similar to shut-down, after a power-down, airgun activity will not resume until the marine mammal has cleared the applicable zone of influence. The animal will be considered to have cleared the applicable zone if it:

- is visually observed to have left the applicable ZOI

- has not been seen within the zone for 15 minutes in the case of pinnipeds; or
- has not been seen within the zone for 30 minutes in the case of cetaceans

### *Ramp-up Procedure*

A ramp-up procedure gradually increases airgun volume at a specified rate and involves a step increase in the number and total volume of airguns until the full volume is achieved. The purpose of the ramp-up or "soft start" is to warn marine mammals in the area and provide sufficient time for them to leave and avoid potential injury. Ramp-up is used at the start of airgun operations, including a power-down, shut-down, and after any period greater than 10 minutes in duration without airgun operations. The rate of ramp-up will be no more than 6 dB per 6 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 applicable ZOI for the full airgun array will be maintained.

If the complete applicable zone has not been visible for at least 30 minutes prior to the start of operations, ramp-up will not start 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 full source from a complete shut-down in thick fog or at other times when part of the applicable zones are not visible.

It will not be permissible to commence ramp-up if the complete safety radii are not visible for at least 30 minutes prior to ramp-up in either daylight or nighttime. Ramp-up will not commence at night unless the seismic source has maintained a minimum sound source pressure level at the source during the interruption of seismic survey operations.

### *Speed or Course Alteration*

A vessel's speed and/or course can be changed, as long as the ship's crew is not compromised, when a marine mammal is detected outside the safety radius or ZOI and, based on its position and relative motion, is likely to enter the safety radius. 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 applicable zone. If the mammal appears likely to enter the zone, further mitigation actions (further course alterations, power-down, shut-down) will be taken.

Additionally, SAE will reduce vessel speed when within one kilometer of whales. Vessels capable of steering around pods will do so. Vessels will not be operated in such a way as to separate members of a pod of whales from other members of the pod. Vessel captains will avoid multiple changes in direction and speed when within one kilometer of whales.

### *Subsistence*

Where the proposed operations would occur in or near a subsistence hunting area, SAE will communicate with the subsistence users and involved agencies to minimize any adverse effects on the availability of marine mammals for subsistence uses. SAE will provide information on the time, location, and operations of the proposed program, opportunities for involvement by local people, potential impacts to marine mammals and mitigation measures to avoid impacts. SAE will develop a plan of cooperation. It is expected that this plan will be finalized during the spring of 2015. All seismic activities will follow mitigation procedures to minimize effects on the behavior of marine mammals which will give opportunities for subsistence harvest by Alaska Native communities.

# 3.0 AFFECTED ENVIRONMENT

This section describes the environmental conditions and resources in areas potentially affected by the Proposed Action.

## 3.1. Expected Operating Conditions

### 3.1.1. Meteorology and Climate Change

The wind and marine conditions of the lower Cook Inlet are strongly influenced by the seasonal fluctuations of three weather systems – the Continental High, the Aleutian Low, and the Pacific High (Shulski and Wendler, 2007). In the winter, the Continental High occurs over the Alaskan landmass while the Aleutian Low sits in the western Gulf of Alaska, displacing the Pacific High to the south. In the summer, the Aleutian Low migrates across the Alaska Peninsula into the Bering Sea, the Pacific High moves up into the Gulf of Alaska, and the Continental High dissipates. This seasonal fluctuation in dominant weather systems results in strong north and northeast winds over the northern lower Cook Inlet, and strong east and northeast winds over the southern lower Cook Inlet in winter, and weaker, southerly winds in the summer – south and southwest winds in the north lower Cook Inlet, and west southwest winds in the south. The number of monthly storm occurrences decreases during the summer.

The Lower Cook Inlet is located along the maritime-continental gradient, an area of transition from a strictly marine climate to the south and east (coastal rainforests), and a continental climate to the north and west (the Alaska interior). The Inlet includes 11 watersheds that drain major mountain ranges; and snowmelt and glaciers that cover 11 percent of the land area of the Cook Inlet basin that store massive amounts of water as ice providing a large portion of the input into area watersheds. Several geologic features exist in the area, including volcanoes, ice, and sediment. The area is subject to earthquakes, tsunamis, flooding, tides, and coastal erosion. It is one of the most seismically active regions in the world, with several volcanoes nearby (ADNR, 2009b). The meteorological conditions of the lower Cook Inlet are further influenced by local interactions between wind and topography. The inlet is bounded on the west by the Chigmit Mountains, a subrange of the Aleutian Range, and on the east by the much lower Caribou Hills that gradually fade out into the lowlands along the Inlet's eastern coastline.

Historical National Weather Service (NWS) records of meteorological conditions of the lower Cook Inlet are limited as operational weather reporting stations are scarce (Schumacher, 2005). As such, the average meteorological databases for Kenai and Homer, Alaska, are presumed to be representative of conditions that would exist for the SAE Cook Inlet seismic program during the timeframe of the proposed seismic surveys.

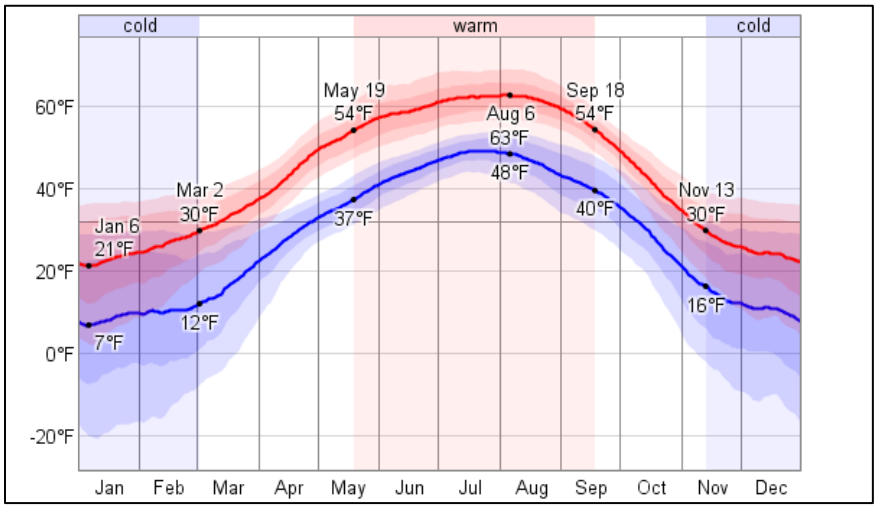
The annual number of daylight hours is about the same for both Kenai and Homer, Alaska. On the shortest day of the year, December 21, there are 5:43 hours of daylight in Kenai. In the southern portion of the project area, sunlight lasts slightly longer on the same day, 6:00 hours of daylight in Homer.

Temperatures are more temperate in Homer, Alaska, than in Kenai, Alaska, where Homer has a warmer winter than Kenai, and a slightly cooler summer. While temperatures in the winter in Kenai can plunge to -21°F, temperatures rarely fall below zero in Homer. Temperatures in January in Kenai are generally around 10°F, whereas low temperatures in Homer average around 20°F in January. Summer temperatures are just slightly higher in Kenai than in Homer. Average August temperatures are in the lower to middle 60s in Kenai, whereas in Homer, August temperatures average in the upper 50s to lower 60s. A graphical plot of average daily high and low temperatures is shown in Figure 3.

Rainfall in the Lower Cook Inlet is most likely to occur from June through September in Kenai, and from September through January in Homer. Rain is least likely in April and May for both locations, and what rain does fall, will more likely occur in the southern portions of the project area (Shulski and Wendler, 2007). Winter and summer, most all precipitation is in the form of light rain and light snow, where in the northern portions, precipitation is more likely to be light snow, as illustrated in Figure 4.

Wind speeds range generally from 5 to 10 miles per hour at both locations, Kenai and Homer. While prevailing winds in Kenai and Homer are easterly, this occurs mostly October through March. During the time period of the proposed seismic survey, winds will be from the south and southwest in Kenai, and more westerly, west and southwest, in Homer. Otherwise, the winds at both locations will be north through east, as illustrated in Figure 5 and Figure 6.

**Kenai, Alaska – North Lower Cook Inlet: Daily Average High and Low Temperature**




**Homer, Alaska – South Lower Cook Inlet: Daily Average High and Low Temperature**

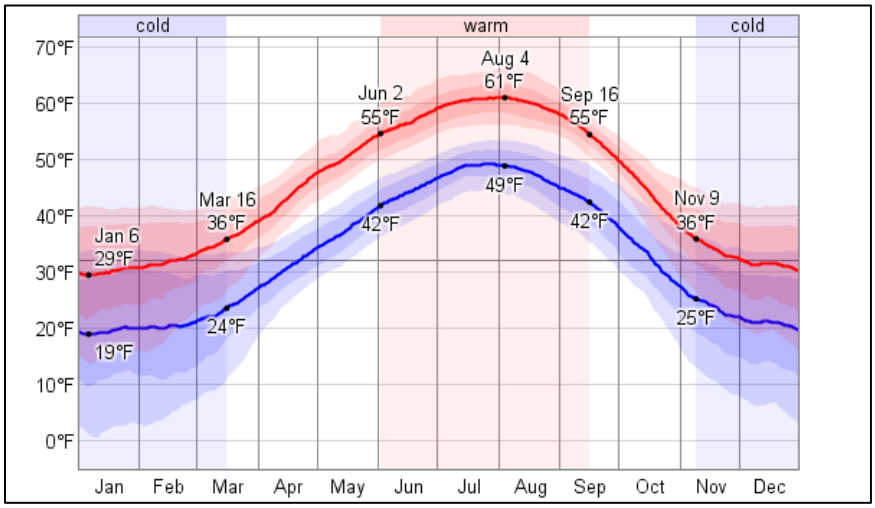
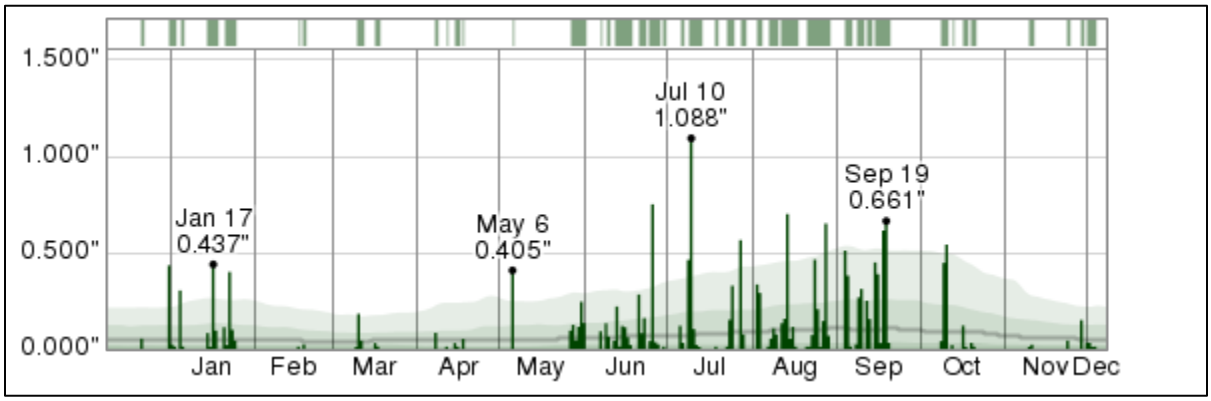



**Figure 3. Average Daily High and Low Temperatures in Kenai and Homer, Alaska by Month of the Year by Degrees Fahrenheit.**

Source: Weatherspark.com Average Weather for Kenai, Alaska, USA, and Average Weather for Homer, Alaska, USA. http://weatherspark.com/averages/32938/Kenai-Alaska-United-States and http://weatherspark.com/averages/32967/Homer-Alaska-United-States

**Kenai, Alaska – North Lower Cook Inlet: Liquid Water Equivalent**




**Homer, Alaska – South Lower Cook Inlet: Liquid Water Equivalent**

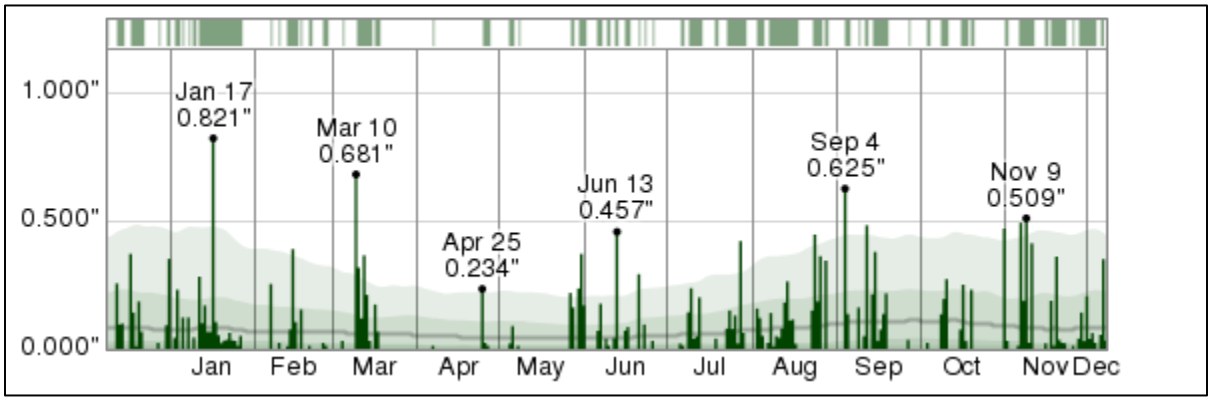
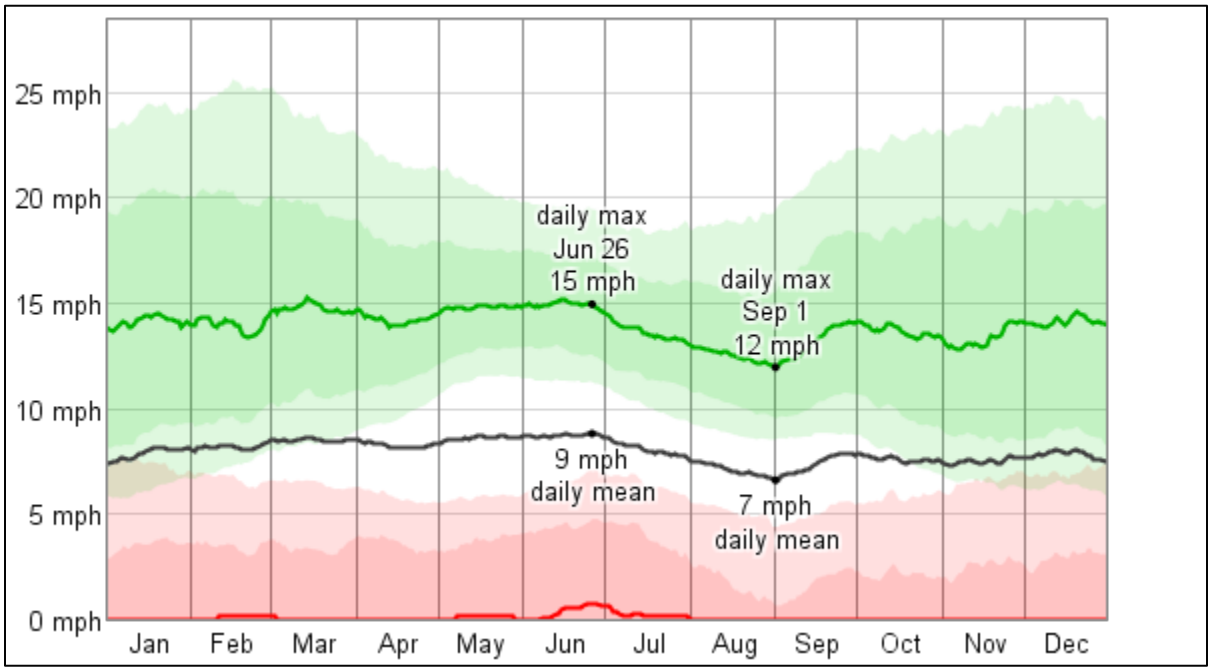



**Figure 4. Liquid Equivalent Quantity in Kenai and Homer, Alaska.**

For each month of the year, the graphs show the average liquid equivalent precipitation in inches. Source: Weatherspark.com Historical Weather for Kenai, Alaska, USA, and Historical Weather for Homer, Alaska, USA. http://weatherspark.com/history/32938/2014/Kenai-Alaska-United-States

**Kenai, Alaska – North Lower Cook Inlet: Average Wind Speed**




**Distribution of Various Wind Directions**

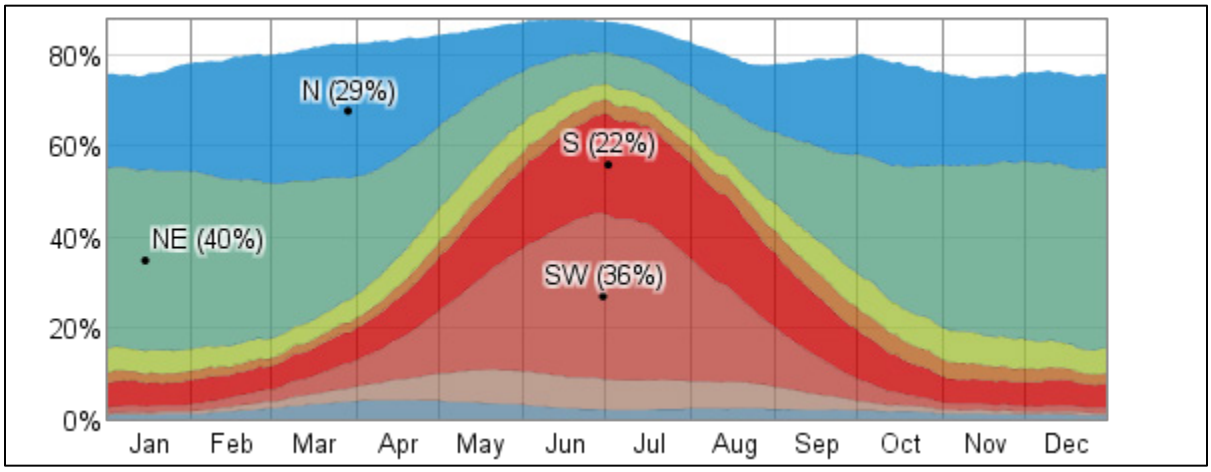
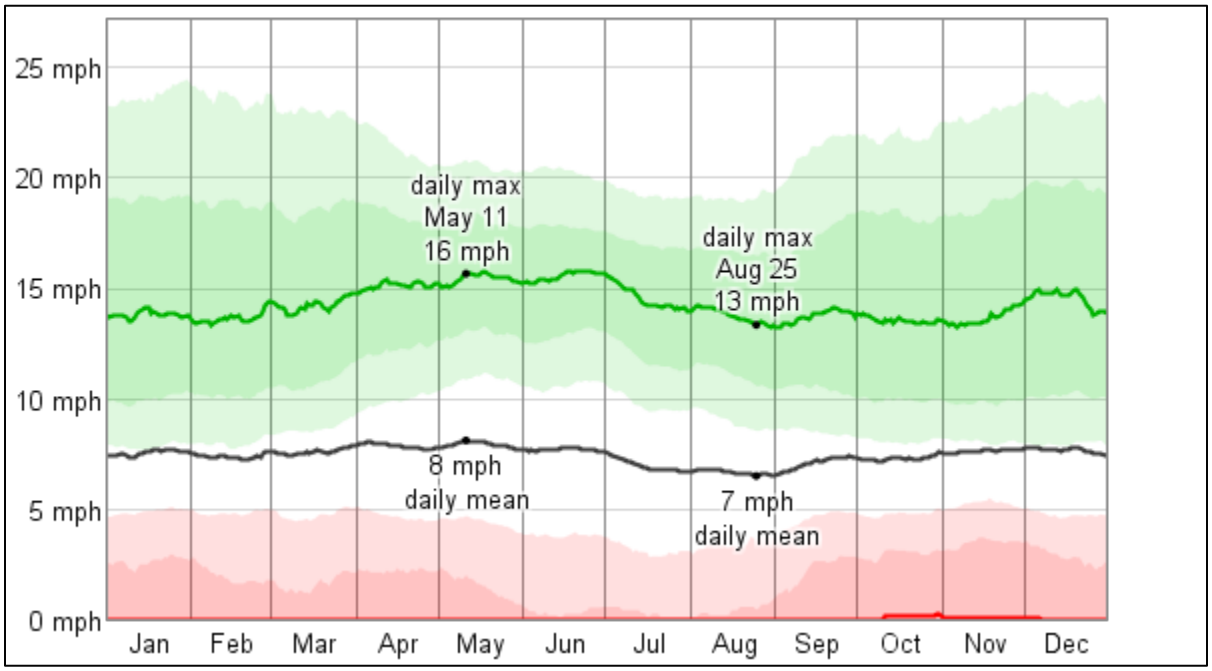



**Figure 5. Average Daily Minimum, Maximum, and Average Wind Speed and Distribution of Annual Wind Direction, in Kenai, Alaska, for Each Month of the Year.**

Source: Weatherspark.com Average Weather for Kenai, Alaska, USA.
http://weatherspark.com/averages/32938/Kenai-Alaska-United-States

**Homer, Alaska – South Lower Cook Inlet: Average Wind Speed**




Note: Higher graph line (green) is the average daily maximum wind speed, the middle line (black) is the average wind speed, and the lower line (red) is the average daily minimum wind speed.

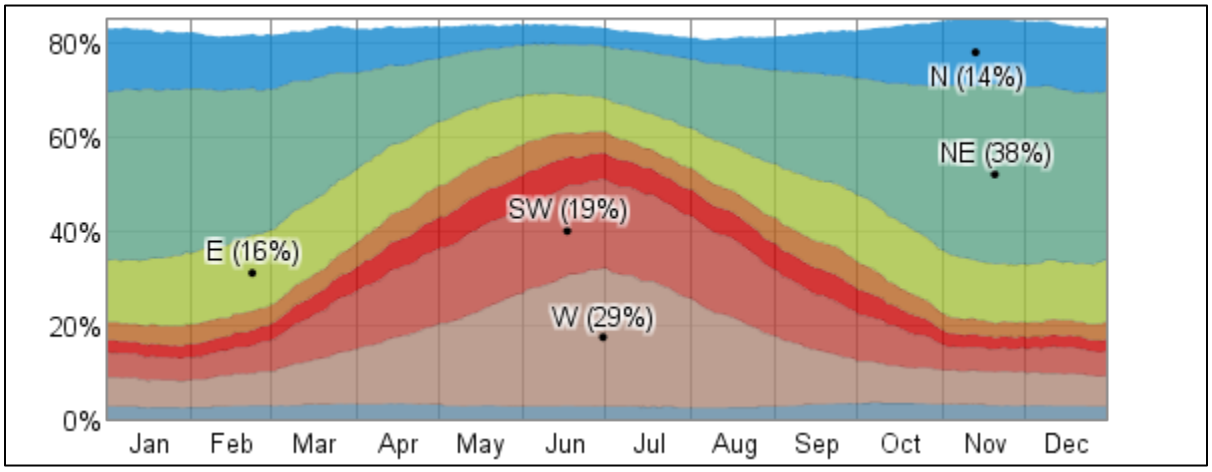



**Figure 6. Average Daily Minimum, Maximum, and Average Wind Speed and Distribution of Annual Wind Direction, in Homer, Alaska, for Each Month of the Year.**

Source: Weatherspark.com Average Weather for Kenai, Alaska, USA.
http://weatherspark.com/averages/32967/Homer-Alaska-United-States

## 3.1.2. Sea Ice and Sea State

Sea ice is seasonal and most prevalent in the OCS project area during late winter after the Proposed Action has been completed (Brower et al., 1988; LaBelle et al., 1983; Mulherin et al., 2001). Sea-ice formation is influenced in upper Cook Inlet primarily by air temperature and in lower Cook Inlet by the temperature and inflow rate of the Alaska Coastal Current (Poole and Hufford, 1982).

The lower Cook Inlet generalized mean circulation within the project area is a northward flow along the eastern side of the inlet (Johnson, 2008; Okkonen, Pegau and Saupe, 2009). The northward flow

originates from the Alaska Coastal Current and deeper water that enters Cook Inlet from the Gulf of Alaska through Kennedy and Stevenson entrances (Okkonen, Pegau and Saupe, 2009). Superimposed on the mean flow, mixed tides are the primary surface circulation driving force (Ezer et al., 2013). Two unequal high and low tides occur per tidal day (24 hours, 50 minutes), with the mean tidal range increasing northward. Mean diurnal range is 5.8 meters (19.1 feet) on the eastern side of the inlet, and tidal velocities reach up to 4-5 knots in the project area. Source activities are proposed to only occur during low and high slack tides or when vessels can operate safely to acquire quality data. Typically, source activities will occur for two to three hours at each slack tide (SAE, 2014a, p.5).

## 3.2. Resources

### 3.2.1. Air Quality

The Proposed Action is located within the Kenai Peninsula Borough (a local government entity), where the Cook Inlet dissects the borough from north to south – the Kenai Peninsula to the east and the Chigmit Mountains to the west. The Kenai Peninsula comprises 99% of the Borough's population and most of the development. Thus, nearly all sources of emissions, though few, are located on the western coast of the Kenai Peninsula. Even less development exists on the west side of the Cook Inlet along the coastline of the Chigmit Mountains (Kenai Peninsula Borough, 2014). The Environmental Protection Agency (EPA) finds the air quality within the borough does not exceed Federal guidelines defining good air quality. The existing condition of air quality in the vicinity of the Proposed Action 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. The stronger the wind, the more turbulent the air, and pollutants are diluted during transport, which decreases pollutant concentrations and reduces the environmental impact of emissions caused by the Proposed Action (Ahrens, 2012). Thus, the wind conditions over the lower Cook Inlet, together with the relatively few pollutant sources either onshore or offshore causes the quality of the air over the affected area to be consistently better than required by Federal standards (EPA, 2014).

### 3.2.2. Water Quality

Water quality describes the chemical and physical characteristics of water, usually in respect to its suitability for a particular purpose such as enabling fish and wildlife to carry on biological cycles of life. Wind, tidal currents, river runoff, glacial melt, and sea ice dynamics influence Cook Inlet's water quality. The rivers and streams flowing directly into the nearshore environments of Cook Inlet release sediments and minerals to the marine system, affecting salinity, temperature and other aspects of water. Water quality is generally good in the Cook Inlet, though anthropogenic impacts, as well as biological activities, and other environmental processes impact certain aspects of water quality.

Glass et al. (2004) in the National Water-Quality Assessment Program for 1997 – 2001 reported:

> Water quality is generally good in the Cook Inlet Basin, supporting most beneficial uses of water most of the time, including drinking, recreation, and protection of fish, other aquatic life, and wildlife. Much of the water originates in the mountainous headwaters from melting snow and glaciers, and because the snow is relatively pure, much of the water is either free of, or contains only low concentrations of, contaminants. Although water quality generally is good, natural geologic and climatic features, including the presence or absence of glaciers, affect this quality. …in the northwestern and southwestern regions of the [upper Cook Inlet] basin,

> naturally occurring trace elements, such as arsenic, chromium, nickel, and zinc, frequently are found in streambed sediments at concentrations that exceed guidelines for the protection of sediment-dwelling organisms. Human activities also affect water quality in the basin, particularly in urban areas on lowlands along the northern and eastern shores of Cook Inlet.

BOEM is in agreement with Glass et al. (2004); lower Cook Inlet's water quality is generally good as discussed in the Cook Inlet Planning Area Oil and Gas Lease Sales 191 and 199 FEIS (USDOI, MMS, 2003, Section III.A.4, pages III-12 - III-32). Cook Inlet is a tidal estuary with a sizable tidal range. Tidal turbulence, associated mainly with tidal currents but also winds, results in the vertical mixing of the waters. A large variety of naturally occurring inorganic and organic substances are transported into Cook Inlet by the relatively large volume of waters from freshwater tributaries and by marine currents from the Gulf of Alaska. These natural inorganic and organic substances are dissolved in the water column, or remain in suspension and are dispersed by tidal currents and winds. In addition to naturally occurring substances, a variety of anthropogenic substances are discharged into Cook Inlet. Various point sources of contaminants enter from municipalities bordering Cook Inlet or its tributaries, as well as discharges from seafood processors and the petroleum industry.

Municipalities have wastewater that may contain a variety of organic and inorganic contaminants, metals, nutrients, sediments, bacteria, and viruses. Seafood processors generate organic wastes that usually are discharged into the waters adjacent to the onshore plant or into the waters in which the offshore processors are operating. The petroleum industry has various exploration and production discharges, produced waters, and discharges of approved generic drilling muds and additives. In addition to the routine discharges, there have been a number of accidental spills of refined petroleum products and crude oil, including spills from pipelines and vessels carrying petroleum products to communities and other vessels, commercial fishing boats, recreational boats, and cruise vessels. Concentrations of hydrocarbons are generally low, mainly derived from terrestrial plants, and are found throughout the waters of Cook Inlet. The low concentrations of hydrocarbons are similar to concentrations found in other unpolluted coastal areas. The amount of total organic carbon in the sediments is low and indicates an environment that generally is uncontaminated.

The recent EA for the Issuance of an IHA for the Apache Alaska Corporation 3D Seismic Survey in Cook Inlet, Alaska (NMFS, 2013, Section 3.2, page 24) supplements earlier water quality descriptions and indicates that surface waters are well oxygenated and typically carry high silt and sediment loads. A variety of metals such as zinc, barium, mercury, and cadmium are carried in suspended sediment loads. Hydrocarbon levels in the water column are generally low, often below the detection limit. Elevated methane levels were observed in upper Cook Inlet's Trading Bay, an area with oil and natural gas fields. Although saturated hydrocarbons were detected in treated production waters from Trading Bay, levels were below regulated limits. Polycyclic aromatic hydrocarbons were often less than reporting limits of area waters, although treated production waters held elevated levels.

The Alaska Department of Environmental Conservation (ADEC) Final 2012 Integrated Water Quality Monitoring and Assessment Report (ADEC, 2013) is a biannual report and identifies actions that can be taken to improve water quality and the health of waterbodies. While ADEC's report does not evaluate the water quality of lower Cook Inlet, it helps focus on the origins of anthropogenic impacts. Most streams and lakes in populated areas in the Cook Inlet Drainage have been determined to be impaired, though most belong to categories that do not require a recovery plans. Those waterbodies are: Category 2 - previously identified as impaired but are now attaining water quality criteria; Category 3 - data or information are insufficient to determine whether the water quality standards criteria are attained; and Category 4a - previously listed in Category 5, however a total maximum daily limit (TMDL) plan has been completed and approved by EPA. Waterbodies within the Cook Inlet drainage that were identified as Category 5 include: Hood/Spenard Lake in Anchorage for low

dissolved oxygen as well as bacteria, lead, nitrates, and phosphates; Wasilla's Cottonwood Creek for fecal coliform bacteria; and the Alaska Railroad's active open dump of debris in the Matanuska River near Palmer.

### Existing Regulatory Control of Discharges

The primary regulation for controlling pollutant discharges into waters of the U.S. is the Clean Water Act (CWA) of 1972, as amended. Section 402 of the CWA established the National Pollutant Discharge Elimination System (NPDES) permit program. The ADEC has issued general permits under state authority for discharges from facilities that require an NPDES permit but where EPA has not issued one. Accordingly, EPA regulates through the NPDES discharge permits. Alaska General Permits include discharges incidental to the operation of offshore seafood processors, stormwater, Cook Inlet Oil and Gas General Permit, General for Facilities Related to Oil and Gas Extraction, and General permits for vessel discharges. Additionally, EPA has issued various individual NPDES permits to regulate water quality for domestic and industrial activities. These include but are not limited to: publicly owned treatment works, CWA Section 301(h) waivers, hatcheries, mining, power plants, seafood processors and others. Coast Guard regulations (33 CFR Part 151) that are in place are intended to reduce the transfer of invasive species from vessels brought by ballast water into the State of Alaska or Federal waters.

## 3.2.3. Lower Trophic Levels

The Cook Inlet region is known for a rich and diverse invertebrate fauna consisting of numerous species of barnacles, polychaetes, clams, mussels (Lees and Driskell, 2006) and cephalopods (Scheel, 2002). Historically and into the present, the Central (within the project area), Southern (south of Anchor Point), Kamsihak Bay (west of project area), and Barren Island (south of Kamishak Bay) designations within the Cook Inlet Management Area are known for nearshore clam fisheries and nearshore to mid-inlet shellfish, crab, and shrimp fisheries (Trowbridge and Goldman, 2006).

The onshore areas of the geospatial boundaries of the Proposed Action include the Clam Gulch, Ninilchik, Happy Valley, and Whiskey Gulch Beach Management Areas (Kerkvliet and Booz, 2013). These areas are historically known for subsistence and sport harvests of razor clams (*Siliqua patula*). Harvest has been monitored since the 1964 earthquake. They were stable between 1973 and 2004, varying between approximately 520,000 in 2004 and 1.3 million clams in 1995. Clam Gulch historically was the most popular harvest site until the mid-1980s, when Ninilchik began to register 60% of the harvest base. Shifts in harvest are thought to be a result of changes in large clam abundance (Szarsi and Hanson, 2009).

Crab and shrimp harvesting has shown similar trends, with recorded harvest numbers lowering over time (Rumble, et al., 2014). Tanner crab (*Chionoecetes bairdi* or *C. opilio*) numbers in the Southern District of the Cook Inlet Management Area have dropped from a range of 1-2.3 million in the commercial harvests of the 60s and 70s to being closed from 1995 to the present. Commercial harvests of King Crab (*Paralithodes spp.*) shows similar trends with harvests in the 60s and 70s showing similar numbers and seasons closed after 1984. Both species have remained caught in low numbers according to research done by the Alaska Department of Fish and Game (ADF&G) and interviews with subsistence and personal use fisherman. Harvest of shrimp (*Pandalus spp*.) has lowered over the same time periods, with commercial seasons closed since 1987-1988 (Trowbridge and Goldman, 2006).

## 3.2.4. Fish

There are 52 species of fish that have been described in Cook Inlet (Piatt et al., 1999). These fish fall into three basic groups; freshwater, anadromous, and marine species (MMS, 2003), which are further classified as pelagic and ground fishes. Pelagic fish inhabit the water column above the abyssal and

the littoral zones, while ground fish, also referred as demersal, benthic, or bottom-dwelling fish, inhabit the seafloor sometime during their life cycle (Nemeth et al., 2007). Ground fish comprise all marine finfish except halibut, smelt, herring and salmonids (ADF&G, 2013). For reference, common pelagic fish include Pacific salmon, while ground fish species include Pacific cod and walleye pollock.

Many pelagic and ground fish species are classified as forage fish. The term 'forage fishes' applies to mid-water, schooling fishes that are prey to marine mammals, seabirds, and larger fishes during some phase of their life-history (Springer and Speckman, 1997). Forage fish are widely distributed throughout Cook Inlet and play an important role as a link between lower and higher trophic levels. The nutritional or energetic value of forage fish varies among species and life stage, and is often determined by their lipid content. The most common forage fish species can be divided into lipid-rich species such as Pacific sand lance, Pacific herring, and capelin, and lipid-poor species such as Pacific cod and walleye pollock (Abookire and Piatt, 2005), but the quintessential ocean forage fish are small, silvery schooling lipid-rich oily fish such as herring, capelin, smelts, and sand lance. Forage fish are considered 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).

The majority of forage fish studies have been conducted in Lower Cook Inlet (Rodrigues et al., 2006). Abookire and Piatt (2005) studied the occurrence of forage fish in three geographic areas of Lower Cook Inlet, covering Chisik Island, Kachemak Bay, and Barren Islands. The dominant forage fish species caught were Pacific herring, walleye pollock, capelin, Pacific sand lance, and eulachon. Both species richness and species diversity were highest in waters near Chisik Island; located approximately 15 miles west of the Proposed Action area (Figure 1). Kachemak Bay, located south of the Proposed Action area, had an intermediate value of species richness; species richness was lowest at the Barren Islands, the area furthest from the Proposed Action area. Table 4 lists the most common forage fish found in Cook Inlet.

**Table 4. Selected Forage Fish Species Occurring in Lower Cook Inlet.**

| Common Name | Taxonomic Name |
|---|---|
| Pacific sand lance | *Ammodytes hexapterus* |
| Eulachon | *Thaleichthys pacificus* |
| Pacific herring | *Clupea pallasii* |
| Pacific cod | *Gadus macrocephalus* |
| Walleye Pollock | *Gadus chalcogrammus* |
| Capelin | *Mallotus villosus* |

The forage fish listed in Table 4 are discussed in more detail below:

**Pacific sand lance** is a characteristic forage fish and possibly the single most important taxon of forage fish in the Northern Hemisphere (MMS, 2003). Their range includes the Bering Sea and eastern North Pacific Ocean and occurs throughout coastal marine waters of Alaska (Mecklenburg et al., 2002). A schooling species, Pacific sand lance are found both in benthic and pelagic habitats in relatively shallow water to 100 m (328 ft) and reach a length of 28 cm (11 inches; Mecklenburg et al., 2002). Because of their high lipid content, it is an important prey species for predators. The Sand lance reaches sexual maturity at age 2, and spawns once a year in late September-October (Robards et al., 1999). They are abundant in Cook Inlet from spring to late summer and uncommon during winter (Rodrigues et al., 2006).

**Eulachon** (commonly called smelt, candlefish, or hooligan) are small anadromous forage fish found throughout the Cook Inlet. Eulachon reach a length of 25.4 cm (10 inches; Mecklenburg et al., 2002) and spend 3 to 5 years in saltwater before returning to freshwater to spawn from late winter through mid-spring. Abookire and Piatt (2005) reported small numbers of eulachon in the Chisik Island area and none in Kachemak Bay or the Barren Islands during mid-water trawl sampling from 1996 to 1999. The Cook Inlet population also supports small Eulachon dipnet fisheries in upper Cook Inlet (SAIC, 2002).

**Pacific herring** distribution and abundance in Cook Inlet is variable, but occur in large schools in early April and through early fall (Rodrigues et al., 2006). They spawn during the spring in intertidal and subtidal zones (MMS, 2003). Herring, with a life span of about 8 years, reach sexual maturity at about 3 or 4 years and spawn annually thereafter (ADNR, 2008). Herring population abundance trends are very dynamic and are subject to fairly substantial changes on both large and small geographic scales. In 1997, Fechhelm et al. (1999) reported that Pacific herring was the most abundant species (79% of total catch) in both trawl and seine nets in the Chisik Island area.

**Pacific cod** are widely distributed in the pelagic and demersal environment of Cook Inlet. They are fast-growing bottom-dwellers that mature in approximately 3 years reaching lengths of up to 1 m (3.3 ft) (MMS, 2003). Pacific cod spawn in relatively deep water during the winter and move to shallower waters to feed. Males become sexually mature at age 2 and females at age 3 (Rodrigues et al., 2006). Their abundance, wide distribution and role in the food web make this species important in the overall ecosystem of Cook Inlet. Abookire et al. (2001) found that Pacific cod were one of the most abundant species captured during sampling in Kachemak Bay (SAIC, 2002).

**Walleye pollock** is an abundant species that is widely distributed across the Gulf of Alaska and is a commercially and ecologically important species (NOAA, 2014a). Although walleye pollock is grouped with groundfish, young pollock is a forage fish. Pollock in the Gulf of Alaska are managed as a single stock independently of pollock in the Bering Sea and Aleutian Islands (NOAA, 2014a). The separation of pollock in Alaskan waters into eastern Bering Sea and Gulf of Alaska stocks is supported by analysis of larval drift patterns from spawning locations (NOAA, 2014a). Spawning occurs in the spring within parts of Shelikof Strait (MMS, 2003). Studies by Abookiere and Piatt (2005) reported that in lower Cook Inlet, most walleye pollock are found in the Barren Island area and in Kachemak Bay and relatively few occurred near Chisik Island.

**Capelin** is a wide ranging member of the smelt family that occurs from the Arctic Ocean, Gulf of Alaska, and northeast Pacific Ocean (Doyle et al., 2002). Despite its importance as a forage fish and its role in the trophic web of Alaskan coastal waters, there have been few studies pertaining to capelin life history in the North Pacific (Rodrigues et al., 2006). Capelin reach a length of 25.2 cm (10 inches) and spawn on gravel beaches below the tide line. Abookire and Piatt (2005) reported that capelin comprised 23.5% of the total catch in the Chisik Island area from 1996 to 1999, and Speckman et al. (2005) reported that capelin were present in the Barren Island area during sampling in 1997 and 1998.

**Select Anadromous Fishes in the Proposed Action Area**

Rivers and streams discharging into Cook Inlet within the boundary of the Proposed Action area provide estuarine and freshwater habitats for several anadromous and migratory species including all five species of Pacific salmon (*Oncorhynchus spp*.), Dolly Varden (*Salvelinus malma*), and Steelhead trout (*O. mykiss*) (ADF&G, 2014a). These rivers and streams and the fish species they provide habitat for are shown in Table 5.

**Table 5. Anadromous Fish Streams Located in the Proposed Action Area.**

| Drainage | Anadromous Fish Species |
|---|---|
| Kasilof River | King, Pink, Dolly Varden, Steelhead |
| Crooked Creek | Coho, King, Sockeye, Dolly Varden, Steelhead |
| Ninilchik River | Coho, Dolly Varden, Steelhead |
| Deep Creek | Coho, King, Pink, Dolly Varden, Steelhead |
| Stariski Creek | Coho, King, Pink, Dolly Varden, Steelhead |
| Anchor River | Coho, Chum, King, Pink, Sockeye, Dolly Varden, Steelhead |

Anadromous fishes that migrate through Cook Inlet to spawn in drainages that enter the Proposed Action area include the following:

**Pink salmon** (*O. gorbuscha*) spawn at two years of age and return to spawning streams in alternating odd and even year cycles between late June and October and typically spawn within a few miles of the shore. In Cook Inlet, larger pink runs occur during even years (ADF&G, 1986) and spawn in the Kasilof River and Deep and Stariski Creeks (Table 5).

**Sockeye salmon** (*O. nerka*) spend two to three winters in the North Pacific Ocean before returning to natal streams to spawn (SAIC 2002) including Crooked Creek. Adult sockeye return to Cook Inlet in late June through early August and is the most important commercial salmon species in Cook Inlet (ADF&G, 1999).

**Coho salmon** (*O. kisutch*) reside in fresh water streams up to three winters before migrating to the sea where they typically remain for two winters before returning to spawn (ADF&G, 1986) in Crooked, Deep, and Stariski Creeks and in the Ninilchik and Anchor Rivers from July to November.

**Chum salmon** (*O. keta*) enter the Cook Inlet region after 3 to 5 years at sea (SAIC, 2002), and spawn from July through early August. They grow to an average weight of 7 to 18 pounds. Newly emerged chum fry migrate directly to salt water, and early marine survival is dependent on healthy estuaries providing good quality water, abundant food resources, and refuge from predators. As shown in Table 5, Chum salmon are represented only in Anchor River.

**Chinook salmon** (*O. tshawytscha*), the largest of all Pacific salmonids commonly exceed 30 pounds. The largest Chinook salmon run occurs in the Susitna River located in upper Cook Inlet (ADF&G, 1986), but other systems such as the Kasilof and Anchor Rivers and Crooked, Deep, and Stariski Creeks support Chinook salmon spawning in their fourth or fifth year (SAIC, 2002).

**Dolly Varden** can be anadromous or reside in fresh water. In Cook Inlet, Dolly Varden spawn annually in rivers during the fall from late August to October (Scott and Crossman, 1973; Morrow, 1980) and are represented in all streams that drain into the Proposed Action area (Table 5). Dolly Varden lay eggs in hollowed out redds located in swift moving water; hatching occurs the following spring. Juveniles remain in their natal streams for 2 to 3 years (SAIC, 2002).

**Steelhead trout** is a rainbow trout that spends a part of its life in the ocean. Small numbers of these fish are found in streams throughout Cook Inlet. Spawning begins in about mid-April and generally continues throughout May and early June. Juveniles remain in the parent stream for about 3 years before they enter saltwater (MMS, 2003). Steelhead trout are represented in all streams that drain into the Proposed Action area (Table 5).

### 3.2.5. Marine and Coastal Birds

Cook Inlet provides an important resting and staging area for migrating birds, as well as breeding and nesting habitat for several coastal and marine avian species. More than 100 species of waterfowl, shorebirds, and seabirds are known to occur in Cook Inlet (ADNR, 2009a). Areas such as mudflats, deltas, flood plains and salt marshes provide habitats for the largest variety and number of birds. Bays and exposed inshore waters are habitats for loons (*Gavia spp.*), grebes (*Podiceps spp.*), cormorants (*Phalacrocorax spp.*), sea ducks, and alcids. Geese and dabbling ducks primarily use river flood plains and marshes, while diving ducks spend most of their time on bay waters. Shorebirds are found primarily on mud flats and gravel areas. Gulls are found in a variety of habitats, especially lagoons. In 1994, Kachemak Bay (southeast of the seismic survey area) was identified as a Western Hemisphere Shorebird Reserve because of its importance to shorebirds of the Pacific Flyway.

General descriptions of the distribution, abundance, and biology of marine and coastal birds that occur in Cook Inlet are in the Cook Inlet Planning Area Oil and Gas Lease Sales 191 and 199 Final EIS (USDOI, MMS, 2003), which are hereby incorporated by reference. More detailed information can be found in Osgood (1901, 1904), Gabrielson and Lincoln (1959), Isleib and Kessel (1973), Erikson (1976, 1977), Gill, Handel and Petersen (1978), Kessel and Gibson (1978), Ameson (1980), Sowls et al. (1982), Agler et al. (1995), Gill and Tibbitts (1999), Piatt (2002), Speckman (2002), URS (2006), and Ulman (2012). Additionally, information on the locations, sizes, and species compositions of seabird colonies in Cook Inlet is available from the U.S. Fish and Wildlife Service (USFWS) Catalog of North Pacific Seabird Colonies online database (USFWS, 2012a). These documents and data are incorporated by reference and the information on common or abundant marine and coastal birds that are resident or migrant species in or near the seismic survey area is summarized below. A list of marine and coastal birds known or with potential to occur in lower Cook Inlet is provided in Table 6.

**Table 6. Common Resident and Migratory Marine and Coastal Birds in Lower Eastern Cook Inlet**

| Species | Breeding Range Adjacent to Seismic Survey Area[1] | Species | Breeding Range Adjacent to Seismic Survey Area[1] |
|---|---|---|---|
| **Waterfowl** | | | |
| ***Dabbling Ducks*** | | ***Loons and Grebes*** | |
| American Wigeon | Yes | Arctic Loon[2] | No |
| Barrow's Goldeneye | Yes | Common Loon | Yes |
| Bufflehead | No | Horned Grebe | No |
| Canvasback | No | Pacific Loon | No |
| Common Goldeneye | No | Red-necked Grebe | Yes |
| Gadwall | Yes | Red-throated Loon | No |
| Greater Scaup | Yes | Yellow-billed Loon | No |
| Green-winged Teal | Yes | ***Seaducks*** | |
| Harlequin Duck | Yes | Black Scoter | Yes |
| Mallard | Yes | Common Eider | Yes |
| Northern Pintail | Yes | Common Merganser | Yes |
| Northern Shoveler | Yes | King Eider | No |
| ***Geese and Swans*** | | Long-tailed Duck | No |
| Brant | No | Red-breasted Merganser | Yes |
| Cackling Goose | No | Steller's Eider[3] | No |

| Species | Breeding Range Adjacent to Seismic Survey Area[1] | Species | Breeding Range Adjacent to Seismic Survey Area[1] |
|---|---|---|---|
| Canada Goose | Yes | Surf Scoter | Yes |
| Emperor Goose | No | White-winged Scoter | No |
| Greater White-fronted Goose | No | | |
| Trumpeter Swan | No | | |
| Tundra Swan | No | | |
| **Shorebirds** | | | |
| American Golden-plover[2] | No | Pectoral Sandpiper | No |
| Baird's Sandpiper | No | Red Knot[2] | No |
| Bar-tailed Godwit[2] | No | Red-necked Phalarope | Yes |
| Black Oystercatcher[2] | No | Rock Sandpiper | No |
| Black Scoter | Yes | Ruddy Turnstone | No |
| Black Turnstone | No | Sanderling | No |
| Black-bellied Plover[2] | No | Semipalmated Plover | Yes |
| Common Snipe | No | Semipalmated Sandpiper | No |
| Dunlin | No | Short-billed Dowitcher | Yes |
| Greater Yellowlegs | Yes | Solitary Sandpiper[2] | Yes |
| Hudsonian Godwit[2] | No | Spotted Sandpiper | Yes |
| Least Sandpiper | Yes | Surfbird | No |
| Lesser Yellowlegs | Yes | Wandering Tattler | Yes |
| Long-billed Dowitcher | No | Western Sandpiper | No |
| Marbled Godwit[2] | No | Whimbrel[2] | No |
| Pacific Golden Plover | No | Wilson's Snipe | Yes |
| **Seabirds** | | | |
| ***Alcids*** | | ***Tubenoses*** | |
| Ancient Murrelet | Yes | Fork-tailed Storm Petrel | No |
| Common Murre | No | Leach's Storm-petrel | No |
| Horned Puffin | No | Northern Fulmar | No |
| Kittlitz's Murrelet | Yes | Parasitic Jaeger | Yes |
| Marbled Murrelet | Yes | Pomarine Jaeger | No |
| Parakeet Auklet | Yes | Short-tailed Shearwater | No |
| Pigeon Guillemot | Yes | Sooty Shearwater | No |
| Rhinoceros Auklet | No | ***Gulls*** | |
| Thick-billed Murre | No | Black-legged Kittiwake | No |
| Tufted Puffin | No | Bonaparte's Gull | Yes |
| ***Cormorants*** | | Glaucous Gull | No |
| Double-crested Cormorant | Yes | Glaucous-winged Gull | Yes |
| Pelagic Cormorant | No | Herring Gull | Yes |
| Red-faced Cormorant[2] | Yes | Mew Gull[4] | Yes |

| Species | Breeding Range Adjacent to Seismic Survey Area[1] | Species | Breeding Range Adjacent to Seismic Survey Area[1] |
|---|---|---|---|
| ***Terns*** | | | |
| Aleutian Tern[2,4] | Yes | | |
| Arctic Tern[4] | Yes | | |

[1] Defined as breeding range that occurs along the eastern coast of Cook Inlet between south of the mouth of Kenai River and Homer Spit.
[2] U.S. Fish and Wildlife Service Bird of Conservation Concern (BCC).
[3] Listed as threatened under the U.S. Endangered Species Act of 1973, as amended.
[4] Known breeding colonies occur within or immediately adjacent to the seismic survey area.
Sources: ABR 2012; Alaska Audubon, 2014; ADNR 2009a; ANHP 2014; NOAA, 2002a, b, c, d; USDOI, MMS, 2003

## Seasonal Distribution

Avian species diversity and density in Cook Inlet varies seasonally, and is typically highest in spring months, in association with waterfowl and shorebird migrations (Arneson, 1980; Gill and Tibbitts, 1999). Migratory waterfowl and shorebirds begin arriving in Cook Inlet in April and numbers swell quickly, peaking at 175,000 birds or more by mid-May (Gill and Tibbitts, 1999). Arneson (1980) recorded densities of more than 300 birds per square kilometer in Tuxedni Bay and more than 400 per square kilometer in southern Kamishak Bay; a majority of the latter were shorebirds and sea ducks.

Densities decline in summer, a trend driven by the departure of most shorebirds and waterfowl to summer breeding and nesting grounds in the Arctic. Densities of cormorants, gulls, and alcids increase in summer (Arneson, 1980). Agler et al. (1995) found the most common seabirds during June to be alcids (particularly murres, puffins, and murrelets); tubenoses (including shearwaters, fulmars, and storm-petrels) were the second most abundant. They counted an estimated 798,000 marine birds in lower Cook Inlet, with densities decreasing with distance from shore; 152.9 birds per square kilometer were counted within 200 meters of shore, 71.6 birds per square kilometers between 200 meters and 3 nautical miles, and 50.7 birds per square kilometer beyond 3 nautical miles (Agler et al., 1995). Bird densities of more than 200 per square kilometer have been estimated for Kachemak Bay, with gulls and sea ducks being the major species groups (Arneson, 1980). Sea ducks are abundant in the outer Kachemak Bay area, and high densities of gulls occur near Kenai and in the Chugach Islands. During June, marine birds are distributed throughout Cook Inlet, with concentrations of more pelagic species such as shearwaters, murres, puffins, and murrelets occurring in the eastern half near the entrance to Kachemak Bay and the southeastern corner of the Inlet (Agler et al., 1995).

Concentrations of marbled murrelets generally occur within bays and fjords on the eastern side of Kodiak and Afognak islands; they are also found along the coasts of lower Kenai Peninsula, Kachemak Bay, Shuyak Island, and Hallo Bay on the south side of the Alaska Peninsula (Piatt and Naslund, 1995).

Average bird densities in fall are only one-third to one-half of those observed in spring and summer. The departure of gulls and sea ducks accounts for most of the decline. By October, most alcids have departed for pelagic waters. Only dabbling duck and goose densities increase in fall, as migrating birds move into the area. Numbers of shorebirds remain low (Gill and Tibbitts, 1999).

During winter months, the most numerous species groups occupying lower Cook Inlet are waterfowl, alcids, gulls, and cormorants (Agler et al., 1995; Arneson, 1980). Overall, winter bird densities in lower Cook Inlet are roughly half that observed in summer (Agler et al., 1995). Most of this decrease occurs offshore, reflecting seasonal changes in species composition as shearwaters, gulls, and murres leave the area (Agler et al., 1995). In contrast, waterfowl densities increase markedly; sea ducks

(primarily scoters, long-tailed ducks, eiders, and goldeneyes) are the most abundant group remaining in winter (Agler et al., 1995). Winter bird densities are higher in eastern Cook Inlet than on the western side. Inner Kachemak Bay has the highest density, with ducks making up most of this total. Birds reported by Agler et al. (1995) in Kachemak Bay were primarily sea ducks, of which 52% were scoters and alcids, 63% were murres, and 29% were murrelets.

### Waterfowl

The coastal marshes found in Cook Inlet provide important staging and resting areas for migrating waterfowl as well as breeding habitats. Common waterfowl found in the salt marshes and wetlands of Cook Inlet include dabbling ducks such as pintail, American widgeon, mallard, green-winged teal, northern shoveler; diving ducks such as scaups, scoters, canvasback, goldeneyes, bufflehead, long-tailed duck, harlequin duck, and mergansers; and geese and swans, including Canada goose, white-fronted goose, snow goose, tundra swan, and trumpeter swan (Table 6) (NOAA, 2002a, b, c, and d; ADNR, 2009a).

Areas along the western coast, including the Kasilof River, are especially important spring (April-May) migration areas for waterfowl from mid-April through mid-May. Between April and June, waterfowl concentrate near the mouth and shores of the Kasilof River, towards and including the northwest shores of Tustumena Lake. Smaller groups are found on the southern half of Kalgin Island (NOAA, 2002a). In summer months (June-August), waterfowl continue to use the areas described above, although fewer individuals are typically found on the northern side of the mouth of the Kasilof River. Species molt annually between mid-June and mid-August; waterfowl are considered particularly vulnerable during the molting period (NOAA, 2002b). Between September and November, waterfowl disperse, although lingering groups can be found on Kalgin Island and at the Kasilof River mouth. By December, waterfowl have moved away from the vicinity of Kalgin Island (NOAA, 2002c). Overwintering populations and early spring migrants are concentrated in nearshore waters from Stariski Creek (north of Anchor Point) southward along the northern and southern shores of Kachemak Bay (NOAA, 2002d).

### Shorebirds

The Cook Inlet area is important for many species of shorebirds as a stopover site during migrations and as a wintering location; 28 species have been identified in the area (Table 6; Gill and Tibbitts, 1999).

Common shorebirds include plover, sandpipers, yellowlegs, dowitchers, and phalaropes (Table 6). The Cook Inlet area supports from 11-21% of the Pacific flyway population of dunlin, and perhaps the entire population of rock sandpiper (Gill and Tibbitts, 1999). Southern Redoubt Bay, with 73% of all shorebirds during the spring, is a particularly important area. Also important is Tuxedni Bay, which averaged over 6,000 birds per day in the spring (Gill and Tibbitts, 1999).

The distribution of shorebirds in Cook Inlet is related to food availability such as clams, gammarid amphipods and algal cover. Tidal flats are important to shorebirds, providing their food supply of bivalves (Gill and Tibbitts 1999). Vegetated flats and marshes provide important shelter and food sources with alkali-grass, insects and algae for shorebirds and waterfowl. The primary shorebird concentration areas are along the western shores of upper Cook Inlet in Redoubt Bay, Trading Bay, and the marsh flats of the Matanuska, Knik, Susitna, and little Susitna Rivers (NOAA, 2002a, b, c, and d; ADNR, 2009a). While the National Oceanic and Atmospheric Administration (NOAA) has not identified environmentally sensitive areas for shorebirds in the vicinity of the seismic survey area, shorebirds are likely to occur where tidal flats are found, including the exposed flats at the mouths of Anchor River, Deep Creek, and Kasilof River, and the exposed and sheltered tidal flats of Kalgin Island. They may also be associated with razor clam beds, including those extending from Kasilof River southward to, and including, Homer (NOAA, 2002a, b, c, and d).

Migrating shorebirds appear suddenly in the Cook Inlet area in early May, their numbers increase rapidly, and then they depart abruptly by late May. In excess of 150,000 birds have been counted in surveys during that time period (Gill and Tibbitts, 1999). Few shorebirds use the area during the summer breeding season, except for the Hudsonian godwit, for which the Cook Inlet drainage is the preferred nesting site. The Cook Inlet area may be critical to a major portion of the continental population of the Hudsonian godwit (Gill and Tibbitts, 1999).

The Cook Inlet area is also an important wintering area for many species, including rock sandpipers, migrating western sandpipers and dunlin, and for breeding and migrating Hudsonian godwits, greater yellowlegs, solitary sandpipers, and short-billed dowitchers (ADNR, 2009a; Gill and Tibbitts, 1999). Sandpipers forage in the winter on mudflats kept free of ice, such as the Susitna Flats near the Beluga and Ivan rivers. Trading Bay, off Nikolai Creek, also provides important alternate foraging habitat in the winter, as well as mudflats in the area south of Redoubt, Tuxedni, and Kachemak bays and the Homer Spit. The Pribilof rock sandpiper is the only shorebird species that winters in the Southcentral region where the majority of the population is concentrated in a small area (sometimes as restricted as 2 to 5 km of shoreline) and highly susceptible to perturbation (Gill and Tibbitts, 1999).

### Seabirds

Seabirds are birds that spend most of their lives at sea, including feeding, resting, and sleeping, although all nest on land (USGS, 2014). There are many species of seabirds in the Cook Inlet area, including murres, gulls, kittiwakes, cormorants, murrelets, and puffins (Table 6). Lower Cook Inlet is one of the most productive areas for seabirds in Alaska, with 2.2 million seabirds foraging in the area in July 1992 (Piatt, 1994). Shallow coastal habitats are particularly important for seabirds at sea, as these areas have high densities of forage fish (Piatt and Roseneau, 1997), and the east side of lower Cook Inlet is particularly productive and important habitat for seabirds (Piatt and Harding, 2007). Important food items include small fish, squid, and crustaceans such as krill and crabs (USGS, 2014).

Seabirds tend to nest in colonies on islands and bluffs, with nesting sites including beach rubble and boulders, cracks in cliff faces, rocky ledges, burrows in soft soil at a cliff edge, or flat ground (USGS, 2014). Important nesting sites in Cook Inlet include Chisik Island and Duck Island, located near Tuxedni Channel; Gull Island, located in Kachemak Bay outside the lease sale area; and Barren Islands and Shuyak Island, located south of the lease sale area (Piatt, 1994; USFWS, 2012a; USGS, 2014). About 5,000 seabirds use Duck Island, including about 3,000 horned puffins, and more than 16,000 use Gull Island (USFWS, 2012a; USGS, 2014).

Population trends in seabird colonies appear to be related to differences in food availability (USGS, 2014). In the late 1970s, a significant regime shift occurred in the Gulf of Alaska, characterized by changes in seawater temperature and decreases in abundance of forage fish; this resulted in reduced food availability to seabirds, lower reproductive success, large-scale die-offs, and long-term decreases in some populations (Piatt and Harding, 2007). In fact, although the 1989 Exxon Valdez oil spill had a serious and immediate impact on seabird populations, effects of the regime shift are considered to have had an even more significant effect (Piatt and Harding, 2007).

Two comparatively small seabird colonies are present near the seismic survey area: the Cohoe River Colony (Arctic and Aleutian terns) and the Kalifornosky Colony (Arctic and Aleutian terns, mew gulls). A mixed gull (mew and glaucous-winged gull) colony exists inland at Headquarters Lake, east of the survey area. All three colonies are adjacent to the mouth of the Kasilof River (USFWS, 2012a).

In addition to the colonies mentioned above, NOAA has identified several environmentally sensitive areas near the seismic survey area that are important to seabirds. In summer months (June through August) foraging seabirds are known to concentrate in both near- and offshore waters from southeastern lower Cook Inlet northward to Ninilchik, and in nearshore waters along the southern half of Kalgin Island (NOAA, 2002b). During autumn, (September-November) feeding birds are

associated with the waters south of Anchor Point and into southeast Kachemak Bay (NOAA, 2002c). In winter months both the nearshore waters from the mouth of Anchor River southward to Homer, and the north and south nearshore waters of Kachemak Bay are important seabird foraging habitat (NOAA, 2002d).

### 3.2.5.1. Threatened and Endangered Marine and Coastal Birds

**Steller's Eiders.** Steller's eiders (*Polysticta stelleri*), a species of sea duck, are the smallest and also least abundant of the eiders in Alaska. (ADF&G, 1994). ADF&G listed the Alaska breeding population as a species of special concern in 1993 (Alaska Division of Oil and Gas, 2004). The USFWS listed the Steller's eider as threatened on June 11, 1997 because of apparent declines in abundance of nesting birds, but the reasons for the decline are unknown (ADNR, 2009a).

Steller's eiders generally nest in northeastern Siberia, but also breed in Alaska along the coast from the Alaska Peninsula northward, including the Seward Peninsula, St. Lawrence and Nunivak islands, and the Beaufort Sea coast (ADF&G, 1994). Three breeding populations are recognized: two in Arctic Russia and one in Alaska but it is unknown if birds wintering in Cook Inlet are part of the Alaska breeding population (ADNR, 2009a). Steller's eiders winter from the eastern Aleutian Islands to lower Cook Inlet, as well as islands in southeastern Russia. They are usually found in protected nearshore waters that are less than 10 m in depth. From mid- to late-April, they leave wintering areas and migrate to their Arctic nesting areas. The species was most abundant on the Yukon Delta where 3,500 pairs were thought to nest, but sightings are now rare and no nests have been found in the region since the mid-1970s (ADNR, 2009a). The unexplained disappearance of Steller's eiders from the Yukon-Kuskokwim Delta has caused great concern and recently stimulated intensive research into the problem.

Cook Inlet is the easternmost extent of the molting and winter range for Steller's eider. Steller's eiders begin to arrive at molting grounds in late August, and some may continue to occupy the molting area through the winter, departing for breeding grounds in April (ADNR, 2009a). A majority of Steller's eiders remain in molting areas along the north side of the Alaska Peninsula until at least November (Jones, 1965; Laubhan and Metzner, 1999; Ward and Stehn, 1989). They then move to overwintering areas in the Aleutian Islands, south side of the Alaska Peninsula, Kodiak Archipelago, and Cook Inlet. Several surveys of wintering Steller's eiders have been conducted, in and surrounding the seismic survey area, including opportunistic and pre-planned shoreline and aerial surveys by USFWS from 1997-2003 that were conducted from the mouth of Kachemak Bay to Kenai (USDOI, MMS, 2003; Larned, 2001, 2006; Larned, 2002, pers. comm, as cited in USDOI, MMS, 2003; Larned and Bowman, 2000 as cited in USFWS, 2003; Larned and Eldridge, 1997 as cited in USFWS, 2003). Counts ranged from 252-2,370, most within 2 km of shore over shoals between Deep Creek and Homer Spit. Additional surveys counted over 4,000 birds (ADNR, 2009a). Within the Proposed Action area, substantial numbers of Steller's eiders have been observed in nearshore areas from Anchor Point to 25 km north of Ninilchik. Petrula and Rosenberg (2002) have observed tens to hundreds of Steller's eiders south and east of Anchor Point in winter.

Of the areas where Steller's eiders overwinter in lower Cook Inlet, the shallow, nearshore region just off of Deep Creek may represent especially high quality (relative to other areas in the region near the seismic survey area) overwintering feeding habitat for Steller's eiders, possibly due to high productivity associated with outflow from the creek (Larned, 2002, pers. comm, as cited in USDOI, MMS, 2003; Larned and Eldridge, 1997 as cited in USFWS, 2003). During two separate surveys in 2001, large aggregations (800 versus 1500) were observed in this area. Other large aggregations have been observed just south of Ninilchik: in 1997 (650) and early March in 2001 (800). In the southern end of the seismic survey area, substantial numbers of Steller's eiders have been observed in nearshore areas from Homer Spit to Anchor Point (ADNR, 2009a; Larned, 2001, 2006; Larned, 2002, pers. comm, as cited in USDOI, MMS, 2003). NOAA has identified the nearshore waters from south

of Deep Creek to the mouth of Falls Creek, and the nearshore waters north of the Anchor River mouth southward and throughout Kachemak Bay as important environmentally sensitive areas for Steller's Eiders during winter and spring months (November-May) (NOAA, 2002a and d). NOAA has not identified any environmentally sensitive areas for Steller's eiders during the months of June through October because the species occupies habitat on the North Slope and in Russia during summer months (NOAA, 2002b and c).

### 3.2.6. Marine Mammals

Marine mammals most likely to be found in lower Cook Inlet are the beluga whale (*Delphinapterus leucas*), harbor porpoise (*Phocoena phocoena*), harbor seal (*Phoca vitulina*), humpback whale (*Megaptera novaeangliae*), minke whale (*Balaenoptera acutorostra*), gray whale (*Eschrichtius robustus*), killer whale (*Orcinus orca*), Dall's porpoise (*Phocoenoides dalli*), Steller sea lion (*Eumetopia jubatus*), and northern sea otter (*Enhydra lutris kenyoni*). Minke whales are migratory in Alaska (Allen and Angliss, 2014) but have recently been observed off Cape Starichkof and Anchor Point year-round. Humpback and gray whales are seasonal visitors to lower Cook, while the remaining species could be encountered at any time of the year. During marine mammal monitoring conducted off Cape Starichkof between May and August 2013 observers recorded small numbers of humpback whales, minke whales, gray whales, killer whales, and Steller sea lions, and moderate numbers of harbor porpoises and harbor seals (Allen and Angliss 2014; Owl Ridge, 2014). This survey also recorded a single beluga observed 6 kilometers north of Cape Starichkof in August 2013. The stock population estimates for marine mammals found in Cook Inlet are shown in Table 7. The following species descriptions reflect updated information since the Cook Inlet Lease Sales 191 and 199, and the Cook Inlet-Shelikof Strait Sale 60 FEIS which contain more detailed descriptions of the existing environment. Cook Inlet Lease Sales 191 and 199, and Cook Inlet-Shelikof Strait Sale 60 FEIS should be referenced for more information on marine mammal species.

**Table 7. 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*) | 3,000-5,000 | Central North Pacific Stock, ESA-listed as Endangered |
| Steller Sea Lion (*Eumetopia jubatus*) | 52,200 | Western U.S. Stock, ESA-listed as Endangered |
| Dall's Porpoise *(Phocoenoides dalli*) | 83,400 | Alaska Stock |
| Gray Whale (*Eschrichtius robustus*) | 19,126 | Eastern North Pacific Stock |
| Harbor Porpoise (*Phocoena phocoena*) | 31,046 | Gulf of Alaska Stock |
| Harbor Seal (*Phoca vitulina*) | 22,900 | Cook Inlet/Shelikof Stock |
| Killer Whale (*Orcinus orca*) | 587 | Gulf of Alaska, Aleutian Islands, and Bering Sea Transient Stock |
| Killer Whale (*Orcinus orca*) | 2,347 | Alaska Resident Stock |
| Minke Whale (*Balaenoptera acutorostra*) | 1,233 | Alaska Stock |
| Northern Sea Otter (*Enhydra lutris kenyoni*) | 15,090 | Southcentral Alaska Stock |

Source: Allen and Angliss (2014), Carretta et al. (2013), USFWS, 2014a, Zerbini et al. (2006)

#### ESA-Listed Mammals

##### *Beluga Whale (Delphinapterus leucas)*

The Cook Inlet beluga whale Distinct Population Stock (DPS) is a small geographically isolated population that is separated from other beluga populations by the Alaska Peninsula. The population is genetically (mtDNA) distinct from other Alaska populations indicating barriers to genetic exchange (O'Corry-Crowe et al., 1997) and that these whales may have been separated from other stocks at

least since the last ice age. Laidre et al. (2000) examined data from over 20 marine mammal surveys conducted in the northern Gulf of Alaska and found that sightings of belugas outside Cook Inlet were rare, consisting of a few stragglers from the Cook Inlet DPS observed at Kodiak Island, and Prince William Sound. Several marine mammal surveys specific to Cook Inlet (Laidre et al. 2000, Speckman and Piatt, 2000), including those that concentrated on beluga whales (Rugh et al., 2000, 2005), revealed this stock largely confines itself to Cook Inlet.

The Cook Inlet beluga DPS was originally estimated at 1,300 whales in 1979 (Calkins, 1989) and has been the focus of management concerns since experiencing a dramatic decline in the 1990s. Between 1994 and 1998 the stock declined 47% and is attributed to overharvesting by subsistence hunting. In 2000 NMFS declared the stock was depleted, and listed it as endangered under the Endangered Species Act (ESA) in 2008 (73 *FR* 62919). In April 2011, NMFS designated critical habitat for the beluga under the ESA (76 *FR* 20179) (Figure 7).

During the summer and fall, beluga whales are concentrated in upper Cook Inlet and Knik Arm, near the Susitna River mouth, Eagle River mouth, Chickaloon Bay, and in Turnagain Arm (Nemeth et al., 2007) to feed on migrating eulachon and salmon (Moore et al., 2000). Most of this area has been designated summer critical habitat.

In winter, beluga whales concentrate in deeper waters in the mid- and lower-inlet below Kalgin Island, and in shallows along west shore down to Kamishak Bay, and in Kachemak Bay leading to a winter critical habitat designation for these areas (Figure 1) (Federal Register, 2011). The Proposed Action would occur in or near Cook Inlet Beluga Critical Habitat Area 2. This area includes waters within a 2 nmi buffer along the western Cook Inlet coast (60°15.0’N – 59°04.0’N, 153°46.0’W), Kachemack Bay east of 151°40.0’W, and Cook Inlet waters between 60°15.0’N. and Point Possession in the east and Threemile Creek in the west (Figure 7).

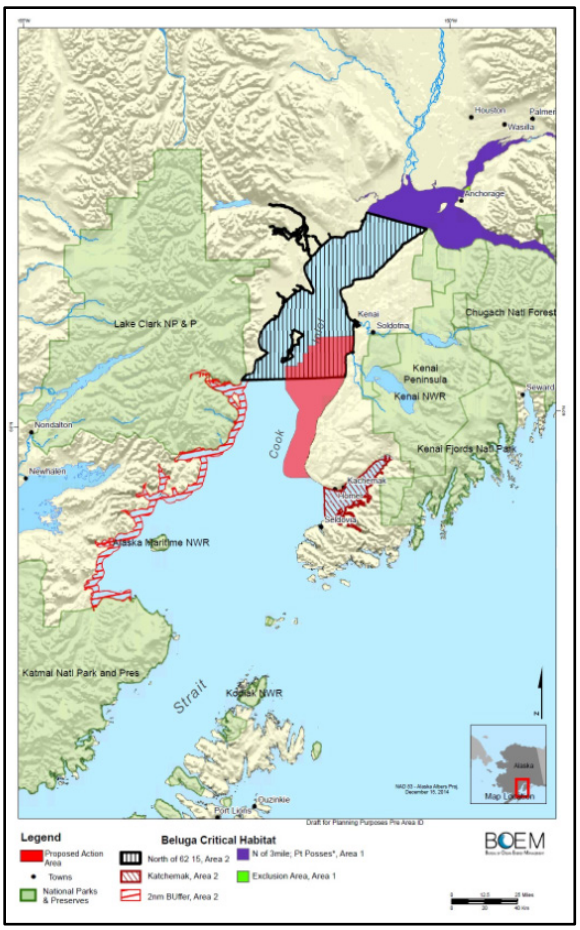



**Figure 7. Cook Inlet Beluga Whale Critical Habitat**

Source: Federal Register, 2011

### *Humpback Whale (Megaptera novaeangliae)*

The humpback whales that seasonally occur in lower Cook Inlet are most likely individuals from the Central North Pacific stock which is listed as endangered under the ESA. Recent stock size has been estimated at 7,469, with 2,845 individuals feeding in the Gulf of Alaska (Allen and Angliss, 2014). The Central North Pacific stock winters in Hawaii and summers from British Columbia to the Aleutian Islands (Calambokidis et al., 1997), an area that includes Cook Inlet.

Humpback use of Cook Inlet is largely confined to lower Cook Inlet, regularly near Kachemak Bay during summer (Rugh et al., 2005). Anecdotal observations exist of humpback whales in the vicinity of Anchor Point, Alaska, and recent summer observations showing their presence near Cape Starichkof, Alaska. Humpbacks might be encountered in the vicinity of Starichkof, Alaska if seismic operations were to occur during the summer.

### *Steller Sea Lion (Eumetopia jubatus)*

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 most recent estimate for this stock is 45,649 animals (Allen and Angliss, 2014), considerably less than the estimated 140,000 animals in the 1950s (Merrick et al., 1987). Because of this dramatic decline, the stock was listed as threatened under ESA in 1990, and was relisted as endangered in 1997. Critical habitat was designated in 1993, and is defined as a 20-nautical-mile (nmi) radius around all major rookeries and haulout sites (Figure 8).

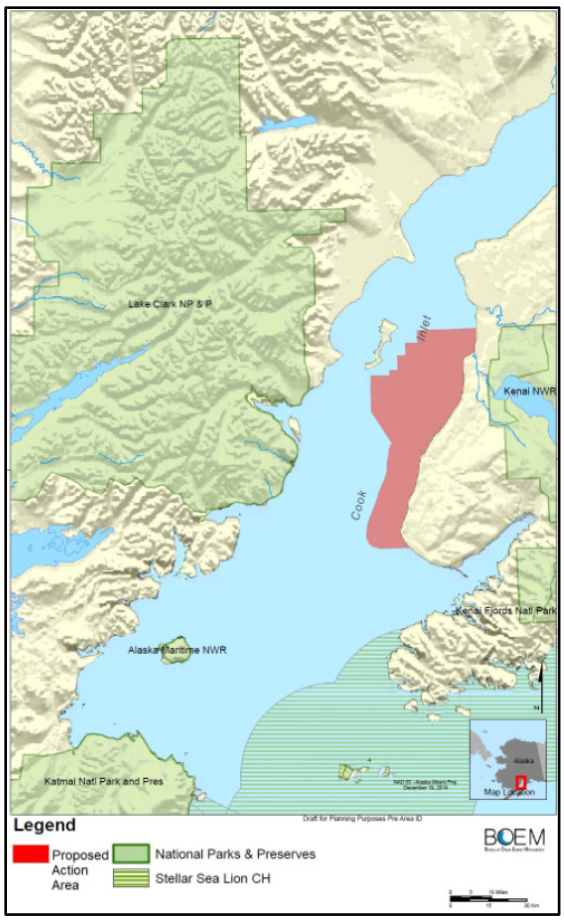



**Figure 8. Cook Inlet Steller Sea Lion Critical Habitat**

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), but are rarely seen in upper Cook Inlet (Nemeth et al., 2007). Of the 42 Steller sea lion groups recorded during Cook Inlet aerial surveys between 1993 and 2004, none were recorded north of Anchor Point and only one in the vicinity of Kachemak Bay (Rugh et al., 2005). Marine mammal observers associated with Buccaneer's drilling project off Cape Starichkof did observe seven Steller sea lions in 2013.

The 20 nmi buffer was established based on telemetry data indicating sea lions concentrate summer foraging efforts within 20 nmi from rookeries and haul outs. Upper Cook Inlet might not have adequate foraging habitat to support sea lions and sea lion haulouts. They mostly feed on walleye pollock (*Theragra chalcogramma*), salmon (*Onchorhyncus spp*.), and arrowtooth flounder (*Atheresthes stomias*) during summer, and walleye pollock and Pacific cod (*Gadus macrocephalus*) in winter (Sinclair and Zeppelin, 2002). Steller sea lions could be encountered along the Kenai Peninsula, particularly around Anchor Point.

## Other Marine Mammals

### *Dall's Porpoise (Phocoenoides dalli)*

Dall's porpoise are widely distributed throughout the North Pacific Ocean including Alaska (Allen and Angliss, 2014), preferring deep offshore and shelf slope waters. The Alaskan population has been estimated at 83,400 animals (Allen and Angliss, 2014), making it one of the more numerous cetaceans in Alaskan waters. They have been observed in lower Cook Inlet, around Kachemak Bay

and Anchor Point, but only rarely, making the chances of interactions between Dall's porpoises and the Proposed Action highly unlikely.

### *Gray Whale (Eschrichtius robustus)*

Though commercial exploitation reduced this stock to a few thousand animals (Jones and Schwartz, 2002), by the late 1980s the stock (26,600 individuals) seemed to be nearing habitat carrying capacity (Jones and Schwartz, 2002). Due to a mortality event in 1999-2000 the stock size was reduced to about 16,000 animals by 2002; however, the stock has since grown to an estimated size of 19,126 animals with a minimum estimate of 18,017 (Carretta et al., 2013).

In spring, the Eastern North Pacific stock of gray whale migrates 8,000 kilometers (5,000 miles) from wintering and calving areas around Baja California to feeding grounds in the Bering and Chukchi seas, before returning to their wintering areas in the fall (Rice and Wolman, 1971). Their migration route is mostly in coastal waters until reaching the Bering Sea and Chukchi Sea feeding areas; however, some gray whales refrain from making the full Baja-Chukchi migration, opting to feed in select coastal areas in the Pacific Northwest, including lower Cook Inlet, Alaska (Rice et al., 1984; Moore et al., 2007).

Though most gray whales migrate past Cook Inlet, small numbers have been noted by fisherman near Kachemak Bay, and north of Anchor Point. During Buccaneer's Cosmopolitan drilling program in 2013, gray whales were seen in waters off Cape Starichkof. Gray whales might be encountered during seismic operations along the Kenai Peninsula south of Ninilchik.

### *Harbor Porpoise (Phocoena phocoena)*

Harbor porpoise are small (1.5 meters length), relatively inconspicuous toothed whales. The Gulf of Alaska Stock is distributed from Cape Suckling to Unimak Pass and was most recently estimated at 31,046 animals (Allen and Angliss, 2014). They are found primarily in coastal waters less than 100 meters (100 meters) deep (Hobbs and Waite, 2010) where they feed on Pacific herring (*Clupea pallasii*), other schooling fishes, and cephalopods.

Though frequently observed during aerial surveys of Cook Inlet, most sightings involve individuals concentrated at 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 population at only 136 animals, yet they are one of the three marine mammals (besides belugas and harbor seals) regularly seen throughout Cook Inlet (Nemeth et al., 2007), especially during spring eulachon and summer salmon runs. Because harbor porpoise are observed throughout Cook Inlet throughout summer, there is a strong likelihood they would be encountered during operations in lower Cook Inlet, Alaska.

### *Harbor Seal (Phoca vitulina)*

At over 150,000 animals state-wide (Allen and Angliss, 2014), harbor seals are one of the more common marine mammal species in Alaskan waters, and are commonly seen at haulout areas. They largely feed on schooling fishes such a walleye pollock, Pacific cod, salmon, Pacific herring, eulachon, and squid. Though harbor seals may seasonally shift their presence in response to prey resources, they do not migrate from a general area.

The Cook Inlet/Shelikof Stock is estimated to number 22,900 (Allen and Angliss, 2014), and is distributed from Anchorage into lower Cook Inlet during summer, and from lower Cook Inlet through Shelikof Strait to Unimak Pass during winter (Boveng et al., 2012). O'Corry-Crowe (2011) analyzed genetic data, and found evidence of very limited mixing with other harbor seal stocks. Large numbers concentrate at the river mouths and embayments of lower Cook Inlet, including the Fox River mouth in Kachemak Bay, and several haulouts have been identified on the Southern end of Kalgin Island, near the proposed seismic survey area in lower Cook Inlet (Rugh et al., 2005; Boveng et al., 2011). Montgomery et al. (2007) recorded over 200 haulout sites in lower Cook Inlet alone. In 2012, up to

100 harbor seals were observed hauled out at the mouths of the Theodore and Lewis rivers during monitoring activity associated with SAE's (with Apache) 2012 Cook Inlet seismic program. Montgomery et al. (2007) also found seals elsewhere in Cook Inlet move in response to local steelhead (*Onchorhynchus mykiss*) and salmon runs. Harbor seals would likely be encountered during seismic operations in lower Cook Inlet.

### *Killer Whale (Orcinus orca)*

Two different stocks of killer whales inhabit the Cook Inlet region of Alaska: the Alaska Resident Stock and the Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock (Allen and Angliss, 2014). The resident stock is estimated at 2,347 animals and occurs from Southeast Alaska to the Bering Sea (Allen and Angliss, 2014). Resident whales feed exclusively on fish and are genetically distinct from transient whales (Saulitis et al., 2000). The transient whales feed primarily on marine mammals (Saulitis et al., 2000). The transient population inhabiting the Gulf of Alaska shares mitochondrial DNA haplotypes with whales found along the Aleutian Islands and the Bering Sea suggesting a common stock, although there appears to be some subpopulation genetic structuring occurring to suggest the gene flow between groups is limited (see Allen and Angliss, 2014). For the three regions combined, the transient population has been estimated at 587 animals (Allen and Angliss, 2014).

Killer whales are occasionally observed 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 that have been photographically identified in lower Cook Inlet belong to resident groups more commonly found in nearby Kenai Fjords and Prince William Sound (Shelden et al., 2003). Prior to the 1980s, killer whale sightings in upper Cook Inlet were very rare. During aerial surveys conducted between 1993 and 2004, killer whales were observed on only three flights, all in the Kachemak and English Bay area (Rugh et al. 2005). However, anecdotal reports of killer whales feeding on belugas in upper Cook Inlet began increasing in the 1990s, possibly in response to declines in sea lion and harbor seal prey elsewhere (Shelden et al., 2003). These sporadic ventures of transient whales into beluga summering grounds have been implicated as a possible contributor to decline of Cook Inlet belugas in the 1990s, although the number of confirmed mortalities from killer whales is small (Shelden et al., 2003). Killer whales are likely to be encountered during seismic operations in lower Cook Inlet.

### *Minke Whale (Balaenoptera acutorostra)*

Minke whales are the smallest species of baleen whales reaching lengths of up to 35 feet. They are also the most common of the baleen whales. There are no population estimates for the North Pacific, although estimates have been made for some portions of Alaska. Zerbini et al. (2006) estimated the coastal population between Kenai Fjords and the Aleutian Islands at 1,233 animals.

During Cook Inlet-wide aerial surveys conducted from 1993 to 2004, minke whales were encountered only twice (1998, 1999), both times off Anchor Point 16 miles northwest of Homer. Owl Ridge (2014: citing A. Holmes, pers. comm.; and 2013 E. Fernandez and C. Hesselbach, pers. comm.) reported a minke whale off Cape Starichkof in 2011 suggesting this location is regularly used by minke whales during the winter. Likewise minke whales were documented in low numbers (Piatt, 2002) during seabird surveys in lower Cook Inlet, and recently, in 2013, several minke whales were recorded off Cape Starichkof during exploration drilling operations. Consequently it is likely small numbers of minke whales would be near the survey area in lower Cook Inlet during the Proposed Action.

### *Sea Otter (Enhydra lutris kenyoni)*

Three stocks of Northern sea otters are present in Alaska: the Southeast, the Southcentral, and the Southwest stocks (Gorbics and Bodkin, 2001). Of these, only the Southcentral stock is anticipated to occur in the seismic survey area (Angliss and Outlaw, 2008; USFWS, 2014a, b; 79 *FR* 51584). The Southcentral sea otter stock is not listed as depleted, threatened or endangered under Federal regulations.

BOEM provided considerable detail about the biology, status, population stock designations, and regulatory status of the Alaska stocks of sea otters occurring in Cook Inlet, and about sea otters in general, in USDOI, MMS, 2003. Additional information on the life history, status, and habitat use of the Southwestern and Southcentral stocks of northern sea otter are presented in Kenyon (1969), Estes et al. (1998), Lensink (1962), Riedman and Estes (1990), Rotterman and Simon-Jackson (1988), USFWS (2014a,b), the Final Rule to List (70 *FR* 46366 46386) and other listing documents (65 *FR* 67343). These documents are incorporated into this Environmental Assessment by reference and information pertaining to the Southcentral DPS is summarized below.

The estimated abundance of the Southcentral sea otter stock is approximately 18,000 animals (USFWS, 2014a). An estimated 6,900 individuals are presumed to use Cook Inlet (USFWS, 2014b). The overall trend for the Southcentral stock, which includes Cook Inlet, appears to be stable or slightly increasing, and the population in lower Cook Inlet and Kenai Fjords also appears to be increasing slightly (Angliss and Outlaw, 2008).

In lower Cook Inlet the Southcentral Alaska stock of northern sea otter is found generally at low densities; they do not occur in upper Cook Inlet (USFWS, 2014b). The approximate range of sea otters within the proposed seismic survey area extends from Ninilchik along the eastern side of Cook Inlet southward to the southeastern edge of the area near Anchor Point (79 *FR* 51584). Sea otters are found within all water depths and distances from shore in the proposed seismic survey area. During summer (June and August) sea otters were observed to predominantly use areas within 40 m of shore due to increased potential foraging opportunities (Bodkin et al., 2003; Riedman and Estes, 1990; Schneider, 1976) although otters may also occur in offshore areas, often rafting together while transiting through these more open waters (Schneider, 1976).

Surveys within and adjacent to the seismic survey area indicate the otters are less abundant north of Anchor Point; however, individuals have been observed during winter and spring months (December through April) between Anchor Point and Clam Gulch at densities of up to 92 otters per 300 sq km (Doroff and Badajos, 2010; Larned, 2006). Sea otters can occur intermittently in the area throughout summer months (July and August) (Doroff and Badajos, 2010; Rugh et al., 2005; USFWS, 2014b). Since none of the previous surveys were conducted during the fall, it is unknown how late into fall large numbers of sea otters are found north of Anchor Point.

## 3.2.7. Archaeological Resources

BOEM defines potential submerged archaeological resources as ranging from historic to prehistoric. Historic resources include man-made objects or structures older than 50 years, such as shipwrecks, submerged structures, and aircraft. Prehistoric archaeological resources may occur in areas that were subaerially exposed during the low stand of sea level approximately 13,000 years before present (generally 60 m below sea level on the Alaska OCS). Relict terrestrial landforms such as preserved levees or terraces associated with paleo-river channels, river confluences, ponds, lakes, lagoons, or paleo-shorelines are areas where archaeological sites are most likely to occur. The best definition of these archaeological resources may be found in NTL No. 05-A03 (2005).

Thus, underwater archaeology can be divided into two discrete parts: (a) shipwrecks or submerged aircraft, and any remains thereof; and (b) submerged landscapes and sites, both prehistoric and historic, on the seabed that have been inundated by rising sea levels; or subseabed sites that had been

occupied when lands were exposed but have since dropped due to uniform or differential movement of the land. These processes would include tectonic subsidence or geomorphological processes associated with late Quaternary glaciation and early Holocene deglaciation, although isostatic rebound has not been well documented in the Cook Inlet region (Thurston and Choromanski, 1985).

The shores of Cook Inlet were likely occupied by humans soon after the advent of the Holocene such as the Beluga Point site in Upper Cook Inlet (Reger, 1981). Several buried stratified archaeological sites have been discovered in the intertidal zone in Kachemak Bay, just east of the south end of the proposed project area. These sites are buried in beaches below the high tide (de Laguna, 1975; Workman, Lobdell, and Workman, 1980). The potential for identifying buried archaeological deposits and geomorphic features considered by BOEM to be prehistoric resources in Cook Inlet exists in waters up to 60 m in depth.

More is known about submerged shipwrecks than submerged prehistoric archaeological sites. In the project area, the BOEM shipwreck inventory identifies 17 shipwrecks, all associated with activities after the Alaska Purchase in 1869. There is also one reported shipwreck associated with the Russian fur trade.

The only Russian American shipwreck was recently recorded from Dena'ina oral traditions and reportedly is south of Tyonek on the west side of Cook Inlet outside of the proposed project area (Kari, Fall, and Pete, 2003). Considering that the Russian American period spanned 86 years, navigational equipment was more primitive, and the ships were plying uncharted waters, it would seem probable that there were actually more shipwrecks that were not recorded, or the records of which were lost or have not yet been translated. It is noteworthy that the only record of this shipwreck was obtained from a knowledgeable Dena'ina elder, rather than the historic written record. Thus, the shipwreck inventory should by no means be considered comprehensive as a reliable indicator of precise numbers of maritime disasters in Cook Inlet.

During the American period, documentation exists of 17 ships or boats having met their doom in the project area in the cold, confused seas of Cook Inlet. Four ships that wrecked during the U.S. historical period include the following eighteenth century disasters:

**Table 8. 19th Century Shipwrecks in the Proposed Project Area, Cook Inlet**

| Ship | Year | Type | Location |
|---|---|---|---|
| *Jabez Hawes* | 1869 | Schooner | Cook Inlet |
| *Washington* | 1871 | Bark | Kasilof |
| *Corea* | 1896 | Bark | Ninilchik |
| *Alice* | 1894 | Schooner | Anchor Point |

Thirteen ships were wrecked during the twentieth century:

**Table 9. 20th Century Shipwrecks 50 Years Old or Older in the Proposed Project Area, Cook Inlet**

| Ship | Year | Type | Location |
|---|---|---|---|
| *Kate Davenport* | 1916 | Bark | Anchor Point |
| *On Time* | 1920 | Gas Screw | Cook Inlet |
| *PG No. 4* | 1925 | Scow | Cook Inlet |
| *Acusha* | 1927 | Gas Screw | Cook Inlet |
| *Discoverer* | 1932 | Diesel | Ninilchik |
| *Kenai 1* | 1948 | Diesel | Kasilof |
| *Agate* | 1951 | Gas Screw | Lower Cook Inlet |
| *Maggie* | 1953 | Gas Screw | Anchor Point |
| *A.S.P. No. 7* | 1958 | Scow | Cook Inlet |
| *Lew-Al* | 1958 | Oil | Lower Cook Inlet |
| *Portifico No. 1* | 1959 | Gas Screw | Ninilchik |

| Ship | Year | Type | Location |
|---|---|---|---|
| *Virginia* | 1964 | Gas Screw | Cook Inlet |
| *Polly* | 1965 | Gas Screw | Cook Inlet |

The place names associated with the wrecks should be considered only in the most general sense; as can be seen, a number of ships – or fishing boats – are designated to having sunk at Anchor Point, but many of them foundered, probably on the shoals that extend a considerable distance offshore. As another example, the *Corea* did not actually sink in Cook Inlet at Ninilchik but ran aground, likely on the shore at what long term residents refer to as "Corea Bend," north of Ninilchik. The crew was rescued and the ships timbers and freight were salvaged (https://redoubtreporter.wordpress.com/category/cook-inlet/page/5/).

Archives, University of Alaska, Fairbanks

**Figure 9. The Demise of the Corea, 1890**

All of the shipwrecks except those noted as having occurred in Cook Inlet were near or on shore. Aircraft crashes in Cook Inlet have not been assembled on any historic register, although a number of small fixed wing planes have crashed in Cook Inlet.

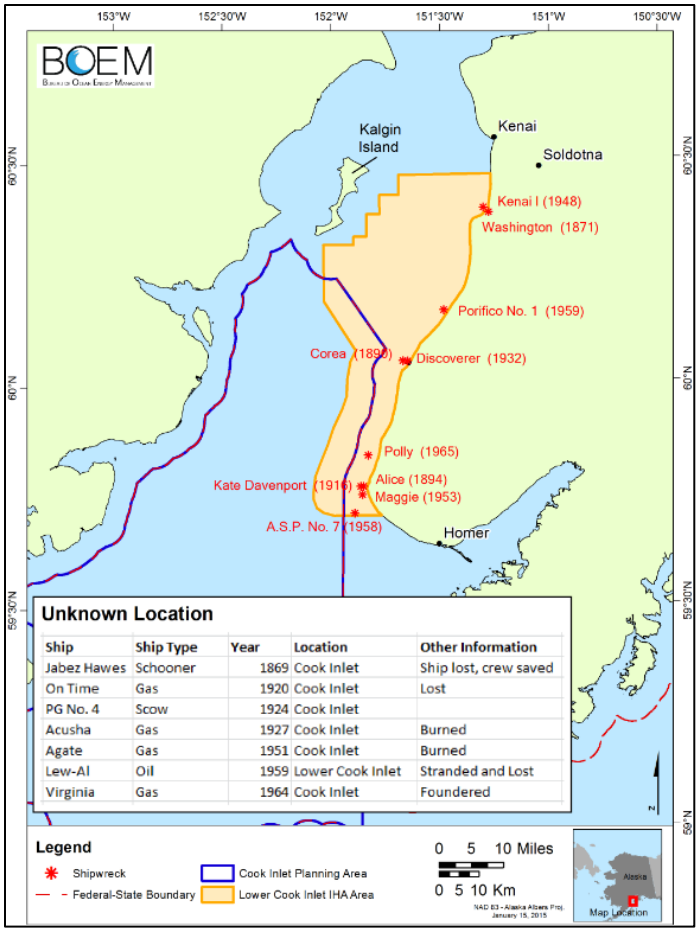



**Figure 10. Map of Reported Shipwrecks in Proposed Project Area**

## 3.2.8. Subsistence Harvest and Sociocultural Systems

"Subsistence harvest" is generally considered hunting, fishing, and gathering for the primary purpose of acquiring traditional food as practiced by Alaska Natives and rural residents alike. "Sociocultural systems" refer to the social organizations and structures in which these practices are embedded.

Subsistence harvest and sociocultural systems encompass customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal family consumption as food, shelter, fuel, clothing, tools or transportation; for the making and selling of handicraft articles out of nonedible products of fish and wildlife resources taken for personal or family consumption; for bartering or sharing for personal or family consumption; and customary trade. Subsistence resources provide more than dietary benefits. They also provide materials for personal and family use.

Traditional marine subsistence resources in the Proposed Action area include marine invertebrates, five species of salmon, non-salmon fish, and marine mammals including harbor seal, Steller sea lion and northern sea otter (USDOI, MMS, 2003; NMFS, 2013; Wolfe, et. al., 2009).

Subsistence take by Alaska Natives of Steller sea lions, harbor seals, and sea otters in the Proposed Action area has no seasonal restriction, areal restrictions, or quotas. NMFS manages harbor seals and Steller sea lions, while USFWS manages sea otters. Information on management restriction and co-management arrangements with a number of Alaska Native organizations such as the Alaska Native Harbor Seal Commission and the Alaska Sea Otter and Steller Sea Lion Commission can be found for

NMFS at http://alaskafisheries.noaa.gov/protectedresources/comanagement.htm, and for the USFWS at http://www.fws.gov/alaska/fisheries/mmm/hunting_seaotter.htm. Federal subsistence fishing regulations in the freshwater drainages of the Cook Inlet and Kenai Peninsula establish harvest limits, method of catch, and seasonal restrictions for anadromous species such as salmon (USDOI, 2013).

Sea otter harvest reported by Alaska Native subsistence hunters for hunts that originated in the Proposed Action area indicate that from 1989 through 2014, 47 sea otters were taken, 31 reported (tagged) at Kenai and 16 at Ninilchik. Another 683 otters were reported at Homer, most of which were taken in the Kachemak Bay area (USFWS, 2014c). Community subsistence harvest take of harbor seals from 1992 to 2008 in the Proposed Action area (Upper Kenai-Cook Inlet) was estimated to be 939 seals with 37 taken in 2008 (Wolfe, et. al., 2009, Table 3). In 2008, harbor seal harvest occurred between March and December (Wolfe, et. al, 2009, Appendix B, Table 3). Community subsistence harvest take of sea lions in the Proposed Action area (Upper Kenai-Cook Inlet) from 1992 to 2008 was estimated to be 27 sea lions, with no take occurring after 2001 (Wolfe, et. al., 2009, Appendix B, Table 3). Note that subsistence harvest of beluga in Cook Inlet does not presently occur.

Subsistence activities in general and those related to marine mammals in particular are linked to sociocultural systems primarily through the sharing of resources that help maintain traditional family organization. Subsistence resources also provide special foods for religious and social occasions. The sharing, trading, and bartering of subsistence foods structures relationships among communities while at the same time, the giving of such foods helps maintain ties with family members elsewhere in Alaska. In the Proposed Action area, these communities are primarily the Alaska Native villages of Kenai (Kenaitze), Salamatof, and Ninilchik. In addition to these villages, social organization includes the associated Alaska Native Claims Settlement Act village corporations, the Cook Inlet Regional Corporation, and various non-profit Alaska Native organizations and resource co-management commissions. These villages and organizations, in turn, have commercial, cultural and social connections to nearby cities in or adjacent to the Proposed Action area and the Kenai Peninsula Borough. For example, the office of the Kenaize Indian Tribe is located in the City of Kenai, near the original village site in Old Kenai. The Salamatof Tribe, whose village is located just to the north between Kenai and Nikiski, also has its office in Kenai. The Ninilchik Tribal office is located in Ninilchik (USDOI, MMS, 2003; NMFS 2013).

Subsistence use and its relationship to sociocultural systems are reflected in statements on traditional knowledge on subsistence in statements from Kenai subsistence users (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999, as quoted in USDOI, MMS, 2003, III-170).

> *Some believe there is no traditional season for seal hunting for food; instead, whenever they need or want seal for food, they go out. But when harvesting seals for hides as well as food, they go when the water turns cold at the end of October and quit harvesting by March…Natives in the Kenai-Soldotna area have in the past had get-togethers once a month to eat things such as seal it was estimated that 100 or so families in the Kenai area use seal…The number of families using seal and beluga has been growing as more families move down here from up north.*

### 3.2.9. Economy

Economic activity for the Proposed Action is measured in the form of employment, income, and revenues. The Kenai Peninsula economy is diverse. In 2013, the Alaska Department of Labor and Workforce Development (ADOLWD) estimated that 23,909 Borough residents were employed, with an annual average unemployment rate of 7.5%. Industries employing the most workers include: trade, transportation, and utilities (19.1% of total employment); educational and health services (15.2%); local government (14.4%); natural resources and mining (12.1%); and leisure and hospitality (10.5%) (ADOLWD, 2014). According to the U.S. Bureau of Economic Analysis, per capita income in the

Borough was $48,485. The main sources of revenue for the Borough are from real and personal property taxes ($56,910,322), sales tax ($29,647,452), and oil and gas property taxes ($7,800,432) (ADOLWD, 2014).

The study area also supports important commercial fisheries. In 2013, for all commercial fisheries in the Kenai Peninsula Borough (KPB) combined, there were 1,429 permit holders and gross earnings of $135,515,228 (CFEC, 2014).

### 3.2.10. Public Health

Health was defined in 1948 by the World Health Organization (WHO) as a "state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." Community health is defined as "the status of a defined group of people, or community, and the actions and conditions that protect and improve the health of the community." Effects to public health could be brought about on a regional, community, or individual level and would occur in close parallel with subsistence, sociocultural, and environmental quality. Social determinants of health are conditions of the environment in which people are born, live, learn, work, play, worship, and age, that affect a wide range of health, functioning, and quality-of-life outcomes and risks. Understanding the relationship between how population groups experience "place" and the impact of "place" on health is fundamental to the determinants of health, both social and physical.

Some of the determinants of health include the availability of resources to meet daily needs, such as the availability of subsistence foods, quality of the natural environment, and exposure to toxic substances (air and water quality) and other physical hazards. While anyone dependent on subsistence resources could experience these effects to some degree, they could be more prominent in Alaska Native communities of the region where subsistence and related practices are a cornerstone of well-being as well as physical health. As described in Section 3.2.8. Subsistence Resources and Sociocultural Systems these communities are the Native Villages of Salamatof, Kenai, and Ninilchik.

### 3.2.11. Environmental Justice

Executive Order 12898 (EO), "Federal Actions to Address Environmental Justice (EJ) in Minority Populations and Low-Income Populations," makes each Federal agency responsible for achieving environmental justice as part of its mission, and for identifying and addressing, as appropriate, "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low income populations." The intent of EO 12898 is to promote the fair treatment of people of all races and income brackets, so no person or group of people bears a disproportionate share of the negative effects from Federal agency decisions.

Alaska Natives, a recognized minority, are the primary residents in the project area to consider in an Environmental Justice analysis, especially given their reliance on fisheries resources and subsistence foods (BOEM 2003). These residents are primarily located in the Kenai Peninsula Borough in Salamatof (a census designated place), Kenai City, and Ninilchik. In the 2010 Census, the percentage of residents identifying as American Indian and Alaska Native (alone) was 17.86% for Salamof, 8.90% for Kenai City, and 15.40% for Ninilchik (NMFS, 2013).

# 4.0 ENVIRONMENTAL CONSEQUENCES

The following subsections analyze potential direct, indirect, and cumulative effects on environmental resources as a result of Alternative 1 - No Action, and Alternative 2 - Proposed Action.

Each alternative is analyzed for direct and indirect effects to the resources identified in Section 3.0. Potential cumulative effects are then discussed under each resource category. Each cumulative effects subsection discusses past, present, and reasonably foreseeable future actions that could affect each resource, and analyzes the potential for the Proposed Action to contribute incrementally to these impacts. The cumulative effects scenario (past, present, and reasonably foreseeable activities in the Proposed Action area) is presented in Appendix B.

A level of effect determination (i.e., negligible, minor, moderate, or major) is provided by resource. Level of effect definitions are provided in Appendix A.

**Fuel Spill Scenario.** The potential for an accidental oil spill was examined and evaluated. An accidental small spill during refueling has a reasonably foreseeable chance of occurring during any project. This EA considers the impacts of up to one accidental offshore refueling spill. The vessel will fuel approximately once every 10 days at dock and will supply fuel to smaller vessels at times (SAE, 2014, p. 9). All fueling will occur in accordance with applicable regulations and SAE spill prevention practices. Spill prevention practices include a fuel transfer plan filed with the U.S. Coast Guard, which designates certified fluid off-loaders and receivers, spill prevention equipment, secondary containment and drip liners.

For purposes of this analysis, no fuel spills are assumed to occur at the dock and enter the water. A seismic vessel transfer spill during offshore refueling was estimated to have a volume range from <1-13 bbl (USDOI, BOEMRE, 2010a, b) for Alternative 2, the Proposed Action. The <1 bbl minimum volume represents a fuel spill where dry quick disconnect and positive pressure hoses function properly. The 13 bbl maximum spill volume represents a spill where spill prevention measures fail and fuel lines rupture. For Alternative 2, the Proposed Action, fuel spills could range from zero bbl if no fuel spills occur to <1 bbl-13 bbl if there is a spill during refueling offshore, and spill prevention equipment functions properly (<1 bbl) or fails completely (13 bbl).

Previous NEPA analyses, such as those for Statoil, ION, TGS, and SAE (USDOI, BOEMRE, 2010a, b; USDOI, BOEM, 2012, 2013, 2014) determined a <1-13 bbl spill would be localized and temporary based on oil weathering estimates for diesel fuel. In Cook Inlet a <1 bbl fuel spill could persist for up to 12 hours in open water and up to 3 days in broken ice should ice blow into the area; a 13 bbl fuel spill could persist for up to 2 days in open water and up to 4 days should ice blow into the area. Although SAE is not planning on operating in ice, ice blowing into the Proposed Action area or oil spreading into ice was considered for estimates of fuel oil persistence. A <1-13 bbl spill is also considered localized and temporary in Cook Inlet.

## 4.1.1. Air Quality

### 4.1.1.1. Direct and Indirect Effects

#### Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to air quality.

#### Alternative 2 – Proposed Action

The operation of diesel marine propulsion and auxiliary engines on vessels proposed for the seismic survey, including the support vessels, have the potential to cause harmful air emissions over the lower Cook Inlet. An evaluation of the Proposed Action's inventory of vessels and their projected

emissions, together with meteorological considerations such as local wind speed and direction, was conducted to predict the tendency of emissions from the survey vessels to affect onshore air quality.

The mobile nature of the vessels used for the seismic survey, along with the temporary conditions under which the survey and support ships operate, are not expected to allow transport of emissions to a single onshore location, nor allow accumulation of emissions sufficient for the concentration of the pollutants to exceed the Federal air standards. As a result, the quality of air on land areas adjacent to the lower Cook Inlet will remain better than required by Federal standards and the seismic survey would have a negligible air quality level of effect.

#### 4.1.1.2. Cumulative Effects

##### Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on air quality to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

##### Alternative 2 – Proposed Action

The incremental air quality impact to the lower Cook Inlet and surrounding areas within the Kenai Peninsula Borough from the seismic operations under the Proposed Action, when considered cumulatively with past, present, and reasonably foreseeable future emission sources summarized in Appendix B, would be no greater than a negligible level of effect to onshore air quality 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.

### 4.1.2. Water Quality

#### 4.1.2.1. Direct and Indirect Effects

##### Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to water quality.

##### Alternative 2 – Proposed Action

The level of effects of the Proposed Action on water quality during this period would be negligible. Depending on the specific activity, the effects would be localized (e.g., node placement and retrieval) or dispersed (e.g., source vessel discharges).The potential direct and indirect effects from the Proposed Action on water quality include the following:

***Insertion and Retrieval of Receiver Nodes***

The insertion and retrieval of nodes may cause temporary and localized increases in suspended sediment and turbidity on the seafloor; however, the turbidity created by placing and removing nodes on the seafloor would be negligible because the sediment and turbidity would settle to background levels within minutes after the cessation of activity.

***Vessel Discharges***

Vessel discharges and deck runoff would cause degradation of water quality in localized surface and near-surface water due to particulate and contaminants in the wastewater. Wastewater would result from approximately 111 personnel that would be based on the vessels during the Proposed Action. The five vessels that are larger than 79 feet in length are required to obtain coverage under EPA's NPDES Vessel General Permit (VGP). The remaining four vessels, smaller than 79 feet, would not be required to obtain a VGP. Wastewater concentrations would be highest near the vessel at the point of discharge from the vessel. Wastewater would be diluted and pollutions would be quickly dissipated;

the water quality effects are expected to be short-term and negligible and mitigated through EPA's NPDES Vessel General Permit requirements and the Coast Guard's ballast water and marine waste regulations.

#### *Accidental Fuel Spill*

An accidental small fuel spill (<1 to 13 bbl) while refueling would cause temporary water quality degradation in surface waters from introduction of diesel fuel hydrocarbons. This type of spill in open water could persist at the water surface for up to 2 days before volatizing and dissipating. If broken ice is present and prevents the fuel from spreading and dissipating, the fuel could persist on the water surface for up to 4 days. The effect of the Proposed Action on water quality is expected to be minor and temporary in the immediate area of the vessels and negligible on the spatial scale of lower Cook Inlet.

### 4.1.2.2. Cumulative Effects

#### Alternative 1 – No Action

Selection of the No Action alternative would add no incremental effects on water quality to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

#### Alternative 2 – Proposed Action

Existing water quality impacts would not appreciably increase with the addition of the Proposed Action; existing impacts impact would remain minor. When added to the past, present and reasonably foreseeable future activities described in Appendix B, the effects to water quality would remain minor in a regional context. The cumulative effects of the Proposed Action on water quality from past, current and reasonably foreseeable activities would be negligible to minor in a regional context.

## 4.1.3. Lower Trophic Levels

### 4.1.3.1. Direct and Indirect Effects

#### Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to lower trophic levels.

#### Alternative 2 – Proposed Action

Direct effects from activities associated with Proposed Action would be limited to energy emitted during the 3D seismic survey. Indirect effects would include disturbance of lower trophic populations due to vessel operations.

Vessel operations and the noise associated with ship operations are not known to have adverse effects on benthic invertebrate populations. However, available evidence suggests that seismic survey noise in the environment is not completely without consequences to pelagic invertebrate populations. Off the coast of Spain in 2001 and 2003, beaching of giant squid (*Architeuthis dux*) coincided with vessels conducting seismic surveys using airguns. Investigations of remains of the beached animals found pathological damage to the statocyst organs (a sensory organ comparable to the mammalian cochlea, a part of the inner ear enabling control of balance and equilibrium) of the beached squid (André et al., 2011). Christian (2003) concluded that there were no obvious effects from seismic signals on crab behavior and no significant effects on the health of adult crabs. Pearson et al. (1994) had previously found no effects of seismic signals upon crab larvae for exposures as close as 1 m (3.3 ft) from the array, or for mean sound pressure as high as 231 dB re 1 μPa. Squid and other invertebrate species have complex statosysts (Nixon and Young, 2003) that resemble the otolith organs of fish that may allow them to detect sounds (Budelmann, 1992). Normandeau Associates, Inc.

(2012) concluded that invertebrates are sensitive to local water movements and to low-frequency particle accelerations generated by sources in their close vicinity. Nearshore vessel operations, including deployment and retrieval of nodes, have the potential of affecting behavior of invertebrate populations in the area. Overall effects on populations of invertebrates in the Proposed Action area will be negligible.

#### 4.1.3.2. Cumulative Effects

##### Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on lower trophic levels to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

##### Alternative 2 – Proposed Action

The level of effects for the Proposed Action with respect to lower trophic resources is negligible. The cumulative effects include those past, ongoing, planned, or reasonably foreseeable activities discussed in Appendix B, Cumulative Effects Scenario. Given the local and temporary potential impact to lower trophic populations from the Proposed Action, the incremental impact to lower trophic populations when added to these other cumulative factors would still result in a negligible level of effect.

### 4.1.4. Fish

#### 4.1.4.1. Direct and Indirect Effects

##### Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to fish.

##### Alternative 2 – Proposed Action

The activities associated with SAE's proposed 3D seismic surveys have the potential to impact fish. As described below, the main sources of disturbance from the Proposed Action will be airgun and vessel noise, placement and retrieval of nodes, vessel discharge, and accidental fuel spills and vessel re-fueling.

***Airgun and Vessel Noise***

Airgun shots and vessel noise would radiate through the marine environment. The noise could mask natural ambient sounds and cause scattering of fish and their prey, reduce feeding efficiency, disturb sensory orientation, disrupt reproductive activities, and alter migratory pathways (Fay, 2009; Radford et al., 2010; Simpson et al., 2010; Slabbekoorn et al., 2010; Purser and Radford, 2011). Fish exposed to operating airguns may sustain damage to their auditory hair cells (McCauley et al., 2003). Fish with impaired hearing may experience reduced fitness, become more vulnerable to predators, and be less successful at locating prey (MMS, 2005). Some fishes exposed to airgun emissions have been observed to display aberrant and disoriented swimming behavior, suggesting that damage to the ears also may have vestibular impacts (McCauley et al., 2003).

***Placement and Retrieval of Receiver Nodes***

During node receiver placement and retrieval from the seafloor, physical disturbance to demersal and benthic fish species could occur (e.g., walleye pollock, Pacific cod and sculpin species). Fish would be affected by increased suspended sediment and decreased visibility in the water column during placement and removal of nodes, which could interrupt feeding and reproductive activities of anadromous species by altering migration routes into and out of the riverine systems. Noise from node placement vessels and pingers used for node placement may temporarily displace bottom dwelling fish by scattering both the fish and their prey.

#### *Vessel Discharge*

Fish near work vessels could be exposed to water quality degradation at localized surface and near-surface areas from particulate and contaminant discharges from vessel deck runoff. The type and degree of effect from these discharges would depend on the species, life stage, location of fish relative to the discharge, concentration in the discharge, and exposure time. Early life stages of fish, such as eggs, larvae and young of year, would be more vulnerable and sensitive to vessel discharges than adult fish due to their relative lack of mobility. Morbidity and mortality of young life stages could occur in localized areas. Potential vessel discharges and deck runoff from seismic and support vessels would cause temporary water quality degradation at localized sites which could reduce visibility.

#### *Accidental Fuel Spills*

Temporary water quality degradation could occur from accidental fuel and oil spills during vessel refueling at sea. Toxicity effects on fish (particularly early life stages) could occur in the immediate area of a spill.

The level of effects of the Proposed Action on fish is expected to range from negligible to minor with affected fish species. Depending on the specific activity, the effects would be localized (e.g., node placement and retrieval) or dispersed (e.g., airgun discharges from source vessel) over the Proposed Action area.

### 4.1.4.2. Cumulative Effects

#### Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on fish to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

#### Alternative 2 – Proposed Action

Effects from the Proposed Action alternative would have negligible to minor impacts to individual fish species when measured with past, present, and reasonably foreseeable future actions. Past projects include marine seismic surveys, oil and gas exploration, development and production, commercial fishing, recreation, shipping, and scientific activities. Seismic activities have the potential to affect fish species found in Cook Inlet, the impacts of the effects of the Proposed Action are likely to vary from negligible to minor with affected fish species, as described. The cumulative effects of the Proposed Action would not appreciably add to the existing and potential effects on pelagic, ground fish and forage fish species that occur in Cook Inlet.

## 4.1.5. Marine and Coastal Birds

The activities associated with SAE's proposed 3D seismic surveys have the potential to impact marine and coastal birds. The main source of disturbance from the Proposed Action will be vessel presence that could temporarily displace birds from the seismic survey area or, less likely, result in vessel strikes because birds may be attracted to vessel lights. Other impacts associated with the seismic surveys that could affect marine and coastal birds include the anthropogenic noise from seismic airguns, pingers and transponders associated with positioning and locating receiver nodes, and propeller noise from the vessel fleet operations; potential for entanglement in ocean-bottom ropes, and contact with small spills.

#### 4.1.5.1. Direct and Indirect Effects

### Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to marine and coastal birds.

### Alternative 2 – Proposed Action

On average, waterfowl and gulls would be the most frequent groups anticipated to be encountered during SAE's proposed surveys because some more abundant species (e.g., Canada goose, scoters, mallards, glaucous-winged gull; Section 3.2.5) are year-round residents in and near the seismic survey area and because large numbers of waterfowl migrate through Cook Inlet in spring and, to a lesser extent, fall (Section 3.2.5, Seasonal Distribution). Potential adverse effects of the Proposed Action on coastal and marine birds are summarized below according to:

- disturbance from vessel presence and activity
- birds encountering/striking vessels
- bird entanglements with underwater cables; and
- birds contacting or ingesting small fuel oil spill products

#### *Vessel Disturbance*

Vessel presence and activities could disturb birds. Flocks of migrating or flightless birds would generally move away from vessel activity. There is an energetic cost to repeatedly moving away from vessel disturbances as well as a cost in terms of lost foraging opportunities or displacement to an area of lower prey availability. Seismic survey activity is expected to have localized disturbance effects on certain marine bird species that are distributed across the Proposed Action area (as described in Section 3.2.5). The more abundant species would be affected more than ESA-listed species that are less common in the action area. Migrating birds would likely experience temporary impacts as they moved through the seismic survey area. Molting birds could be disturbed repeatedly if they were unable to relocate (i.e., flightless) to another area when seismic operations were occurring. The potential for vessel disturbance to birds is highest in spring (April-June), when northward spring migrations result in high densities of waterfowl and shorebirds in Cook Inlet (as described in Section 3.2.5, Seasonal Distribution). Overall, the impacts of displacement from vessel presence would be temporary and localized, resulting in a negligible effect on marine and coastal birds.

#### *Seismic Activities*

Few studies have examined responses of marine and coastal birds to seismic airgun pulses. A study in the Beaufort Sea found that the proportion of Long-tailed Ducks detected in areas with seismic surveys was not significantly different from control areas without the surveys; the study also found that there was no difference in diving behavior of ducks in the seismic and non-seismic areas (Lacroix et al., 2003). Likewise, Stemp (1985) found no difference in the numbers of diving Thick-billed Murres in the presence of a 1,500 cui airgun array compared with a control area. During the course of normal feeding or escape behavior, some birds could conceivably be near enough to an airgun to be injured by a pulse. The reactions of birds to airgun noise suggest that a bird would have to be very close to the airgun to receive a pulse strong enough to cause injury (Owl Ridge, 2013). Injury to birds is expected to result in a negligible level of effect because birds are most likely to move away from slow-moving seismic vessels well in advance of the towed seismic-airgun array. Flightless birds at sea remain capable of slowly moving away from disturbances.

### *Vessel Collisions*

Marine and coastal birds, attracted to lights and vessels in nearshore waters, could collide with a vessel and be injured or killed. Birds could collide with vessels during inclement weather (e.g., fog, rain) or darkness (Black, 2005; Dick and Donaldson, 1978; Weir, 1976). Vessels operating in marine environments often encounter species when the birds are migrating (Day et al., 2005; Schorger, 1952). In some cases, birds may seek refuge on a vessel in inclement weather and use it to rest and continue migration. In other cases, exhausted birds alight on a vessel, but do not survive. For the majority of mortalities, however, there have been strong indications from previous industry monitoring that dead birds found aboard vessels collided with vessel structures and died on impact, or later succumbed to injuries. During the Proposed Action, lights onboard the vessel fleet will be shielded or oriented downward to avoid disorientation and collision of marine and coastal birds (Owl Ridge, 2013). Vessel collisions would have a minor effect on marine and coastal birds because, while a few individuals could be injured or killed despite the lighting mitigation measures described above, the distribution, abundance, and overall survival of species would not be altered as a result.

### *Entanglements*

The USFWS is aware of the few entanglements that have occurred in the Gulf of Mexico (GOM) and have not deemed entanglement of wildlife to be a serious issue in Alaska. In previously published Biological Opinions on the impacts to ESA-listed birds from seismic survey activities in Alaskan waters (including in the same waters of lower Cook Inlet as the proposed survey area), the USFWS has not identified entanglement as a potential effect (USFWS, 2003; USFWS, 2007; USFWS, 2012c). The small size of the Proposed Action combined with the proper use of equipment; and implementation of protocols, and mitigations described in the IHA would ensure entanglements do not occur from the Proposed Action. Therefore, the potential effects of entanglement to marine and coastal birds would be highly localized and minor.

### *Spills*

Should a fuel spill of the magnitude defined in the Section 4.0 fuel spill scenario occur during refueling, a small number of birds in the immediate vicinity of the vessel could be affected, depending on current and wind patterns. In the unlikely occurrence of a fuel spill, there is some potential for a limited amount of individual bird injury or fatality due to contact with or ingestion of oil. Direct contact with oil can foul feathers, thus compromising thermoregulation; toxic effects can result from ingestion during preening of oiled feathers (Leighton, 1993; Malins, D.C. 1977). Birds can also experience toxic effects through consumption of contaminated food resources (Leighton, 1993; Malins, 1977) and reductions in prey availability due to the toxic effects of petroleum on prey species (Leighton, 1993; Malins, 1977). Exposure can be acute, due to direct contact with surface oil, resulting in death, injury, or illness or it can be chronic via exposure to contaminated prey leading to sub-lethal effects on reproduction, immune function, and conditioning (Fry, 1995; USFWS, 2003).

The injury, illness, or death of a few birds as a direct result of spilled fuel oil is considered a minor level of effect (Appendix A, Levels of Effects Definitions); however, it is most likely that spill prevention and response measures would minimize adverse effects to marine and coastal bird populations. It is unlikely that a bird would come in contact with any small spill during offshore refueling. Individuals would likely avoid the waters immediately surrounding any refueling or spill clean-up activities, and because any spills would be contained and cleaned up quickly.

A small fuel oil spill would be unlikely to impact marine bird prey species because any residual fuel oil would be likely to evaporate and dissipate within 24 hours or less. Vessel presence and associated cleanup activities could disturb and displace highly-mobile prey; however, any disturbance would be temporary and highly localized.

Overall, the Proposed Action is expected to have a minor level of effect on marine and coastal birds. This assessment is predicated on implementation of special conditions described in Sections 7.7 through 7.12 in the SAE Plan of Operations (SAE, 2014a). SAE must report specific information to BOEM on all birds found on their vessels within specified timeframes. This reporting is intended to allow BOEM (and USFWS) to monitor the incidental take under the Endangered Species Act and to review or modify ongoing SAE operations if large numbers of migratory birds or ESA-listed species are being harmed.

#### 4.1.5.2. Cumulative Effects

##### Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on marine and coastal birds to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

##### Alternative 2 – Proposed Action

The level of effects for the Proposed Action with respect to individual species would remain negligible to minor when considered in combination with other past, present, and reasonably foreseeable actions. Past projects include marine seismic surveys, exploration and production drilling, commercial fishing, recreation, shipping, and scientific activities. While seismic activities have potential to affect all of the marine and coastal bird species found in Cook Inlet, the impacts of the effects of the Proposed Action are likely to vary from negligible to minor with the affected species, as previously described. Consequently, the Proposed Action would not appreciably add to the existing and potential effects on marine and coastal birds in Cook Inlet. Appendix B, Cumulative Effects Scenario, identifies activities that could overlap in space and time with the Proposed Action.

#### 4.1.5.3. Direct and Indirect Effects – Threatened and Endangered Marine and Coastal Birds

Steller's Eiders are the only ESA-listed marine or coastal bird species anticipated to occur in or near the seismic survey area. They occupy waters in both western and eastern lower Cook Inlet during winter months and overwintering flocks are known to rest and forage near and within the survey area (Section 3.2.5.1). No critical habitat for Steller's Eiders exists in or near the survey area.

##### Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to Steller's Eiders.

##### Alternative 2 – Proposed Action

Steller's Eiders occur seasonally in the SAE's seismic survey area during winter months and could be impacted by the Proposed Action. Because SAE intends to conduct seismic surveys along the Kenai Peninsula during the fall when wintering Steller's eiders begin arriving from molting areas, vessel presence could have a direct effect on these birds. Disturbance of feeding and resting Steller's eiders by seismic vessel presence has been documented, and may have varying degrees of severity based on season and frequency of disturbance (Lanctot and King, 2000). It has been suggested that the Cook Inlet overwintering population of Steller's Eiders is food limited and furthermore, ice conditions may displace Steller's Eiders from preferred winter foraging habitat, increasing potential for starvation (Camphuysen, 2000; Laubhan and Metzner, 1999). Alternative foraging areas of sufficient quality may not be available for some wintering eiders. Thus, eiders displaced by noise disturbance may not be able to simply relocate (USFWS, 2003).

Direct exposure of wintering Steller's Eiders to impulsive noise levels which exceed effect thresholds established by the USFWS for marbled murrelets could occur during seismic airgun use. Based on

sound exposure level (SEL) and rms source levels of the 1,760-cubic-inch gun, the distance to the injury threshold is 20 meters (66 feet). The disturbance threshold radius extends to 7.9 kilometers (4.9 miles) and is only relative to feeding eiders (when their heads are underwater) (Owl Ridge, 2013). Furthermore, the USFWS considers the 150 dB disturbance threshold an "effects analysis guideline" – not an actual threshold criterion – and requests that during the NEPA and ESA processes other factors, such as duration, be considered when determining whether exposure in these zones will result in adverse effects (Teachout, 2011; USFWS, 2012b).

Noise injury could potentially occur to any Steller's Eider diving within 20 meters (66 feet) of the seismic array. However, given the configuration of the array, this scenario is unlikely. Eiders will more likely move away from the approaching source vessel and the operating guns centered 4.6 meters (50 feet) behind the vessel long before the airguns reach within 20 meters of an eider group (Owl Ridge, 2013).

Previous conclusions by BOEM regarding impacts to Steller's Eiders from seismic surveys in the Federal waters of Cook Inlet (USDOI, MMS, 2003, 2005) and information of Steller's Eider habitat use in the seismic survey area (Section 3.2.5.1) indicate that direct disturbance from vessel presence and activities would be limited to seismic operation occurring after approximately November 15 (when Steller's Eiders typically arrive in the vicinity of the survey area) and within 3 nmi of shore. The seismic surveys will not result in a permanent loss of any near-shore habitat that is used by wintering Steller's Eiders. Foraging habitat may be disturbed through the deployment and retrieval of the ocean-bottom nodes, however, this disturbance will likely not result in permanent loss. No critical habitat for Steller's Eiders occurs within the action area of the project.

The types and levels of potential impacts to Steller's Eiders from collisions and entanglements are anticipated to be comparable to those described previously for marine and coastal birds (Section 4.1.5.1). Day et al. (2005) suggested that eider species may be particularly susceptible to collisions with offshore structures as they fly low and at relatively high speed (~ 45 mph) over water; however, the overall potential for vessel collisions with Steller's Eiders would not be sufficiently probable to create more than a minor impact to the Steller's Eider population, particularly as lights onboard the vessel fleet will be shielded or oriented downward to avoid disorientation and collision of marine and coastal birds.

The types of potential effects of direct or indirect exposure of Steller's Eiders to a small fuel oil spill as described in Section 4.0 would be identical to those described previously for other marine and coastal birds; however, because large flocks of Steller's Eiders can be concentrated along the eastern shores of lower Cook Inlet in winter months (in the vicinity of the survey area), a fuel spill occurring after approximately November 15 would have potential to impact a large number of birds. No population-level impacts would be expected. As previously discussed, the potential spill associated with the Proposed Action is anticipated to be small. It would be contained and cleaned-up quickly with both the fueling and clean-up activities anticipated to deter birds from occupying waters close enough to the spill to risk contact. Spills are expected to have a minor effect on Steller's Eiders.

Overall, the Proposed Action is expected to have a minor level of effect on Steller's Eiders. This assessment is predicated on implementation of special conditions described in Sections 7.7 through 7.12 in the SAE Plan of Operations (SAE, 2014a). SAE must report specific information to BOEM on all birds found on their vessels within specified timeframes. This reporting is intended to allow BOEM (and USFWS) to monitor the incidental take under the ESA and to review or modify ongoing SAE operations if large numbers of migratory birds or ESA-listed species are being harmed.

#### 4.1.5.4. Cumulative Effects - Threatened and Endangered Marine and Coastal Birds

##### Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on Steller's Eiders to those produced by ongoing or reasonably foreseeable activities in the Proposed Action.

##### Alternative 2 – Proposed Action

The level of effects for the Proposed Action with respect to Steller's Eiders would remain minor. Past projects include marine seismic surveys, exploration and production drilling, commercial fishing, recreation, shipping, and scientific activities. While seismic activities have potential to affect Steller's Eiders found in Cook Inlet, the impacts of the effects of the Proposed Action are likely to vary from negligible to minor, as previously described. Consequently the Proposed Action would not appreciably add to the existing and potential effects on Steller's Eiders in Cook Inlet. Appendix B, Cumulative Effects Scenario, identifies activities that could overlap in space and time with the Proposed Action.

### 4.1.6. Marine Mammals

#### 4.1.6.1. Direct and Indirect Effects

##### Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to marine mammals.

##### Alternative 2 – Proposed Action

Anticipated impacts to marine mammals associated with the Proposed Action would be from vessel noise, vessel movement and airgun noise; however entanglements are not anticipated to result from the Proposed Action. Use of the 1,760-cubic-inch airgun arrays should be the primary impact producing element of the Proposed Action. Potential impacts to marine mammals might include one or more of the following: tolerance, masking of important natural signals, behavioral disturbance, and temporary or permanent hearing impairment or non-auditory effects.

A large body of information on the effects of noise on some marine mammals exists, and research indicates noise levels may produce Temporary Threshold Shifts (TTS) and Permanent Threshold Shifts (PTS) in marine mammal hearing. TTS is a term used to represent a temporary loss in hearing sensitivity, while PTS represents a permanent loss of hearing sensitivity. Using such research and empirical data from captive and wild marine mammals, NMFS established the in-water noise level thresholds for Level B acoustic harassment to be 160 dB re: 1 μPa for impulsive sounds, and 120 dB re: 1 μPa for continuous noise (Table 10). Likewise the acoustic threshold for Level A harassment, which could cause injury, has been set at 180 dB re: 1 μPa for cetaceans and 190 dB re: 1 μPa for pinnipeds. No Level A harassment is authorized or anticipated for the Proposed Action. As no sound levels have been effectively measured to establish the threshold where injury caused by an acoustic source exists for sea otters, the 190-dB criterion for seals applies most closely to sea otters given their more similar natural history than compared to cetaceans. To avoid exposing marine mammals to these received noise levels, safety zones will be established based on the zones of impact (the area ensonified by a specific sound level) for the 440- (221.1 dB source), 880- (226.86 dB source) and 1,760- (236.55 dB source) cubic-inch airgun arrays (USFWS, 2014b).

**Table 10. NOAA Fisheries Current In-Water Acoustic Thresholds**

| Criterion | Criterion Definition | Threshold |
|---|---|---|
| Level A | PTS (injury) conservatively based on TTS | 190 $dB_{rms}$ for pinnipeds and sea otters<br>180 $dB_{rms}$ for cetaceans |
| Level B pulsed | Behavioral disruption for impulsive noise (e.g., impact pile driving, seismic surveys) | 160 $dB_{rms}$ |
| Level B continuous | Behavioral disruption for non-pulse noise (e.g., vibratory pile driving, drilling, vessels traffic) | 120* $dB_{rms}$ |

Notes: Thresholds exclude tactical sonar and explosives.
All decibels referenced to 1 micro Pascal (re: 1µPa). All thresholds are based off root mean square (rms) levels.
*The 120 dB threshold may be slightly adjusted if background noise levels are at or above this level.
Source: NOAA, 2014b: NOAA Fisheries, West Coast Region Interim Sound Threshold Guidance at: http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html

**Table 11. Boxcar Frequency Range – Marine Mammals Using Navy Acoustic Effects Model Compared to Frequency Bands Used by Airgun Arrays and Sonar Equipment.**

| Species Group | Limit (Hz) | |
|---|---|---|
| | Lower | Upper |
| LF Cetaceans (Gray Whales, Humpback Whales, Minke Whales) | 5 | 30,000 |
| MF Cetaceans (Beluga Whale) | 50 | 200,000 |
| HF Cetaceans (Dall's Porpoise, Harbor Porpoise, Killer Whale) | 100 | 200,000 |
| Otariid Pinnipeds (Steller Sea Lion) | 20 | 60,000 |
| Phocid Pinnipeds (Harbor Seal) | 50 | 80,000 |
| Sea Otters | 125 | 32,000 |
| | | |
| 1760-cubic-inch airgun array | 10 | 120 |
| 440 cubic-inch-airgun array | 10 | 120 |
| Vessel Traffic | 37 | 6,300 |
| Sonardyne Scout USBL | 35,000 | 55,000 |
| Sonardyne TZ/OBC Type 7815-000-06 | 35,000 | 55,000 |

Source: Ciminello et al., 2012; Ghoul and Reichmuth, 2012a; Greene and Moore, 1995; Owl Ridge, 2014.

### *Vessels*

Vessels have a transient presence in any location, with a limited effect on marine mammals since marine mammals can detect and avoid vessels (Richardson et al., 1995; Richardson, 1995). Vessels produce continuous low frequency sounds, frequently around 160 dB, that are perceptible to marine mammals; however, these noise levels quickly attenuate in the marine environment, so vessel noise should have negligible effects on marine mammals.

Small ships (55-85 m) and boats (<55 m) generally emit noise in frequencies of 37 - 6300 Hz, with source noise levels of 170-180 dB re 1 µPa for small vessels and 152- 170 dB re 1 µPa for boats (Greene and Moore, 1995). The actual noise produced could vary with vessel size, engine size, engine type, hull structure, number and placement of propellers, and vessel speed. Typical responses of marine mammals to small vessel noise are behavioral reactions, or no visible reaction, depending upon circumstances. Small vessel types used to hunt or harass marine mammals elicit greater responses than vessel types that don't engage in such activities (Richardson, 1995).

All vessels listed in Table 1 fit the length criteria for the boat class of vessels just described; however *M/V Arctic Wolf* and *M/V Dreamcatcher* emit noise source levels at 200.1 dB re 1 µPa, and the crew transport vessel (TBD) is expected to emit noise source levels of 191.8 dB re 1 µPa. These three vessels would emit noise levels sufficient to meet the Level A harassment criteria for cetaceans and pinnipeds, and all vessels would meet the Level B harassment criteria thresholds described in Table 10.

The low speeds (4-5 kts/hr) used by seismic vessels and existing mitigation protocols NMFS has established for marine mammal protection would ensure no strikes to marine mammals occur from the Proposed Action.

Generally, seals enter the water if approached too closely by vessels. PSOs and vessel crew would be on constant lookout for marine mammals in the water and would avoid disturbing them with close approaches. Careful monitoring and avoidance procedures (as described in Chapter 2) will minimize impacts to marine mammals from vessel presence.

### *Seismic Airgun(s)*

The effects of sounds from airgun pulses might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and temporary or permanent hearing impairment or non-auditory effects (Richardson 1995). Noise frequencies produced by the proposed airguns and airgun arrays would be audible at the low end of the auditory bandwidth for marine mammals, particularly harbor porpoises, killer whales, and beluga whales (Table 11). Overall, odontocete 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, 2014c).

One 1,760-cubic-inch airgun array would be towed by M/V Arctic Wolf, and another by *M/V Peregrine Falcon*, at 4-5 knts/hr (7.4-9.3 km/hr), alternately firing every 16 seconds with 8 second intervals between discharges. Airgun noise source noise levels of 236.55 dB re 1 µPa (rms) are expected, and would attenuate to 190 dB at 880 m (2,887 ft), 180 dB at 1.84 km (6,037 ft), and 160 dB at 6.83 km (22,408 ft) (Table 3). A 440-cubic-inch airgun array would be used in lieu of the 1,760 array at some locations, as warranted. This airgun array would emit noise source levels of 221.08 dB re 1 Pa rms, which would drop to 190 dB at 50 m (164 ft), 180 dB at 182 m (597 ft), and 160 dB at 3.05 km (10,007 ft) (Table 3). During turns and periods when the seismic survey is not occurring a single (~10 cubic inch) mitigation airgun will operate. The mitigation airgun produces less noise than the airgun arrays, using the same frequencies and safety radii would be closely monitored.

The acoustical broadband energy of these airguns provided by the manufacturer indicates that energy is focused along the vertical axis with little energy focused horizontally, and horizontally radiated noise quickly attenuates in the ocean, with decibel levels dropping from source levels to much lower levels in a few tens of meters (Blackwell et al., 2013; Greene and Moore, 1995). Airgun operations would occur during low and high slack tides or when vessels can operate safely to acquire quality data, usually in 2-3 hour work efforts. Airgun arrays typically produce most noise energy in the 10 to 120 hertz range, with some energy extending to 1 kilohertz (Greene and Moore, 1995).

NMFS uses a 160 dB sound source level as the standard to assess Level B harassment impacts including incidental takes. SAE has applied for an IHA for the Proposed Action. If issued, the IHA will include appropriate zones of influence for Level B Harassment from 160 dB airgun noise (such as described in Chapter 2). PSOs would monitor the zones according to procedures outlined in by NMFS in the pending IHA, using mitigations promised in Owl Ridge, (2013, 2014), and based on existing mitigation measures typically applied by the NMFS IHA, a negligible level of effect on marine mammals is expected.

#### *Sonar*

The Sonardyne Scout USBL and Sonardyne TZ/OBC Type 7815-000-06 produce noise source levels of 197 dB re 1 µPa @ 1 m and 184 to 187 dB re 1µPa @ 1 m respectively, and both operate at frequencies of 35-55 kHz (35,000-55,000 Hz).

The frequency ranges used by this suite of sonar equipment would likely remain inaudible to humpback, minke, and gray whales since it occurs below their auditory bandwidth (Table 11); however, they do use frequency bands that should be audible to Dall's porpoises, harbor porpoises, killer whales, beluga whales, pinnipeds and sea otters. Since odontocetes cetaceans use higher auditory bandwidths, their responses to the sonar equipment would likely be stronger than what would be noted for mysticetes cetaceans (Richardson, 1995; Southall et al., 2007).

#### *Fuel Spills*

A fuel spill up to 13 bbl could occur in a refueling accident. Such a small fuel spill would be insufficient to produce noticeable adverse effects on marine mammals other than sea otters due to the rapid volatilization of spilled fuel, the low spill, and the fact that spilled fuel doesn't affect the ability of pinnipeds or cetaceans to thermoregulate and feed. Consequently, this effector will only be analyzed for sea otters.

#### *Entanglements*

The Proposed Action would employ stringers of nodes to detect geologic characteristics below the seafloor. Entanglements of certain species (dolphin, ray, and sea turtle) have occurred in GOM from surveys using ocean bottom nodes. None of these species occur in Cook Inlet, Alaska, and no entanglements with lines or cables during ocean bottom node surveys have ever been recorded for Alaska. Marine mammals should be present in the Proposed Action area, but these animals should avoid noise and activity associated with the survey (as described above). In addition, the weighted ropes used in this survey are designed to lie on the sea floor, and are semi-rigid, minimizing entanglement risks.

NMFS and USFWS are aware of the few entanglements that have occurred in the GOM and have not deemed entanglement to be a serious issue in Alaska. NMFS and USFWS have received IHA applications from SAE for 2015. SAE currently has an IHA from the USFWS for sea otters good through October, 2015. The small size of the Proposed Action combined with the proper use of equipment, implementation of protocols, and mitigations described in the IHA would ensure entanglements do not occur from the Proposed Action.

### 4.1.6.2. Direct and Indirect Effects by Species

#### ESA-Listed Marine Mammals

#### *Beluga Whale*

Research indicates beluga whales could be displaced by seismic noise (Erbe and Farmer, 2000), which could result in increased energetic losses, leading to reduced fitness. However, there would be little opportunity for beluga whales to be affected by the Proposed Action because most beluga whales concentrate in upper Cook Inlet when most of the Proposed Action would occur. The exception to this occurs when large numbers of salmon stage near river mouths in anticipation of spawning runs. Nearby rivers where large runs are expected include the Kasilof River, Kenai River, Bradley River in Kachemak Bay, Ninilchik River, Drift River, Crescent River, and Anchor River.

Belugas, if present in the vicinity of survey activities, should avoid the area unless they are engaged in feeding or social activity. Noise produced by seismic airgun arrays, sonar, and vessel traffic would be audible to belugas; however airgun array noise would occur at the very bottom end of their audible noise spectrum. The noise most audible to belugas would come from sonar equipment, which would

occur in the bottom quarter of the audible noise spectrum for beluga whales. Data suggests belugas may be more responsive to airgun noise than might be expected considering their poor low-frequency hearing (SAE, 2014c). Reactions at longer distances may be particularly likely when sound propagation conditions are conducive to transmission of the higher-frequency components of airgun sound to the animals' location (DeRuiter et al., 2006; Goold and Coates, 2006; Tyack et al., 2006; Potter et al., 2007). If belugas are encountered during seismic activities, the standard suite of monitoring and operational procedures in a NMFS IHA should reduce adverse effects including disturbance from vessel presence and noise, airgun noise, entanglements, and vessel strikes to negligible or minor levels of effect and prevent any Level A Harassment from occurring.

### *Humpback Whale*

Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable among species, locations, whale activities, oceanographic conditions affecting sound propagation, etc. (reviewed in Richardson et al. 1995; Gordon et al. 2004). Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances.

Baleen whales show considerable tolerance of vessels and sonar operations; however, when exposed to strong sound pulses from airguns, often react by deviating from their normal migration route and/or interrupting their feeding and moving away (Malme et al., 1984, 1985, 1988; Malme and Miles, 1985; Richardson, 1995; McCauley et al., 1998, 2000a, 2000b; Gordon et al., 2004; Johnson et al., 2007; Nowacek et al., 2007; and Weir, 2008). Although baleen whales often show only slight overt responses to operating airgun arrays (Stone and Tasker, 2006; Weir, 2008), strong avoidance reactions by several species of mysticetes have been observed at ranges up to 6 – 8 km and occasionally as far as 20 – 30 km from the source vessel when large arrays of airguns were used.

Humpback whales could occur in Cook Inlet near Kachemak Bay, and near the Proposed Action area. Experiments with a single airgun showed that humpback and gray whales showed localized avoidance to a single airgun of 20 – 100 in3 (Malme et al. 1984, 1985, 1988; McCauley et al. 1998, 2000a, 2000b), while other studies of gray, and humpback whales found seismic pulses with received levels of 160 – 170 dB re 1 μPa (rms) cause obvious avoidance behavior in a substantial portion of animals (Richardson, 1995). In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 4 – 15 km from the source.

In the cases of migrating whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals; they simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors (Malme et al. 1984; Malme and Miles 1985; Richardson, 1995). Feeding whales, in contrast to migrating whales, show much smaller avoidance distances (Miller et al. 2005; Harris et al. 2007), presumably because moving away from a food concentration has greater cost to the whales than does a course deviation during migration.

For these reasons, the use of seismic airgun arrays is expected to have the greatest effect on humpback whales in lower Cook Inlet, resulting in temporary displacement from feeding areas by a factor of several kilometers until the airgun arrays are moved to other areas with a minor level of effects. Vessel noise and presence, and the use of sonar devices should have negligible to minor effects on humpback whales occurring in lower Cook Inlet, and the duration of such disturbances should be brief.

### *Steller Sea Lion*

The Eastern DPS of Steller sea lions have critical habitat to the south of the Proposed Action area. While no rookeries are actually within Cook Inlet, some are located just outside Cook Inlet on the southern coastline of the Kenai Peninsula (Figure 8). For this reason, sea lion rookeries and the 20

nmi critical habitat buffer around those rookeries would not be disturbed by the Proposed Action. Some Steller sea lions should occur in the reaches of lower Cook Inlet, particularly near the mouth of Kamishak Bay, and Anchor Point. Those individuals or groups could be disturbed by the Proposed Action; however, Cook Inlet–particularly Homer, Seldovia, and Anchor Point–experiences a great deal of vessel activity during summer from recreation, commercial fisheries, barging, and other forms of commercial and scientific vessel traffic. Because of the frequent vessel activity within Cook Inlet, sea lions in the area should be at least partially habituated to vessel presence and noise, such that the vessel component of the Proposed Action should have negligible effects on this species.

Some individuals or groups of Steller's sea lions could be in or near the Proposed Action area, and would likely respond to seismic surveys, discharging airguns, and sonar operations by spy-hopping, or with a very slight avoidance of a few hundred meters. The standard suite of NMFS mitigations expected to be applied in the IHA should only allow for incidents of Level B Harassment, with no significant adverse effects. For these reasons, the Proposed Action is expected to have a negligible to minor level of effects on Steller's sea lions.

## Other Marine Mammals

### *Dall's Porpoise*

Dall's porpoises sometimes occur in lower Cook Inlet, Alaska, near Kachemak Bay and Anchor Point, but sightings are rare. Due to their scarcity in the Proposed Action area, they are unlikely to be affected by the Proposed Action. Furthermore, the bandwidth they use for audition is 100 – 200,000 Hz, indicating seismic noise from the Proposed Action would only be audible in the bottom 20 Hz of their 199,000 Hz audibility range, while the noise from sonar devices would occur in the 35,000 – 55,000 Hz portion of their hearing range and vessel traffic would be audible in the 100-6,300 Hz portion of that range. Data suggests a ≥170 dB re 1 μPa (rms) disturbance criterion (rather than ≥160 dB) could be more appropriate for Dall's porpoise. Received noise levels typically diminish to 170 dB within 1 – 4 km for medium to large aigun arrays, and noise levels usually remain ≥160 dB out to 4 – 15 km (e.g., Tolstoy et al., 2009), and reaction distances for Dall's porpoises are more consistent with the typical 170 dB re 1 μPa (rms) distances.

Any Dall's porpoises affected by the survey noise would likely avoid the 170 dB or greater noise field surrounding the noise source. Furthermore, there is a lesser likelihood that avoidance could also occur at the 160 dB noise field, which is the sound level NMFS uses to determine Level B Harassment. Such disturbances would be temporary, yet progress at low speed (4-5 knots: seismic survey ships), permitting porpoises to avoid noise fields and potential injury. Because of the scarcity of Dall's porpoises, noise bandwidths from noise sources vs. audible noise bandwidths for Dall's porpoises, the standard suite of NMFS mitigations anticipated in the IHA, and survey characteristics, a negligible level of effects to Dall's porpoises is expected from the Proposed Action.

### *Gray Whale*

Low numbers of gray whales are expected to occur in lower Cook Inlet. Gray whales in the seismic survey area are expected to be affected in a manner consistent with that described for humpback whales. Typical monitoring and operational procedures as identified in the IHA are anticipated to reduce the potential for adverse impacts, including disturbance from vessel presence, vessel or airgun sounds, or collisions. A negligible to minor level of effect to gray whales is expected from vessel noise and traffic, and the use of sonar devices; and a minor level of effect to gray whales is expected from the noise produced by firing airgun arrays.

### *Harbor Porpoise*

The effects of the Proposed Action would be consistent with what was described for Dall's porpoises, and mostly for similar reasons (i.e. audible sound frequencies); however harbor porpoises are seen

throughout Cook Inlet with greater regularity than Dall's porpoises. The frequent presence of harbor porpoises in waters where the Proposed Action would occur greatly increases the likelihood of individual, or groups of harbor porpoises being temporarily displaced by the Proposed Action. Brief displacements, such as are anticipated from the Proposed Action, would constitute a minor level of effects, amounting to temporary changes in behavior (avoidance).

### *Harbor Seal*

Impacts to harbor seals that could arise from the Proposed Action would be limited to disturbance or displacement effects caused by a seal's avoidance of vessel presence and noise, and airgun noise. The expected suite of mitigation measures expected in the NMFS IHA should prevent Level A Harassment from occurring and limit incidents of Level B Harassment to brief episodic events with no lingering or chronic effects. Overall, harbor seal responses to the Proposed Action would be consistent with those described for Steller sea lions; however, harbor seals are common throughout Cook Inlet, unlike Steller sea lions, with haulout, concentration, and feeding areas extending into upper Cook Inlet.

Harbor seals use onshore haulouts for pupping and resting during spring and summer, and should avoid the Proposed Action to a degree. Haulout, concentration and feeding areas occur at Kalgin Island, Kachemak Bay, Tuxedni Bay, Chinitna Bay, and Anchor Point; and should be avoided, especially when pups are present. If approached too closely pups could panic, enter the water, and become separated from their mothers. Under such circumstances, those seal pups would effectively be unprotected and susceptible to predation or other forms of mortality.

Responses to vessel operations would be similar to those described for Steller sea lions, and noise from vessel operations would not produce lingering effects among harbor seals. Furthermore, individual seals would avoid vessels long before noise levels cross the 190 dB or 160 dB noise thresholds developed by NMFS for Level A or B harassment. Cook Inlet receives a significant amount of vessel traffic, with barging, recreational boating, and other vessel-based activities regularly occurring. This level of vessel activity suggests some level of harbor seal habituation to vessel presence and noise. Previous seismic surveys conducted in Cook Inlet elicited minor behavioral reactions (disturbance) among harbor seals and no incidents of Level A harassment have been documented to date. For these reasons, there should be negligible to minor effects to harbor seals from the Proposed Action if NMFS mitigations are implemented and if seal haulout and concentration areas are avoided.

### *Killer Whale*

The effects of the Proposed Action on killer whales would be consistent with what was described for Dall's and harbor porpoises, and using the same rationale.

### *Minke Whale*

Minke whales are anticipated to be affected in a manner consistent with that described for humpback whales. Low numbers of minke whales are expected to occur in lower Cook Inlet, and typical monitoring and operational procedures as identified in the IHA should reduce the potential for adverse impacts, including disturbance from vessel presence, vessel or airgun sounds, or collisions. A negligible to minor level of effects to minke whales is expected from vessel noise and traffic, and the use of sonar devices; and a minor level of effects to them is expected from the noise produced by firing airgun arrays.

### *Northern Sea Otter*

Northern sea otters occur in and adjacent to the seismic survey area at low densities and previous industry monitoring suggests that otters could be encountered during the Proposed Action (USFWS, 2014b). Otters could be disturbed by seismic and vessel noise from the Proposed Action. Sea otters

exposed to anthropogenic noise may respond behaviorally (e.g., escape response) or physiologically (e.g., increased heart rate, hormonal stress response) (Atkinson et al., 2009; Fair and Becker, 2000; Goudie and Jones, 2004; Wikelski and Cook, 2006); however, sea otters are generally quite resistant to the effects of sound, and change to presence, distribution, or behavior resulting from acoustic stimuli, including airguns, is rare (Davis et al., 1988; Ghoul and Reichmuth, 2012a, 2012b; Riedman, 1983, 1984). Otters also quickly become habituated to anthropogenic noises (Ghoul and Reichmuth, 2012b). The range at which most seismic energy is produced is beyond the effective hearing range of sea otters (125 Hz to 32 kHz, Ghoul and Reichmuth, 2012b, 2014), and the transceiver and transponders for the proposed project produce noise levels that are above the most sensitive hearing range of otters (0.125 to 32 kHz, Ghoul and Reichmuth 2012a, 2012b, 2014). Only animals within immediate proximity to the sound source (approximately 100 m; USFWS, 2014b) would be expected to exhibit a response. Additionally, sea otters spend a great deal of time at the surface feeding and grooming (Riedman, 1983, 1984; Wolt et al., 2012), therefore their potential exposure to noise from underwater anthropogenic sound sources is lower than that of many other marine mammal species. To date, the USFWS has not documented and is not aware of any evidence that serious injury, death, or stranding of sea otters can occur from exposure to airgun pulses, even in the case of large airgun arrays and no physical injury or fatality is anticipated from the proposed airgun pulses (79 *FR* 51584).

Any disturbance to sea otters from anthropogenic noise associated with the Proposed Action is expected to be at most temporary and localized. Mitigation measures for seismic surveys, especially nighttime seismic surveys, typically assume that many marine mammals tend to avoid approaching airguns, or the seismic vessel itself, before being exposed to levels high enough for there to be any possibility of injury. This assumes that the ramp-up (soft start) procedure is used when commencing airgun operations, to give sea otters near the vessel the opportunity to move away before they are exposed to sound levels that might be strong enough to elicit TTS.

Routine boat traffic noise from the Proposed Action will also generate airborne sound; but these sound sources are not expected to exceed 160 dB (Level B harassment) and will not affect sea otters (Richardson, 1995; USFWS, 2014b). Sea otter collisions with vessels associated with the Proposed Action are unlikely. Adherence to operating conditions will reduce the already unlikely probability of a vessel strike.

A small spill during offshore refueling could affect sea otters in the immediate area of the spill. BOEM's 2003 Environmental Impact Statement for Cook Inlet Lease Sales 191 and 199 (USDOI, MMS, 2003) provides a detailed account of the potential impacts of spills to sea otters. In brief, an otter that came in physical contact with spilled fuel oil via inhalation, ingestion, or skin contact could experience physical effects, including irritation and inflammation of the mucus membranes, respiratory impacts, compromised insulative properties of the animal's pelt, and organ damage (Geraci and St. Aubin, 1990). These impacts could lead to reduced fitness, additional injury or illness, or fatality. In particular, sea otters could suffer direct mortality from oiling through a reduced thermoinsulative capacity that would result in hypothermia.

It is unlikely that a sea otter would come in contact with any small spill during offshore refueling. Individuals would likely avoid the waters immediately surrounding any refueling or spill clean-up activities, and because any spills would be contained and cleaned up quickly. The effects of a <1-13 bbl spill would be localized and temporary and are not expected to impact otters.

The Proposed Action would not result in substantial damage to ocean and coastal habitats that might constitute sea otter habitat. The insertion and retrieval of nodes may cause temporary and localized increases in suspended sediment and turbidity on the seafloor; however, the turbidity created by placing and removing nodes on the seafloor would settle to background levels within minutes after the cessation of activity. The Proposed Action would not physically alter the marine environment or

negatively impact the physical environment in the seismic survey area. The Proposed Action would not impact physical habitat features, such as substrates.

The Proposed Action is unlikely to impact important sea otter prey species in Cook Inlet. While little research has been conducted on the effects of seismic operations on the invertebrate prey of sea otters (Riedman and Estes, 1990; Normandeau Associates, Inc., 2012) the available data suggest no obvious short- or long-term impacts (Budelmann, 1992; Christian, 2003; Nixon and Young, 2003; Pearson et al., 1994). A spill associated with the Proposed Action is unlikely to impact sea otter prey species because the spill would likely be restricted to the upper water column and would be contained before reaching the benthos. Any residual fuel oil would be likely to evaporate and dissipate within 24 hours or less. Vessel presence and associated clean-up activities could disturb and displace highly-mobile prey; however, any disturbance would be temporary and highly localized.

Due to the pre-existing levels of vessel traffic in Cook Inlet, resident marine mammals including beluga whales, northern sea otters, harbor seal, harbor porpoises, and some Steller sea lions are likely to be at least partially habituated to vessel presence and noise levels. The remaining marine mammal species are uncommon to rare and so are not very likely to be affected by vessel noises or traffic from the Proposed Action. Though seismic surveys are audible to all groups of marine mammals, the grouping most affected would be mysticetes whales such as gray whales, humpback whales, and minke whales which hear in the low-frequency bands. Mid- and high-frequency cetaceans such as Dall's porpoise, harbor porpoise, and killer whales, sea otters, and pinnipeds (harbor seals, and Steller sea lions) would only detect seismic noises in the very bottom of their audibility bandwidths and should not be greatly affected. The use of sonar devices should not appreciably affect the gray, humpback, or minke whales, but could affect the other marine mammal species; however, the noise field surrounding the sonar equipment would be directed down towards the sea floor and should not appreciably affect any marine mammals beyond the sonar noise field. Moderate effects could occur if individuals were lethally taken as a result of a vessel strike, an entanglement, or contact with a small spill; however, these events are unlikely to occur during the Proposed Action. Furthermore, USFWS has determined that no lethal take of sea otters is anticipated during the Proposed Action (79 *FR* 51584). This finding likely holds true for other marine mammal species with similar abundance and distribution in the vicinity of the survey area. With the mitigations described in Section 2.1.2.6, and any further mitigations required by NMFS and the USFWS in their IHAs, the effects of the Proposed Action on marine mammals are expected to be negligible to minor.

#### 4.1.6.3. Cumulative Effects

##### Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on marine mammals to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

##### Alternative 2 – Proposed Action

The level of effects for the Proposed Action with respect to individual species would remain negligible to minor. Past projects include marine seismic surveys, exploration and production drilling, commercial fishing, recreation, shipping, and scientific activities. While seismic activities have potential to affect all of the marine mammal species found in Cook Inlet, the impacts of the effects of the Proposed Activity are likely to vary from negligible to minor with the affected species, as previously described. Consequently, the Proposed Action would not appreciably add to the existing and potential effects on marine mammals in Cook Inlet.

### 4.1.7. Archaeological Resources

The State of Alaska Historic Preservation Officer (SHPO) has not considered setting 3D survey nodes on the seabed as being a type of action that has the potential to affect historic properties under 36

CFR 800. This Proposed Action will have the benefit of delineating the seabed of the Proposed Action area, and has the potential for identifying aircraft, shipwrecks, and buried archaeological sites or resources in the Proposed Action area. At the conclusion of the Proposed Action, SAE will provide BOEM with the coordinates, in digital format, of any near surface seismic data that may constitute an archaeological resource.

#### 4.1.7.1. Direct and Indirect Effects

##### Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to archaeological resources.

##### Alternative 2 – Proposed Action

The Proposed Action is considered by SHPO to have no effect on historic properties under 36 CFR 800.

#### 4.1.7.2. Cumulative Effects

##### Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on archaeological resources to those produced by ongoing or reasonable foreseeable activities in the Proposed Action area.

##### Alternative 2 – Proposed Action

In the absence of no direct and indirect effects, no cumulative effects would occur as a result of the Proposed Action.

### 4.1.8. Subsistence Harvest and Sociocultural Systems

#### 4.1.8.1. Direct and Indirect Effects

##### Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to subsistence harvest and sociocultural systems.

##### Alternative 2 – Proposed Action

Effects to subsistence harvest activities and sociocultural systems from the Proposed Action can result from (1) temporal/space-use conflicts which result when presence or movement of seismic survey vessels preclude or interfere with water-borne subsistence harvest activities in an area (2) displacement of subsistence harvest resources because of noise from seismic survey activities which make the resource unavailable for harvest (3) alteration of habitat by seismic survey activity which results in an area being unusable for subsistence harvest and (4) accidental discharge of fuel or other substances into the water which causes subsistence resources to become either unavailable for harvest or undesirable for use.

***Space Use Conflicts***

Space use conflicts can potentially occur because the vessels used in the seismic survey will be operating during the time (late Spring, Summer, and Fall) and in an area (nearshore to six miles offshore between the Kenai River and Anchor Point) in which waterborne subsistence harvest activities take place. However, the nature of the survey–that is, the sequential placement of a survey patch receiver and source lines, shooting the seismic survey, retrieval and repositioning of receiver and source lines to adjacent areas over a period of three to five days, with source activities occurring for two to three hours at each slack tide, means that only a small area of the project area would be

occupied for a short period of time. No area would be made inaccessible for a substantial period of the entire harvest season. Furthermore, as described in the Plan of Operations, information provided by SAE on the time and location of operations would be posted at local gathering centers near the area of work, and the proposed Plan of Cooperation should further reduce the potential for space use conflicts. Displacement of subsistence-harvest activities from vessel and survey operations is expected not to occur or occur incidentally. Effects from space-use conflicts and related sociocultural practices are negligible.

#### *Displacement of Subsistence Resources*

Displacement of subsistence resources from an area could occur because of noise from seismic survey activities. For fish resources, displacement from seismic activities is not estimated to be measurable. Displacement of marine mammals along vessel transit routes is estimated to be very short (less than an hour) and very local (less than one mile). Displacement of marine mammals from seismic activities could occur, but the effect would be temporary; it is estimated that displaced animals would return to normal behavior and distribution after operations are complete. Furthermore, as described in the Plan of Operations, mitigation measures are in place such as seismic source ramp up, speed and course alternation, power down and shutdown, and use of PSOs to minimize the disturbance and therefore reduce the possibility that the resource would not be available for harvest. Effects to subsistence resource availability and related sociocultural practices would be negligible.

#### *Habitat Alteration*

Habitat alteration could occur from the placement of survey patch receiver and source lines. However, as discussed in the Fish and Marine Mammals sections, this alteration is expected to be negligible. Therefore, effects to subsistence harvest activities and related sociocultural practices from habitat alteration are expected to be to be negligible as well.

#### *Accidental Discharges*

Effects to subsistence resources could occur from an accidental discharges of fuel (<1-13 bbl) from vessels engaged in the survey if the discharge contaminated subsistence resources making them unavailable for harvest or undesirable for consumption or use. The effects would occur for the duration of dispersal and cleanup, anticipated to be temporary (2 to 4 days) and local. While tainting of the resources could occur, harvest locations would likely shift away from the area of contamination. Therefore, effects to subsistence harvest activities and related sociocultural practices from accidental discharges are expected to be negligible to minor.

Effects from space use conflicts, subsistence harvest resource displacement, habitat alteration, and accidental discharges are negligible. Taken together (synergistic effects), the combination of these impact producing factors remains negligible. Therefore, the Proposed Action would have a negligible effect on subsistence harvest resources and the related sociocultural practices.

### 4.1.8.2. Cumulative Effects

#### Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on subsistence harvest and sociocultural resources to those produced by ongoing or reasonable foreseeable activities in the Proposed Action area.

#### Alternative 2 – Proposed Action

The Cook Inlet region is a major population center in the State of Alaska and supports a wide range of activities. The proposed seismic survey would add another, albeit temporary and limited to a small area, industrial activity to lower Cook Inlet. Under the Proposed Action, no objects or materials would be permanently released into the water column.

Fishing is a major industry in Alaska. As long as fish stocks are sustainable, subsistence, personal use, recreational, and commercial fishing will continue to take place in Cook Inlet. As a result of fisheries interactions, competition for fish resources between users may continue, there will be continued prey competition, risk of space use conflicts, potential harassment of marine mammals, potential for entanglement of marine mammals in fishing gear, and potential displacement of subsistence resources from the Proposed Action area. The USFWS, NMFS, and the Alaska Department of Fish and Game will continue to manage marine mammals stocks, fish stocks and monitor and regulate fishing in Cook Inlet.

Most of the existing gas and oil development occurs adjacent to the Proposed Action area, and it is likely that future gas and oil development will continue to take place in and adjacent to the Proposed Action area. Apache, for example, may be conducting a multiple-year seismic survey program in Cook Inlet. NMFS has received IHA applications from Apache requesting takes of marine mammals incidental to seismic surveys (79 *FR* 45428, August 5, 2014). Impacts from oil and gas development include increased noise from seismic activity and support vessel traffic out of Nikiski. When conducted under an IHA issued by NMFS or the USFWS, the effects to subsistence harvest are minimal because the IHA is based on a finding by the issuing agency that the activity will have no unmitigable adverse effects to subsistence.

The potential impact from the Proposed Action to subsistence harvest activities and related sociocultural practices as a result of space use conflicts, resource displacement, habitat alteration, and accidental discharges is negligible. Based on the activity in and adjacent to the project area for the period of the Proposed Action, the incremental impact of the Proposed Action also would be negligible and would not result in a cumulatively significant impact to the human environment from past, present, and reasonably foreseeable future actions.

## 4.1.9. Economy

### 4.1.9.1. Direct and Indirect Effects

#### Alternative 1—No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects on the Kenai Peninsula Borough (KPB) economy.

#### Alternative 2—Proposed Action

The Proposed Action would have negligible effects on the KPB economy, including employment, income, revenues, population, infrastructure, commercial fishing, shipping, or oil and gas activities in the area. While there may be some employment opportunities and revenues from lodging and sales taxes, 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. This alternative would have a negligible effect on the KPB economy.

### 4.1.9.2. Cumulative Effects

#### Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on the KPB economy to those produced by ongoing or reasonable foreseeable activities in the Proposed Action area.

#### Alternative 2 – Proposed Action

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, and are therefore expected to have a negligible cumulative effect on the KPB economy when added to past, present and reasonably foreseeable future actions.

## 4.1.10. Public Health

### 4.1.10.1. Direct and Indirect Effects

#### Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects on public health.

#### Alternative 2 – Proposed Action

Air emissions from vessels associated with the Proposed Action are not expected to reach a single onshore location nor allow accumulation of emissions sufficient for the concentration of the pollutants to exceed the Federal air standards. As a result, the quality of air on land areas adjacent to the lower Cook Inlet will remain better than required by Federal health-based standards. Air quality effects would be negligible. Vessel discharges and accidental spills could degrade ocean water quality due to introduction of contaminants, but these would quickly disperse and result in a negligible impact to water quality. Effects to subsistence harvest activities and sociocultural systems from the Proposed Action could result from (1) temporal/space-use conflicts (2) displacement of subsistence harvest resources because of noise from seismic survey activities (3) alteration of habitat by seismic survey activity which results in an area being unusable for subsistence harvest and (4) accidental discharge of fuel or other substances into the water which causes the subsistence resources to become either unavailable for harvest or undesirable for use. Taken together, the combination of these impact producing factors is also negligible. Therefore, the Proposed Action would have a negligible effect on public health.

### 4.1.10.2. Cumulative Effects

#### Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on public health to those produced by ongoing or reasonable foreseeable activities in the Proposed Action area.

#### Alternative 2 – Proposed Action

The Cook Inlet region is a major population center in the State of Alaska and supports a wide range of activities. The proposed seismic survey would add another, albeit temporary and limited to a small area, industrial activity to lower Cook Inlet. Under the Proposed Action, no objects or materials would be permanently released into the water column. The components contributing to the maintenance of public health that could be affected by the Proposed Action–air quality, water quality, and subsistence harvest and sociocultural practices–are not expected to change substantially over the life of the project. Based on the activity in and adjacent to the project area for the period of the Proposed Action, the incremental impact the Proposed Action also would be negligible and would not result in a cumulatively significant impact to the human environment from past, present, and reasonably foreseeable future actions.

## 4.1.11. Environmental Justice

Effects to subsistence activities from the Proposed Action are negligible. SAE's plan of operation has identified mitigation measures to reduce potential impacts on subsistence activities. There may be slight incidental disruption to subsistence based hunting, but no long-term impacts to the health and well-being of area residents will result. Subsistence harvest will continue sufficient to maintain food security and consumption. Water quality effects and air quality effects related to public health will be negligible. Therefore, the Proposed Action will not result in highly disproportionate effects to Alaska Native residents of the Proposed Action Area.

# 5.0 CONSULTATION

## 5.1. Endangered Species Act Consultation

Section 7(a)(2) of the ESA requires each Federal agency 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 consults with USFWS and NMFS for listed species under each Service's jurisdiction. ESA Section 7 consultation with each agency is currently in progress and will be completed before SAE begins its surveys in Cook Inlet.

## 5.2. Essential Fish Habitat Consultation

The Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801-1884) mandated the identification of Essential Fish habitat (EFH) for managed species and requires that Federal agencies consult with NMFS on actions that may adversely affect EFH. EFH consultation with NMFS is currently in progress and will be completed before SAE begins its surveys in Cook Inlet.

## 5.3. Archaeological Resources

BOEM consulted with SHPO regarding effects that might result from the Proposed Action. BOEM made a finding that the use of nodes on the seabed, in conjunction with the use of pingers to avoid any geohazards, is the type of activity that has no potential to cause effects to historic properties as per 36 CFR 800.3(a)(1). The SHPO provided concurrence on January 21, 2015.

## 5.4. Public Involvement

Public participation regarding SAE's Proposed Action has been provided through a combination of public notifications: 1) BOEM's receipt of the application and 2) a public notice that BOEM was preparing an EA and requested that the public provide input for that document. Comments were accepted at http://www.regulations.gov through midnight December 12, 2014. One comment was received. The request and the sole comment are available for review at: http://www.regulations.gov/#!docketDetail;D=BOEM-2014-0099.

## 5.5. Reviewers and Preparers

The persons responsible for the review of the SAE permit application and supporting information and analysis, and preparation of this EA are listed below:

| Name | Title | Contribution |
|---|---|---|
| Gene Augustine | Biologist | Water Quality |
| Scott Blackburn | Supervisory Environmental Protection Specialist | Project Manager |
| Jerry Brian | Socioeconomic Specialist | Economics/Commercial Fishing |
| Chris Campbell | Sociocultural Specialist | Archaeological Resources and State Historic Preservation Office Consultation, Sociocultural Resources |
| Christopher Crews | Wildlife Biologist | Terrestrial and Marine Mammals |
| Dan Holiday | Wildlife Biologist | Lower Trophic Levels, Cumulative Effects |
| James Lima | Sr. Minerals Leasing Specialist | Sociocultural Resources, Subsistence, Public Health, Environmental Justice |
| Caron McKee | Technical Writer / Editor | Technical Writer / Editor |
| Sharon Randall | Environmental Coordinator | NEPA Coordinator |

| Name | Title | Contribution |
|---|---|---|
| Virginia Raps | Meteorologist | Air Quality, Climate Change |
| Rick Raymond | Wildlife Biologist | Fish |
| Jill-Marie Seymour | Wildlife Biologist | Marine and Coastal Birds, Sea Otters |
| Pete Sloan | Geologist | Geological and Geophysical Permit Review |
| Caryn Smith | Oceanographer | Oil / Fuel Spills, Sea Ice and Sea State |

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# APPENDIX A

## LEVELS OF EFFECTS DEFINITIONS

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# A-1. Levels of Effects Definitions

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) and 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).

Use the best available information and your 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 are determined based on changes on the stock or population, rather than the individual level.

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), 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 available in greatly reduced numbers for a substantial portion of a subsistence season for any community.

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# APPENDIX B

## CUMULATIVE EFFECTS SCENARIO

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# CUMULATIVE EFFECTS SCENARIO

## B-1. PAST, PRESENT AND REASONABLY FORESEEABLE FUTURE ACTIONS

The Council on Environmental Quality (CEQ) Regulations defines cumulative effects at 40 CFR 1508.7:

> *Cumulative impact* is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR 1508.7)

This appendix provides a description of past, present and reasonably foreseeable future actions in Cook Inlet, which may contribute to cumulative impacts of oil and gas activities in the area of the SAE seismic survey.

## B-2. IMPACT SOURCES

The main sources of impacts which could have a cumulative impact with the Proposed Action on the resources in Cook Inlet are: (1) subsistence and other community activities, (2) fishing, (3) oil and gas related activities, 4) coastal zone development, and (5) climate change.

The Cook Inlet region is a major population center in the State of Alaska and supports a wide range of activities. The proposed seismic survey would add another, albeit temporary, industrial activity to upper Cook Inlet. This activity would be limited to a small area of the lower Cook Inlet for a relatively short period of time, and there would be no objects or materials permanently released into the water column. This section provides a brief summary of the relevant past, present and reasonably foreseeable future actions.

## B-3. SUBSISTENCE ACTIVITIES AND OTHER COMMUNITY ACTIVITIES

Subsistence hunting and other community activities associated with regional Native villages of Kenai (Kenaitze), Salamatof, and Ninilchik have persisted for millennia, and are expected to continue during the period of the Proposed Action. Marine traffic associated with subsistence hunting consists of small craft used during fishing and hunting. Vessel traffic associated with other community activities consists primarily of supply barges traveling close to shore and ferry service.

## B-4. FISHING

Fishing is a major industry in Alaska. As long as fish stocks are sustainable, subsistence, personal use, recreational, and commercial fishing will continue to take place in Cook Inlet. As a

result there will be continued prey competition, risk of ship strikes, potential harassment, and potential for entanglement in fishing gear. NMFS, USFWS, and the ADF&G will continue to manage fish stocks and monitor and regulate fishing in Cook Inlet to maintain sustainable stocks.

# B-5. OIL AND GAS RELATED ACTIVITIES

Past oil and gas related activities in Cook Inlet include exploration wells, exploration seismic surveys, shallow geologic hazards surveys, geotechnical sampling programs, baseline biological studies and surveys, biological, chemical and physical oceanography monitoring programs, and other environmental studies and sampling programs including ongoing work funded by industry for the purpose of understanding the environment within and outside the project areas.

Currently, there are several gas and oil development projects in State waters in the Proposed Action area, and it is likely that future gas and oil development will continue to take place in the Proposed Action area. APACHE will be conducting seismic surveys in Cook Inlet for the next three to five years. NMFS will likely continue to receive and issue IHA authorizations for SAE, APACHE, and other oil and gas companies requesting takes of sea otters incidental to seismic surveys and drilling operations, including requests to conduct seismic surveys similar to that proposed by SAE. These operations potentially will have limited spatial and temporal overlap. Impacts from oil and gas exploration or development include increased noise from seismic activity, vessel and air traffic and well drilling; discharge of wastewater; disturbance of benthic habitat and similar habitat loss from the construction of oil and gas facilities; and contaminated food sources and/or injury from a natural gas leak or oil spill. The frequency of these impacts may increase as oil and gas development increases; however, new development will undergo consultation and follow permitting requirements prior to exploration and development.

# B-6. COASTAL ZONE DEVELOPMENT

Coastal zone development may result in the loss of habitat, increased vessel traffic, increased pollutants, and increased noise associated with construction and post-construction activities. The Port of Anchorage (POA) is currently expanding their facilities and Port MacKenzie is scheduled to expand their facilities. Both port facilities may have an effect on Cook Inlet marine animal populations in the action area due to increased vessel traffic passing through the area on their way to both facilities.

## 6.1. Port of Anchorage and Port MacKenzie Expansions

The POA and Port MacKenzie in upper Cook Inlet are each scheduled to further expand their facilities. These ports will contribute to increased vessel traffic throughout Cook Inlet. The POA is expanding its facilities to accommodate increased growth in Alaska and to support military services at Joint Base Elmendorf-Richardson. In the next five years a fuel tank farm, a Rail Extension, and a deep draft dock are scheduled for construction at Port MacKenzie. The Rail Extension would connect Port MacKenzie to the Alaska Railroad Corporation's existing mainline between Wasilla and Willow, providing freight service between Port MacKenzie and Interior Alaska. Port MacKenzie will be exporting coal from Healy, Alaska with the construction of the Rail Extension. The Rail Extension should be completed in 2017. Additionally, Port MacKenzie is currently preparing permits to construct a deep draft dock. As a result, the number of ships calling to port at Port MacKenzie is expected to increase over the next five years.

Increased vessel traffic may result in increased sediment disturbance, water noise, and potential ship strikes with marine animals.

As the population in urban areas continue to grow, an increase in amount of pollutants that enter Cook Inlet is likely to occur. Sources of pollutants in urban areas include runoff from streets and discharge from wastewater treatment facilities. Gas, oil, and coastal zone development projects (e.g., the Chuitna Coal Mine) also contribute to pollutants that enter Cook Inlet through discharge. Gas, oil, and coastal zone development will continue to take place in Cook Inlet; therefore, it would be expected that pollutants could increase in Cook Inlet. However, the EPA and the ADEC will continue to regulate the amount of pollutants that enter Cook Inlet from point and non-point sources through NPDES permits. As a result, permittees will be required to renew their permits, verify they meet permit standards and potentially upgrade facilities.

## B-7. CLIMATE CHANGE

The 2007 Intergovernmental Panel on Climate Change concluded that there is very strong evidence for global warming and associated weather changes and that humans have “very likely” contributed to the problem through burning fossil fuels and adding other “greenhouse gases” to the atmosphere (IPCC, 2007). This study involved numerous models to predict changes in temperature, sea level, ice pack dynamics, and other parameters under a variety of future conditions, including different scenarios for how human populations respond to the implications of the study.

Evidence of climate change in the past few decades, commonly referred to as global warming, has accumulated from a variety of geophysical, biological, oceanographic, and atmospheric sources. The scientific evidence indicates that average air, land, and sea temperatures are increasing at an accelerating rate. Although climate changes have been documented over large areas of the world, the changes are not uniform and affect different areas in different ways and intensities. Arctic regions have experienced some of the largest changes, with major implications for the marine environment as well as for coastal communities.

Marine mammals are classified as sentinel species because they are good indicators of environmental change. Arctic marine mammals are ideal indicator species for climate change, due to their circumpolar distribution and close association with ice formation. BOEM recognizes that warming of the Arctic, which results in the diminishing of ice, could be a cause for concern to marine mammals. In Cook Inlet, marine mammal distribution is also dependent upon ice formation and prey availability, although a loss of sea ice might benefit some species, such as sea otters, given sea ice limits otter distribution wherever it prevents otters from foraging.

It is not clear how governments and individuals will respond or how much of these future efforts will reduce greenhouse gas emissions. Although the intensity of climate changes will depend on how quickly and deeply humanity responds, the models predict that the climate changes observed in the past 30 years will continue at the same or increasing rates for at least 20 years. Although USFWS recognizes that climate change is a concern for the sustainability of the entire ecosystem in Cook Inlet, it is unclear at this time the full extent to which climate change will affect marine animal populations.

## B-8. CONCLUSION

Based on the summation of activity in the area provided in this section, BOEM believes that the incremental impact of the proposed SAE seismic operations in Cook Inlet would not be expected to result in a cumulative significant impact to the human environment from past, present, and future activities. The potential impacts to marine animal populations, their habitats, and the human environment in general are expected to be minimal based on the limited and temporary noise footprint and mitigation and monitoring requirements of this EA.

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally-owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.

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