REQUEST

FOR

LETTER OF AUTHORIZATION

HILCORP ALASKA AND HARVEST ALASKA

OIL AND GAS ACTIVITIES

COOK INLET, ALASKA

YEAR 1: JULY 1, 2019-JULY 1, 2020

Prepared for

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ACRONYMS AND ABBREVIATIONS

3D	three-dimensional
4MP	Marine Mammal Monitoring and Mitigation Program
ADF&G	Alaska Department of Fish and Game
AFSC	Alaska Fisheries Science Center
AGL	above ground level
AOGCC	Alaska Oil and Gas Conservation Commission
Apache	Apache Alaska Corporation
APDES	Alaska Pollutant Elimination Discharge System
BIA	Biologically Important Areas
bbl	billions barrel of oil
BMP	Best Management Practices
BOEM	Bureau of Ocean Energy Management
BOP	Blowout preventer
BPL	Beluga Pipeline
CetMap	Cetacean Density and Distribution Mapping Working Group
CFR	Code of Federal Regulations
CIGGS	Cook Inlet Gas Gathering System
CISPRI	Cook Inlet Spill, Prevention, and Response, Incorporated
cm	centimeter
cui	cubic inches
dB re 1 µPa	decibels referenced to one microPascal
DNR	Department of Natural Resources
DOG	Division of Oil and Gas
DP	Dynamic Positioning
DPS	Distinct Population Segment
DSV	Dive Support Vessel
EEZ	Exclusive Economic Zone
EIS	Environmental Impact Statement
ENP	Eastern North Pacific
ESA	Endangered Species Act
EZ	Exclusion Zone
FEIS	Final Environmental Impact Statement
FR	Federal Register
ft	feet
GPTF	Granite Point Take Farm
Harvest Alaska	Harvest Alaska, LLC
Hilcorp Alaska	Hilcorp Alaska, LLC
HP	horsepower
hrs	hours
Hz	Hertz
IHA	Incidental Harassment Authorization
in	inches
ITR	Incidental Take Regulations

ITS	Incidental Take Statement
kg	kilograms
kHz	kiloHertz
km	kilometers
KPL	Kenai Pipeline
lbs	pounds
LCI	Lower Cook Inlet
LOA	Letter of Authorization
LOC	Letter of Concurrence
L_{pk}	peak level
m	meter
MHHW	mean higher high water
mg	milligram
mi	miles
mL	milliliter
MMPA	Marine Mammal Protection Act
MPI	magnetic particle inspection
ms	milliseconds
MSD	marine sanitation device
NEPA	National Environmental Policy Act
nm	nautical miles
NMFS	National Marine Fisheries Service
NMML	National Marine Mammal Laboratory
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
OSK	Offshore Systems Kenai
OSP	Optimum Sustainable Population
POA	Port of Anchorage
psi	pounds per square inch
PTS	permanent threshold shift
PSO	Protected Species Observer
RA	rope access
rms	root mean square
s	seconds
SCA	secondary containment system
SEL	sound exposure level
SEP	Stakeholder Engagement Plan
SPL	sound pressure level
SSV	sound source verification
SZ	Safety Zone
TBPF	Trading Bay Production Facility
TS	threshold shift
TTS	temporary threshold shift
UAS	unmanned aerial system

USACE	United States Army Corps of Engineers
USC	United States Code
USCG	United States Coast Guard
USDOT	United States Department of Transportation
USFWS	United States Fish and Wildlife Service
UT	ultrasonic testing
VHF	very high frequency
WDPS	western distinct population segment
WFA	weighting factor adjustment

1.0 DESCRIPTION OF ACTIVITIES

A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals.

1.1 NATURE OF REQUEST

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

Founded in 1989, Hilcorp Alaska is one of the largest privately-held oil and natural gas exploration and production companies in the United States. Hilcorp Alaska has been operating in Alaska since 2011 owning interests and operating in over 29 oil and gas field production facilities located in both Cook Inlet (Figure 1) and the North Slope. In addition, Hilcorp Alaska provides operational support to Harvest Alaska for Harvest Alaska's consolidated gas and oil pipeline systems in the Cook Inlet region. Harvest Alaska was formed in 2014 as a wholly-owned subsidiary of Hilcorp Alaska. Throughout its subsidiaries (Cook Inlet Pipeline Company, Kenai Beluga Pipeline, LLC, and Swanson River Oil Pipeline, LLC) and in its own right, Harvest Alaska owns and operates over four major pipeline systems in Cook Inlet, as well as the Drift River Terminal and the Christy Lee loading platform.

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

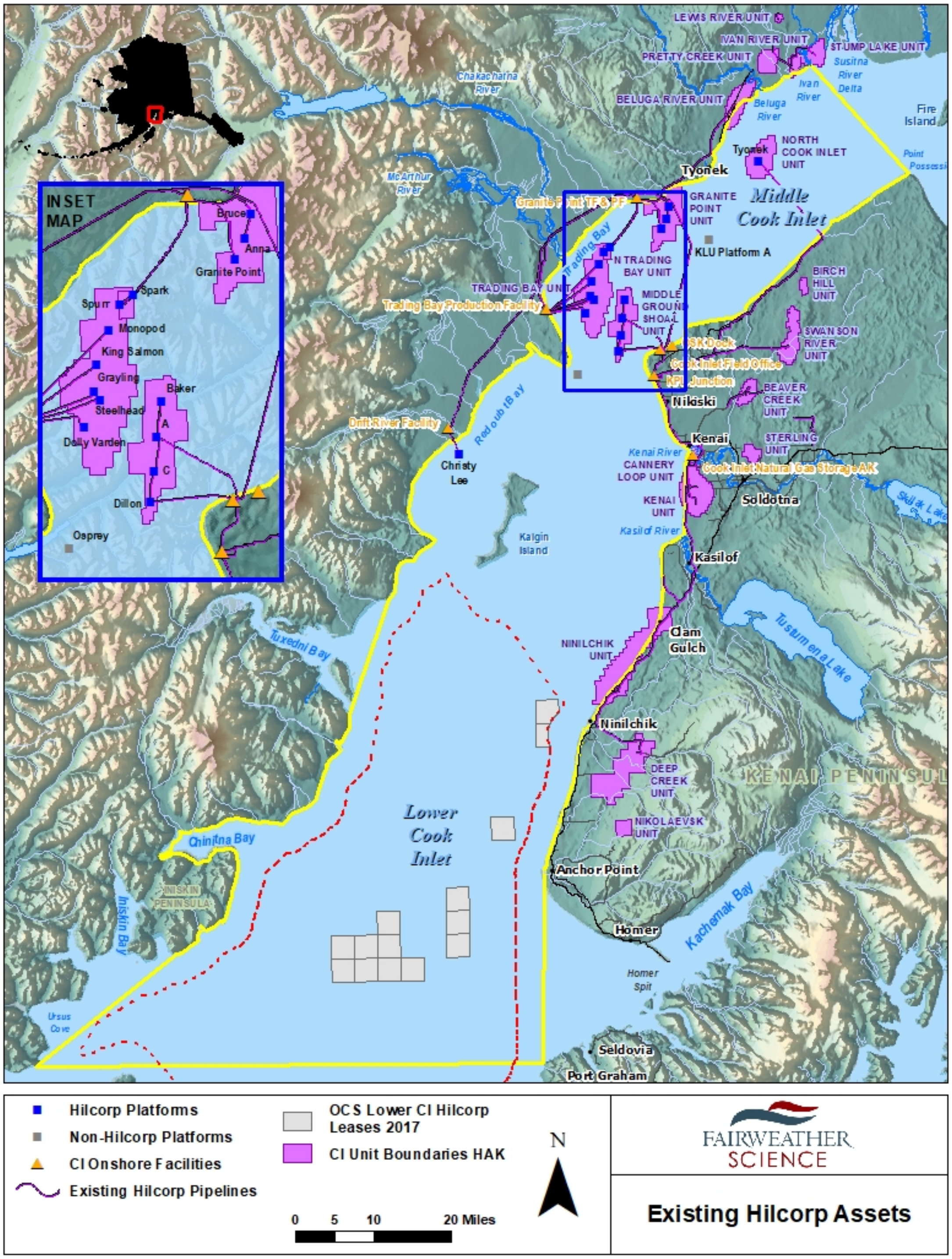

Figure 1. Map showing existing Hilcorp Alaska assets in Cook Inlet.

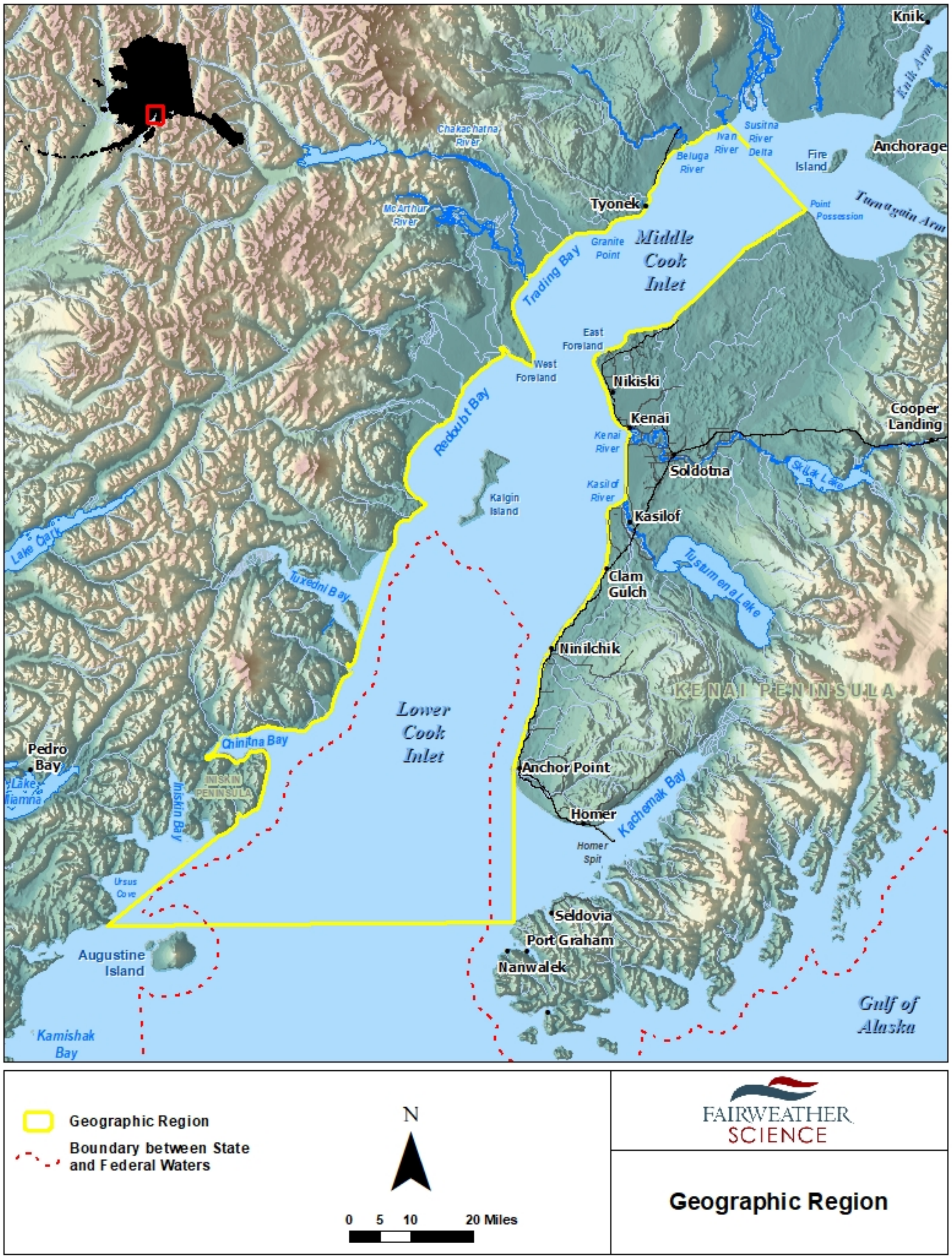

Figure 2. Geographic region of ITR.

1.2 DESCRIPTION OF ACTIVITIES

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

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

Project Name	Cook Inlet Region	Seasonal Timing	Anticipated Duration	Anticipated Noise Sources
OCS 3D seismic survey	Lower Cook Inlet OCS	September-October 2019 or April-May 2020	45-60 days	1 source vessel with airguns, 1 mitigation vessel, 1 support vessel, 1 chase vessel
OCS geohazard survey	Lower Cook Inlet OCS	April-May 2020	30 days	1 vessel with echosounders and/or sub-bottom profilers
Platform & pipeline maintenance	Middle Cook Inlet	July 2019-July 2020	180 days	Vessels, water jets, hydraulic grinders, pingers, helicopters, and/or sub-bottom profilers
Granite Point Platform Development Drilling	Middle Cook Inlet	July-November 2019	120-150 days	1 jack-up rig, tugs towing rig, support vessel, helicopters

1.3 ACTIVITIES WITHIN LOWER COOK INLET

The lower Cook Inlet region is comprised of both Bureau of Ocean Energy Management (BOEM) OCS and State of Alaska Department of Natural Resources (DNR) Division of Oil and Gas (DOG) leases. Over the last 40 years, there have been OCS lease sales in the Cook Inlet Planning Area, but there were no active leases until 2017 when BOEM held Lease Sale 244 in June 2017, offering 224 OCS blocks for sale. A Final EIS (FEIS) was prepared by BOEM (BOEM 2016). Hilcorp acquired 14 lease blocks in Lease Sale 244 and intends to start exploration activities on their leases. Under the BOEM OCS 2017-2022 Leasing Plan, another Cook Inlet lease sale is anticipated in 2021 (BOEM 2018). Hilcorp Alaska may acquire more leases in this region in this lease sale.

The State of Alaska DNR DOG holds annual lease sales under AS 38.05.035(e) and AS 38.05.180. Under these statutes, land that is subject to a best interest finding issued within the previous 10 years may be offered for oil and gas leasing. The current areawide leasing best interest finding is for 2018-2028 (DNR 2018). Hilcorp Alaska holds State leases throughout the Cook Inlet. Hilcorp Alaska may acquire more leases in this region in future State lease sales.

The following text outlines the type of activities and anticipated dates and duration in the lower Cook Inlet region (Figure 3).

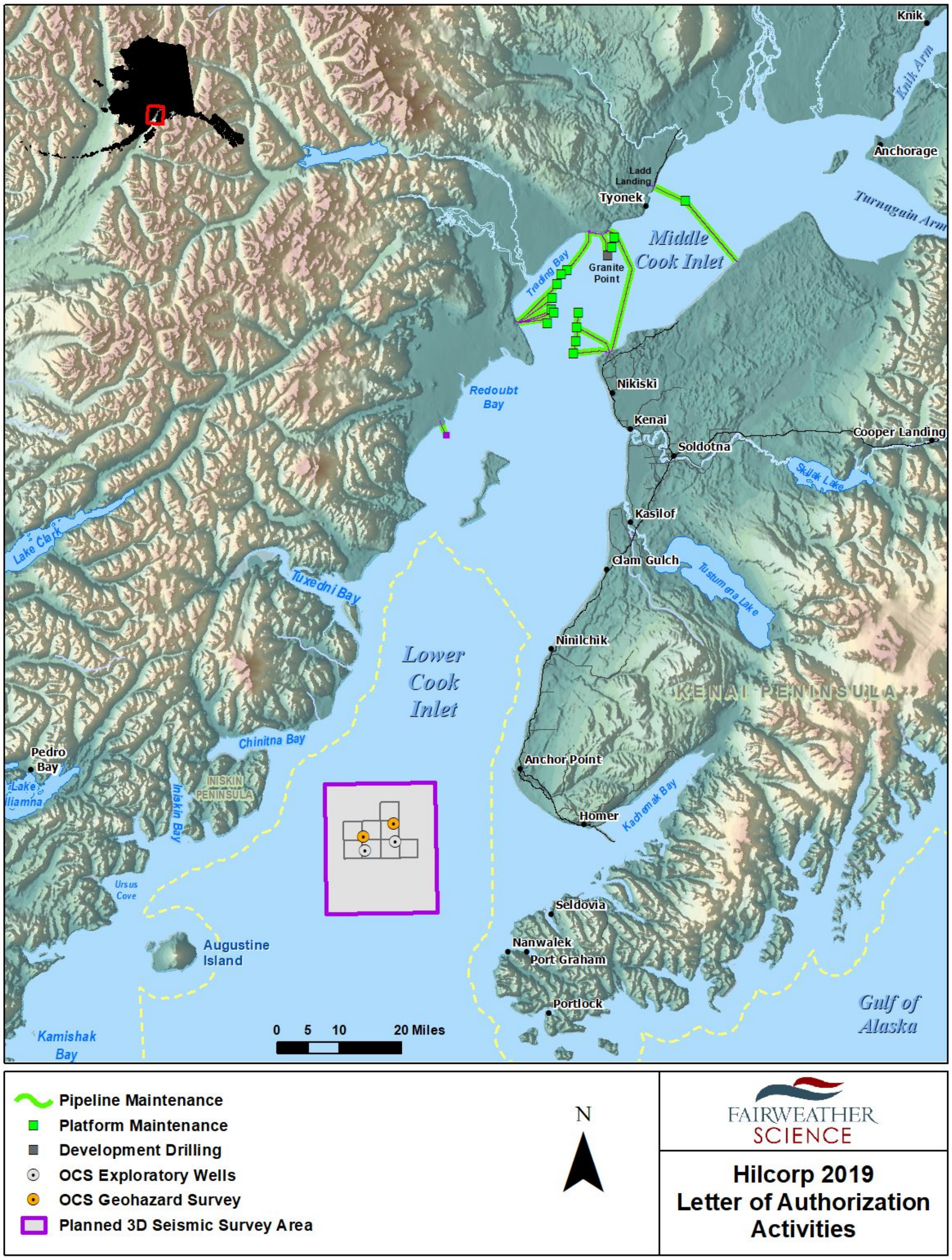

Figure 3. Map showing planned activities in Cook Inlet for Year 1 LOA.

1.3.1 3D Seismic Survey

Hilcorp Alaska plans to collect three-dimensional (3D) seismic data over 8 of the 14 OCS lease blocks in lower Cook Inlet (Figure 3). The 3D seismic survey is comprised of an area of approximately 790 km^2 (305 mi^2) through 8 blocks (6357, 6405, 6406, 6407, 6455, 6456, 6457, 6458). The survey program target start date is September 1, 2019 but the actual start date will depend on arrival of the seismic source vessel. The survey is planned to last for approximately 45-60 days. The length of the survey will depend on weather, equipment, and marine mammal delays. If there are delays to this fall program, it will be rescheduled for the spring (April-May) 2020.

1.3.1.1 3D Seismic Survey Design

Polarcus is the seismic contractor and the general seismic survey design is provided below. The 3D seismic data will be acquired using a specially designed marine seismic vessel towing 8-12 x ~2,400-meters (m; 1.5 mi) recording cables (i.e., streamers) with a dual air gun array. The survey will involve one source vessel, one support vessel, one chase vessel, and one mitigation vessel. The anticipated seismic source to be deployed from the source vessel is a 14-airgun array with a total volume of 1,945 cui. Crew changes are expected to occur every four to six weeks using a helicopter or support vessel from shore bases in lower Cook Inlet.

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

The data will be shot parallel to the Cook Inlet shorelines in a north/south direction. This operational direction will keep recording equipment/streamers in line with Cook Inlet currents and tides and keep the equipment away from shallow waters on the east and west sides. The program may be modified if the survey cannot be conducted as a result of noise conditions onsite (i.e., ambient noise). The airguns are typically turned off during the turns. The vessel will turn into the tides to ensure the recording cables/streamers remain in line behind the vessel. A diagram showing the relative positions of the source and streamer cables is provided in Figure 4.

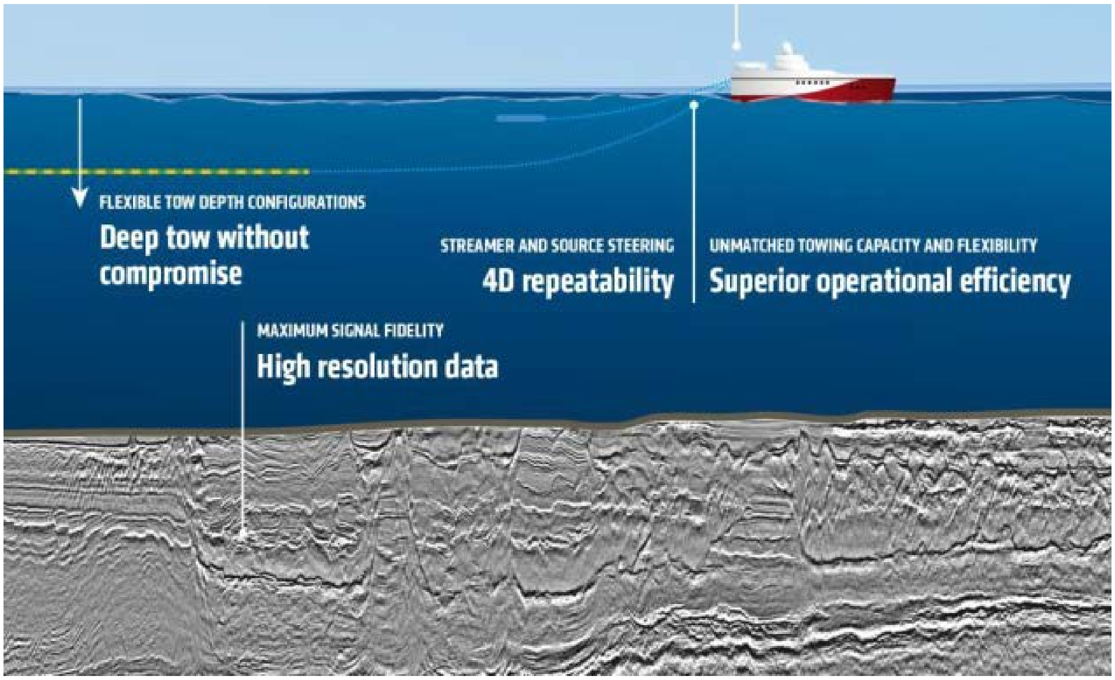

Figure 4. Diagram of typical seismic vessel with streamers and source.

1.3.1.2 Airguns

Hilcorp Alaska plans to use an array that provides for the lowest possible sound source to collect the target data. The proposed array is a Bolt 1900 LLXT dual gun array. The airguns will be configured as two linear arrays or "strings;" each string will have 7 airguns shooting in a "flip-flop" configuration for a total of 14 airguns. The airguns will range in volume from 45 to 290 cui for a total of 1,945 cui, as shown in the configuration provided in Figure 5. The first and last are spaced approximately 14 m (45.9 feet [ft]) apart and the strings are separated by approximately 10 m (32.8 ft). The two airgun strings will be distributed across an approximate area of 30 x 14 m (98.4 x 45.9 ft) behind the source vessel and will be towed 300-400 m (984-1,312 ft) behind the vessel at a depth of approximately 5 m (16.4 ft). The firing pressure of the array is 2,000 pounds per square inch (psi). The airgun will fire every 4.5 to 6 seconds (s), depending on the exact speed of the vessel. When fired, a brief (25 milliseconds [ms] to 140 ms) pulse of sound is emitted by all airguns nearly simultaneously.

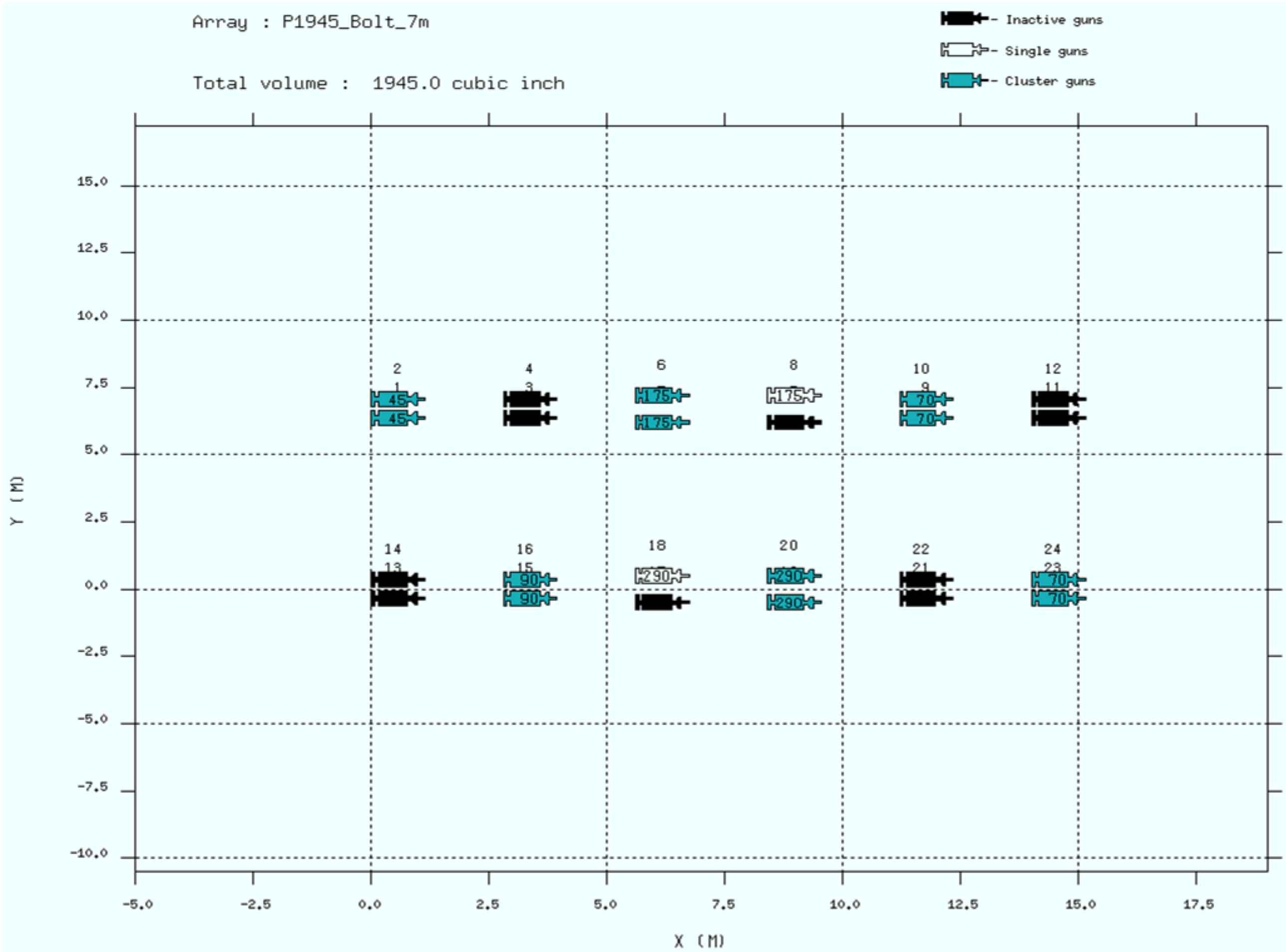

Figure 5. Layout of a 1,945 cui airgun array. Symbol sizes and labels indicate the volumes of the airguns in cubic inches. Tow direction is to the left.

1.3.1.3 Streamers

Hilcorp Alaska intends to use 8-10 Sercel-type solid streamers or functionally similar for recording the seismic data (Figure 4). Each streamer will be approximately 2,400 m (1.5 mi) in length and will be towed approximately 8-15 m (26.2-49.2 ft below the surface of the water. The streamers will be placed approximately 50 m (165 ft) apart to provide a total streamer spread of 350-550 m (1,148-1,804 ft). Solid streamers are now recognized as best in class for marine data acquisition because of unmatched reliability, signal to noise ratio, low frequency content, and noise immunity.

1.3.1.4 Vessels

The survey will involve one source vessel, one support vessel, one chase vessel, and one mitigation vessel. The source vessel tows the airgun array and the streamers. The support vessel provides general support for the source vessel, including supplies, crew changes, etc. The chase vessel(s) monitors the in-water equipment and maintains a security perimeter around the streamers. The mitigation vessel provides a viewing platform to augment the marine mammal monitoring program. Details of anticipated vessels are provided in Table 2. Figure 6 and Figure 7 show a picture of a typical, modern source vessel.

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

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

Figure 6. Photos of typical marine source / streamer vessel (left) and support vessel (right).

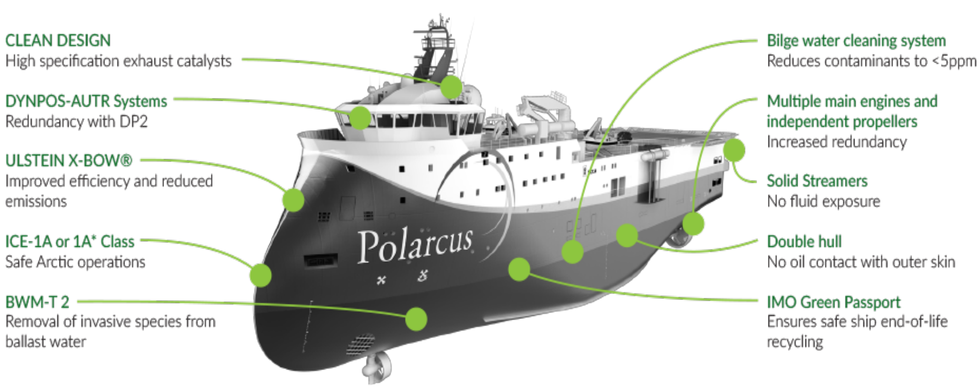

Figure 7. Polarcus source vessel environmental capabilities.

1.3.2 Geohazard and Geotechnical Surveys

After completing a 3D seismic survey and prior to conducting exploratory wells, operators perform a geohazard survey to evaluate any potential geological hazards; document any potential cultural resources or benthic communities; identify shallow hazards such as old pipelines or wrecks; obtain engineering data for placement of structures (e.g., proposed platform locations and pipeline routes); and detect subsurface geologic hazards (e.g., faults and gas pockets).

Upon completion of the 3D seismic survey over the lower Cook Inlet OCS leases, Hilcorp Alaska plans to conduct a geohazard survey on site specific regions within the area of interest prior to conducting exploratory drilling. The precise location is not known, as it depends on the results of the 3D seismic survey, but the location will be within the lease blocks. The anticipated timing of the activity is in either the fall of 2019 or the spring of 2020. The actual survey duration will take approximately 30 days. The sub-bottom profiler will likely not be used the entire survey, so the assumptions used for duration in the take analysis include down time for other equipment.

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

The echosounders and sub-bottom profilers are generally hull-mounted or towed behind a single vessel. The ship travels at 3-4.5 knots (5.6-8.3 km/hr). Surveys are site specific and can cover less than one lease block in a day, but the survey extent is determined by the number of potential drill sites in an area. BOEM guidelines at NTL-A01 require data to be gathered on a 150 by 300 m (492 by 984 ft) grid within 600 m (1,969 ft) of the surface location of the drill site, a 300 by 600 m (984 by 1,969 ft) grid along the wellbore path out to 1,200 m (3,937 ft) beyond the surface projection of the conductor casing, and extending an additional 1,200 m (3,937 ft) beyond that limit with a 1,200 by 1,200 m (3,937 ft) grid out to 2,400 m (7,874 ft) from the well site.

1.4 ACTIVITIES WITHIN EXISTING COOK INLET ASSETS

The Applicant operates multiple assets throughout Cook Inlet in State of Alaska waters, including gathering facilities and platforms while Harvest operates the transmission pipelines, the Drift River Terminal, the Christy Lee loading platform, and part of Granite Point Tank Farm (Figure 1). Details of the onshore and offshore units are provided in the ITR Petition. Activities that are planned in the Year 1 LOA period are included in the text below and on Figure 3.

1.4.1 Offshore Production Platforms

Of the 17 production platforms in central Cook Inlet, 15 are owned by Hilcorp. The two remaining platforms are owned by Furie (KLU Platform A) and Glacier Oil and Gas (Osprey). Table 3 summarizes each of the Hilcorp Alaska-owned platforms.

Hilcorp Alaska performs routine construction on their platforms, depending on needs of the operations. Construction activities may take place up to 24 hrs a day. In-water activities include support vessels bringing supplies five days a week up to two trips per day between OSK and the platform. Depending on the needs, there may also be barges towed by tugs with equipment and helicopters for crew and supply changes.

Table 3. Hilcorp Alaska production platforms in Cook Inlet.

Platform Name	Unit	Location (Lat/Lon)	Installation Date	Hilcorp Acquisition Date	Water Depth (at MLLW)	Number of Wells	Platform Status
A	Middle Ground Shoal	60.79521 151.49781	1964	2015	83 ft	15 producers, 1 disposal	Active
Anna	Granite Point	60.97638 151.31509	1966	2012	77 ft	56	Active
Baker	Middle Ground Shoal	60.82868 151.48584	1965	2012	102 ft	36	Lighthoused
Bruce	Granite Point	60.99845 151.30017	1966	2012	62 ft	32	Active
C	Middle Ground Shoal	60.76341 151.50429	1967	2015	73 ft	13 producers, 1 disposal	Active
Dillon	Middle Ground Shoal	60.73491 151.51502	1966	2012	92 ft	21	Lighthoused
Dolly Varden	Trading Bay	60.80712 151.63504	1967	2012	112 ft	70	Active
Granite Point	Granite Point	60.95758 151.33374	1966	2013	75 ft	40	Active
Grayling	Trading Bay	60.83919 151.61529	1967	2012	125 ft	61	Active
King Salmon	Trading Bay	60.86485 151.60804	1967	2012	73 ft	53	Active
Monopod	Trading Bay	60.89629 151.58100	1966	2012	66 ft	106	Active
Spark	North Trading Bay	60.92833 151.53055	1968	2013	62 ft	6	Lighthoused
Spurr	North Trading Bay	60.91944 151.55722	1968	2013	67 ft	6	Lighthoused
Steelhead	Trading Bay	60.83128 151.60423	1986	2012	183 ft	36	Active
Tyonek	North Cook Inlet	61.07583 150.950277	1968	2016	100 ft	19	Active

1.4.2 Offshore Production Drilling

Hilcorp Alaska routinely conducts development drilling activities at offshore platforms on a regular basis to meet the asset's production needs. Development drilling activities occur from existing platforms within

Cook Inlet through either open well slots or existing wellbores in existing platform legs. All Hilcorp platforms have a potential for development drilling activities. Drilling activities from platforms within Cook Inlet are accomplished by using conventional drilling equipment from a variety of rig configurations.

Some platforms in Cook Inlet have permanent drilling rigs installed that operate under power provided by the platform power generation systems, while others do not have drill rigs, and the use of a mobile drill rig is required. Mobile offshore drill rigs may be powered by the platform power generation (if compatible with the platform power system) or self-generate power with the use of diesel fired generators.

Helicopter logistics for development drilling programs operations will include transportation for personnel and supplies. The helicopter support will be managed through existing offshore services based at the OSK Heliport to support rig crew changes and cargo handling. Helicopter flights to and from the platform while drilling is occurring is anticipated to increase (on average) by two flights per day from normal platform operations.

Major supplies will be staged on-shore at the OSK Dock in Nikiski. Required supplies and equipment will be moved from the staging area to the platform in which drilling occurring by existing supply vessels that are currently in use supporting offshore operations within Cook Inlet. Vessel trips to and from the platform while drilling is occurring is anticipated to increase (on average) by two trips per day from normal platform operations. During mobile drill rig mobilization and demobilization, one support vessel is used continuously for approximately 30 days to facilitate moving rig equipment and materials.

1.4.2.1 Granite Point Development Drilling

Hilcorp Alaska plans to conduct a multi-well development drilling program at the Granite Point Platform between July and November 2019. The exact start date is currently unknown and is dependent on scheduling availability of the drill rig and receipt of all applicable authorizations. A jack-up rig will be cantilevered over the Granite Point Platform and utilized to complete the drilling program with the same equipment and methods as described in Section 1.5.4 of the Petition ITR. All currently proposed wells are sidetracks and or completions of existing wellbores. It is expected that each well will take approximately 40-60 days to drill and test and convert to production if applicable. A geohazard survey over the areas of interest will be conducted to locate potential hazards prior to drilling with the same suite of equipment as described in Section 1.3.2 of the Petition with the exception of the use of a sub-bottom profiler. Because the wells are sidetracks, there is no need to survey beneath the seafloor so only echosounders and side scan sonar are used (all above 200 kiloHertz [kHz]).

1.4.3 Oil and Gas Pipelines

Natural gas is supplied to Southcentral Alaska via pipeline from the Kenai assets. The Applicant has the ability to ship gas via either the west or east side of Cook Inlet up to Anchorage. Gas on the west side of Cook Inlet is transported from the Trading Bay Production Facility (TBPF) and Granite Point Tank Farm (GPTF) to the Beluga Power Plant via the Cook Inlet Gas Gathering System (CIGGS) and the Beluga Pipeline (BPL). East side gas is transported across Cook Inlet via the Tyonek Pipeline from the Kenai Pipeline (KPL) Junction to the west side of Cook Inlet where it connects to the BPL.

Oil is transported from TBPF and GPTF on the west side of Cook Inlet to KPL Junction on the east side of Cook Inlet through the Cook Inlet Pipeline.

1.4.4 Routine Maintenance

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

Table 4 provides the timing and durations of the proposed maintenance and repair activities; exact dates each year are not known. In general, pipeline stabilization and pipeline repair are anticipated to occur in succession for a total of 6-10 weeks. However, if a pipeline stabilization location also requires repair, the divers will repair the pipeline at the same time they are stabilizing it. Pipeline repair activities are only to be conducted on an as-needed basis whereas pipeline stabilization activities will occur annually. During underwater inspections, if the divers identify an area of the pipeline that requires stabilization, they will place Sea-Crete bags at that time rather than waiting until the major pipeline stabilization effort that occurs later in the season.

Table 4. Timing and durations of Cook Inlet maintenance and repair activities.

Location	Activity	Estimated Timing	Estimated Duration	Frequency	Anticipated Resources						
					Dive Support	Multi-Beam Sonar	Water jet	Sea-Crete	Helicopter	RA Team	Drones
Subsea Pipelines	Pipeline Inspections	Apr/May	2 weeks	Annual	X	X	X	X			
	Pipeline Stabilization	Jun-Oct	3-5 weeks	Annual	X		X	X			
	Pipeline Repair	Jun-Oct	3-5 weeks	As needed	X		X	X			
Platform Legs	Platform Leg Inspection and Repair - *Subsea*	Apr-Jun	3 weeks	Annual	X		X	X			
	Platform Leg Inspection and Repair – *Tidal Zone*	May-Jul	3 weeks per wrap	As needed					X	X	X
Anode Sleds	Anode Sled Installation / Replacement	May-Aug	2-3 weeks	As needed	X		X	X			

1.4.4.1 Subsea Pipelines

Natural gas and oil pipelines located on the seafloor of the Cook Inlet are inspected on an annual basis using ultrasonic testing (UT), cathodic protection surveys, multi-beam sonar surveys, and sub-bottom profilers. Deficiencies identified are corrected using pipeline stabilization methods or USDOT-approved pipeline repair techniques.

Pipeline Inspections

The Applicant employs dive teams to conduct physical inspections and evaluate cathodic protection status and thickness of subsea pipelines on an annual basis. If required for accurate measurements, divers may use a water jet to provide visual access to the pipeline. For stabilization, inspection dive teams may place Sea-Crete bags beneath the pipeline to replace any materials removed by the water jet. Results of the inspections are recorded and significant deficiencies are noted for repair.

Multi-beam sonar and sub-bottom profilers may also be used to obtain images of the seabed along and immediately adjacent to all subsea pipelines. Strong currents within the Cook Inlet can scour and erode the seafloor beneath the pipelines, creating potentially significant integrity issues. Specifically, multi beam sonar is used to evaluate and identify:

- Significant subsea topographic anomalies located within 10 ft of all pipelines
- Unsupported pipeline spans of 50 ft or greater
- Pipeline alignment
- Location of pipeline crossings
- Locations and tracking of the M/V *Monarch* shipwreck
- Up-to-date current velocity data

Elements of pipeline inspections that could produce underwater noise include:

- Dive Support Vessel (DSV)
- Water jet
- Multi-beam sonar/sub-bottom profiler and vessel

1.4.4.2 Pipeline Stabilization

Scour spans beneath pipelines greater than 23 m (75 ft) have the potential to cause pipeline failures. To be conservative, scour spans of 15 m (50 ft) or greater identified using multi-beam sonar surveys are investigated using dive teams. Divers perform tactile inspections to confirm spans greater than 15 m (50 ft). The pipeline is stabilized along these spans with Sea-Crete concrete bags.

While in the area, the divers will also inspect the external coating of the pipeline and take cathodic protection readings if corrosion wrap is found to be absent.

Elements of pipeline stabilization that could produce underwater noise include:

- DSV
- Water jet

1.4.4.3 Pipeline Repair

Significant pipeline deficiencies identified during pipeline inspections are repaired as soon as practicable using methods including, but not limited to, USDOT-approved clamps and/or fiber glass wraps, bolt/flange replacements, and manifold replacements. In some cases, a water jet may be required to remove sand and gravel from under or around the pipeline to allow access for assessment and repair. The pipeline surface may also require cleaning using a hydraulic grinder to ensure adequate repair. If pipeline replacement is required, an underwater pipe cutter such as a diamond wire saw or hydraulically-powered Guillotine saw may be used.

Elements of pipeline repair that could produce underwater noise include:

- DSV
- Water jet
- Hydraulic grinder
- Underwater pipe cutter

1.4.4.4 Platform Legs

Hilcorp Alaska's platforms in Cook Inlet are inspected on a routine basis. Divers and certified rope access (RA) technicians visually inspect subsea platform legs. These teams also identify and correct significant structural deficiencies.

Platform Leg Inspection and Repair - Subsea

Platform leg integrity and pipeline-to-platform connections beneath the water surface are evaluated by divers on a routine basis. Platform legs, braces, and pipeline-to-platform connections are evaluated for cathodic protection status, structure thickness, excessive marine growth, damage, and scour. If required, divers may use a water jet to clean or provide access to the structure. Material removed from the seafloor may be replaced by Sea-Crete bags to stabilize the pipeline. Cathodic protection of the platform legs and associated pipelines are evaluated using a submersible Silver Chloride half-cell coupled to a digital multi-meter. Cathodic protection readings are taken continuously while the divers travel down legs, along members/pipelines, and at all inspected nodes. Measurements are collected while the cathodic protection system remains active.

RA teams may use magnetic particle inspection (MPI) to detect structure surface and near-surface flaws. If necessary, remedial grinding using a hydraulic under water grinder may be required to determine extent damage and/or to prevent further crack propagation. All inspection results are recorded and significant deficiencies are noted for repair.

Elements of subsea platform leg inspection and repair that could produce underwater noise include:

- DSV
- Hydraulic grinder
- Water jet

Platform Leg Inspection and Repair– Tidal Zone

Platform leg integrity along the tidal zone is inspected on a routine basis. Difficult-to-reach areas may be accessed using either commercially-piloted unmanned aerial systems (UAS) or certified RA teams.

Commercially-piloted UASs may be deployed from the top-side of the platform to obtain images of the legs. These images are then used to direct further inspections using RA Teams. Platform legs and braces are evaluated for cathodic protection status, structure thickness, excessive marine growth, and damage. All welds and corrosion leg wraps along the platform leg are inspected for damage or peeling. Significant structural deficiencies identified during inspections are repaired as soon as practicable using methods including, but not limited to, coarse metal repair such as welding seams or patches or replacing wraps.

Platform leg braces may be repaired as necessary to maintain the structural integrity of the platform. Loose bolts or evidence of cracking may be repaired by replacing bolts, installing new clamps, applying a composite material, or replacing the entire brace. In some situations, filling the brace with a composite material may be the most effective method of repair.

These visual inspections occur on an annual basis for each platform. Generally, the UAS is in the air for 15-20 minutes at a time due to battery capacity, which allows for two legs and part of the underside of the platform to be inspected. The total time to inspect a platform is approximately 1.5 hrs of flight time. The UAS is operated at a distance of up to 30.5 m (100 ft) from the platform at an altitude of 9-15 m (30-50 ft) above sea level. To reduce potential harassment of marine mammals, the area around the platform would be inspected prior to launch of the UAS to ensure there are no flights directly above marine mammals.

Elements of tidal zone work that could disturb marine mammals include:

- UAS

1.4.4.5 Anode Sled Installation and/or Replacement

Galvanic and impressed current anode sleds are used to provide cathodic protection for the pipelines and platforms in Cook Inlet. Galvanic anode sleds do not require a power source and may be installed along the length of the pipelines on the seafloor. Impressed current anode sleds are located on the seafloor at each of the corners of each platform and are powered by rectifiers located on the platform.

Anodes are placed at the seafloor using dive vessels and hand tools. If necessary, a water jet may be used to provide access for proper installation. Anodes and/or cables may be stabilized using Sea-Crete bags.

Elements of anode sled inspection and repair that could produce underwater noise include:

- DSV
- Water jet

1.4.4.6 Vessel Traffic

Hilcorp Alaska's maintenance activities will require the use of dive vessels, typically ranging up to 70 ft in length x 24 ft in width x 7 ft draft capable of approximately 7 knots, traveling with the speed of the incoming/outgoing tide. On average, vessels may travel approximately 8 miles per day (mi/day), three times each day for a total of about 48 mi/day during normal operations.

1.4.4.7 Pingers

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

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

2.0 DATES, DURATION, AND REGION OF ACTIVITY

The dates and duration of such activity and the specific geographical region where it will occur.

The scope of this LOA for Year 1 includes exploration, development, and production activities (Figure 3) within the Applicant's area of operations in and adjacent to Cook Inlet within the Petition's geographic area (Figure 2) for the period of one year July 1, 2019 through July 1, 2020.

The geographic area of activity covers a total of approximately 10,926 km^2 (2.7 million acres) in Cook Inlet. It includes land and adjacent waters in Cook Inlet including both State of Alaska and Federal OCS waters (Figure 2). The area extends from the north at the Susitna Delta on the west side (61º10'48 N, 151º0'55 W) and Point Possession on the east side (61º2'11 N, 150º23'30 W) to the south at Ursus Cove on the west side (59º26'20 N, 153º45'5 W) and Nanwalek on the east side (59º24'5 N, 151º56'30 W).

The specific activities included in this LOA Year 1 request include (Figure 3):

- 3D seismic survey in lower Cook Inlet OCS leases (45-60 days) September-October 2019 or April-May 2020 (preferred timing is fall 2019)
- OCS geohazard survey in lower Cook Inlet OCS leases (30 days) in April-May 2020
- Platform and pipeline maintenance activities in middle Cook Inlet July 2019-July 2020
- Development drilling at several wells at Granite Point Platform (120-150 days) between July and November 2019

3.0 TYPE AND ABUNDANCE OF MARINE MAMMALS IN PROJECT AREA

The species and numbers of marine mammals likely to be found within the activity area.

The marine mammal species known to occur in the LOA area are listed in Table 5 and described in the Section 4.

In the cases of marine mammals for which separate stocks have been delineated, description and evaluation of potential effects is focused on those stocks that may occur within the Cook Inlet region. However, information on the biological species is integrated if it enhances the understanding of the relevant stock(s) or aids in evaluation of the significance of any potential effects on the stock that occurs within or near the Cook Inlet region. Table 5 presents the species conservation status under the Endangered Species Act (ESA), latest stock, and minimum population estimate.

Table 5. Species, conservation status, and abundance estimates of marine mammals in the project area.

Species	Conservation Status	Stock	Minimum Population Estimate
Fin whale (*Balaenoptera physalus)*	ESA – Endangered	Northeastern Pacific Stock	1,036[1]
Humpback whale (*Megaptera novaeangliae*)	ESA – Endangered	Western North Pacific Stock	865[1]
Minke whale (*Balaenoptera acutorostrata*)	ESA – Not Listed	Alaska Stock	1,233[2]
Gray whale (*Eschrichtius robustus*)	ESA – Not Listed	Eastern Pacific Stock	20,125[3]
Beluga whale (*Delphinapterus leucas*)	ESA – Endangered	Cook Inlet Stock	328[4]
Killer whale (*Orcinus orca*)	ESA – Not Listed	Alaska Resident Stock	2,347[1]
Killer whale (*Orcinus orca*)	ESA – Not Listed	Alaska Transient Stock	587[1]
Harbor porpoise (*Phocoena phocoena*)	ESA – Not Listed	Gulf of Alaska Stock	31,046[1]
Dall's porpoise (*Phocoenoides dalli*)	ESA – Not Listed	Alaska Stock	83,400[1]
Harbor seal (*Phoca vitulina*)	ESA – Not Listed	Cook Inlet/Shelikof Stock	27,386[1,5]
Steller sea lion (*Eumetopias jubatus*)	ESA – Endangered	Western U.S. Stock	50,983[1,5]
California sea lion (*Zalophus californianus*)	ESA – Not Listed	U.S. Stock	153,337[3]

[1]Muto et al. 2017

[2]Zerbini et al. 2006

[3]Allen and Angliss 2015

[4]Shelden et al. 2017

[5]NEST is the best estimate of pup and non-pup counts, which have not been corrected to account for animals at sea during abundance surveys

4.0 DESCRIPTION OF MARINE MAMMALS IN PROJECT AREA

A description of the status, distribution, and seasonal distribution of the affected species or stocks of marine mammals likely to be affected by such activities.

A description of the status, distribution, and seasonal distribution of the affected species or stocks of marine mammals in the LOA area is listed in Table 5 and is presented in the following pages. We encourage the reader to refer to the latest Alaska Marine Mammal Stock Assessment Report (Muto et al. 2017) for a more detailed discussion on each species, as well as previous environmental compliance documents associated with exploration in Cook Inlet including other oil and gas programs such as Apache Alaska Corporation (Apache; 81 Federal Register [FR] 47239; 79 FR 13626; 80 FR 29161; 77 FR 27720), Furie (78 FR 80385), and SAExploration (80 FR 29161); and two drilling programs Bluecrest (81 FR 35547) and Buccaneer (79 FR 19251).

4.1 FIN WHALE

Fin whales were listed as endangered in 1970 (35 FR 18319) and protected under the MMPA in 1973. Commercial whaling for fin whales ended in 1976 in the North Pacific, 1976-77 in the Southern Ocean, and 1987 in the North Atlantic. Subsistence hunts continue in Greenland under the aboriginal subsistence whaling scheme managed by the International Whaling Commission. The population declined dramatically due to twentieth century commercial whaling.

For management purposes, three stocks of fin whales are currently recognized in U.S. Pacific waters: Alaska (Northeast Pacific), California/Washington/Oregon, and Hawaii. Recent analyses provide evidence that the population structure should be reviewed and possibly updated, however substantially new data on the stock structure is lacking (Muto et al 2017).

4.1.1 Status

Fin whales are listed as endangered under the ESA in 1990 and depleted under the MMPA. The Northeast Pacific stock is categorized as a strategic stock. Much of the North Pacific range has not been surveyed, and reliable abundance estimates for the entire stock are not available. The status of the Northeast Pacific stock relative to its Optimum Sustainable Population (OSP), therefore, is currently not available. No critical habitat has been designated or proposed for fin whales in the North Pacific.

4.1.2 Distribution

In the U.S. Pacific waters, fin whales are found seasonally in the Gulf of Alaska, Bering Sea, and as far north as the northern Chukchi Sea (Muto et al. 2017). Surveys conducted in coastal waters of the Aleutians and the Alaska Peninsula found that fin whales occurred primarily from the Kenai Peninsula to the Shumagin Islands and were abundant near the Semidi Islands and Kodiak Island (Zerbini et al. 2006). An opportunistic survey conducted on the shelf of the Gulf of Alaska found fin whales concentrated west of Kodiak Island in Shelikof Strait, and in the southern Cook Inlet region. Smaller numbers were also observed over the shelf east of Kodiak to Prince William Sound (Alaska Fisheries Science Center [AFSC] 2003). In the northeastern Chukchi Sea, visual sightings and acoustic detections have been increasing, which suggests the stock may be re-occupying habitat used prior to large-scale commercial whaling (Muto et al. 2017). Most of these areas are feeding habitat for fin whales.

Fin whales are rarely observed in Cook Inlet and most sightings occur near the entrance of the inlet. During the NMFS aerial surveys in Cook Inlet from 2000-2016, 10 sightings of 26 estimated individual fin whales in lower Cook Inlet were observed (Shelden et al. 2013, 2015, 2017).

4.1.3 Seasonal Distribution

Mizroch et al. (2009) provided a comprehensive summary of fin whale sightings data, including whaling catch data, and determined there could be at least six populations of fin whales. Evidence suggests two populations are migratory (eastern and western North Pacific) and two to four more that are year-round residents in peripheral seas such as the Gulf of California, East China Sea, Sanriku-Hokkaido, and possibly the Sea of Japan. The two migratory stocks are likely mingling in the Bering Sea in July and August. Moore et al. (1998, 2006), Watkins et al. (2000), and Stafford et al. (2007) documented high rates of calling along the Alaska coast beginning in August/September and lasting through February. Fin whales are regularly observed in the Gulf of Alaska during the summer months, even though calls are seldom detected during this period (Stafford et al. 2007). Instruments moored in the southeast Bering Sea detected calls over the course of a year and found peaks from September to November as well as in February and March (Stafford et al. 2010). Delarue et al. (2013) detected calls in the northeastern Chukchi Sea from instruments moored from July through October from 2007 through 2010. Fin whales are found in the lower Cook Inlet region as shown in Figure 8.

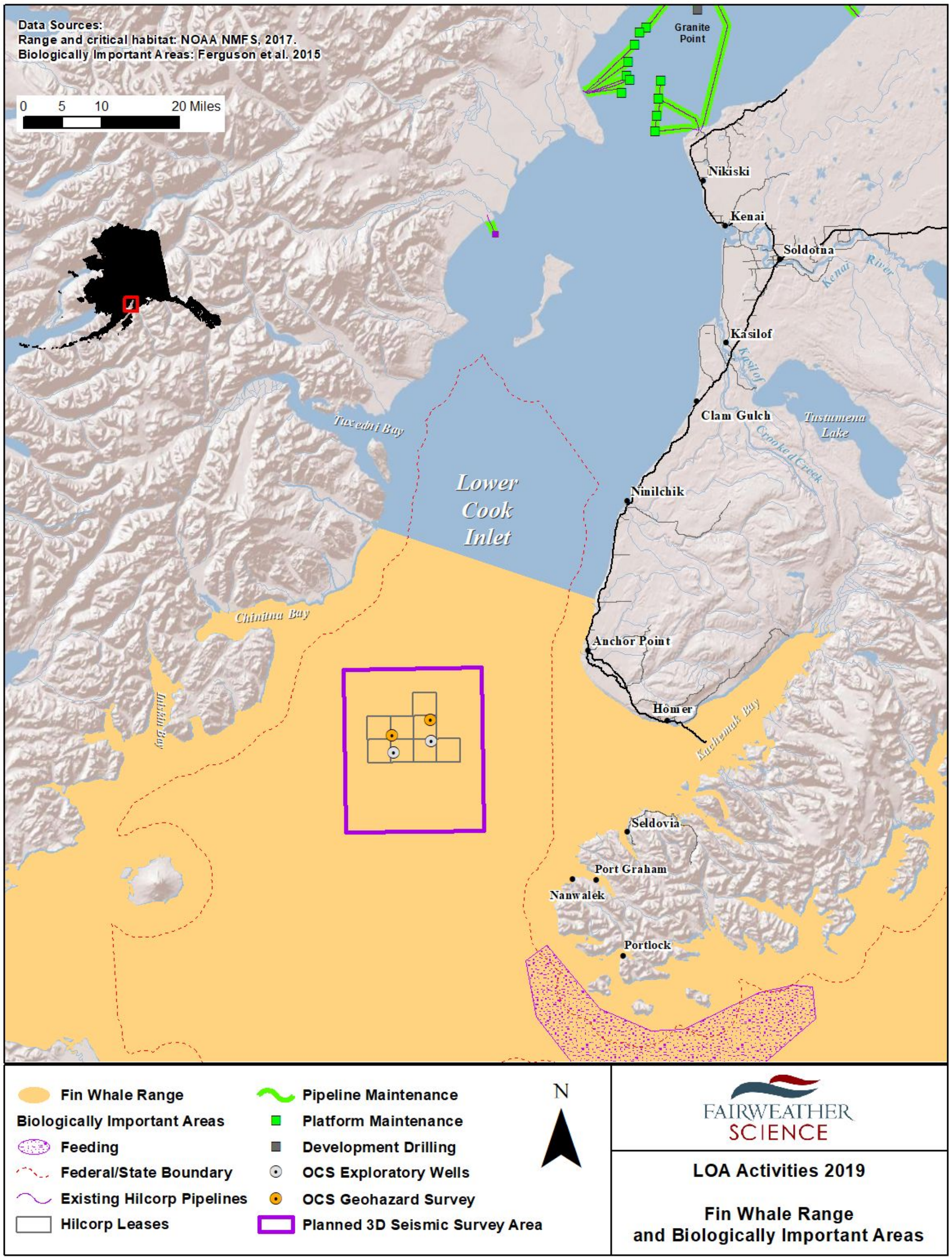

Figure 8. Distribution and biologically important areas (BIAs) for fin whales in the LOA area.

4.2 HUMPBACK WHALE

To date, three management units (populations) of humpback whales are recognized in the North Pacific, migrating between their respective summer/fall feeding areas and winter/spring calving and mating areas as follows (Baker et al. 1998; Calambokidis et al. 1997). Although there is considerable distributional overlap in the humpback whale stocks that use Alaska, the whales seasonally found in lower Cook Inlet are probably of the Central North Pacific stock (Muto et al. 2017). Listed as endangered under the ESA, this stock has recently been estimated at 7,890 animals (Muto et al. 2017). The Central North Pacific stock winters in Hawaii and summers from British Columbia to the Aleutian Islands (Calambokidis et al. 1997), including Cook Inlet.

4.2.1 Status

Humpback whales were listed as endangered under the ESA in 1973 due to the reduced population levels resulting from harvest pressure that occurred in the 20th Century (Perry et al. 1999; Rice 1978). Humpback whales are listed as depleted under the MMPA in 1973. In 1991, NMFS published a Final Recovery Plan for Humpback Whales (NMFS 1991).

In 2013, NMFS published a 90-day finding to identify the Central North Pacific population of Humpback whales as a distinct population segment (DPS) under the ESA and recommended that this DPS be delisted from the ESA based on population abundance (78 FR 53391). On September 8, 2016, NMFS revised the listing status of the humpback whale. NMFS divided the globally listed species into 14 DPSs, removing the current species listing and replacing it with four DPS as endangered (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea) and one DPS as threatened (Mexico). The remaining nine DPS did not warrant listing. Critical habitat for the three DPS found in U.S. waters (Western North Pacific, Central America, and Mexico) has not been determined (81 FR 62260).

4.2.2 Distribution

The humpback whale is distributed worldwide in all ocean basins. In winter, most humpback whales occur in the subtropical and tropical waters of the northern and southern hemispheres. Humpback whales in the high latitudes of the North Pacific Ocean are seasonal migrants that feed on euphausiids and small schooling fishes (Muto et al. 2017). During the spring, these animals migrate north and spend the summer feeding in the prey-rich sub-polar waters of southern Alaska, British Columbia, and the southern Chukchi Sea. Individuals from the Western North Pacific (endangered), Hawaii (not listed under the ESA), and the Mexico (threatened) DPSs migrate to areas near and potentially in the Petition region; however, most of the individuals that migrate to the Cook Inlet area are likely from the Hawaii DPS and not the Western North Pacific or Mexico DPSs (NMFS 2017).

4.2.3 Seasonal Distribution

In the summer, humpback whales are regularly present and feeding in the Cook Inlet region, including Shelikof Strait, Kodiak Island bays, and the Barren Islands, in addition to Gulf of Alaska regions adjacent to the southeast side of Kodiak Island (especially Albatross Banks), the Kenai and Alaska peninsulas, Elizabeth Island, as well as south of the Aleutian Islands. Humpbacks also may be present in some of these areas throughout autumn (Muto et al. 2017).

Humpback whales have been observed during marine mammal surveys conducted in Cook Inlet; however, their presence is largely confined to lower Cook Inlet. During SAExploration's 2015 seismic program, three humpback whales were observed in Cook Inlet; two near the Forelands and one in Kachemak Bay (Kendall et al. 2015). During NMFS Cook Inlet beluga whale aerial surveys from 2000-2016, there were 88 sightings of 191 estimated individual humpback whales in lower Cook Inlet (Shelden et al. 2017). They have been regularly seen near Kachemak Bay during the summer months (Rugh et al. 2005). There are observations of humpback whales as far north as Anchor Point, with recent summer observations extending to Cape Starichkof (Owl Ridge 2014). Although several humpback whale sightings occurred mid-inlet between Iniskin Peninsula and Kachemak Bay, most sightings occurred outside of the Petition region near Augustine, Barren, and Elizabeth Islands (Shelden et al. 2013, 2015, 2017). There were two sightings of three humpback whales observed near Ladd Landing north of the Forelands on the recent Harvest Alaska Cook Inlet Pipeline Extension (CIPL) project (Sitkiewicz et al. 2018).

Ferguson et al. (2015) has established Biologically Important Areas (BIAs) as part of the NOAA Cetacean Density and Distribution Mapping Working Group (CetMap) efforts. This information supplements the quantitative information on cetacean density, distribution, and occurrence by: 1) identifying areas where cetacean species or populations are known to concentrate for specific behaviors, or be range-limited, but for which there is not sufficient data for their importance to be reflected in the quantitative mapping effort; and 2) providing additional context within which to examine potential interactions between cetaceans and human activities. A 'Feeding Area' BIA for humpback whales in the Gulf of Alaska region encompasses the waters east of Kodiak Island (the Albatross and Portlock Banks), a target for historical commercial whalers based out of Port Hobron, Alaska (Ferguson et al. 2015; Reeves et al. 1985; Witteveen et al. 2007). This BIA also includes waters along the southeastern side of Shelikof Strait and in the bays along the northwestern shore of Kodiak Island. The highest densities of humpback whales around the Kodiak Island BIA occur from July-August (Ferguson et al. 2015). Humpback whales are found in the Cook Inlet region as shown in Figure 9.

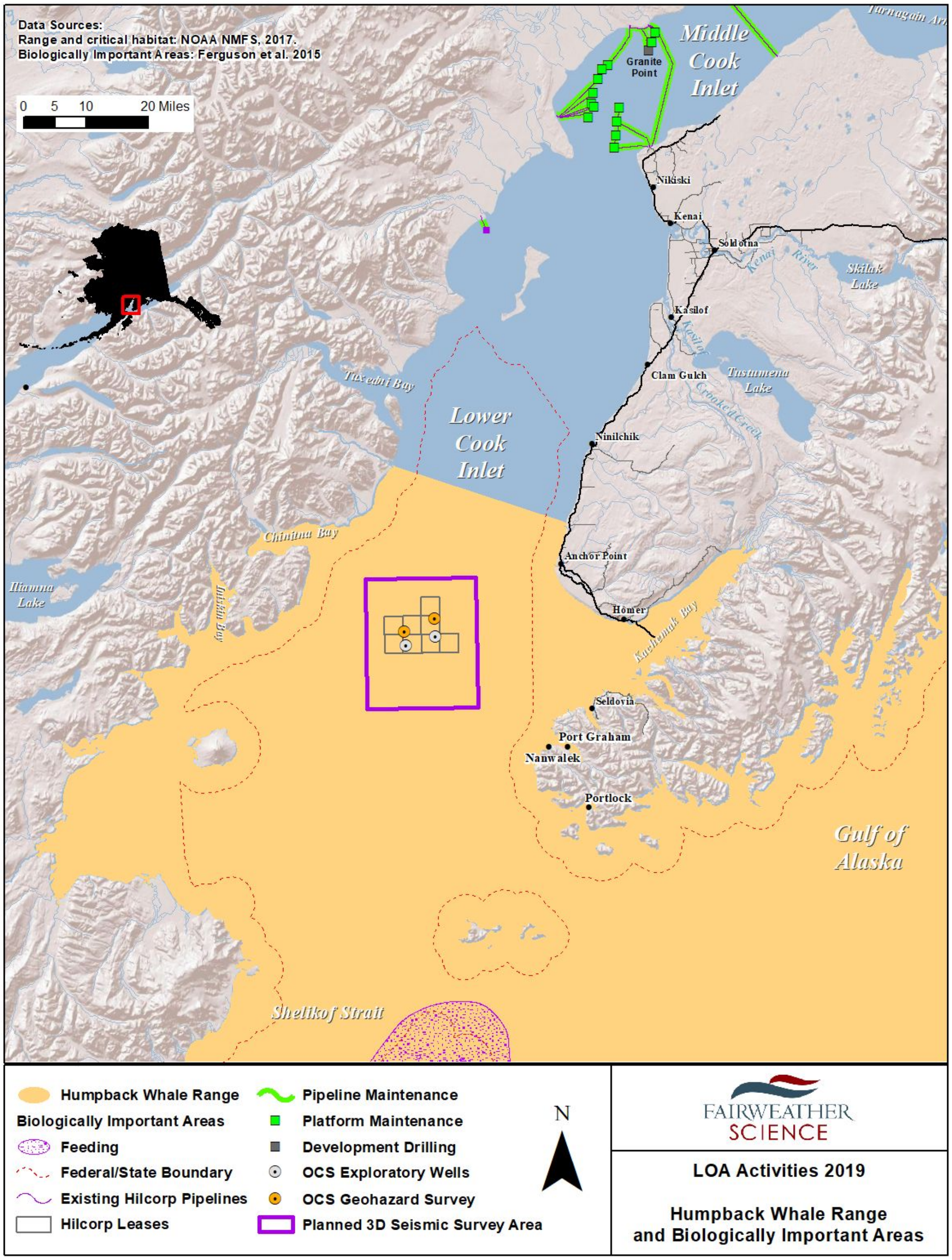

Figure 9. Distribution and biologically important areas (BIAs) for humpback whales in the LOA area.

4.3 MINKE WHALE

Minke whales are most abundant in the Gulf of Alaska during summer and occupy localized feeding areas (Zerbini et al. 2006). Concentrations of minke whales have occurred along the north coast of Kodiak Island (and along the south coast of the Alaska Peninsula (Zerbini et al. 2006). The current estimate for minke whales between Kenai Fjords and the Aleutian Islands is 1,233 individuals[1] (Zerbini et al. 2006). During shipboard surveys conducted in 2003, three minke whale sightings were made, all near the eastern extent of the survey from nearshore Prince William Sound to the shelf break (National Marine Mammal Laboratory [NMML] 2003).

4.3.1 Status

Minke whales are a non-ESA listed cetacean uncommonly found in the Cook Inlet region. Minke whales are not designated as depleted under the MMPA or listed as threatened or endangered under the ESA.

4.3.2 Distribution

In the North Pacific, minke whales occur from the Bering and Chukchi seas south to near the Equator (Leatherwood et al. 1982). Figure 10 displays the minke whale range in the project area. In the eastern North Pacific, minke whales are relatively common in the Bering and Chukchi seas and in the inshore waters of the Gulf of Alaska (Moore et al. 2002; Friday et al. 2013; Clarke et al. 2013).

4.3.3 Seasonal distribution

Minke whales become scarce in the Gulf of Alaska in fall; most whales are thought to leave the region by October (Consiglieri et al. 1982). Minke whales are migratory in Alaska, but recently have been observed off Cape Starichkof and Anchor Point year-round (Muto et al. 2017).

During Cook Inlet-wide aerial surveys conducted from 1993 to 2004, minke whales were encountered three times (1998, 1999, and 2006), both times off Anchor Point 25.7 km northwest of Homer (Shelden et al. 2013, 2015, 2017). A minke whale was also reported off Cape Starichkof in 2011 (A. Holmes, pers. comm.) and 2013 (E. Fernandez and C. Hesselbach, pers. comm.), suggesting this location is regularly used by minke whales, including during the winter. Several minke whales were recorded off Cape Starichkof in early summer 2013 during exploratory drilling (Owl Ridge 2014), suggesting this location is regularly used by minke whales year-round. During Apache's 2014 survey, a total of 2 minke whale groups (3 individuals) were observed during this time period, one sighting to the southeast of Kalgin Island and another sighting near Homer (Lomac-MacNair et al. 2014). SAExploration noted one minke whale near Tuxedni Bay in 2015 (Kendall et al. 2015). This species is unlikely to be seen in upper Cook Inlet but may be encountered in the mid and lower Inlet (Figure 10).

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[1] Line transect surveys were conducted in shelf and nearshore waters (within 30-45 nautical miles [nm] of land) in 2001-2003 from the Kenai Fjords in the Gulf of Alaska to the central Aleutian Islands. Most of the sightings were in the Aleutian Islands, rather than in the Gulf of Alaska, and in water shallower than 200 m.

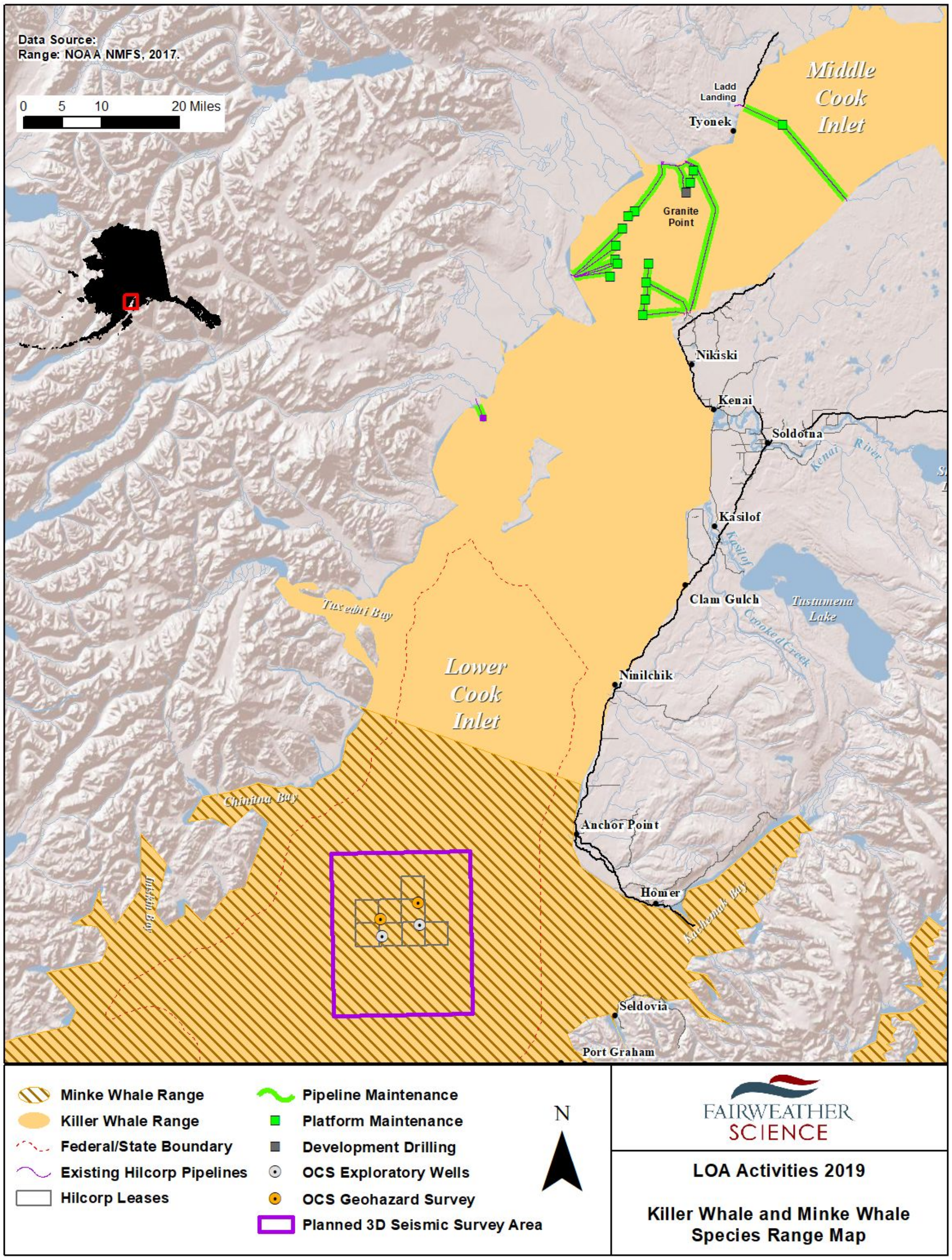

Figure 10. Distribution of minke and killer whales in the LOA area.

4.4 KILLER WHALE

Based on data regarding association patterns, acoustics, movements, and genetic differences, eight killer whale stocks are now recognized within the Pacific U.S. Exclusive Economic Zone (EEZ). 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 (Muto et al 2017).

The population estimate for the Alaska Resident Stock is estimated at 2,347 individuals, with a minimum population estimate of 2,084 (Muto et al. 2017). Though no official abundance estimate exists for this stock because of incomplete surveys of the range, a minimum population estimate for the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient Stock was estimated to be 587 individuals (Muto et al. 2017).

4.4.1 Status

The Alaska Resident Stock and the Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock of killer whales are not designated as depleted under the MMPA or listed as threatened or endangered under the ESA.

4.4.2 Distribution

Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982), where whales have been labeled as ‘resident,’ ‘transient,’ and ‘offshore’ type killer whales (Dahlheim et al. 2008; Ford et al. 2000). The killer whales using Cook Inlet are thought to be a mix of resident and transient individuals from two different stocks: the Alaska Resident Stock, and the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient Stock (Allen and Angliss 2015). Figure 10 shows the killer whale range in relation to the Petition region. Although recent studies have documented movements of Alaska Resident killer whales from the Bering Sea into the Gulf of Alaska as far north as southern Kodiak Island, none of these whales have been photographed further north and east in the Gulf of Alaska where regular photo-identification studies have been conducted since 1984 (Muto et al. 2017).

4.4.3 Seasonal distribution

Killer whales are occasionally observed in lower Cook Inlet, especially near Homer and Port Graham (Shelden et al. 2003; Rugh et al. 2005). 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). The availability of these prey species largely determines the likeliest times for killer whales to be in the area. 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).

One killer whale group of two individuals was observed during the 2015 SAExploration seismic program near the North Foreland (Kendall et al. 2015). During NMFS aerial surveys, killer whales were observed in 1994 (Kamishak Bay), 1997 (Kachemak Bay), 2001 (Port Graham), 2005 (Iniskin Bay), 2010 (Elizabeth and Augustine Islands), and 2012 (Kachemak Bay; Shelden et al. 2013). Eleven killer whale strandings have been reported in Turnagain Arm, six in May 1991, and five in August 1993. This species is expected to be rarely seen in upper Cook Inlet but may be encountered in the mid and lower Inlet (Figure 10).

4.5 GRAY WHALE

4.5.1 Status

In 1994, the Eastern North Pacific (ENP) stock of gray whales was removed from the ESA in 1994 (59 FR 31094). The ENP is an estimated size of 20,990 animals, with an estimated minimum of 20,125 (Muto et al. 2017).

4.5.2 Distribution

Gray whales have been reported feeding near Kodiak Island, in southeastern Alaska, and south along the Pacific Northwest (Allen and Angliss 2013). Because most gray whales migrating through the Gulf of Alaska region are thought to take a coastal route, BIA boundaries for the migratory corridor in this region were defined by the extent of the continental shelf (Ferguson et al. 2015).

4.5.3 Seasonal distribution

Most gray whales calve and breed from late December to early February in protected waters along the western coast of Baja California, Mexico. In spring, the ENP stock of gray whales migrates approximately 8,000 km (5,000 mi) to feeding grounds in the Bering and Chukchi seas before returning to their wintering areas in the fall (Rice and Wolman 1971). Northward migration, primarily of individuals without calves, begins in February; some cow/calf pairs delay their departure from the calving area until well into April (Jones and Swartz 1984). Figure 11 displays the gray whale range in the project area.

Gray whales approach the proposed Petition region in late March, April, May, and June, and leave again in November and December (Consiglieri et al. 1982; Rice and Wolman 1971) but migrate past the mouth of Cook Inlet to and from northern feeding grounds. Some gray whales do not migrate completely from Baja to the Chukchi Sea but instead feed in select coastal areas in the Pacific Northwest, including lower Cook Inlet (Moore et al. 2007).

Most of the population follows the outer coast of the Kodiak Archipelago from the Kenai Peninsula in spring or the Alaska Peninsula in fall (Consiglieri et al. 1982; Rice and Wolman 1971). Though most gray whales migrate past Cook Inlet, small numbers have been noted by fishers near Kachemak Bay, and north of Anchor Point (BOEM 2015). During the NMFS aerial surveys, gray whales were observed in the month of June in 1994, 2000, 2001, 2005 and 2009 on the east side of Cook Inlet near Port Graham and Elizabeth Island but also on the west side near Kamishak Bay (Shelden et al. 2013). One gray whale was sighted as far north at the Beluga River. Additionally, summering gray whales were seen offshore of Cape Starichkof by marine mammal observers monitoring Buccaneer's Cosmopolitan drilling program in 2013 (Owl Ridge 2014). During Apache's 2012 seismic program, nine gray whales were observed in June and July (Lomac-MacNair et al. 2013). During Apache's seismic program in 2014, one gray whale was observed (Lomac-MacNair et al. 2014). During SAExploration's seismic survey in 2015, no gray whales were observed (Kendall et al. 2015). This species is unlikely to be seen in upper Cook Inlet but may be encountered in the mid and lower Inlet (Figure 11).

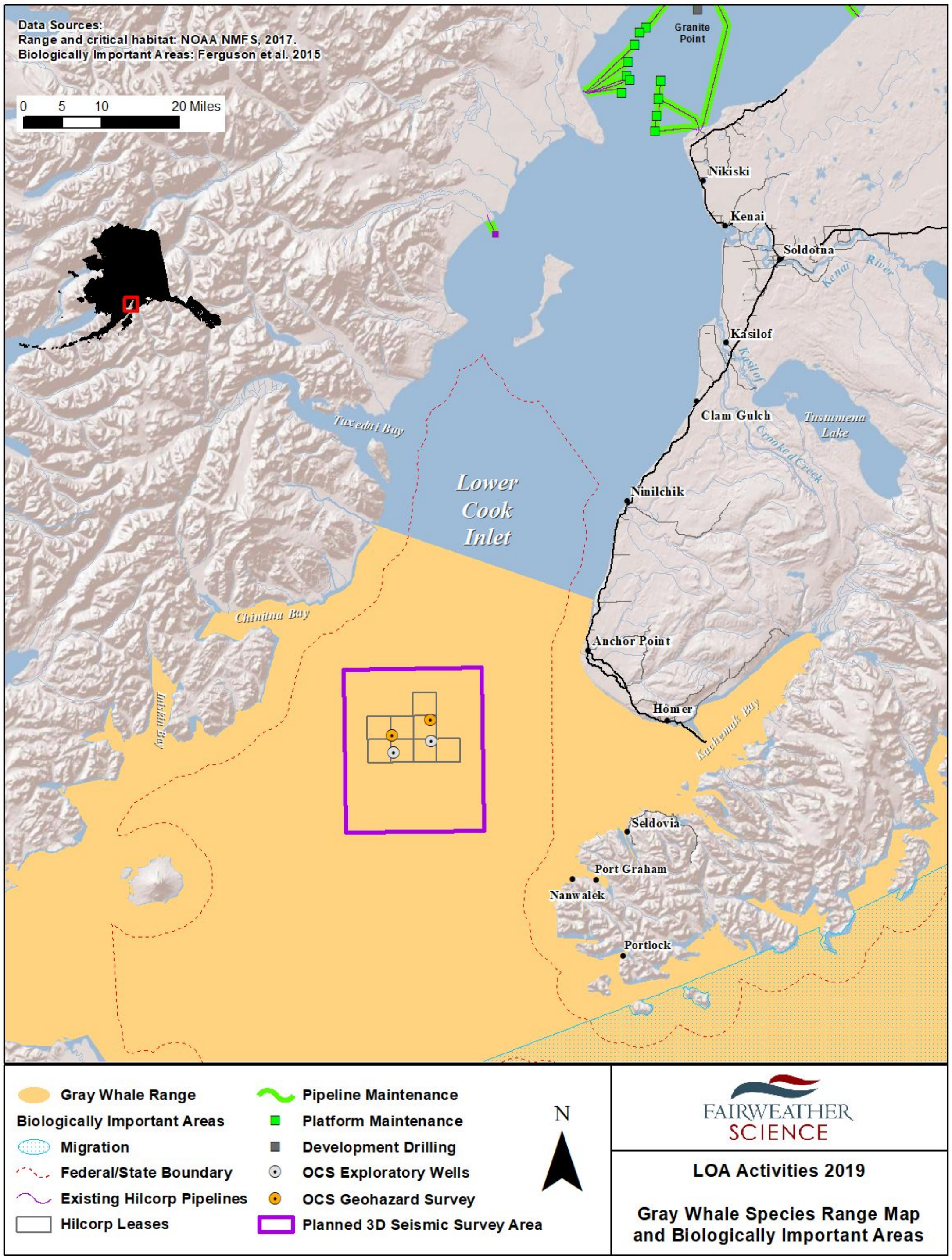

Figure 11. Distribution and biologically important areas (BIA) of gray whales in the LOA area.

4.6 COOK INLET BELUGA WHALE

The Cook Inlet beluga whale DPS is a small geographically isolated population that is separated from other beluga populations by the Alaska Peninsula. The population is genetically distinct from other Alaska populations suggesting the Peninsula is an effective barrier to genetic exchange (O'Corry-Crowe et al. 1997).

The Cook Inlet beluga whale population is estimated to have declined from 1,300 animals in the 1970s (Calkins 1989) to about 340 animals in 2014 (Shelden et al. 2015). The current population estimate is 328 animals (Shelden et al. 2017). The precipitous decline documented in the mid-1990s was attributed to unsustainable subsistence practices by Alaska Native hunters (harvest of >50 whales per year) (Mahoney and Shelden 2000). In 2006, a moratorium to cease hunting was agreed upon to protect the species.

4.6.1 Status

NMFS listed the population as depleted in 2000 because of the decline and as endangered under the ESA in 2008 when the population failed to recover following a moratorium on subsistence harvest (65 FR 34590). In April 2011, NMFS designated critical habitat for the beluga under the ESA (76 FR 20180) as shown on Figure 12. NMFS finalized the Conservation Plan for the Cook Inlet beluga in 2008 (NMFS 2008a). NMFS finalized the Recovery Plan for Cook Inlet beluga whales in 2016 (NMFS 2016a).

4.6.2 Distribution

The Cook Inlet beluga stock remains within Cook Inlet throughout the year (Goetz et al. 2012a). Two areas, consisting of 7,809 km^2 (3,016 mi^2) of marine and estuarine environments considered essential for the species' survival and recovery were designated critical habitat (Figure 12). However, in recent years the range of the beluga whale has contracted to the upper reaches of Cook Inlet because of the decline in the population (Rugh et al. 2010). Area 1 of the Cook Inlet beluga whale critical habitat encompasses all marine waters of Cook Inlet north of a line connecting Point Possession (61.04°N, 150.37°W) and the mouth of Three Mile Creek (61.08.55°N, 151.04.40°W), including waters of the Susitna, Little Susitna, and Chickaloon Rivers below mean higher high water (MHHW). This area provides important habitat during ice-free months, and is used intensively by Cook Inlet beluga between April and November (NMFS 2016a).

Since 1993, NMFS has conducted annual aerial surveys in June, July or August to document the distribution and abundance of beluga whales in Cook Inlet. The collective survey results show that beluga whales have been consistently found near or in river mouths along the northern shores of upper Cook Inlet (i.e., north of East and West Foreland). In particular, beluga whale groups are seen in the Susitna River Delta, Knik Arm, and along the shores of Chickaloon Bay. Small groups had also been recorded seen farther south in Kachemak Bay, Redoubt Bay (Big River), and Trading Bay (McArthur River) prior to 1996, but very rarely thereafter. Since the mid-1990s, most (96 to 100 percent) beluga whales in upper Cook Inlet have been concentrated in shallow areas near river mouths, no longer occurring in the central or southern portions of Cook Inlet (Hobbs et al. 2008). Based on these aerial surveys, the concentration of beluga whales in the northernmost portion of Cook Inlet appears to be consistent from June to October (Rugh et al. 2000, 2004a, 2004b, 2005, 2006, 2007).

4.6.3 Seasonal distribution

Though Cook Inlet beluga whales can be found throughout the inlet at any time of year, generally, they spend the ice-free months in the upper Cook Inlet, shifting into the middle and lower Inlet in winter (Hobbs et al. 2005). In 1999, one beluga whale was tagged with a satellite transmitter, and its movements were recorded from June through September of that year. Since 1999, 18 beluga whales in upper Cook Inlet have been captured and fitted with satellite tags to provide information on their movements during late summer, fall, winter, and spring. Using location data from satellite-tagged Cook Inlet belugas, Ezer et al. (2013) found most tagged whales were in the lower to middle inlet (70 to 100% of tagged whales) during January through March, near the Susitna River Delta from April to July (60 to 90% of tagged whales) and in the Knik and Turnagain Arms from August to December.

During the spring and summer, beluga whales are generally concentrated near the warmer waters of river mouths where prey availability is high and predator occurrence is low (Moore et al. 2000). Beluga whales in Cook Inlet are believed to mostly calve between mid-May and mid-July, and concurrently breed between late spring and early summer (NMFS 2016a), primarily in upper Cook Inlet. Movement was correlated with the peak discharge of seven major rivers emptying into Cook Inlet. Boat-based surveys from 2005 to the present (McGuire and Stephens 2017), and initial results from passive acoustic monitoring across the entire inlet (Castellote et al. 2016) also support seasonal patterns observed with other methods, and other surveys confirm Cook Inlet belugas near the Kenai River during summer months (McGuire and Stephens 2017).

During the summer and fall, beluga whales are concentrated near the Susitna River mouth, Knik Arm, Turnagain Arm, and Chickaloon Bay (Nemeth et al. 2007) where they feed on migrating eulachon (*Thaleichthys pacificus*) and salmon (*Onchorhyncus* spp.) (Moore et al. 2000). Data from tagged whales (14 tags between July and March 2000 through 2003) show beluga whales use upper Cook Inlet intensively between summer and late autumn (Hobbs et al. 2005). Critical Habitat Area 1 reflects this summer distribution (Figure 12).

As late as October, beluga whales tagged with satellite transmitters continued to use Knik Arm and Turnagain Arm and Chickaloon Bay, but some ranged into lower Cook Inlet south to Chinitna Bay, Tuxedni Bay, and Trading Bay (McArthur River) in the fall (Hobbs et al. 2005). Data from NMFS aerial surveys, opportunistic sighting reports, and satellite-tagged beluga whales confirm they are more widely dispersed throughout Cook Inlet during the winter months (November-April), with animals found between Kalgin Island and Point Possession. In November, beluga whales moved between Knik Arm, Turnagain Arm, and Chickaloon Bay, similar to patterns observed in September (Hobbs et al. 2005). By December, beluga whales were distributed throughout the upper to mid-inlet. From January into March, they moved as far south as Kalgin Island and slightly beyond in central offshore waters. Beluga whales also made occasional excursions into Knik Arm and Turnagain Arm in February and March despite ice cover greater than 90 percent (Hobbs et al. 2005).

During Apache's seismic test program in 2011 along the west coast of Redoubt Bay, lower Cook Inlet, a total of 33 beluga whales were sighted during the survey (Lomac-MacNair et al. 2013). During Apache's 2012 seismic program in mid-inlet, a total of 151 sightings of approximately 1,463 estimated individual beluga whales were observed (Lomac-MacNair et al. 2014). During SAExploration's 2015 seismic program, a total of eight sightings of approximately 33 estimated individual beluga whales were visually observed during this time period and there were two acoustic detections of beluga whales (Kendall et al. 2015). During Harvest Alaska's recent CIPL project on the west side of Cook Inlet in between Ladd Landing and Tyonek Platform, a total of 143 beluga whale sightings (814 individuals) were observed almost daily from May 31 to July 11, even though observations spanned from May 9 through September 15 (Sitkiewicz et al. 2018).

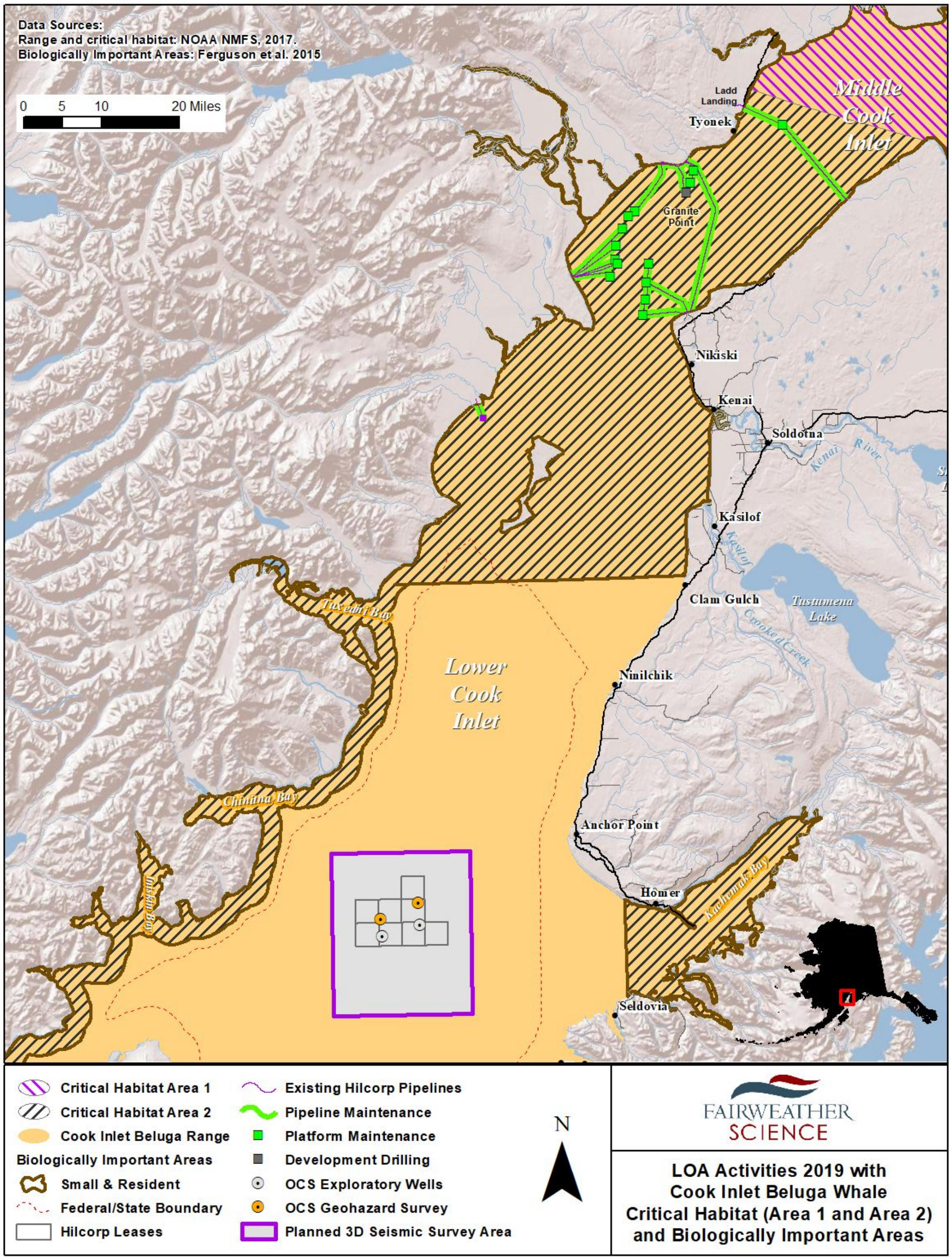

Figure 12. Distribution, critical habitat, and biologically important areas (BIAs) of Cook Inlet beluga whales in the LOA area.

Ferguson et al. (2015) delineated one ‘Small’ and ‘Resident’ BIA for Cook Inlet beluga whales. Small and Resident BIA’s are defined as “areas and time within which small and resident populations occupy a limited geographic extent” (Ferguson et al. 2015). The Cook Inlet beluga whale BIA was delineated using the habitat model results of Goetz et al. 2012 and the critical habitat boundaries (76 FR 20180).

4.7 HARBOR PORPOISE

In Alaskan waters, three stocks of harbor porpoises are currently recognized for management purposes: Southeast Alaska, Gulf of Alaska, and Bering Sea Stocks (Muto et al. 2017). Porpoises found in Cook Inlet belong to the Gulf of Alaska Stock which is distributed from Cape Suckling to Unimak Pass and most recently was estimated to number 31,046 individuals (Muto et al. 2017). They are one of the three marine mammals (the other two being belugas and harbor seals) regularly seen throughout Cook Inlet (Nemeth et al. 2007), especially during spring eulachon and summer salmon runs.

4.7.1 Status

Harbor porpoises are not designated as depleted under the MMPA or listed as threatened or endangered under the ESA.

4.7.2 Distribution

Harbor porpoises primarily frequent the coastal waters of the Gulf of Alaska and Southeast Alaska (Dahlheim et al. 2000, 2008), typically occurring in waters less than 100 m deep (Hobbs and Waite 2010). The range of the Gulf of Alaska stock includes the entire Cook Inlet, Shelikof Strait, and the Gulf of Alaska (Figure 13). Harbor porpoises have been reported in lower Cook Inlet from Cape Douglas to the West Foreland, Kachemak Bay, and offshore (Rugh et al. 2005). Although they have been frequently observed during aerial surveys in Cook Inlet (Shelden et al. 2014), most sightings are of single animals, and are concentrated at Chinitna and Tuxedni bays on the west side of lower Cook Inlet (Rugh et al. 2005) and in the upper inlet.

The occurrence of larger numbers of porpoise in the lower Cook Inlet may be driven by greater availability of preferred prey and possibly less competition with beluga whales, as belugas move into upper inlet waters to forage on Pacific salmon, *Oncorhynchus* spp., during the summer months (Shelden et al. 2014).

4.7.3 Seasonal Distribution

The harbor porpoise frequently has been observed during summer aerial surveys of Cook Inlet, with most sightings of individuals concentrated at Chinitna and Tuxedni Bays on the west side of lower Cook Inlet (Figure 13; Rugh et al. 2005). Mating probably occurs from June or July to October, with peak calving in May and June (as cited in Consiglieri et al. 1982). Small numbers of harbor porpoises have been consistently reported in the upper Cook Inlet between April and October, except for a recent survey that recorded higher numbers than typical. NMFS aerial surveys have identified many harbor porpoise sightings throughout Cook Inlet: 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2004, 2005, 2007, 2008, 2009, 2010, 2011, 2012, 2014, and 2016. During Apache’s 2012 seismic program, 137 sightings (190 individuals) were observed between May and August (Lomac-MacNair et al. 2013). Lomac-MacNair et al. 2014 identified 77 groups of harbor porpoise totaling 13 individuals during Apache’s 2014 seismic survey, both from vessels and aircraft, during the month of May. During SAExploration’s 2015 seismic survey, 52 sightings (65 individuals) were observed north of the Forelands (Kendall et al. 2015).

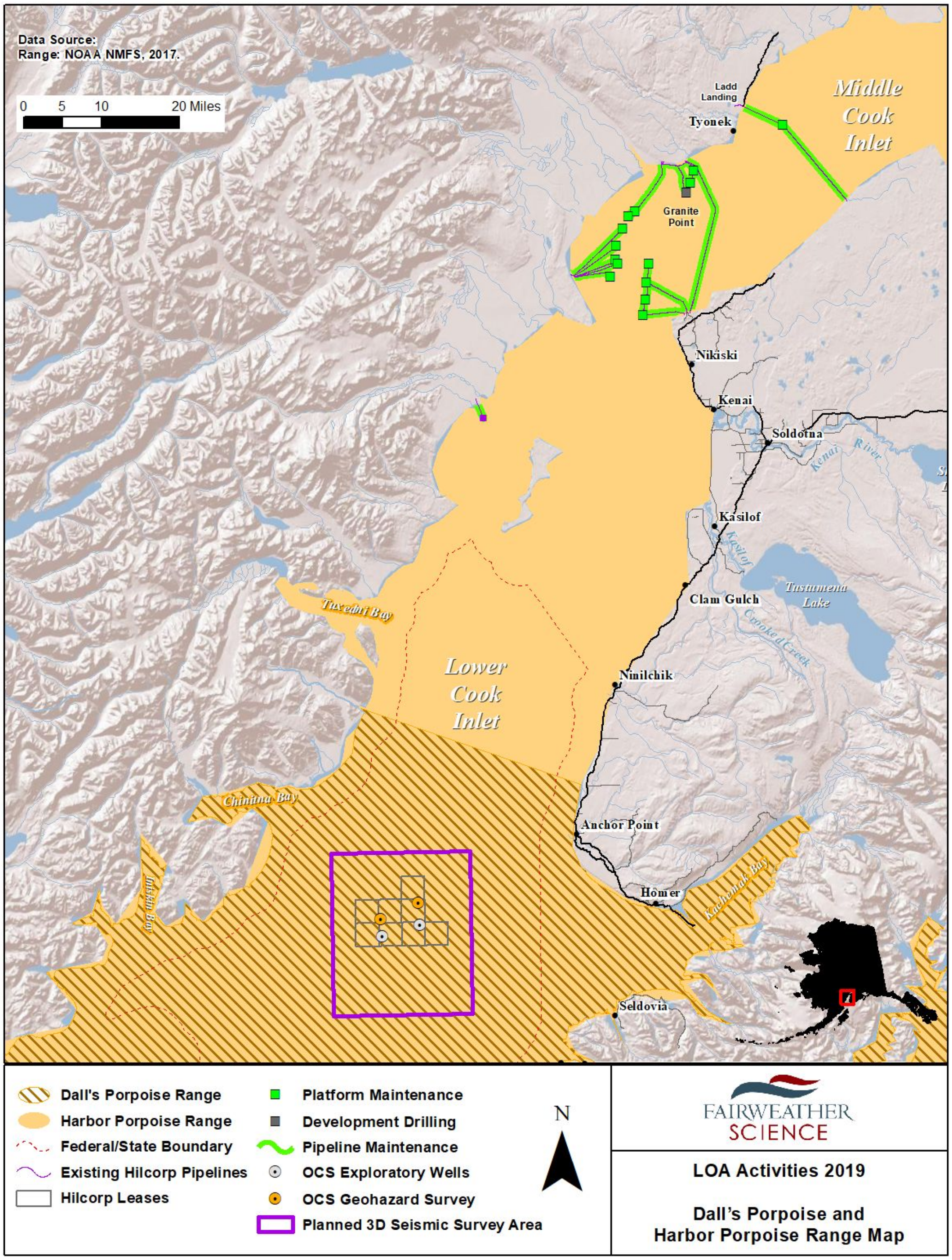

Figure 13. Distribution of Dall's porpoises and harbor porpoises in the LOA area.

A total of 29 sightings (44 individuals) were observed north of the Forelands from May to September during the Harvest Alaska CIPL project (Sitkiewicz et a. 2018). Recent passive acoustic research in Cook Inlet by Alaska Department of Fish and Game (ADF&G) and NMML have indicated that harbor porpoises occur more frequently than expected, particularly in the West Foreland area in the spring (Castellote et al. 2016), although overall numbers are still unknown at this time. Because harbor porpoises have been observed throughout Cook Inlet during the summer months, including mid-inlet waters, they represent one species that could be encountered throughout Cook Inlet.

4.8 DALL'S PORPOISE

4.8.1 Status

Dall's porpoises are not designated as depleted under the MMPA or listed as threatened or endangered under the ESA (Muto et al. 2017). The abundance estimate for the Alaska Stock of Dall's porpoise is 83,400 animals (Muto et al. 2017), making it one of the more abundant cetaceans in Alaskan waters.

4.8.2 Distribution

Dall's porpoises are widely distributed throughout the North Pacific Ocean including preferring deep offshore and shelf-slopes, and deep oceanic waters (Muto et al. 2017). The Dall's porpoise range in Alaska extends into the southern portion of the Petition region (Figure 13). Dall's porpoises are present year-round throughout their entire range in the northeast including the Gulf of Alaska, and occasionally the Cook Inlet area (Morejohn 1979). This porpoise also has been observed in lower Cook Inlet, around Kachemak Bay, and rarely near Anchor Point (Owl Ridge 2014; BOEM 2015).

4.8.3 Seasonal distribution

Throughout most of the eastern North Pacific they are present during all months of the year, although there may be seasonal onshore-offshore movements along the west coast of the continental U.S. and winter movements of populations out of areas with ice such as Prince William Sound (Muto et al. 2017). Dall's porpoises were observed (2 groups, 3 individuals) during Apache's 2014 seismic survey which occurred in the summer months (Lomac-MacNair et al. 2014). Dall's porpoises were observed during the month of June in 1997 (Iniskin Bay), 199 (Barren Island), and 2000 (Elizabeth Island, Kamishak Bay and Barren Island) (Shelden et al. 2013). Dall's porpoises have been observed in lower Cook Inlet, including Kachemak Bay and near Anchor Point (Owl Ridge 2014). One Dall's porpoise was observed in August north of Nikiski in the middle of the Inlet during SAExploration's 2015 seismic program (Kendall et al. 2015).

4.9 HARBOR SEAL

4.9.1 Status

No harbor seal stocks in Alaska are designated as depleted under the MMPA or listed as threatened or endangered under the ESA (Muto et al. 2017). Harbor seals are common in Alaskan waters with statewide abundance estimates at 152,602 animals (Muto et al. 2017; Figure 14). The Cook Inlet/Shelikof Stock, ranging approximately from Anchorage down along the south side of the Alaska Peninsula to Unimak Pass is estimated at a stable 27,386 animals (Muto et al. 2017).

In 2010, NMFS and their co-management partners, the Alaska Native Harbor Seal Commission, defined 12 separate stocks of harbor seals based largely on genetics. The harbor seal stocks present in or near the Petition region include the Cook Inlet/Shelikof Stock. In 2006, the estimated abundance was 22,900 animals with a minimum population estimate of 21,896 (Muto et al. 2017).

4.9.2 Distribution

Harbor seals occupy a wide variety of habitats in freshwater and saltwater in protected and exposed coastlines and range from Baja California north along the west coasts of Washington, Oregon, and California, British Columbia, and Southeast Alaska; west through the Gulf of Alaska, Prince William Sound, and the Aleutian Islands; and north in the Bering Sea to Cape Newenham and the Pribilof Islands. Harbor seals are found throughout the entire lower Cook Inlet coastline, hauling out on beaches, islands, mudflats, and at the mouths of rivers where they whelp and feed (Muto et al. 2017).

4.9.3 Seasonal distribution

The major haul out sites for harbor seals are located in lower Cook Inlet. The presence of harbor seals in upper Cook Inlet is seasonal (Figure 14). In Cook Inlet, seal use of western habitats is greater than use of the eastern coastline (Boveng et al. 2012). NMFS has documented a strong seasonal pattern of more coastal and restricted spatial use during the spring and summer for breeding, pupping, and molting, and more wide-ranging seal movements within and outside of Cook Inlet during the winter months (Boveng et al. 2012). Large-scale patterns indicate a portion of harbor seals captured in Cook Inlet move out of the area in the fall, and into habitats within Shelikof Strait, Northern Kodiak Island, and coastal habitats of the Alaska Peninsula, and are most concentrated in Kachemak Bay, across Cook Inlet toward Iniskin and Iliamna Bays, and south through the Kamishak Bay, Cape Douglas and Shelikof Strait regions (Boveng et al. 2012).

A portion of the Cook Inlet seals move into the Gulf of Alaska and Shelikof Strait during the winter months (London et al. 2012). Seals move back into Cook Inlet as the breeding season approaches and their spatial use is more concentrated around haul-out areas (Boveng et al. 2012; London et al. 2012). Some seals expand their use of the northern portion of Cook Inlet, however, in general, seals that were captured and tracked in the southern portion of Cook Inlet remained south of the Forelands (Boveng et al. 2012). Important harbor seal haul-out areas occur within Kamishak and Kachemak Bays and along the coast of the Kodiak Archipelago and the Alaska Peninsula. Chinitna Bay, Clearwater and Chinitna Creeks, Tuxedni Bay, Kamishak Bay, Oil Bay, Pomeroy and Iniskin Islands, and Augustine Island are also important spring-summer breeding and molting areas and known haul-outs sites (Figure 14). Small-scale patterns of movement within Cook Inlet also occur (Boveng et al. 2012). Montgomery et al. (2007) recorded over 200 haul out sites in lower Cook Inlet alone. However, only a few dozens to a couple hundred seals seasonally occur in upper Cook Inlet (Rugh et al. 2005), mostly at the mouth of the Susitna River where their numbers vary in concert with the spring eulachon and summer salmon runs (Nemeth et al. 2007; Boveng et al. 2012).

The Cook Inlet/Shelikof Stock 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). Large numbers concentrate at the river mouths and embayments of lower Cook Inlet, including the Fox River mouth in Kachemak Bay, and several haul outs have been identified on the southern end of Kalgin Island in lower Cook Inlet (Rugh et al. 2005; Boveng et al. 2012). Montgomery et al. (2007) recorded over 200 haul-out sites in lower Cook Inlet alone.

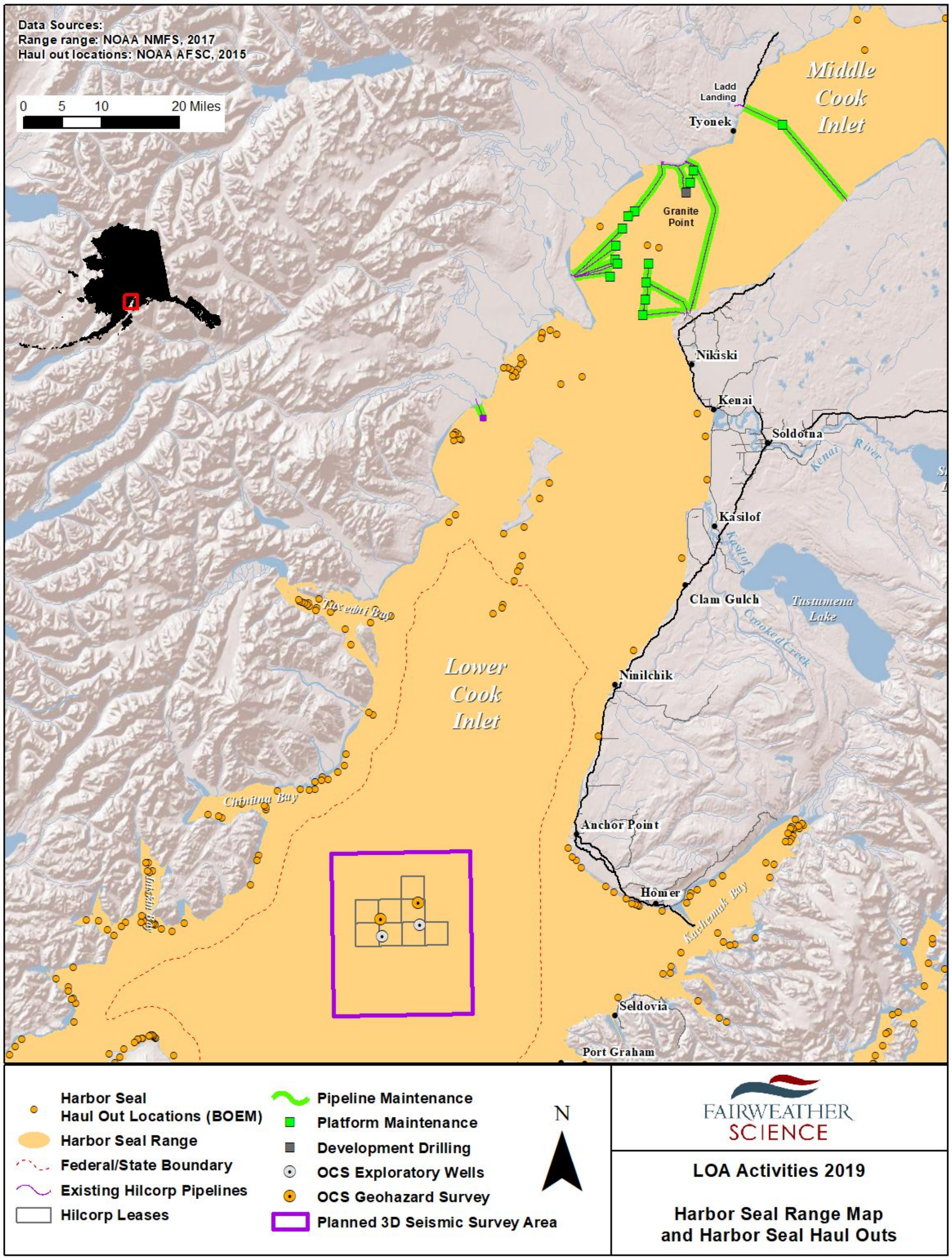

Figure 14. Distribution and haul out sites of harbor seals in the LOA area.

NMFS aerial surveys have identified many harbor seals sightings throughout Cook Inlet: 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2014, and 2016. During Apache's 2012 seismic program, harbor seals were observed in the project area from early May until the end of the seismic operations in late September (Lomac-MacNair et al. 2013). Also 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 Apache's 2012 Cook Inlet seismic program. During Apache's 2014 seismic program, 492 groups of harbor seals (613 individuals) were observed; this highest sighting rate of any marine mammal observed during the summer of 2014 (Lomac-MacNair et al. 2014). During SAExploration's 2015 seismic survey, 823 sightings (1,680 individuals) were observed north and between the Forelands (Kendall et al. 2015). Recently, a total of 313 sightings (316 individuals) were observed near Ladd Landing for the Harvest Alaska CIPL project during the summer (Sitkiewicz et al. 2018).

4.10 STELLER SEA LION

The western DPS (WDPS) stock of Steller sea lions most likely occurs in Cook Inlet (78 FR 66139). The center of abundance for the Western DPS is considered to extend from Kenai to Kiska Island (NMFS 2008b). The WDPS of the Steller sea lion is defined as all populations west of longitude 144°W to the western end of the Aleutian Islands. The range of the WDPS includes 38 rookeries and hundreds of haul out sites. The Petition only considers the WDPS stock. The most recent comprehensive aerial photographic and land-based surveys of WDPS Steller sea lions in Alaska were conducted during the 2014 and 2015 breeding seasons (Fritz et al. 2015). Western Steller sea lion pup and non-pup counts in 2015 in Alaska were estimated to be 12,492 and 38,491, respectively (Fritz et al. 2015), which total 50,983 and is used as the minimum population estimate for the U.S. portion of the WDPS of Steller sea lions (Wade and Angliss 1997).

4.10.1 Status

The WDPS of Steller sea lions is currently listed as endangered under the ESA (55 FR 49204) and designated as depleted under the MMPA. Critical habitat was designated on August 27, 1993 (58 FR 45269) south of the proposed project area in the Cook Inlet region (Figure 15). The critical habitat designation for the WDPS of Steller sea lions was determined to include a 37 km (20 nautical mile [nm]) buffer around all major haul outs and rookeries, and associated terrestrial, atmospheric, and aquatic zones, plus three large offshore foraging areas (Figure 15). NMFS also designated no entry zones around rookeries (50 Code of Federal Regulations [CFR] 223.202). Designated critical habitat is located outside Cook Inlet at Gore Point, Elizabeth Island, Perl Island, and Chugach Island (NMFS 2008b).

4.10.2 Distribution

The geographic center of Steller sea lion distribution is the Aleutian Islands and the Gulf of Alaska, although as the WDPS has declined, rookeries in the west became progressively smaller (NMFS 2008b). Steller sea lion habitat includes terrestrial sites for breeding and pupping (rookeries), resting (haul outs), and marine foraging areas. Nearly all rookeries are at sites inaccessible to terrestrial predators on remote rocks, islands, and reefs.

Steller sea lions inhabit lower Cook Inlet, especially near Shaw Island and Elizabeth Island (Nagahut Rocks) haul out sites (Rugh et al. 2005) but are rarely seen in upper Cook Inlet (Nemeth et al. 2007). Steller sea lions occur in Cook Inlet but south of Anchor Point around the offshore islands and along the west coast of the upper inlet in the bays (Chinitna Bay, Iniskin Bay, etc.) (Rugh et al. 2005). Portions of the southern reaches of the lower inlet are designated as critical habitat, including a 20-nm buffer around all major haul out sites and rookeries. Rookeries and haul out sites in lower Cook Inlet include those near the mouth of the inlet, which are far south of the project area.

Steller sea lions feed largely on walleye pollock (*Theragra chalcogramma*), salmon (*Onchorhyncus* spp.), and arrowtooth flounder (*Atheresthes stomias*) during the summer, and walleye pollock and Pacific cod (*Gadus macrocephalus*) during the winter (Sinclair and Zeppelin 2002), none which, except for salmon, are found in abundance in upper Cook Inlet (Nemeth et al. 2007).

4.10.3 Seasonal distribution

Steller sea lions can travel considerable distances (Baba et al. 2000). Steller sea lions are not known to migrate annually, but individuals may widely disperse outside of the breeding season (late-May to early-July; Jemison et al. 2013; Allen and Angliss 2014). Most adult Steller sea lions inhabit rookeries during the breeding season (late May to early July); some juveniles and non-breeding adults occur at or near rookeries during the breeding season, but most are on haul outs. Adult males may disperse widely after the breeding season and during fall and winter, many sea lions increase use of haul outs, especially terrestrial sites but also on sea ice in the Bering Sea (NMFS 2008b).

Steller sea lions have been observed during marine mammal surveys conducted in Cook Inlet. In 2012, during Apache's 3D Seismic surveys, there were three sightings of approximately four individuals in upper Cook Inlet (Lomac-MacNair et al. 2013). Marine mammal observers associated with Buccaneer's drilling project off Cape Starichkof observed seven Steller sea lions during the summer of 2013 (Owl Ridge 2014). During SAExploration's 3D Seismic Program in 2015, four Steller sea lions were observed in Cook Inlet. One sighting occurred between the West and East Forelands, one near Nikiski and one northeast of the North Foreland in the center of Cook Inlet (Kendall et al. 2015). During NMFS Cook Inlet beluga whale aerial surveys from 2000-2016, there were 39 sightings of 769 estimated individual Steller sea lions in lower Cook Inlet (Shelden et al. 2017). Sightings of large congregations of Steller sea lions during NMFS aerial surveys occurred outside the Petition region, on land in the mouth of Cook Inlet (e.g., Elizabeth and Shaw Islands).

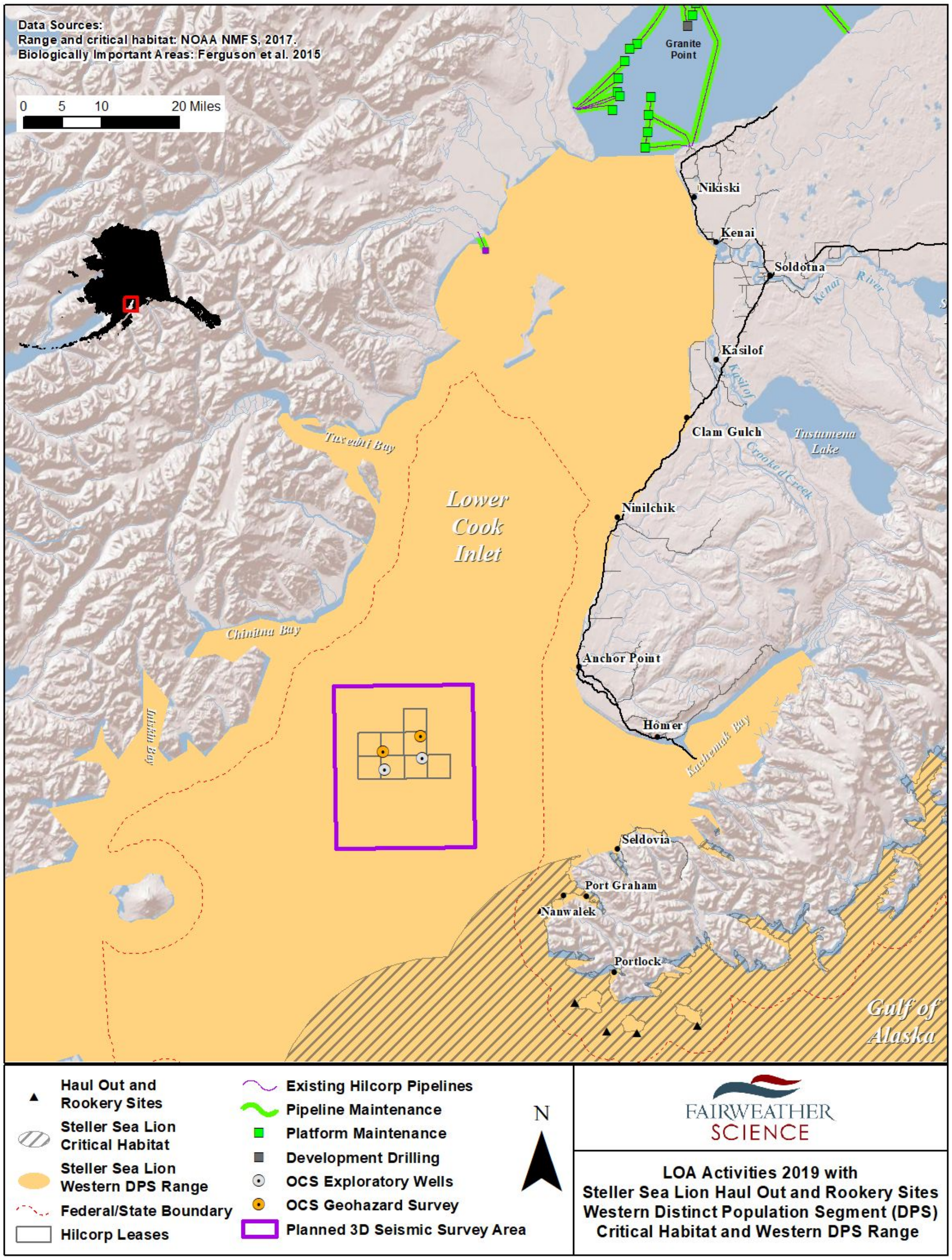

Figure 15. Distribution, haul out and rookery sites, and critical habitat of the western distinct population segment (WDPS) of Steller sea lions in the LOA area.

4.11 CALIFORNIA SEA LION

There is limited information on the presence of California sea lions in Alaska. From 1973 to 2003, a total of 52 California sea lions were reported in Alaska, with sightings increasing in the later years. Most sightings occurred in the spring, however, they have been observed during all seasons. California sea lion presence in Alaska was correlated with increasing population numbers within their southern breeding range (Maniscalco et al. 2004).

4.11.1 Status

California sea lions in the U.S. are not listed as endangered or threatened under the ESA or as depleted under the MMPA. The growth rate of the species is approximately 5.4% annually, and the population estimate is 296,750 (Allen and Angliss 2015). The OSP status of the population has not been formally determined. The total human-caused mortality of this stock is considered to be insignificant and approaching zero mortality and serious injury rate. California sea lions are not considered strategic under the MMPA, and no critical habitat has been designated or proposed for California sea lions.

4.11.2 Distribution

California sea lions are distributed along the North Pacific waters from central Mexico to southeast Alaska, with breeding areas on islands located in southern California, western Baja California, and the Gulf of California (Allen and Angliss 2015). There are five genetically distinct geographic populations: Pacific Temperate, Pacific Subtropical, Southern Gulf of California, Central Gulf of California, and Northern Gulf of California (Schramm et al. 2009). Males, and occasionally females, migrate long distances from the colonies, and animals from the pacific temperate population range into Canadian waters and beyond (Allen and Angliss 2015).

There have been relatively few California sea lions observed in Alaska, most are often alone or occasionally in small groups of two or more and usually associated with Steller sea lions at their haulouts and rookeries (Maniscalco et al. 2004). California sea lions are not typically observed farther north than southeast Alaska, and sightings are very rare in Cook Inlet. California sea lions have not been observed during the annual NMFS aerial surveys in Cook Inlet. However, a sighting of two California sea lions was documented during for the Apache 2012 seismic survey (Lomac-MacNair et al. 2013). Additionally, NMFS' anecdotal sighting database has four sightings in Seward and Kachemak Bay.

4.11.3 Seasonal distribution

The California sea lion breeds from the southern Baja Peninsula north to Año Nuevo Island, California. Breeding season lasts from May to August, and most pups are born from May through July. Their nonbreeding range extends northward into British Columbia and occasionally farther north into Alaskan waters. California sea lions have been observed in Alaska during all four seasons, however, most of the sightings have occurred during the spring (Maniscalco et al. 2004).

5.0 REQUESTED TYPE OF INCIDENTAL TAKING AUTHORIZATION

The type of incidental taking authorization that is being requested and the method of incidental taking.

Hilcorp Alaska and Harvest Alaska request NMFS to issue an LOA for Year 1 under the soon-to-be promulgated ITRs for the incidental take by harassment (as defined in 50 CFR 216.3) of a small number of marine mammals during oil and gas operations in Cook Inlet from July 1, 2019 through July 1, 2020. The operations outlined in Section 1 have the potential to result in incidental takes of marine mammals by acoustic exposure during various oil and gas operations. The effects will depend on the species and received level of the sound (Section 6). Temporary disturbance or localized displacement reactions may potentially occur.

Hilcorp Alaska is requesting a small number of Level A takes for humpback whales, Dall's porpoises, harbor porpoises, and harbor seals. Hilcorp Alaska does not anticipate that any of the activities will result in mortality or serious injury to marine mammals, but these species may be exposed to Level A SEL levels. Hilcorp Alaska is requesting a small number of Level B takes for all other species. Implementation of the mitigation and monitoring measures described in Sections 11 and 13 will minimize Level A and Level B harassment.

6.0 NUMBER OF INCIDENTAL TAKES BY ACTIVITIES

By age, sex, and reproductive condition, the number of marine mammals [by species] that may be taken by each type of taking, and the number of times such takings by each type of taking are likely to occur.

A detailed description of exploration and production activities that are planned in the geographic region (Figure 3) and during the scope of this Year 1 LOA (July 1, 2019-July 1, 2020) is provided in Section 1 and summarized in Table 1**.** The planned activities that have the potential to temporarily disturb or displace small numbers of marine mammals in Cook Inlet are discussed in this section. The mitigation measures to be implemented during various activities are based on the Level A and B harassment acoustic criteria defined below. This section provides information on the applicable noise criteria, a description of the noise sources for the activities, and a description of the methods used to calculate numbers of marine mammals that may be potentially encountered during the activities included in the scope of this LOA request.

6.1 APPLICABLE NOISE CRITERIA

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

For Level A, the NOAA Technical Memorandum NMFS-OPR (NMFS 2016b) provides guidelines for assessing the onset of permanent threshold shifts (PTS) from anthropogenic sound. Under this guideline, marine mammals are separated into five functional hearing groups; source types are separated into impulsive (e.g., seismic) and non-impulsive; and require analyses of the distance to the peak received sound pressure level (SPL); L_{pk}) and 24-hr cumulative SEL (SEL_{24h}).

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

Table 6 provides a summary of the disturbance guidelines. For purposes of this section, all underwater SPLs are reported as dB re 1 µPa.

Table 6. Summary of NMFS acoustic thresholds.

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

6.2 DESCRIPTION OF SOUND SOURCES

Section 1 describes the various types of activities, as well as general location and timing of these activities in the geographic region and timing of this LOA request. The acoustic characteristics of each of the activities are described in the following section and summarized in Table 7. Not all sources of noise will result in Level A or B acoustic harassment; each description identifies whether this source was included in the evaluation of harassment.

Table 7. Summary of noise sources for each activity.

Activity	Sound Pressure Levels (dB re 1 µPa)	Frequency	Reference
General vessel operations	145-175 dB rms at 1 m	10 Hz – 1,500 Hz	Richardson et al. 1995; Blackwell and Greene 2003; Ireland and Bisson 2016
General aircraft operations	100-124 dB rms at 1 m	<500 Hz	Richardson et al. 1995
3D seismic survey (2400 cui airgun)	217 dB peak at 100 m 185 dB SEL at 100 m 197 dB rms at 100 m	<300 Hz	Austin and Warner 2012; 81 FR 47239
Geohazard Surveys	210-220 dB rms at 1 m	Echosounders & side scan sonar: >200 kHz High resolution sub-bottom profiler: 2-24 kHz Low resolution sub-bottom profiler: 1-4 kHz	Manufacturer specifications
Development drilling rig	137 dB rms at 1 m	<200 Hz	Marine Acoustics Inc. 2011
Tugs under load towing rig	167 dB rms 1 at m	<500 Hz	Austin et al. 2013
Offshore production platforms	97-111 dB rms at 0.3-19 km	<500 Hz	Blackwell and Greene 2003
Water jet	176 dB rms at 1 m	500 Hz – 2 kHz	Austin 2017
Hydraulic grinder	159 dB at 1 m	<1 kHz	Stanley 2014
Drones	100 dB rms at 1 m	<500 Hz	Christiansen et al. 2016
Pingers	192 dB rms at 1 m	4-14 kHz	Manufacturer specifications

6.2.1 Vessels Operations

Vessels of various types and sizes are used to support all the activities include in the scope of this LOA, specifically for crew and supplies transfer for rigs, platforms, and other maintenance activities. Vessels are major contributors to the overall acoustic environment (Richardson et al. 1995), particularly in the Alaska and the Arctic region (Huntington et al. 2015). In a 2012 Cook Inlet Vessel Traffic Study Report (Cape International, Inc. 2012), patterns of activities were described for vessels over 300 gross tons operating during 2010. Results showed that there were 480 port calls or transits through Cook Inlet, with 80% of the transits made by 15 ships for the purpose of crude oil and product transport, packaged commodity shipments, and passenger/vehicle carriage. This class of vessel is characterized with source levels of 160 to 200 dB re 1 µPa rms at 1 m within the 6 to 500 Hertz (Hz) range (Richardson et al. 1995).

Position-keeping in Cook Inlet is a challenge due to the strong currents, so some vessels use dynamic positioning (DP) with bow thrusters when anchoring is not possible. Ireland and Bisson (2016) measured source levels from 148.5 dB re 1 µPa rms at 1 m at 2,000 Hz to 174.5 dB re 1 µPa rms at 1 m at 10 Hz with 100% of all four thrusters.

Blackwell and Greene (2003) recorded underwater noise produced by both large and small vessels near the Port of Anchorage (POA). The *Leo* tugboat produced the highest broadband levels of 149 dB re 1 µPa at a distance of approximately 100 m, while the docked *Northern Lights* (cargo freight ship) produced the lowest broadband levels of 126 dB re 1 µPa at 100-400 m. Ship noise was generally below 1 kiloHertz (kHz).

Although vessels are a potential source of disturbance for marine mammals, NMFS does not generally regulate incidental harassment for transiting vessels; therefore, vessel noise was not used to evaluate potential Level A or B acoustic harassment in this LOA.

6.2.2 Aircraft Operations

Helicopters and fixed wing aircraft are used to support all the activities included in the scope of this LOA. Helicopters are used for crew changes and supplies for platforms, drilling rigs, and with the 3D seismic survey. Flight routes will follow a direct route to and from the rig or platform location, and flight heights will be maintained 300 to 450 m (1,000 to 1,500 ft) AGL, as practicable, to avoid acoustical harassment of marine mammals.

Helicopters and fixed-wing aircraft generate noise from their engines, airframe, and propellers. The dominant tones for both types of aircraft generally are <500 Hz (Richardson et al. 1995). Richardson et al. (1995) reported that received sound levels in water from aircraft flying at an altitude of 152 m (approximately 500 ft) were 109 dB re 1 μPa for a Bell 212 helicopter, 101 dB re 1 μPa for a small fixed-wing aircraft, 107 dB re 1 μPa for a twin otter, and 124 dB re 1 μPa for a P-3 Orion.

Penetration of aircraft noise into the water is greatest directly below the aircraft; at angles >13 degrees from vertical, much of the sound is reflected and does not penetrate (Richardson et al. 1995). Duration of underwater sound from passing aircraft is much shorter in water than air; for example, a helicopter passing at an altitude of 152 m (approximately 500 ft), audible in air for 4 minutes, may be detectable underwater for 38 seconds at 3 m (10 ft) depth, and 11 seconds at 18 m (59 ft) depth (Richardson et al. 1995).

Because aircraft operations will maintain an altitude of greater than 300 m (1,000 ft) when practicable, levels are anticipated to be below the NMFS criteria; therefore, aircraft was not used to evaluate potential Level A or B acoustic harassment of marine mammals in this LOA.

6.2.3 3D Seismic Survey

As described in 1.3.1, Hilcorp Alaska plans to collect 3D seismic data in the Federal OCS waters in lower Cook Inlet over a 45-60 day period in 2019 or 2020 (Figure 3). The planned volume of the airgun array is 1,945 cui. Polarcus will be conducting detailed modeling of the array output, but a detailed SSV has not been conducted for this array in Cook Inlet. Therefore, for the purposes of estimating acoustic harassment, results from previous seismic surveys in Cook Inlet by Apache and SAExploration, particularly the 2,400 cui array, were used. Apache conducted an SSV for the 440 cui and 2,400 cui arrays in 2012 (Austin and Warner 2013; 81 FR 47239). The location of the SSV was in Beshta Bay on the western side of Cook Inlet (between Granite Point and North Forelands). Water depths ranged from 30-70 m (98-229 ft).

For the 2,400 cui array, the measured levels for the endfire direction were 217 dB peak, 185 dB SEL, and 197 dB rms at a distance of 100 m (328 ft). The estimate distance to the 160 dB rms (90^{th} percentile) thresholds assuming the empirically measured transmission loss of 16.9 log R was 7,770 m (4.8 mi). Sound levels near the source were highest between 30 and 150 Hz in the endfire direction and between 50 and 200 Hz in the broadside direction. However, as part of the Apache ITR process, JASCO provided an updated distance of 7,330 m (4.55 mi) for a 24-hour survey (81 FR 47239). We used the distance of 7,300 m (4.55 mi) for estimation of take for the 2D/3D survey to be consistent with the Apache ITR. It is important to note that neither survey by Hilcorp Alaska is expected to use an airgun array of 2,400 cui; both will be less than this. Further, an SSV will be performed to characterize the actual array and environmental parameters for the area to be surveyed.

These measured levels were used to evaluate potential Level A (217 dB peak and 185 dB SEL at 100 m [328 ft] assuming 15 log transmission loss) and B (7,330 m distance to 160 dB threshold) acoustic harassment of marine mammals in this LOA.

6.2.4 Offshore Production Platforms

There are 17 oil production platforms in Cook Inlet, 15 of which are owned by Hilcorp Alaska (Figure 3). The two remaining platforms are owned by Furie (KLU Platform A) and Glacier Oil and Gas (Osprey). Table 3 summarizes each of the Hilcorp Alaska-owned platforms. Measurements of broadband sound pressure levels near the Phillips A Platform ranged from 97 to 111 dB re 1 μPa rms at 0.3 to 19 km (0.2-11.8 mi; Blackwell and Greene 2003).

Because these measured levels do not exceed the NMFS criteria, noise from drilling was not considered further to evaluate potential Level A or Level acoustic harassment in this LOA.

6.2.4.1 Development Drilling

Hilcorp Alaska plans to conduct a multi-well development drilling program at the Granite Point Platform between June and November 2019. It is expected that each well will take approximately 40-60 days to drill and test. The acoustic sources associated with drilling include the jack-up rig, mobilization of the rig, helicopter operations, and vessel operations. The acoustic characteristics of vessel and helicopters were described earlier in this section. A geohazard survey would be conducted to locate potential hazards prior to drilling, with the exception of the use of a sub-bottom profiler. Because the wells are sidetracks, there is no need to survey beneath the seafloor so only echosounders and side scan sonar are used (all above 200 kHz).

Because these measured levels do not exceed the NMFS criteria, noise from drilling was not considered further to evaluate potential Level A or Level acoustic harassment in this LOA.

6.2.5 Geohazard and Geotechnical Survey

Hilcorp Alaska plans to collect geohazard and geotechnical data 2020 after the 3D seismic survey and before drilling the lower Cook Inlet OCS wells (Section 1, Figure 3). The typical survey duration in each location is approximately 30 days. The surveys are conducted from a single support vessel. The suite of equipment used during a typical geohazards survey consists of single beam and multi-beam echosounders, side scan sonar, sub-bottom profiler, and magnetometer. Sub-bottom profilers and magnetometers are typically towed from the vessel, while echosounders and side scan sonars are typically hull-mounted. The acoustic characteristics for each piece of equipment are summarized in Table 8 and in the following text.

NMFS does not consider sounds over 200 kHz to be harmful to marine mammals; therefore, only reported levels assuming 15 log transmission loss for equipment under 200 kHz (i.e., sub-bottom profilers) are used to evaluate potential Level A and B acoustic harassment of marine mammals in this LOA.

6.2.5.1 Multibeam Echosounder

The proposed multi-beam echosounder operates at source level of a maximum of 220 dB re 1 μPa rms at 1 m. The multibeam echosounder emits high frequency (240 kHz) energy in a fan-shaped pattern of equidistant or equiangular beam spacing. The beam width of the emitted sound energy in the along-track direction is 1.5 degrees, while the across track beam width is 1.8 degrees. The maximum ping rate of the multibeam echosounder is 40 Hz.

The proposed single-beam echosounder operates at source level of approximately 220 dB re 1 μPa rms at 1 m. The transducer selected uses a frequency of 210 kHz and has a ping rate of up to 20 Hz. The transducer's beam width is approximately 3 degrees.

6.2.5.2 Side Scan Sonar

The proposed side scan sonar system will operate at about 400 kHz and 900 kHz. The source level is 215 dB re 1μPa rms at 1 m (3.28 ft). The sound energy is emitted in a narrow fan-shaped pattern, with a horizontal beamwidth of 0.45 degrees for 400 kHz and 0.25 degrees at 900 kHz, with a vertical beam width of 50 degrees. The maximum ping rate is 75 Hz.

6.2.5.3 Sub-Bottom Profiler

The proposed high-resolution sub-bottom profiler operates at source level of 210 dB re 1 μPa rms at 1 m (3.28 ft). The proposed system emits energy in the frequency bands of 2 to 24 kHz. The beam width is 15 to 24 degrees. Typical pulse rate is between 3 and 10 Hz. The secondary low-resolution sub-bottom profiler will be utilized as necessary to increase sub-bottom profile penetration. The proposed system emits energy in the frequency bands of 1 to 4 kHz.

Because these measured levels do exceed the NMFS criteria and are within the hearing range of marine mammals, noise from sub-bottom profilers was considered further to evaluate potential Level A or Level B acoustic harassment in this LOA.

6.2.5.4 Magnetometer

A marine magnetometer will be used for the detection of magnetic deflection generated by geologic features and buried or exposed ferrous objects which may be related to archaeological artifacts or modern man-made debris. The magnetometer will be towed at a sufficient distance behind the vessel to avoid data pollution by the vessel's magnetic properties. Magnetometers passively measure changes in magnetic fields over the seabed and do not impact marine mammals.

Table 8. Typical acoustic characteristics of geohazard sources.

Equipment	Model (or similar)	Source Level	Frequency
Single beam echosounder	Odom SMBB200	220 dB re 1 μPa at 1 m	210 kHz
Multi-beam echosounder	Reson 7101	220 dB re 1 μPa at 1 m	240 kHz
Side scan sonar	Edgetech 4125	215 dB re 1 μPa at 1 m	400 kHz / 900 kHz
High resolution sub-bottom profiler	Edgetech 3200	210 dB re 1 μPa at 1 m	2-24 kHz
Low resolution sub-bottom profiler	Applied Acoustics AA251	212 dB re 1 μPa at 1 m	1-4 kHz

6.2.5.5 Drilling Rig

Hilcorp Alaska proposes to conduct development drilling using a jack-up rig similar to the *Spartan 151* drill rig. Furie Operating Alaska, LLC (Furie) performed detailed underwater acoustic measurements in the vicinity of the *Spartan 151* in 2011 (Marine Acoustics, Inc. 2011) northeast of Nikiski Bay in water depths of 24.4-27.4 m (80-90 ft). Primary sources of rig-based acoustic energy were identified as coming from the

D399/D398 diesel engines, the PZ-10 mud pump, ventilation fans (and associated exhaust), and electrical generators. The source level of one of the strongest acoustic sources, the diesel engines, was estimated to be 137 dB re 1 µPa rms at 1 m in the 141-178 Hz bandwidth. Based on this measured level, the 120 dB rms acoustic received level isopleth would be 50 m (154 ft) away from where the energy enters the water (jack-up leg or drill riser).

Because these measured levels do not exceed the NMFS criteria, noise from drilling was not considered further to evaluate potential Level A or Level B acoustic harassment in this LOA.

6.2.5.6 Rig Mobilization

Depending on the rig selection and location, the drilling jack-up rig will be towed on site using up to three ocean-going tugs licensed to operate in Cook Inlet. Vessel speed during the rig tow is generally less than 5 knots. Three tugs are needed to maintain control and precisely position the rig at the drill site. The exact tugs are not known at this time but will be similar to what has been used for previous drilling projects in Alaska. For purposes of this LOA, the SSV for Shell's drilling activities in 2012 in the Chukchi Sea of the tug *Lauren Foss* towing the *Tuuq* was used (Austin et al. 2013). The source level was estimated to be 167 dB at 1 µPa rms at 1 m, with the estimated distance of 2,154 m to the 120 dB rms threshold. Per NMFS recommendation in the ITR process, tugs towing the rig were not considered further to evaluate Level A or Level B acoustic harassment in this LOA.

6.2.6 Routine Maintenance

As described in Section 1.4.4 routine maintenance activities include: subsea pipeline inspections, stabilizations, and repairs; platform leg inspections and repairs; and anode sled installations and/or replacement. Underwater acoustic sources that may result in disturbance include the DSV, side scan sonar operations, sub-bottom profiler, water jet, hydraulic grinders, pipe cutters, helicopters, and drones (UAS). The acoustic characteristics of vessel operations, side scan sonar, sub-bottom profiler, and helicopter operations were described earlier in this section. The following text describes the water jet, hydraulic grinders, underwater pipe cutter, and drone acoustic characteristics.

6.2.6.1 Water Jet and Hydraulic Grinder

A water jet is a zero-thrust water compressor that is used for underwater removal of marine growth or rock debris underneath the pipeline. The system operates through a mobile pump which draws water from the location of the work. Water jets likely to be used in Cook Inlet include, but are not limited to, the CaviDyne CaviBlaster® and the Gardner Denver Liqua-Blaster. Noise generated during the use of the water jets would be very short in duration (30 minutes or less at any given time) and intermittent.

Hilcorp Alaska conducted underwater measurements during 13 minutes of CaviBlaster® use in Cook Inlet in April 2017 (Austin 2017). Received sound levels were measured up to 143 dB re 1 µPa rms at 170 m (557.7 ft) and up to 127 dB re 1 µPa rms at 1,100 m (3,608 ft). Sounds from the Caviblaster® were clearly detectable out to the maximum measurement range of 1.1 km (3,608 ft). Using the measured transmission loss of 19.5 log R, the source level for the Caviblaster® was estimated as 176 dB re 1 µPa at 1 m (3.28 ft). The sounds were broadband in nature, concentrated above 500 Hz with a dominant tone near 2 kHz.

Specifications for the GR 29 Underwater Hydraulic Grinder state that the SPL at the operator's position would be 97 dB in air (Stanley 2014). There are no underwater measurements available for the grinder, so using a rough estimate of converting sound level in dB in air to water by adding 61.5 dB would result in an underwater level of approximately 159 dB[2]. The measured sound levels for the water jet were used to evaluate potential Level A and B acoustic harassment of marine mammals in this LOA. The grinder was not included as recommended by NMFS.

6.2.6.2 Underwater Pipe Cutter

If necessary, Hilcorp Alaska may use an underwater pipe cutter to replace existing pipeline segments in Cook Inlet. The following tools are likely to be used for pipeline cutting activities:

- A diamond wire saw used for remote cutting underwater structures such as pipes and I-Beams. These saws use hydraulic power delivered by a dedicated power source. The saw usually uses a method that pushes the spinning wire through the pipe.
- A hydraulically-powered Guillotine saw which uses an orbital cutting movement similar to traditional power saws.

Generally, sound radiated from the diamond wire cutter is not easily discernible from the background noise during the cutting operation. The Navy measured underwater sound levels when the diamond saw was cutting caissons for replacing piles at an old fuel pier at Naval Base Point Loma (Naval Base Point Loma Naval Facilities Engineering Command Southwest 2017). They reported an average SPL for a single cutter at 136.1-141.4 dB rms at 10 m (32.8 ft).

Specifications for the Guillotine saw state that the SPL at the operator's position would be 86 dB in air (Wachs 2011). There are no underwater measurements available for the grinder, so using a rough estimate of converting sound level in dB in air to water by adding 61.5 dB would result in an underwater level of approximately 148 dB.

Because the measured levels for use of underwater saws do not exceed the NMFS criteria, the noise from underwater saws was not considered further to evaluate potential Level A or Level B acoustic harassment in this LOA.

6.2.6.3 Drones

Hilcorp may use drones for conducting surveys of structures as part of their routine maintenance activities. Christiansen et al. (2016) recorded in air and underwater noise levels from two small, less than 56 cm (22 in), quadcopter UASs. For airborne levels, the measured frequency was below 500 Hz for both types of UASs and airborne levels were measured around 80 dB re 20 µPa at 1 m (3.28 ft; assuming 10 log transmission loss). For underwater levels, the UAS was only detectable above ambient noise levels when

[2] Converting levels in air to water is not a preferred method as reference intensities used to compute sound levels in dB are different in water (1 µPa) and air (20 µPa) and the intensity of a sound wave depends on the density and sound speed of the medium through which the sound is traveling. The result is that sound waves with the same intensities in water and air when measured in watts per square meter have relative intensities that differ by 61.5 dB. This amount must be subtracted from sound levels in water referenced to 1 µPa to obtain the sound levels of sound waves in air referenced to 20 µPa that have the same absolute intensity in watts per square meter. The difference in reference pressures causes 26 dB of the 61.5 dB difference. The differences in densities and sound speeds account for the other 35.5 dB.

flown at 5 or 10 m (16-32 ft) above the sea surface. The resulting underwater sound levels at those distances above sea surface were 91-101 dB rms at 1 µPa at 1 m (3.28 ft).

These visual inspections occur on an annual basis for each platform. Generally, the UAS is in the air for 15-20 minutes at a time due to battery capacity, which allows for two legs and part of the underside of the platform to be inspected. The total time to inspect a platform is approximately 1.5 hrs of flight time. The UAS is operated at a distance of up to 30.5 m (100 ft) from the platform at an altitude of 9-15 m (30-50 ft) above sea level. To reduce potential harassment of marine mammals, the area around the platform would be inspected prior to launch of the UAS to ensure there are no flights directly above marine mammals. All of the platforms are at least 8 km (5 mi) from shore, so they are not close to any haul out sites for pinnipeds.

Because these measured levels do not exceed the NMFS criteria, noise from drones was not considered further to evaluate potential Level A or Level B acoustic harassment in this LOA. A discussion on potential effects on visual disturbance from UAS is provided in Section 7.2.

6.2.6.4 Pingers

Hilcorp Alaska may deploy moorings for different purposes in Cook Inlet, such as underwater current profilers, bottom-mounted acoustic recorders, or other devices that use a pinger to locate and/or release using a transducer that sends a signal to interrogate the device. These signals range from 4-14 kHz with source levels typically 192 dB rms at 1 m (3.28 ft). Chirps are very short, typically 2 ms, and generally are used for less than a few minutes during the interrogation. NMFS has historically not required evaluation of potential Level A or B acoustic harassment because of the very short duration and directional signal, but the USACE has considered this during recent ESA consultations. Therefore, pingers have been included for NMFS consideration in this LOA.

The types of moorings requiring the use of pingers anticipated to be used in the LOA period include acoustic moorings during the 3D seismic survey (assumed 2-4 moorings) and potential current profilers deployed each season (assumed 2-4 moorings). The total amount of time per mooring device is less than 10 minutes during deployment and retrieval. To avoid disturbance, the pinger would not be deployed if marine mammals have been observed within 135 m (443 ft) of the vessel (distance to the 160 dB threshold assuming 15 log).

Based on the very short duration of pinger use when needed, noise from pingers was not considered further to evaluate potential Level A or Level B acoustic harassment.

6.3 ESTIMATES OF MARINE MAMMAL DENSITY

6.3.1 Beluga Whales

Historically, beluga whales were observed in both upper and lower Cook Inlet in June and July (Rugh et al. 2000). However, between 1993 and 1995, less than 3% of all of the annual sightings were in the lower inlet, south of the East and West Forelands, hardly any (one whale in Tuxedni Bay in 1997 and two in Kachemak Bay in 2001) have been seen in the lower inlet during these surveys 1996-2016 (Rugh et al. 2005; Shelden et al. 2013, 2015, 2017). Because of the extremely low sighting rates, it is difficult to provide an accurate estimate of density for beluga whales in Petition region. Therefore, the densities of Cook Inlet beluga whales were estimated using several methods for NMFS consideration.

6.3.1.1 Goetz Habitat-Based Model

As part of Apache's second IHA in early 2013, Goetz et al. (2012b) developed a habitat-based model to estimate Cook Inlet beluga density. The model was based on sightings, depth soundings, coastal substrate type, environmental sensitivity index, anthropogenic disturbance, and anadromous fish streams to predict densities throughout Cook Inlet. The result of this work is a beluga density map of Cook Inlet, which predicts spatially explicit density estimates for Cook Inlet belugas. Figure 16 shows the Goetz et al. (2012b) estimates with the project area. Using data from the GIS files provided by NMFS and the different project locations, the resulting estimated density is shown in Table 9. The water jets would be used on pipelines throughout the middle Cook Inlet region, so the higher density for the Trading Bay area was used.

Table 9. Cook Inlet beluga whale density based on Goetz habitat model.

Project Location	Project Activity	Beluga whale density (ind/km^2)
Lower Cook Inlet (OCS)	3D seismic, geohazard	0.00
Trading Bay area[1]	Geohazard, development drilling, water jets	0.004453-0.015053

[1] Trading Bay area conservatively used to represent densities of beluga whales potentially encountered during all mid-Cook Inlet activities in this LOA application for 2019-2020.

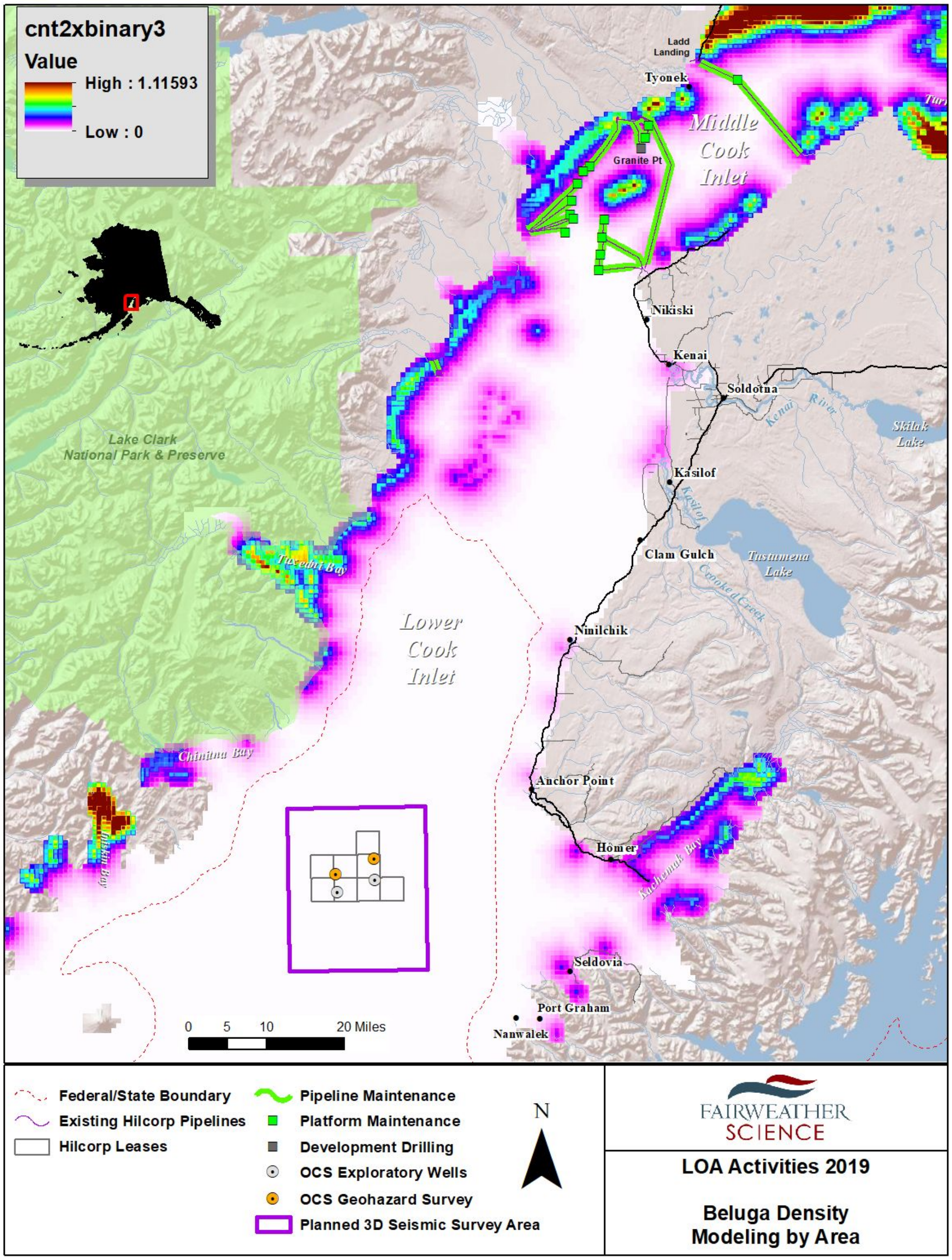

Figure 16. Beluga whale density as defined by Goetz et al. (2012b) in LOA.

6.3.1.2 NMFS Aerial Survey Data

The density was also estimated using the sighting information from the annual NMFS June aerial surveys for beluga whales between 2000 and 2016 (Rugh et al. 2005; Shelden et al. 2013, 2015, 2017). Although these surveys are only flown for a few days in June, they represent the best available relatively long-term dataset for beluga whales in Cook Inlet. Table 10 summarizes the total beluga whales observed for each year for the survey (as surveys take place over a few days), the area covered, the correction factor for missed belugas, and the resulting calculated density. Figure 17 shows the NMFS survey area (Rugh et al. 2005; Shelden et al. 2013, 2015, 2017).

To estimate density, the maximum number of beluga whales was multiplied by the correction factor and divided by the area surveyed. Because of the low sighting numbers, densities were calculated for the entire Cook Inlet survey area, for the mid and lower Cook Inlet (NMFS Zones 1 and 2 from the annual survey reports) south of Point Possession and Trading Bay, and for the lower Cook Inlet only (NMFS Zone 1) south of the East and West Forelands (Table 10). The estimates for these three different regions are fairly low, as the general trend of beluga sightings are in upper Cook Inlet (Rugh et al. 2005; Shelden et al. 2013, 2015, 2017).

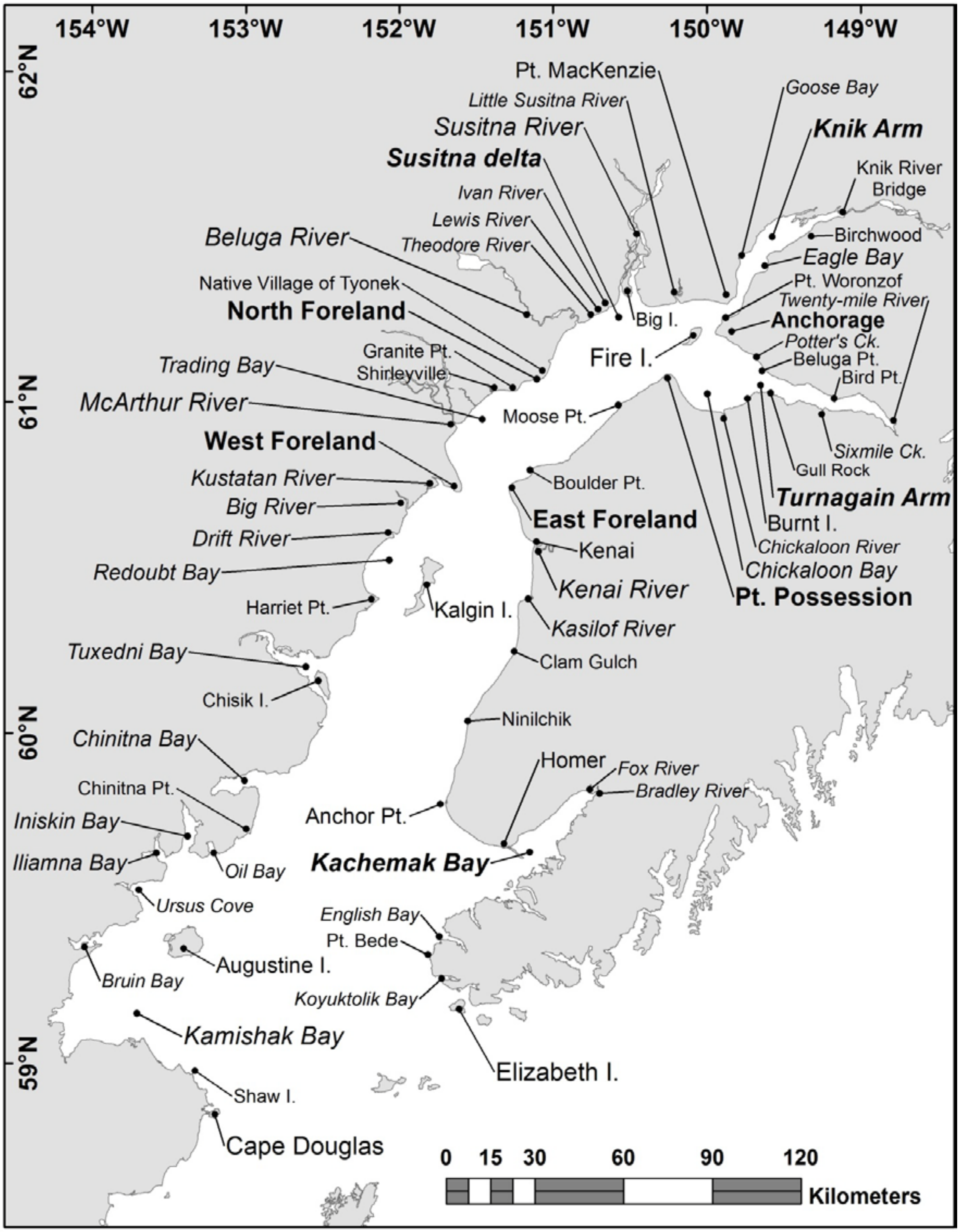

Figure 17. Map showing NMFS annual survey area (Rugh et al. 2005; Shelden et al. 2013, 2015, 2017).

6.3.2 Other Marine Mammals

Density estimates of species other than beluga whales were estimated from the NMFS June aerial surveys conducted for beluga whales between 2000 and 2016 (Rugh et al. 2005; Shelden et al. 2013, 2015, 2017). There are a number of limitations to using these data to estimate density for marine mammals in Cook Inlet, as these surveys are only flown for a few days in one month every other year and are designed with Cook Inlet beluga whales as the target species (which generally results in lower sighting rates for non-targeted species). These data do not represent variations in species distribution across Cook Inlet, so density estimates for species that generally occur only in lower Cook Inlet will be underestimated for activities in middle Cook Inlet but may be overestimated for species that use all of lower Cook Inlet for activities only occurring in part of lower Cook Inlet. Acknowledging these limitations, they represent the best available relatively long-term dataset for marine mammal sightings in Cook Inlet. Table 11 summarizes the maximum marine mammals observed for each year for the survey and area covered.

To estimate density, the total number of individuals per species was divided by the area surveyed. These density estimates were also compared to reported sightings from other projects in Cook Inlet (see seasonal distribution text in Section 4 for summaries) to determine whether the calculated densities were generally similar to the number of sightings from these projects. Harbor seals are the most commonly observed in the highest numbers and have the highest calculated densities (Lomac-MacNair et al. 2013; Lomac-MacNair et al. 2014; Owl Ridge 2014; Kendall et al. 2014; Sitkiewicz et al. 2018). Harbor porpoises have the third highest calculated densities are the second most commonly observed marine mammal for other projects. The remaining species are generally reported at relatively low numbers, much lower than the calculated density estimates. There are no density estimates available for California sea lions for Cook Inlet (83 FR 19224).

Table 10. Beluga whale sightings and calculated densities from NMFS annual surveys 2000-2016.

Location	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2014	2016
Beluga whale sightings (highest observed for survey)															
Turnagain Arm (north and east of Chickaloon Bay)	0	10	0	25	50	21	0	76	0	0	4	0	2	0	5
Chickaloon Bay to Pt. Possession	28	34	11	64	176	66	60	50	33	40	131	72	30	51	72
Point Possession to East Foreland[1, 2]	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0
Mid-Inlet east of Trading Bay[1, 2]	0	0	0	0	0	0	0	0	0	0	9	0	7	0	2
East Foreland to Homer[1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kachemak Bay[1]	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
West side of lower Cook Inlet[1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redoubt Bay[1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trading Bay[1, 2]	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0
Susitna Delta (N. Foreland to Pt. Mackenzie)	114	114	93	41	99	155	126	152	103	290	160	187	286	333	191
Knik Arm	42	60	88	94	0	43	9	23	0	0	0	0	0	0	0
Fire Island	0	0	0	0	0	16	0	2	0	0	9	2	0	0	0
Correction factor	1.021	1.021	1.021	1.021	1.021	1.021	1.021	1.021	1.021	1.021	1.031	1.031	1.001	1.036	1.022
Area surveyed (km^2)	6,911.2	5,445.2	5,445.2	5,235.8	6,492.3	5,445.2	6,701.8	5,235.8	7,120.6	5,864.0	6,073.5	6,701.8	6,282.9	6,701.8	8,377.2
Density Estimates (individuals/km^2)															
Entire Cook Inlet	0.027	0.041	0.036	0.044	0.051	0.056	0.032	0.059	0.020	0.057	0.053	0.040	0.055	0.059	0.033
Lower and Mid Cook Inlet[1, 2]	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.002	0.000	0.004	0.000	0.000
Lower Cook Inlet[1]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

[1]Lower Cook Inlet area (NMFS Zone 1); [2]Mid and Lower Cook Inlet (NMFS Zones 1 and 2)

Annual density estimates calculated by dividing area surveyed by the sum of animals observed in each year by the correction factor. The average of 2000-2016 was used to estimate exposures.

Table 11. Marine mammal sightings and calculated densities from NMFS annual surveys 2000-2016.

Location	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2014	2016
Marine mammal sightings (highest observed for survey)															
Humpback whale	11	26	20	20	16	18	14	3	7	5	2	9	1	11	6
Minke whale	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Gray whale	2	2	0	0	0	2	0	0	0	1	0	0	0	0	0
Fin whale	0	2	0	16	3	2	0	0	0	0	0	0	0	4	1
Killer whale	0	15	0	0	0	0	0	0	0	0	33	0	9	0	0
Dall's porpoise	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harbor porpoise	29	26	0	0	101	2	0	4	6	86	10	30	11	128	17
Harbor seal	1,800	1,485	1,606	974	956	1,087	1,798	1,474	2,037	1,415	1,156	1,811	1,812	2,115	1,909
Steller sea lion	10	35	54	77	1	104	83	0	75	39	1	100	65	43	71
Area surveyed (km^2)	6,911.2	5,445.2	5,445.2	5,235.8	6,492.3	5,445.2	6,701.8	5,235.8	7,120.6	5,864.0	6,073.5	6,701.8	6,282.9	6,701.8	8,377.2
Density Estimates (individuals/km^2)															
Humpback whale	0.00159	0.00477	0.00367	0.00382	0.00246	0.00331	0.00209	0.00057	0.00098	0.00085	0.00033	0.00134	0.00016	0.00164	0.00072
Minke whale	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00015	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Gray whale	0.00029	0.00037	0.00000	0.00000	0.00000	0.00037	0.00000	0.00000	0.00000	0.00017	0.00000	0.00000	0.00000	0.00000	0.00000
Fin whale	0.00000	0.00037	0.00000	0.00306	0.00046	0.00037	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00060	0.00012
Killer whale	0.00000	0.00275	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00543	0.00000	0.00143	0.00000	0.00000
Dall's porpoise	0.00246	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Harbor porpoise	0.00420	0.00477	0.00000	0.00000	0.01556	0.00037	0.00000	0.00076	0.00084	0.01467	0.00165	0.00448	0.00175	0.01910	0.00203
Harbor seal	0.26045	0.27272	0.29494	0.18603	0.14725	0.19963	0.26829	0.28153	0.28607	0.24130	0.19034	0.27023	0.28840	0.31559	0.22788
Steller sea lion	0.00145	0.00643	0.00992	0.01471	0.00015	0.01910	0.01238	0.00000	0.01053	0.00665	0.00016	0.01492	0.01035	0.00642	0.00848
There are no density estimates available for California sea lions in Cook Inlet. Annual density estimates calculated by dividing area surveyed by the total number of animals observed in each year. The average of 2000-2016 was used to estimate exposures.															

6.4 ESTIMATING POTENTIAL EXPOSURES

The numbers of each marine mammal species that could potentially be exposed to sound associated with the specific aspects of the program expected to exceed NMFS acoustic harassment criteria were estimated using the methods described below. We multiplied the following variables: 1) area of ensonification (in km^2), 2) the duration of the activity, and 3) the density of marine mammals (# of marine mammals/km^2).

The acoustic characteristics of the different project activities were described in Section 6.2. While each activity may result in underwater sounds and potential disturbance to marine mammals, not all of the activities are expected to exceed NMFS Level A and B acoustic harassment criteria. Only those specific activities identified in that section were used to evaluate the potential for Level A and B harassment. Specifically, those activities include 3D seismic survey, sub-bottom profilers used in geohazard surveys (i.e., high- and low-resolution), and water jets used during routine maintenance.

6.4.1 Areas of Ensonification

The area of ensonification is calculated differently depending on the type of the source. For impulsive mobile sources (3D seismic, sub-bottom profiler), the area was calculated by multiplying the distances to the NMFS thresholds by the distance of the line to be surveyed each day. The area of a circle (πr^2) where r is the distance to the NMFS thresholds was used to calculate the area of ensonification for non-impulsive stationary sources (water jets).

3D Seismic Survey: The area of ensonification for the 3D seismic survey was calculated by multiplying the distances (in km) to the NMFS thresholds by the distance of the line (in km) to be surveyed each day. The line length is approximately 27.78 km (15 nm), which will take approximately 3.75 hrs to survey at a vessel speed of 7.5 km/hr (4 knots) with a turn of 1.5 hrs. In a 24-hr period, assuming no delays, the survey team will be able to collect data on 4.5 lines or approximately 127 km (78.9 mi). However, delays from weather, equipment, and marine mammals make this level of seismic effort extremely unlikely on a daily basis. Similar 3D seismic projects in Cook Inlet indicate that seismic activity occurs approximately 50% of the time over the duration of the project (Lomac-MacNair et al. 2012; Kendall et al. 2015). To account for these delays, we estimated an average reduction of 42% in daily seismic operations. This estimate includes approximately 20% for weather, 12% for equipment, and 10% for marine mammals. Using this percentage, on average, the survey team will be able to collect data on an estimated 2.66 lines or approximately 74 km (46 mi) in a 24-hr period.

The distance in between line lengths is 3.7 km (2.3 mi), so there will be overlap of the area of ensonification, resulting in an overestimation of exposures. Instead, the total area of ensonification was calculated using GIS. The Level B radii were added to each track line estimated to be traveled in a 24-hour period, and when there was overlapping areas, the resulting polygons were merged to one large polygon to eliminate the chance that the areas could be summed multiple times over the same area. **The results of the overall area are 754 km^2 (186,317 acres), summarized in Table 14 and shown on Figure 18 (only showing Level B).**

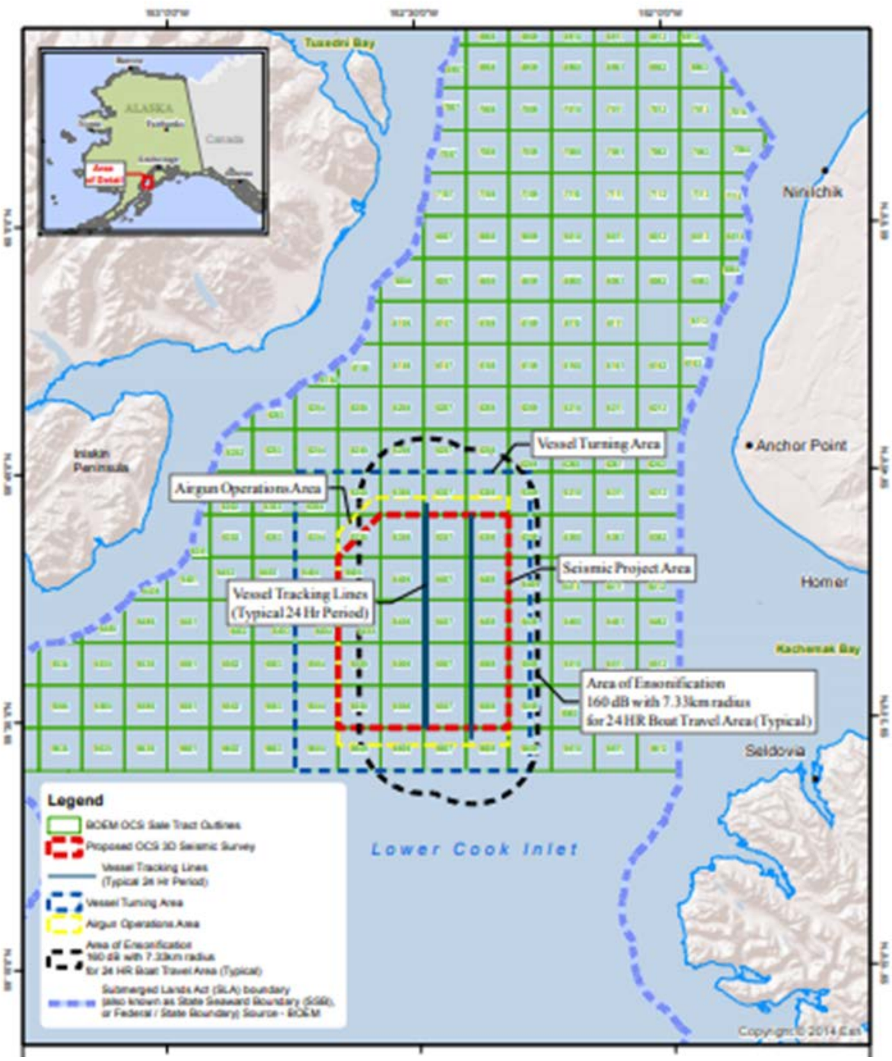

Figure 18. Total area of ensonification for 3D seismic survey using GIS for Level B (km^2).

Geohazard Sub-Bottom Profiler for Well Sites: The area of ensonification for the sub-bottom profiler used during the geohazard surveys for the well sites was calculated by multiplying the distances (in km) to the NMFS thresholds by the distance of the line (in km) to be surveyed each day. The maximum required monitoring distance from the well site per BOEM is 2,400 m (1.49 mi; or a total length of 4,800 m [2.99 mi] in diameter) and the minimum transect width is 150 m (492 ft), so the total maximum number of transects to be surveyed is 32 (4,800 m [2.00 mi]/ 150 m [492 ft]). The total distance to be surveyed is 153.60 km (95.44 mi; 4.8 km [2.99 mi] x 32 transects). Assuming a vessel speed of 4 knots (7.41 km/hr), it will take approximately 0.65 hrs (38 minutes) to survey a single transect of 4.8 km (2.99 mi; time = distance / rate). Assuming the team is surveying for 50% of the day (or 12 hrs), the total number of days it will take to survey the total survey grid is 7.77 days (0.65 hr x 12 hr). Similar to the 3D seismic survey, there will be overlap of the sound because of the distance in between the transects. However, because the area and grid to be surveyed depends on the results of the 3D survey and the specific location, Hilcorp Alaska proposes to use this overestimate for purposes of this ITR. **The total line length to be surveyed per day is 19.76 km (total distance to be surveyed 153.6 km [95.44 mi]/ total days 7.77).**

Geohazard Sub-Bottom Profiler for Pipeline Maintenance: The area of ensonification for the sub-bottom profiler used during geohazard surveys for the pipeline maintenance was calculated by multiplying the distances (in km) to the NMFS thresholds by the distance of the line (in km) to be surveyed each day. The assumed transect grid is 300 m by 300 m (984 ft x 984 ft) with 150 m (492 ft) transect widths, so the total to be surveyed is 2,400 m (2.4 km). Assuming a vessel speed of 4 knots (7.41 km/hr), it will take approximately 0.08 hrs (4.86 min) to survey a single transect. The total number of days it will take to survey the grid is 1 day. Similar to the 3D seismic survey, there will be overlap of the sound because of the distance in between the transects. However, because the area and grid to be surveyed depends on the results of the 3D survey and the specific location, Hilcorp Alaska proposes to use this overestimate for purposes of this ITR. **The total line length to be surveyed per day is 2.4 km (1.49 mi)**.

6.4.1.1 Distances to NMFS Thresholds

The distances to the Level A thresholds were calculated using the NMFS Acoustical Guidance Spreadsheet (NMFS 2016b) based on the type of source and using source levels shown in Table 7. All were calculated assuming a transmission loss of 15 log R. The assumptions are summarized in Table 12. The distances to the thresholds are provided in Table 13 The resulting areas of ensonification are summarized in Table 14.

Table 12. Assumptions for calculation of distances to Level A thresholds.

Activity	Type of Source	Source Level	Weighting Factor Adjustment	Source Velocity	Pulse Duration	Repetition Rate	Duration per Day
3D seismic	mobile, impulsive	217 dB peak @ 100 m 185 dB SEL @ 100 m	1 kHz	2.05 m/s	N/A	every 6 s	N/A
Sub-bottom profiler	mobile, impulsive	212 dB rms @ 1 m	4 kHz	2.05 m/s	0.10 s	every 6 s	N/A
Water jet	stationary, non-impulsive	176 dB rms @ 1 m	2 kHz	N/A	N/A	N/A	3 hrs/day

Table 13. Calculated distances (m) to NMFS thresholds.

Activity	Level A															Level B	
	Low Frequency Cetaceans			Mid Frequency Cetaceans			High Frequency Cetaceans			Phocids			Otariids			All Marine Mammals	
	Impulsive		Non-Impulsive	Impulsive		Non-Impulsive	Impulsive		Non-Impulsive	Impulsive		Non-Impulsive	Impulsive		Non-Impulsive	Impulsive	Non-Impulsive
	219 dB pk	183 dB SEL	199 dB SEL	230 dB pk	185 dB SEL	198 dB SEL	202 dB pk	155 dB SEL	173 dB SEL	218 dB pk	185 dB SEL	201 dB SEL	232 dB pk	203 dB SEL	219 dB SEL	160 dB rms	120 dB rms
3D seismic	74	399	--	14	<1	--	1,000	45	--	86	66	--	10	1	--	7,330	--
Sub-bottom profiler	<1	19	--	<1	1	--	5	277	--	<1	12	--	<1	25	--	2,929	--
Water jet	--	--	14	--	--	<1	--	--	13	--	--	8	--	--	1	--	860

Assumptions summarized in Table 12.

Weighting Factor Adjustment (WFA) only used for SEL calculation

Assumes 15 log practical spreading loss.

Level B zones for 3D seismic and water jet were based on measured levels, rather than the extrapolated level using the transmission loss of 15 log. Level B zones for sub-bottom profiler were based on source levels and extrapolated using the 15 log transmission loss.

Table 14. Areas of ensonification (km^2).

Activity	Level A															Level B	
	Low Frequency Cetaceans			Mid Frequency Cetaceans			High Frequency Cetaceans			Phocids			Otariids			All Marine Mammals	
	Impulsive		Non-Impulsive	Impulsive		Non-Impulsive	Impulsive		Non-Impulsive	Impulsive		Non-Impulsive	Impulsive		Non-Impulsive	Impulsive	Non-Impulsive
	219 dB pk	183 dB SEL	199 dB SEL	230 dB pk	185 dB SEL	198 dB SEL	202 dB pk	155 dB SEL	173 dB SEL	218 dB pk	185 dB SEL	201 dB SEL	232 dB pk	203 dB SEL	219 dB SEL	160 dB rms	120 dB rms
3D seismic[1]	9.34	50.66	--	1.73	0.04	--	127.02	5.71	--	10.89	8.35	--	1.27	0.17	--	754.23	--
Sub-bottom profiler (OCS)	0.01	0.38	--	0.00	0.02	--	0.09	5.47	--	0.01	0.24	--	0.00	0.00	--	57.87	--
Sub-bottom profiler (maintenance)	0.00	0.05	--	0.00	0.00	--	0.01	0.68	--	0.00	0.03	--	0.00	0.00	--	7.23	--
Water jet	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0	--	2.32

[1]Area of ensonification for 3D seismic survey calculated using GIS using line length to be surveyed in 1 day with overlap of sound for different thresholds.

Assumptions summarized in Table 12.

Weighting Factor Adjustment (WFA) only used for SEL calculation

Assumes 15 log practical spreading loss.

6.4.2 Duration of Activities

The duration was estimated for each activity and location. Our assumptions regarding these activities, which were used to estimate duration, are discussed in the following sections.

6.4.2.1 3D Seismic

The total anticipated duration of the survey is **45-60 days,** including delays due to equipment, weather, tides, and marine mammal shut downs. **The duration that was used to assess exposures from the 3D seismic survey is 60 days.**

6.4.2.2 Geohazard

Assuming the team is surveying 50% of the day (or 12 hrs), the total number of days it will take to survey the total geohazard survey grid for a single well is 7.77 days. **This duration was multiplied by the number of wells per site resulting in 15.5 days for an assumed survey of two lower Cook Inlet OCS wells.**

The total number of days it will take to survey the geohazard survey grid for a pipeline maintenance is 1 day. **This duration was multiplied by the number of anticipated surveys Year 1 (high estimate of 3 per year), for a total of 3 days.**

6.4.2.3 Water jets

Water jets are only used when needed for maintenance, therefore, the annual duration was estimated to evaluate exposures. Each water jet event was estimated to be 30 minutes or less in duration. It was estimated that a water jet event occurs 3 times a month, resulting in only 1.5 hrs per month of water jet operation. **Water jets are used during ice-free months, so this duration was multiplied by 7 months (May-November) resulting in 21 days.**

6.4.3 Densities

Table 15 summarizes the density estimates for beluga whales from both NMFS aerial surveys and Goetz model; Table 16 summarizes the densities described for other marine mammals from the NMFS aerial surveys used to estimate exposures.

Table 15. Density estimates for beluga whales in Petition region.

Area/Activity	NMFS Density[1]	Goetz Density[2]
Lower Cook Inlet OCS (3D seismic, geohazard)	0.000593	0.0000
Middle Cook Inlet (routine maintenance: geohazard, water jet)	0.000593	0.001664-0.015053

[1]Density based NMFS aerial survey

[2]Density based on Goetz et al. (2012b) for the specific area

Table 16. Density estimates for marine mammals in Petition region.

Species	Estimated Density (# marine mammals/km^2)[3]
Humpback whale	0.001888
Minke whale	0.000010
Gray whale	0.00080
Fin whale	0.00031
Killer whale	0.000641
Dall's porpoise	0.000164
Harbor porpoise	0.004678
Harbor seal	0.248709
Steller sea lion	0.008110
California sea lion	0.00000

6.4.4 Take Estimates for Year 1 Activities

The estimated exposures (without any mitigation) per activity in Year 1 was calculated by multiplying the density of marine mammals (# of marine mammals/km^2) by the area of ensonification (km^2) and the duration (days per year).

The estimated number of marine mammals without mitigation per activity per location potentially exposed to sound levels exceeding Level A thresholds is provided in Table 17. The activity that may result in the most Level A takes is the 3D seismic survey in lower Cook Inlet, with an estimated 7 humpback whales, 1 fin whale, 38 harbor porpoises, and 288 harbor seals. The take estimates are based on the 2,400 cui airgun size from Apache, and the planned volume for the Hilcorp Alaska survey is 1,945 cui. With the mitigation and monitoring measures outlined in Sections 11 and 13, the probability for these number of Level A takes is expected to be low.

The estimated number of marine mammals potentially exposed to Level B sound levels without mitigation for all activities per activity per location is presented in Table 18. Again, the activity that may result in the most Level B takes is the 3D seismic survey in lower Cook Inlet, with an estimated 85 humpback whales, 29 killer whales, 212 harbor porpoises, 11,255 harbor seals, and 367 Steller sea lions. However, these high numbers of potential Level B takes are based on the total number of marine mammals observed throughout the entire Cook Inlet during the NMFS aerial surveys, including large haulouts for seals, which is not realistic for the density of marine mammals in the middle of lower Cook Inlet. Further, the take estimates are based on the 2,400 cui airgun size from Apache, and the planned volume for the Hilcorp Alaska survey is 1,945 cui.

For beluga whales, the total estimated Level B exposures across all activities using the NMFS aerial survey densities is approximately 29 animals, with 27 of those associated with the 3D seismic survey. Using the Goetz model, the estimated Level B exposures is less than 1 animal for all activities.

Table 17. Estimated number of Level A exposures per activity and location.

Species	3D Seismic	Water jets[4]	Sub-bottom profiler	
	LCI		MCI[3]	LCI[4]
Humpback whale	6.80	0.00	0.00	0.02
Minke whale	0.04	0.00	0.00	0.00
Gray whale	0.29	0.00	0.00	0.00
Fin whale	1.19	0.00	0.00	0.00
Killer whale	0.07	0.00	0.00	0.00
Beluga whale[1]	0.06	0.00	0.00	0.00
Beluga whale[2]	0.00	0.00	0.00	0.00
Dall's porpoise	1.31	0.00	0.00	0.03
Harbor porpoise	37.25	0.00	0.01	0.81
Harbor seal	287.11	0.00	0.02	1.89
Steller sea lion	0.70	0.00	0.00	0.00

[1]Density based NMFS aerial survey

[2]Density based on Goetz et al. (2012b) for the specific area

[3]MCI = Middle Cook Inlet pipeline maintenance

[4]LCI = Lower Cook Inlet geohazard surveys

Table 18. Estimated number of Level B exposures per activity and location.

Species	3D Seismic	Water jets[4]	Sub-bottom profiler	
	LCI[3]		MCI[3]	LCI[4]
Humpback whale	85.43	0.09	0.04	1.70
Minke whale	0.45	0.00	0.00	0.01
Gray whale	3.60	0.00	0.00	0.07
Fin whale	14.99	0.02	0.01	0.30
Killer whale	29.02	0.03	0.01	0.58
Beluga whale[1]	26.83	0.03	0.01	0.53
Beluga whale[2]	0.00	0.73	0.00	0.00
Dall's porpoise	7.42	0.01	0.00	0.15
Harbor porpoise	211.70	0.23	0.10	4.21
Harbor seal	11,255.01	12.14	5.24	223.76
Steller sea lion	366.99	0.40	0.17	7.30

[1]Density based NMFS aerial survey

[2]Density based on Goetz et al. (2012b) for the specific area

[3]MCI = Middle Cook Inlet pipeline maintenance

[4]LCI = Lower Cook Inlet geohazard surveys

6.4.5 Requested Takes

Based on the results of the acoustic harassment analysis, Hilcorp Alaska is requesting a small number of Level A takes for humpback whales, fin whale, Dall's porpoises, harbor porpoises, and harbor seals. Hilcorp Alaska does not anticipate that any of the activities will result in mortality or serious injury to marine mammals, but these species may be exposed to Level A SEL levels. Seals are highly curious and exhibit high tolerance for anthropogenic activity, so they are likely to enter the larger SEL levels. Porpoises are difficult to observer at greater distances and usually only remain in an area for a short period of time. The total requested Level A takes for 7 for humpback whales, 1 fin whale, 1 Dall's porpoise, 38 harbor porpoises, 288 harbor seals, and 1 Steller sea lion (Table 19).

The total requested Level B takes are summarized in Table 19. The requested Year 1 Level B takes for minke and gray whale are rounded up to 5 animals, less than 1% of the population. The requested Year 1 Level B takes for humpback whales is 90 animals, although it is not expected to approach this number. The requested Year 1 Level B takes for fin whales is 15, less than 2% of the population. The requested Year 1 Level B takes for killer whales are rounded up to 20 animals to allow for small groups, still less than 4% of either stocks. The requested Year 1 Level B takes for Dall's and harbor porpoise are rounded up to 10 and 216 animals, respectively; less than 1% of the populations. The requested Year 1 Level B takes for harbor seals is 6,847 animals, because the estimated number of Level B takes of 12,000 is an overestimate due to the inclusion of haul out site numbers. The requested take is 25% of the population. The requested Year 1 Level B takes for Steller sea lions is 375 animals, less than 1% of the population.

The requested Year 1 Level B takes for beluga whales is 35 animals (~10 % of the population), consistent with other MMPA authorizations in Cook Inlet. The Applicant is committed to the conservation of the species and will implement the robust monitoring and mitigation program outlined in Sections 11 and 13 to avoid Level A exposures and minimize Level B exposures.

Table 19. Requested Year 1 LOA Level A and B takes.

Species	Level A				Level B			
	Estimated Exposures	Takes Requested	Population Estimate	% of Population	Estimated Exposures	Takes Requested	Population Estimate	% of Population
Humpback whale	6.80	7	865	0.81%	87.26	90	865	10.40%
Minke whale	0.04	0	1,233	0.00%	0.46	5	1,233	<1%
Gray whale	0.29	0	20,125	0.00%	3.68	5	20,125	<1%
Fin whale	1.19	1	1,036	0.10%	15.31	15	1,036	1.45%
Killer whale (resident)	0.07	0	2,347	0.00%	15.61	20	2,347	<1%
Killer whale (transient	0.06	0	587	0.00%	15.61	20	587	3.41%
Beluga whale (NMFS)	0.06	0	328	0.00%	27.40	35	328	10.67%
Beluga whale (Goetz)	0.00	0	328	0.00%	33.71	35	328	10.67%
Dall's porpoise	1.31	1	83,400	0.00%	7.58	10	83,400	<1%
Harbor porpoise	37.25	38	31,046	0.12%	216.23	216	31,046	<1%
Harbor seal	287.11	288	27,386	1.05%	11,496.15	6,847	27,386	25.00%
Steller sea lion	0.70	1	50,933	0.00%	374.85	375	50,933	<1%
California sea lion	0.00	0	153,337	0.00%	0.00	5	153,337	<1%

7.0 DESCRIPTION OF IMPACT ON MARINE MAMMALS

The anticipated impact of the activity upon the species or stock.

Marine mammals use hearing and sound transmission to perform vital life functions. Introducing sound into their environment could be disrupting to those behaviors. Sound (hearing and vocalization/ echolocation) serves four primary functions for marine mammals, including: 1) providing information about their environment, 2) communication, 3) prey detection, and 4) predator detection. The distances to which noise associated with the LOA activities are audible depends upon source levels, frequency, ambient noise levels, the propagation characteristics of the environment, and sensitivity of the receptor (Richardson et al. 1995).

The effects of sound from industrial activities on marine mammals might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and temporary or permanent hearing impairment, or non-auditory physical effects (Richardson et al. 1995). In assessing potential effects of noise, Richardson et al. (1995) has suggested four criteria for defining zones of influence. These zones are described below from greatest influence to least:

Zone of hearing loss, discomfort, or injury – the area within which the received sound level is potentially high enough to cause discomfort or tissue damage to auditory or other systems. This includes TTS (temporary loss in hearing) or PTS (loss in hearing at specific frequencies or deafness). Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage.

Zone of masking – the area within which the noise may interfere with detection of other sounds, including communication calls, prey sounds, or other environmental sounds.

Zone of responsiveness – the area within which the animal reacts behaviorally or physiologically. The behavioral responses of marine mammals to sound is dependent upon a number of factors, including: 1) acoustic characteristics the noise source of interest; 2) physical and behavioral state of animals at time of exposure; 3) ambient acoustic and ecological characteristics of the environment; and 4) context of the sound (e.g., whether it sounds similar to a predator) (Richardson et al. 1995; Southall et al. 2007). However, temporary behavioral effects are often simply evidence that an animal has heard a sound and may not indicate lasting consequence for exposed individuals (Southall et al. 2007).

Zone of audibility – the area within which the marine mammal might hear the noise. Marine mammals as a group have functional hearing ranges of 10 Hz to 180 kHz, with best thresholds near 40 dB (Ketten 1998; Kastak et al. 2005; Southall et al. 2007). These data show reasonably consistent patterns of hearing sensitivity within each of three groups: small odontocetes (such as the harbor porpoise and Dall's porpoise), medium-sized odontocetes (such as the beluga and killer whales), and pinnipeds (such as the harbor seal and Steller sea lion). There are no applicable criteria for the zone of audibility due to difficulties in human ability to determine the audibility of a particular noise for a particular species.

The following sections describe the potential impacts on marine mammals due to sources associated with Hilcorp Alaska's program (e.g., seismic, vessel and other construction activities). Due to relatively low sound levels, short period of time the louder activities would occur over the entire project and the implementation mitigation and monitoring measures, it is unlikely there would be any temporary or especially permanent hearing impairment, or non-auditory physical effects on marine mammals. Additionally, most of Cook Inlet is a poor acoustic environment because of its shallow depth, soft bottom, and high background noise from currents and glacial silt which greatly reduces the distance sound travels (Blackwell and Greene 2003).

7.1 POTENTIAL EFFECTS OF VESSEL SOUND ON MARINE MAMMALS

Vessels will be used for support, transport, and drill rig mobilization during the exploration and drilling program. Worldwide, vessels are major contributors to increased ocean noise levels (Andrew et al. 2002, McDonald et al. 2006). Sound levels and frequency produced by vessels are generally related to the size and speed of the vessel; however, the primary sound sources from vessels are propeller cavitation, propeller singing and propulsion or other machinery (Richardson et al. 1995).

Marine mammal responses to vessels (mobile non-impulsive sound) are generally associated with noise and depend on changes in the engine and propeller speed (Richardson et al. 1995). As with aircrafts, visual cues may contribute to marine mammal’s reactions to nearby vessels (Richardson et al. 1995). The following sections summarize baleen whales, toothed whales, and pinnipeds responses to noise associated with vessels. A detailed review of marine mammal responses to vessels is available in Richardson et al. (1995).

7.1.1 Baleen Whales

Masking is of special concern for baleen whales that vocalize at low frequencies over long distances, as their communication frequencies overlap with anthropogenic sounds such as shipping traffic. Some baleen whales have adjusted their communication frequencies, intensity, and call rate to limit masking effects. For example, McDonald et al. (1995) found that California blue whales (*Balaenoptera musculus*) have shifted their call frequencies downward by 31 percent since the 1960s, possibly to communicate below shipping sound frequencies. Melcón et al. (2012) found blue whales to increase their call rates in the presence of typically low frequency shipping sound, but to significantly decrease call rates when exposed to mid-frequency sonar. Fin whales have reduced their calling rate in response to boat noise (Watkins 1986). Right whales have been observed changing vocal behavior due to distance shipping that has increased overall background noise (Parks et. al. 2007). Also, Di Iorio and Clark (2010) found blue whales to communicate more often in the presence of seismic surveys, which they attributed to compensating for an increase in ambient sound levels.

Ship noise due to propeller cavitation can cause behavioral changes by baleen whales. Humpback whales show a general avoidance behavior to cruise ships and tankers at distance from 2 to 4 km (Baker et al. 1982, 1983), but no reaction at distances beyond 800 m when the whales were feeding (Watkins et al. 1981, Krieger and Wing 1986). Also, humpback whales are especially responsive to fast moving vessels (Richardson et al. 1995) exhibiting aerial behaviors such as breaching or tail/flipper slapping (Jurasz and Jurasz 1979). However, temporarily disturbed whales often remain in the area despite the presence of vessels (Baker et al. 1988, 1992).

7.1.2 Toothed Whales

Toothed whales often show tolerance to vessel activity; however, they may react at long distances if they are confined by ice, shallow water or were previously harassed by vessels (Richardson et al. 1995). Toothed whale responses to vessel activity also vary depending on the activity of the whale. Narwhals have been observed ceasing activity and becoming silent. They have also been observed avoiding and moving long distances away from vessels. Many species of dolphins tolerate or even approach vessels in the area and often ride the bow and stern waves (this reduces the energy cost of travel); however, dolphins have also been observed avoiding vessels. Other species of toothed whales that have avoided vessels include river dolphins, harbor porpoise, and sperm whales. Sperm whales off of New Zealand have been observed altering their surfacing-respiration-dive patterns as well as participating in erratic surface movements (reviewed in Richardson et al. 1995). Foote et al. (2004) found increases in the duration of killer whale calls over the period 1977 to 2003, during which time vessel traffic in Puget Sound, and particularly whale-watching boats around the animals, increased dramatically.

Beluga whale responses to vessels noise varies greatly from tolerance to extreme sensitivity depending on the activity of the whale and previous experience with vessels (Richardson et al. 1995). Beluga whale responses to vessel noise include changes in behavioral states (Richardson et al. 1995), changes in vocalizations (Lesage et al. 1999; Scheifele et al. 2005; Gervaise et al. 2012) and avoidance (Blane and Jaakson 1994; Erbe and Farmer 2000). Lesage et al. (1999) observed changes in the vocal behavior of beluga whales in the presence of a 7 m (23 ft) vessel powered by two 70 horsepower (HP) engines and a 2,173 gross-ton ferry 80 m (260 ft) long with two 2,000 HP engines each fitted with a propeller 235 cm in diameter. Vocal responses included a reduction in call rate, an increase in emissions of certain call types, repetition of specific calls and a shift in frequency bands. Responses occurred more frequently when exposed to the ferry than the small vessel. Scheifele et al. (2005) documented the Lombard vocal response in beluga whales exposed to different vessel traffic in the St. Lawrence Estuary. The Lombard vocal response occurs when an animal increases the intensity of their vocalizations in response to a change in the environmental noise. Gervaise et al. (2012) suggests that the chronic anthropogenic noise associated with ship traffic in the Saguenay mouth likely masks beluga whale communication and echolocation vocalizations. Blane and Jaakson (1994) observed avoidance behavior by belugas in the presences of a 5 m (16 ft) inflatable boat with an outboard motor. Avoidance behavior of the belugas included decreased surfacing, increased speed and bunching into groups. Once the disturbance ceased, belugas resumed their previous behavior. Additionally, Blackwell and Greene (2003) observed beluga whales in close proximity of the Northern Lights cargo-freight ship docked with motors running (126 dB re 1 µPa) at the POA, indicating that the belugas were not particularly bothered by the ship.

Noise associated with vessel activity will temporarily increase in the Petition region during the exploration and drilling program. To minimize the effects of noise associated with vessel activity on odontocetes in the area, Hilcorp Alaska will implement mitigation and monitoring measures discussed in Section 11 and will follow NMFS's Marine Mammal Viewing Guidelines and Regulations (NMFS 2008c).

7.1.3 Pinnipeds

Most information on the reaction of seals and sea lions to boats relates to disturbance of animals hauled out on land. There is little information on the reaction of these pinnipeds to ships while in the water, other than some anecdotal reports that sea lions are often attracted to boats (Richardson et al. 1995). Seals in general appear quite tolerant of vessels; however, there have been observations of seals entering the water when hauled out in the presence of vessels (reviewed in Richardson et al. 1995)

Generally, sea lions in water show tolerance to close and frequently approaching vessel and sometimes show interest in fishing vessels. They are less tolerance when hauled out on land; however, they rarely react unless the vessel approaches within 100-200 m (330-660 ft; reviewed in Richardson et al. 1995). To minimize the effects of noise associated with vessel activity on pinnipeds in the area, Hilcorp Alaska will implement mitigation and monitoring measures discussed in Section 13 and follow NMFS's Marine Mammal Viewing Guidelines and Regulations (NMFS 2008c).

Based upon the above information regarding pinniped disturbance reactions, some pinnipeds may exhibit minor, short-term disturbance responses to underwater sounds from industrial activities. Any potential impacts on pinniped behavior would be localized within the activity area and would not result in population-level effects.

7.2 POTENTIAL EFFECTS OF AIRCRAFT ON MARINE MAMMALS

Helicopters and fixed-wing aircraft generate noise from their engines, airframe, and propellers. The dominant tones for both types of aircraft generally are <500 Hz (Richardson et al. 1995). Richardson et al. (1995) reported that received sound levels in-water from aircraft flying at an altitude of 152 m (approximately 500 ft) were 109 dB re 1 μPa for a Bell 212 helicopter, and 101 dB re 1 μPa for a small fixed-wing aircraft. Penetration of aircraft noise into the water is greatest directly below the aircraft; at angles >13° from vertical, much of the sound is reflected and does not penetrate (Richardson et al. 1995). Duration of underwater sound from passing aircraft is much shorter in-water than air; for example, a helicopter passing at an altitude of 152 m (approximately 500 ft), audible in air for 4 minutes, may be detectable underwater for 38 seconds at 3 m (10 ft) depth, and 11 seconds at 18 m (59 ft) depth (Richardson et al. 1995). Helicopters and aircraft support Hilcorp Alaska operations by transporting supplies and personnel to the various assets. Helicopters may make one to three flights per day m from shore bases in Kenai, Nikiski, Homer, or Anchorage.

Marine mammal responses to aircraft noise (mobile non-impulsive sound) varies with aircraft type, altitude and flight pattern (Richardson et al. 1995). As with vessels, visual cues may contribute to marine mammal's reactions to aircraft presence (Richardson et al. 1995). The following sections summarize cetacean and pinniped responses to noise associated with aircrafts. A detailed review of marine mammal responses to aircraft is available in Richardson et al. (1995).

7.2.1 Cetaceans

Responses to aircraft by cetaceans are less documented than pinnipeds. Richardson et al. (1995) suggests this could indicate that airborne noise has a greater effect on pinnipeds hauled out on land or ice than on cetaceans in-water. Responses to aircraft by odontocetes and mysticetes are similar and include a change in behavior, diving, slapping the water with flukes or flippers, and swimming away or turning away from the aircrafts flight direction. Belugas did not show a reaction to an aircraft flying at 500 m; however, dove for longer periods of time, had shorter surface intervals and occasionally swam away when the aircraft was at 150-200 m. Foraging belugas were documented as less reactive in the presence of an aircraft, than lone whales which dove when an aircraft was at 500 m. Some humpback whales have shown a response to an aircraft at 305 m, while other whales have shown no response to an aircraft at 152 m. Whales are less reactive in larger feeding or social groups and more reactive in confined waters or with calves. Reactions by cetaceans are likely influenced by group size and behavioral activity (reviewed in Richardson et al. 1995).

To minimize the effects of noise associated with aircraft activity on cetaceans in the area, flight routes will follow a direct route to and from the rig location, and flight heights will be maintained 300 to 450 m (1,000 to 1,500 ft), as practicable, above ground level to avoid acoustical harassment of marine mammals. In addition, Hilcorp Alaska will implement mitigation and monitoring measures discussed in Section 11.

7.2.2 Pinnipeds

Reactions to aircraft noise and/or sight of the aircraft by pinnipeds hauled out on land or ice include increased vigilance and/or rushing into the water. The presence of aircraft can also trigger stampedes causing increase pup mortality due to crushing or pup abandonment. Responses from pinnipeds in-water to aircraft presence may include diving. Pinnipeds react more if the aircraft flies at low altitudes, passes directly overhead or there are changes in aircraft sound. Helicopters may have more of an effect on pinnipeds reactions; however, more studies on sound pressure levels are needed (reviewed in Richardson et al. 1995).

To minimize the effects of noise associated with aircraft activity on pinnipeds in the area, flight routes will follow a direct route to and from the rig location, and flight heights will be maintained 300 to 450 m (1,000 to 1,500 ft), as practicable, above ground level to avoid acoustical harassment of marine mammals. In addition, Hilcorp Alaska will implement mitigation and monitoring measures discussed in the Marine Mammal Monitoring and Mitigation Program (4MP) provided in Appendix A.

7.2.3 Potential Effects of UAS Visual Disturbance on Marine Mammals

The increase in use of UAS for a variety of purposes, including marine mammal research, has raised an important question on the effects of the UAS on marine mammals (Marine Mammal Commission 2016). Most researchers report that, at the altitudes they fly above marine mammals, there is little if any discernible response by the animals (e.g., Acevedo-Whitehouse et al. 2010; Goebel et al. 2015; Koski et al. 2015; Moreland et al. 2015). Most studies do not report data on disturbance and generally do not systematically assess the factors affecting disturbance (e.g., vertical and lateral distance, UAS type, engine type, sound levels, speed), as recommended in Smith et al. 2016. In one published study of disturbance, Pomeroy et al. 2015 found that reaction of gray and harbor seals depended on the vertical and lateral distances to the a UAS and may even result in fleeing if the approach of the UAS is very close. Habituation would also affect the threshold at which the sound or proximity of the UAS creates disturbance.

For purposes of this LOA, UAS will be used on a limited basis for platform leg inspections. Operators will ensure there are no marine mammals prior to takeoff and will increase altitude if a marine mammal surfaces near the UAS. The use of UAS will not be used near any haulout sites. If UAS is used for marine mammal monitoring and mitigation, the Applicant will work with NMFS to identify appropriate operating procedures to ensure no disturbance.

7.3 POTENTIAL EFFECTS OF SEISMIC SOUNDS ON MARINE MAMMALS

The following text describes the potential impacts on marine mammals due to noise associated with seismic activities (mobile impulsive sound). Although seismic operations will be active 24 hrs per day, in-water airguns will only be active for approximately 2.5 hrs during each of the slack tide periods (~ 4 per 24 hr period); therefore, source acquisition may only be active during 10-12 hrs per day. Due to the implementation of mitigation and monitoring measures discussed in the 4MP (Appendix A), it is unlikely there would be any temporary or especially permanent hearing impairment, or non-auditory physical effects on marine mammals.

7.3.1 Tolerance

Studies have shown that pulsed sounds from airguns are often readily detectable underwater at distances of many kilometers (Richardson et al. 1986; Goold and Fish 1998), but they do not necessarily cause behavioral disturbances. Studies have also shown that marine mammals at distances more than a few kilometers away often show no apparent response to various types of industry activities (Moulton and Miller. 2005; Harris et al. 2001; LGL et al. 2014). This is often true even in cases when the sounds are likely audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. All marine mammals have exhibited some behavioral reaction to underwater industry sounds, but they have also exhibited no overt reactions to underwater sounds (Stone and Tasker 2006; Hartin et al. 2013). In general, pinnipeds and small odontocetes appear to be more tolerant of exposure to some types of underwater sound than are baleen whales.

Stone and Tasker (2006) suggested that the different species of cetaceans may adopt different strategies for responding to sound exposure from seismic surveys. For example, some small odontocetes typically move out of the immediate area, while slower-moving mysticetes orient away from the vessel and increase their distance from the source but do not vacate the area. Weir (2008) reported no significant differences in encounter rates (sightings/hr) for humpback and sperm whales during seismic and non-seismic operations. Richardson et al. (1995) also observed that seal sighting rates were similar during periods of seismic and non-seismic activities; however, seals were observed at greater distances from the seismic activity. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to temporarily react behaviorally to airgun pulses under some conditions, at other times they have shown no overt reactions. However, there is some evidence that increased noise increases stress in right whales, which results in unknown long-term effects on marine mammals (Rolland et al. 2012). In general, pinnipeds and small odontocetes are more tolerant of exposure to airgun pulses than baleen whales.

7.3.2 Masking

Masking occurs when louder sounds interfere with marine mammal vocalizations or ability to hear natural sounds in their environment (Richardson et al. 1995), which limit their ability to communicate or avoid predation or other natural hazards. Masking of marine mammal calls and other natural sounds are expected to be limited in the presence of seismic noise, although there are very few specific data of relevance. Some whales are known to continue calling in the presence of seismic pulses. Their calls can be heard between seismic pulses (e.g., Richardson et al. 1986; McDonald et al. 1995; Greene et al. 1999; Nieukirk et al. 2004; Di Iorio and Clark 2010). Masking effects of seismic pulses are expected to be negligible in the case of the odontocete cetaceans, given the intermittent nature of seismic pulses. Also, the sounds important to small odontocetes are predominantly at much higher frequencies than are airgun sounds. Therefore, the potential problem of auditory masking for beluga whales is diminished by the small amount of overlap between frequencies produced by seismic and other industrial noise (<1 kHz) and frequencies which beluga whales call (0.26-20 kHz) and echolocate (40-60 kHz and 100-120 kHz; Blackwell and Greene 2003). Additionally, beluga whales have been known to change their vocalizations in the presence of high background noise possibly to avoid masking calls (Au et al. 1985; Lesage et al. 1999; Scheifele et al. 2005).

7.3.3 Disturbance Reactions

Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, environmental conditions, and many other factors (Richardson et al. 1995). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a short distance, the impacts of the change are unlikely to be significant to the individual, let alone to the stock or to the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, which is not anticipated in the proposed seismic program, impacts on the animals could be significant (e.g., Weilgart 2007). Given the many uncertainties in predicting the quantity and types of impacts of sound on marine mammals, it is common practice to estimate how many mammals were present within a particular distance of industrial activities, or exposed to a particular level of industrial sound to assess behavioral disturbance. The uncertainties in this approach include the differences in how individuals respond to sound, differences in behavioral states and responses therein, or movement of the animal away from the source. However, this procedure likely overestimates the numbers of marine mammals that are affected in some biologically important manner.

The sound criteria used to estimate how many marine mammals might be disturbed to some biologically important but unknown degree by a seismic program are based on behavioral observations during studies of several species. However, information is largely lacking for many species including those species likely to occur in the project areas. Detailed studies have been done on other species found elsewhere in Alaska waters including gray whales, bowhead whales, and ringed seals. The criteria established for these marine mammals, which are applied to others are conservative and have not been demonstrated to significantly affect individuals or populations of marine mammals in Alaska waters. Therefore, the effect of the seismic program on the behavior of marine mammals should be no more than negligible for reasons stated earlier.

7.3.3.1 Baleen Whales

Humpbacks, gray whales, and other large baleen whales, have shown strong overt reactions to impulsive noises, such as seismic operations, at received levels between 160 and 173 dB re 1 μPa rms (Richardson et al. 1986; Ljungblad et al. 1988; McCauley et al. 2000; Miller et al. 2005; Gailey et al. 2007). However, baleen whales seem to be less tolerant of continuous noise (Richardson and Malme 1993), often detouring around drilling activity when received levels are as low as 119 dB re 1 μPa rms (Malme et al. 1983; Richardson et al. 1986). Based on the previously cited studies, NMFS developed the 120 dB re 1 μPa rms harassment criteria for continuous noise sources.

Based upon the information regarding baleen whale disturbance reactions and that baleen whales are rarely present in the Petition region, some baleen whales may exhibit minor, short-term disturbance responses to underwater sounds from seismic activities. Any potential impacts on baleen whale behavior would be localized within the Petition region and would not result in population-level effects.

7.3.3.2 Toothed Whales

Little systematic information is available about reactions of beluga whales, killer whales, and harbor porpoises to noise pulses. Beluga whales exhibit changes in behavior when exposed to strong, pulsed sounds similar in duration to those typically used in seismic surveys (Finneran et al. 2000, 2002a). However, the animals tolerated high received levels of sound (peak–peak level >200 dB re 1 μPa) before exhibiting aversive behaviors (Richardson et al. 1995). Some belugas summering in the eastern Beaufort Sea may have avoided the specific area of seismic operations (2 arrays with 24 airguns per array), which used a larger array than the proposed program (2 arrays of 12 airguns per array), by 10 to 20 km, although belugas occurred as close as 1,540 m to the line of seismic operations (Miller et al 2005). The proposed seismic program may affect beluga whales in the Petition region; however, the seismic activity is short-term, localized and will implement mitigation described in Section 11 and monitoring measures described in Section 13 to reduce impacts from noise associated with the seismic activity on beluga whales.

Observers stationed on seismic vessels operating off the United Kingdom from 1997–2000 have provided data on the occurrence and behavior of various toothed whales exposed to seismic pulses (Stone 2003; Gordon et al. 2004; Stone and Tasker 2006). Data were collected on responses to arrays with large volumes of airguns (peak source level of approximately 250 dB re 1µPa at 1 m) and low power output arrays with peak source levels of approximately 235 dB 1µPa at 1 m. Both harbor porpoises and killer whales were found to be significantly farther from large airgun arrays during periods of shooting compared with periods of no shooting. The displacement of the median distance from the array was ~0.5 km (0.3 mi) or more. No significant difference in closest distance of approach to the sound source was found for either species for surveys using low power arrays. Significant differences in direction of travel by harbor porpoises were observed for both large and small volume array surveys. Fewer animals were observed travelling towards the survey vessel and/or more were observed travelling away from the vessel during periods of shooting. Killer whales were found to be significantly farther from large airgun arrays during periods of shooting compared with periods of no shooting. Killer whales also appear to be more tolerant of seismic shooting in deeper water.

A captive harbor porpoise showed aversive behavior when exposed to a single pulse from a small airgun with received levels above 174 dB re 1 µPa peak-to-peak. The animal also avoided approaching the source prior to further exposures and during control experiments (Lucke et al. 2009). Harbor porpoise reduced buzzing activity during a seismic survey conducted in northeast Scotland (Pirotta el al. 2014). Although the response did not result in displacement, changes in vocal behavior indicate potential affects from seismic noise on foraging and/or social activities for harbor porpoise in the area.

Killer whales are rare to uncommon in the inlet; therefore, the planned seismic program should have no more than a negligible impact on killer whales and no effect on the population. Harbor porpoises are rarely sighted, but have been detected acoustically throughout the inlet. However, based on the relatively few animals observed, the planned program should have no more than a negligible impact and no effect on the population.

7.3.3.3 Pinnipeds

Literature suggests that pinnipeds may be tolerant of underwater industrial sounds, and they are less sensitive to lower frequency sounds. Pinnipeds generally seem to be less responsive to exposure to industrial sound than most cetaceans. Pinniped responses to underwater sound from some types of industrial activities such as seismic exploration appear to be temporary and localized (Harris et al. 2001; Reiser et al. 2009).

While there are no published data on seismic effect on sea lions or harbor seals, anecdotal data and data on arctic seals indicate that sea lions and other pinnipeds generally tolerate strong noise pulses (Richardson et al 1995). Monitoring studies in the Alaskan and Canadian Beaufort Seas during 1996–2002 provided considerable information regarding behavior of arctic seals exposed to seismic pulses (Miller et al. 2005; Harris et al. 2001; Moulton and Lawson 2002). These seismic projects usually involved arrays of 6 to 16 with as many as 24 airguns with total volumes of 560 to 1500 cui. The combined results suggest that some seals avoid the immediate area around seismic vessels. In most survey years, ringed seal sightings tended to be farther away from the seismic vessel when the airguns were operating than when they were not (Moulton and Lawson 2002). However, these avoidance movements were relatively small, on the order of 100 m (328 ft) to (at most) a few hundred meters, and many seals remained within 100 to 200 m (328 to 656 ft) of the trackline as the operating airgun array passed by them. Seal sighting rates at the water surface were lower during airgun array operations than during no-airgun periods in each survey year except 1997. Miller et al. (2005) also reported higher sighting rates during non-seismic than during line seismic operations, but there was no difference for mean sighting distances during the two conditions nor was there evidence ringed or bearded seals were displaced from the area by the operations. The operation of the airgun array had minor and variable effects on the behavior of seals visible at the surface within a few hundred meters of the array. The behavioral data from these studies indicated that some seals were more likely to swim away from the source vessel during periods of airgun operations and more likely to swim towards or parallel to the vessel during non-seismic periods. No consistent relationship was observed between exposure to airgun noise and proportions of seals engaged in other recognizable behaviors, e.g. “looked” and “dove”. Such a relationship might have occurred if seals seek to reduce exposure to strong seismic pulses, given the reduced airgun noise levels close to the surface where “looking” occurs (Miller et al. 2005; Moulton and Lawson 2002).

Consequently, by using the responses of bearded, ringed, and spotted seals (least amount of data on reaction to seismic operations) to seismic operations as surrogates for harbor seals and sea lions, it is reasonable to conclude that the relatively small numbers relative to the population size of harbor seals and the even smaller numbers of Steller sea lions possibly occurring in the project area during seismic operations are not likely to show a strong avoidance reaction to the proposed airgun sources. Pinnipeds frequently do not avoid the area within a few hundred meters of operating airgun arrays, even for airgun arrays much larger than that planned for the proposed project (e.g., Harris et al. 2001). Reactions are expected to be very localized and confined to relatively small distances and durations, with no long-term effects on individuals or populations.

7.3.4 Strandings and Mortality

There is no evidence in the literature that airgun pulses can cause serious injury, death, or stranding of marine mammals even in the case of larger airgun arrays than planned for the proposed program (76 FR 58473). Seismic surveys have been referenced as possible causes of marine mammal strandings (Engel et al. 2004; Taylor et al. 2004), but the evidence is inconclusive (71 FR 43112). While strandings have been associated with military mid-frequency sonar pulses (Jepson et al. 2003; Fernández et al. 2004; Hildebrand 2005), Hilcorp does not plan to use such sonar systems during the seismic survey. Seismic pulses and military mid-frequency sonar pulses are quite different. Sounds produced by airgun arrays are broadband with most of the energy below 1 kHz. In addition, strandings associated with sound exposure have not been documented in Cook Inlet (76 FR 58473).

7.3.5 Noise Induced Threshold Shift

Animals exposed to intense sound may experience reduced hearing sensitivity for some period of time following exposure. This increased hearing threshold is known as noise induced threshold shift (TS). The amount of TS incurred in the animal is influenced by a number of noise exposure characteristics, such as amplitude, duration, frequency content, temporal pattern, and energy distribution (Kryter 1985; Richardson et al. 1995; Southall et al. 2007). It is also influenced by characteristics of the animal, such as behavior, age, history of noise exposure and health. The magnitude of TS generally decreases over time after noise exposure and if it eventually returns to zero, it is known as TTS. If TS does not return to zero after some time (generally on the order of weeks), it is known as PTS. TTS is not considered to be auditory injury and does not constitute ‘Level A Harassment’ as defined by the MMPA. Sound levels associated with TTS onset are generally considered to be below the levels that will cause PTS, which is considered to be auditory injury.

Temporary threshold shift has been studied in captive odontocetes and pinnipeds (reviewed in Southall et al. 2007; Mooney et al. 2009a, b; Lucke et al. 2009; Finneran et al. 2010a, b; Finneran 2015; Kastelein et al. 2012a, b). There are no published TTS data on any mysticetes species (Southall et al. 2007). Data are available for three cetacean species (bottlenose dolphin, *Tursiops truncatus*; beluga whale, and harbor porpoise) and three pinniped species (harbor seal, California sea lion, *Zalophus californianus*; Northern elephant seal, *Mirounga angustirostris*). However, these data have all been collected from captive animals and no documentation exists of TTS or PTS in free ranging marine mammals exposed to airgun pulses. Inner ears of beluga and bowhead whales examined shortly after being taken in subsistence hunts show little to no evidence of auditory trauma sustained pre-mortem. Beluga whales show some acoustic trauma, though not substantial enough to have caused deafness and not attributed to a specific sound source (Thewissen et al. 2011).

Many marine mammal species avoid ships and/or seismic operations. This behavior in and of itself should be sufficient to avoid TTS onset. In addition, monitoring and mitigation measures often implemented during seismic surveys are designed to detect marine mammals near the airgun array and avoid exposing them to sound pulses that may cause hearing impairment. For example, it is standard protocol for many seismic operators to ramp up airgun arrays, which should allow animals near the airguns at startup time to move away from the source and thus avoid TTS. If animals do incur TTS, it is a temporary and reversible phenomenon unless exposure exceeds the TTS-onset threshold by an amount sufficient to cause PTS. The following subsections summarize the available data on noise-induced hearing impairment in marine mammals.

7.3.5.1 Sound Exposure Level (SEL)

Sound exposure level is a measure of sound energy, calculated as 10 times the logarithm of the integral (with respect to duration) of the mean-square sound pressure, referenced to 1 $\mu Pa^2 s$ (Kastak et al. 2005; Southall et al. 2007). It is useful for assessing the cumulative level of exposure to multiple sounds because it allows sounds with different durations and involving multiple exposures to be compared in terms of total energy. This type of comparison assumes that sounds with equivalent total energy will have similar effects on exposed subjects, even if the sounds differ in SPL, duration and/or temporal exposure patterns. Sound exposure level likely over estimates TTS and PTS arising from complex noise exposures because it does not take varying levels and temporal patterns of exposure and recovery into account (Southall et al. 2007). Some support for the use of SEL to evaluate TTS and PTS has been shown for marine mammals (e.g., Finneran et al. 2002a, 2005), and this measure will be referred to in the following sections of this document.

7.3.5.2 Temporary Threshold Shift

Temporary threshold shift is the mildest form of hearing impairment that can occur during exposure to loud sound (Kryter 1985). It is not considered to represent physical injury, as hearing sensitivity recovers relatively quickly after the sound ends. It is, however, an indicator that physical injury is possible if the animal is exposed to higher levels of sound. The onset of TTS is defined as a temporary elevation of the hearing threshold by at least 6 dB (Schlundt et al. 2000). Several physiological mechanisms are thought to be involved with inducing TTS. These include reduced sensitivity of sensory hair cells in the inner ear, changes in the chemical environment in the sensory cells, residual middle-ear muscular activity, displacement of inner ear membranes, increased blood flow, and post-stimulatory reduction in efferent and sensory neural output (Kryter 1994; Ward 1997).

TTS in Odontocetes. Most studies of TTS in odontocetes have focused on non-impulsive sound, and all have been carried out on captive animals. A detailed review of all TTS data available for marine mammals can be found in Southall et al. (2007). The following is a summary of key results.

Finneran et al. (2005) measured TTS in bottlenose dolphins exposed to 3 kHz tones with various durations and SPL levels in a quiet pool. The amount of TTS was positively correlated with the SEL, and statistically significant amounts of TTS were observed for SELs > 195 dB re 1μPa^{2}s. These data agree with those reported by Schlundt et al. (2000) and Nachtigall et al. (2004) and support the use of 195 dB re 1μPa^{2}s as a threshold for TTS onset in dolphins and belugas exposed to mid-frequency sounds. Finneran et al. (2005) also found that each additional dB of SEL produced an additional 0.4 dB of TTS and that for TTS of 3-4 dB, recovery was nearly complete within 10 minutes post-exposure. For larger TTS, longer recovery times were required. The authors caution, however, that interpretation of TTS growth and recovery curves is hampered by the very small amounts of TTS measured relative to the variability of the measurements. They also note that not all exposures above a certain TTS threshold will cause TTS. For example, only 18% of exposures to an SEL of 195 dB re 1μPa^{2}s resulted in measurable TTS.

Mooney et al. (2009a) measured TTS in a bottlenose dolphin exposed to octave-band non-impulse noise ranging from 4 to 8 kHz at SPLs of 130-178 dB re 1 μPa for 1.88 to 30 min. The results of this study showed a strong positive relationship between SEL and the amount of TTS, however the relationship was not a simple equal energy relationship. When SEL was kept constant and exposure duration decreased, TTS did not stay constant, as expected by the equal energy rule. The amount and occurrence of TTS decreased as the duration of sound exposure decreased, so relative to longer duration exposures, shorter duration exposures required greater SELs to induce TTS. Recovery time also varied with both SPL and duration of sound exposure and followed a logarithmic function according to the amount of TTS. Similar results were reported by Mooney et al (2009b). The results of this work illustrate the importance of reporting both SPL and duration of sound exposure when evaluating TTS in odontocetes.

The TTS threshold for odontocetes exposed to a single impulse from a watergun appears to be lower than that for exposure to non-impulse sound (Finneran et al. 2002a). An exposure SEL of 186 dB re 1μPa^{2}s resulted in mild TTS in a beluga whale. However, these measurements were made in the presence of band-limited white noise (masking noise), which may have resulted in a lower TTS than would have been observed in the absence of masking noise. Data from terrestrial mammals also show that broadband pulsed sounds with rapid rise times have a greater auditory effect than do non-impulse sounds (Southall et al. 2007). The rms level of an airgun pulse is typically 10-15 dB higher than the SEL for the same pulse when received within a few km of the airguns. A single airgun pulse might therefore need to have a received level of approximately 196-201 dB re 1 μPa rms to produce brief, mild TTS. Exposure to several strong seismic pulses, each with a flat-weighted received level near 190 dB rms (175-180 dB SEL) could result in cumulative exposure of approximately 186 dB SEL and thus slight TTS in a small odontocete.

While the majority of TTS research has been conducted on bottlenose dolphins and beluga whales (Finneran et al. 2002a; Finneran et al. 2005; Mooney et al. 2009a, b; Finneran et al. 2010a, b) a couple studies involved another odontocete species, the harbor porpoise (Lucke et al. 2009; Kastelein et al. 2012a). Lucke et al. (2009) showed that TTS threshold for this harbor porpoise was lower than that measured for the larger odontocetes. TTS occurred in the harbor porpoise upon exposure to one airgun pulse with a received level of approximately 200 dB re 1 µPa pk-pk or an SEL of 164.3 dB re 1µPa^{2}s (Lucke et al. 2009). Kastelein et al. (2012a) exposed harbor porpoise to an octave-band noise centered around 4 kHz at three mean received SPLS (124, 136, and 148 dB re 1 µPa), six durations (7.5, 15, 30, 60, 120, and 240 minutes), while the approximate SELs varied between 151 and 190 dB re 1µPa^{2}s. The lowest SEL (151 dB re 1µPa^{2}s) causing significant TTS_{1-4} was when the porpoise was exposed to SPL 124 dB re 1 µPa for 7.5 minutes. The maximum TTS_{1-4} induced after 240 minutes exposure to 148 dB was around 15 dB re 1 µPa at a SEL of 190 dB re 1µPa^{2}s. Depending on the exposure level, duration, and the TTS, recovery time varied between 4-96 minutes; however, the longer the exposure duration, the higher the TTS and the longer the recovery time (Kastelein et al. 2012).

When estimating the amount of sound energy required for the onset of TTS, it is generally assumed that the effect of a given cumulative SEL from a series of pulses is the same as if that amount of sound energy were received as a single strong sound (Southall et al. 2007). Data from Finneran et al. (2010b) confirmed potential for accumulation of TTS across multiple exposures and that TTS growth and recovery can occur between exposures (Finneran et al. 2010b); however, for two exposures with equal SELs, the exposure with the longer duration will tend to produce a larger TTS (Finneran et al. 2010a). In addition, more data are needed in order to determine the received levels at which odontocetes would start to incur TTS upon exposure to repeated, low-frequency pulses of airgun sound with variable received levels. For example, the total energy received by an animal will be a function of received levels of airgun pulses as an airgun array approaches, passes at various distances and moves away (e.g., Erbe and King 2009). Finally, as TTS threshold was lower for the harbor porpoise than for bottlenose dolphins or beluga whales, more data are needed regarding TTS thresholds in other odontocete species.

TTS in Pinnipeds. Temporary threshold shift has been measured for only three pinniped species: harbor seals, California sea lions, and northern elephant seals, and only one study has examined TTS in response to exposure to underwater pulses (Finneran et al. 2003). Of the three species for which data are available, the harbor seal exhibits TTS onset at the lowest exposure levels to non-pulsed sounds. A 25 minute exposure to a 2.5 kHz sound elicited TTS in a harbor seal at an SPL of 152 dB re 1 µPa (SEL 183 dB re 1µPa^{2}s), as compared to 174 dB re 1 µPa (SEL 206 dB re 1µPa^{2}s) for the California sea lion and 172 dB re 1 µPa (SEL 204 dB re 1µPa^{2}s) for the elephant seal (Kastak et al. 2005).

The auditory response of pinnipeds to underwater pulsed sounds has been examined in only one study. Finneran et al. (2003) measured TTS onset in two captive California sea lions exposed to single underwater pulses produced by an arc-gap transducer. No measurable TTS was observed following exposures up to a maximum level of 183 dB re 1 µPa peak-to-peak (SEL 163 dB re 1µPa^{2}s). Finneran et al. (2003) suggest that the equal energy rule may apply to pinnipeds, however, Kastak et al. (2005) found that for harbor seals, California sea lions and elephant seals exposed to prolonged non-impulse noise, higher SELs were required to elicit a given TTS if exposure duration was short than if it was longer. For example, for a non-impulse sound, doubling the exposure duration from 25 to 50 min (a 3 dB increase in SEL) had a greater effect on TTS than an increase of 15 dB (95 vs 80 dB) in exposure level. These results are similar to those reported by Mooney et al. (2009a, b) for bottlenose dolphins and emphasize the need for taking both SPL and duration into account when evaluating the effect of sound exposure on marine mammal auditory systems.

7.3.5.3 Permanent Threshold Shift

Permanent threshold shift is defined as 'irreversible elevation of the hearing threshold at a specific frequency (Yost 2000). It involves physical damage to the sound receptors in the ear and can be either total or partial deafness or impaired ability to hear sounds in specific frequency ranges (Kryter 1985). Some causes of PTS are severe extensions of effects underlying TTS (e.g. irreparable damage to sensory hair cells). Others involve different mechanisms, for example exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of inner ear fluids (Ward 1997; Yost 2000). The onset of PTS is determined by pulse duration, peak amplitude, rise time, number of pulses, inter-pulse interval, location, species and health of the receiver's ear (Ketten 1994).

The relationships between TTS and PTS thresholds have not been studied in marine mammals and there is currently no evidence that exposure to airgun pulses can cause PTS in any marine mammal, however, there has been speculation about that possibility (e.g., Richardson et al. 1995; Gedamke et al. 2008). In terrestrial mammals, prolonged exposure to sounds loud enough to elicit TTS can cause PTS. Similarly, shorter term exposure to sound levels well above the TTS threshold can also cause PTS (Kryter 1985). Terrestrial mammal PTS thresholds for impulse sounds are thought to be at least 6 dB higher than TTS thresholds on a peak-pressure basis (Southall et al. 2007). Also, pulses with rapid rise times can result in PTS even when peak levels are only a few dB higher than the level causing slight TTS.

Southall et al. (2007) used available marine mammal TTS data and precautionary extrapolation procedures based on terrestrial mammal data to estimate exposures that may be associated with PTS onset. For terrestrial mammals, TTS exceeding 40 dB generally requires a longer recovery time than smaller TTS, which suggests a higher probability of irreversible damage (Ward 1970) and possibly different underlying mechanisms (Kryter 1994; Nordman et al. 2000). Based on this, and the similarities in morphology and functional dynamics among mammalian cochleae, Southall et al. (2007) assumed that PTS would be likely if the hearing threshold was increased by more than 40 dB and assumed an increase of 2.3 dB in TTS with each additional dB of sound exposure. This translates to an injury criterion for pulses that is 15 dB above the SEL of exposures causing TTS onset. Finneran et al. (2002a) found TTS onset in belugas exposed to a single pulse of sound at an SEL of 183 dB re 1µPa^{2}s. Therefore, according to the assumptions above, the PTS threshold would be approximately 198 dB re 1µPa^{2}s for a single pulse.

There are no data on the sound level of pulses that would cause TTS onset in pinnipeds. Southall et al. (2007) therefore assumed that known pinniped-to-cetacean differences in TTS-onset for non-pulsed sounds also apply to pulse sounds. Harbor seals experience TTS onset at received levels that are 12 dB lower than those required to elicit TTS in beluga whales (Kastak et al. 2005; Finneran et al. (2002a). Therefore, TTS onset in pinnipeds exposed to a single underwater pulse was estimated to occur at an SEL of 171 dB re 1µPa^{2}s. Adding 15 dB results in a PTS onset of 186 dB re 1µPa^{2}s for pinnipeds exposed to a single pulse. This is likely to be a precautionary estimate as the harbor seal is the most sensitive pinniped species studied to date and these results are based on measurements taken from a single individual (Kastak et al. 1999, 2005).

It is unlikely that a marine mammal would remain close enough to a large airgun array long enough to incur PTS. Some concern arises for bowriding dolphins; however, the auditory effects of seismic pulses are reduced by Llyod's mirror and surface release effects. In addition, the presence of the ship between the bowriding animals and the airgun array may also reduce received levels (e.g., Gabriele and Kipple 2009). As discussed in the TTS section, the levels of successive pulses received by a marine mammal will increase and then decrease gradually as the seismic vessel approaches, passes and moves away, with periodic decreases also caused when the animal goes to the surface to breath, reducing the probability of the animal being exposed to sound levels large enough to elicit PTS.

7.4 POTENTIAL EFFECTS OF GEOHAZARD SURVEY SOUNDS ON MARINE MAMMALS

7.4.1 Masking

The proposed high-resolution sub-bottom profiler operates at source level of 210 dB re 1 μPa rms at 1 m. The proposed system emits energy in the frequency bands of 2 to 24 kHz, which is within the maximum sensitivity hearing range of any the species in the Petition region (beluga whales, 40-130 kHz; killer whales, 18-42 kHz; harbor porpoise, 100-140 kHz; and harbor seals, 10-30 kHz; Wartzok and Ketten 1999, Kastelein et al. 2012b). The ability for the chirp sub-bottom profiler to mask marine mammal communication is limited to the immediate vicinity of the survey vessel.

7.4.2 Behavioral Response

The behavioral response of marine mammals to the operation of the sub-bottom profilers is expected to be similar to that of the airgun. The odontocetes are likely to avoid the sub-bottom profiler activity, especially the naturally shy harbor porpoise, while the harbor seals might be attracted to them out of curiosity. However, because the sub-bottom profilers operate from a moving vessel, the area and time that this equipment would be affecting a given location is very small.

7.4.3 Hearing Impairment

It is unlikely that the sub-bottom profilers produce sound levels strong enough to cause hearing impairment or other physical injuries even in an animal that is (briefly) in a position near the source. The likelihood of marine mammals moving away from the source make if further unlikely that a marine mammal would be approach close enough to cause hearing impairment.

7.5 POTENTIAL EFFECTS OF DRILLING SOUNDS ON MARINE MAMMALS

The potential effects of underwater sounds from the proposed exploration drilling activities is unlikely to result in temporary or especially permanent hearing impairment, or non-auditory physical effects but may result in tolerance, masking, or some behavioral disturbance.

7.5.1 Baleen Whales

Southall et al. (2007) reviewed the responses of marine mammals to non-pulsed sound. In general, little or no response was observed in animals exposed at received levels from 90-120 dB re 1 μPa rms. The probability of avoidance and other behavioral effects increased when received levels were 120-160 dB re 1 μPa rms.

Baker et al. (1982) reported some avoidance by humpback whales to vessel noise when received levels were 110-120 dB re 1 μPa rms, and clear avoidance at 120-140 dB re 1 μPa rms. Malme et al. (1983, 1986) used playback of sound from helicopter overflight and drilling rigs and platforms to study behavioral effects on migrating gray whales. Received levels exceeding 120 dB re 1 μPa rms induced avoidance reactions. Malme et al. (1986) observed the behavior of feeding gray whales during four experimental playbacks of drilling sounds (50-315 Hz, source levels 156-162 dB re 1 μPa). In two cases for received levels of 100 to 110 dB re 1 μPa, no behavioral reaction was observed. Avoidance behavior was observed in two cases where received levels were 110 to 120 dB re 1 μPa rms.

McCauley et al. (1996) reported several cases of humpback whales responding to vessels in Hervey Bay, Australia. Results indicated clear avoidance at received levels between 118 to 124 dB re 1 μPa rms in three cases for which response and received levels were observed/measured.

Based upon the above information, some baleen whales may exhibit minor, short-term disturbance responses to underwater sounds from drilling and associated support activities. Any potential impacts on baleen whale behavior would be localized within the activity area and would not result in population-level effects.

7.5.2 Toothed Whales

Most toothed whales have the greatest hearing sensitivity at frequencies higher than that of baleen whales and may be less responsive to low-frequency sound commonly associated with industry activities. Richardson et al. (1995) reported that beluga whales did not show any apparent reaction to playback of underwater drilling sounds at distances greater than 200-400 m (656–1,312 ft). Reactions included slowing down, milling, or reversal of course after which the whales continued past the projector, sometimes within 50-100 m (164-328 ft). They reported that playback of drilling sound had no biologically material effects on migration routes of beluga whales migrating through pack ice and along the seaward side of the nearshore lead east of Pt. Barrow in spring.

Awbrey and Stewart (1983) played back semi-submersible drillship sounds (163 dB re 1 μPa rms) to belugas in Alaska. They reported avoidance reactions at 300 m and 1,500 m (985 and 4,921 ft) and approach by groups at a distance of approximately 3,500 m (3,927 yd) with received levels ~110 to 145 dB re 1 μPa rms. Richardson et al. (1990) played back drilling platform sounds (163 dB re 1 μPa rms) to belugas in Alaska. They conducted aerial observations of eight individuals among ~100 spread over an area several hundred meters to several kilometers from the sound source and found no obvious reactions. Moderate changes in movement were noted for three groups swimming within 200 m (656 ft) of the source.

Based upon the above information regarding toothed whale disturbance reactions, some toothed whales may exhibit minor, short-term disturbance responses to underwater sounds from drilling and associated support activities. Any potential impacts on toothed whale behavior would be localized within the activity area and would not result in population-level effects.

7.5.3 Pinnipeds

Pinnipeds generally seem to be less responsive to exposure to industrial sound than most cetaceans. Pinniped responses to underwater sound from some types of industrial activities such as seismic exploration appear to be temporary and localized (Harris et al. 2001; Reiser et al. 2009).

Southall et al. (2007) reviewed literature describing responses of pinnipeds to non-pulsed sound and reported that the limited data suggest exposures between ~90 and 140 dB re 1 μPa rms generally do not appear to induce strong behavioral responses in pinnipeds exposed to non-pulsed sounds in water; no data exist regarding exposures at higher levels. It is important to note that among these studies of pinnipeds responding to nonpulse exposures in-water, there are some apparent differences in responses between field and laboratory conditions. In contrast to the mid-frequency odontocetes, captive pinnipeds responded more strongly at lower levels than did animals in the field.

Kastelein et al. (2006) exposed nine captive harbor seals in an enclosure to non-pulsed sounds modulated tones, sweeps, and bands of noise with fundamental frequencies between 8 and 16 kHz at 128-130 dB re 1 μPa rms. Seals generally swam away from each source at received levels of ~107 dB re 1 μPa rms, avoiding it by ~5 m, although they did not haul out of the water or change surfacing behavior. Seal reactions did not appear to wane over repeated exposure (i.e., there was no obvious habituation), and the colony of seals generally returned to baseline conditions following exposure. The seals were not reinforced with food for remaining in the sound field.

Based upon the above information regarding pinniped disturbance reactions, some pinnipeds may exhibit minor, short-term disturbance responses to underwater sounds from drilling and associated support activities. Any potential impacts on pinniped behavior would be localized within the activity area and would not result in population-level effects.

7.6 POTENTIAL EFFECTS OF CONSTRUCTION AND MAINTENANCE ACTIVITY SOUNDS ON MARINE MAMMALS

Construction and maintenance activity noise of concern is sounds associated with water jets (stationary non-impulsive sound). A water jet will be used during this exploration and drilling program for routine maintenance of the underwater pipeline to remove marine growth and rock debris. There are no published data on marine mammal responses to noise associated with water jets. Although, the noise associated with water jets are detectable by and have the potential to harass marine mammals, the noise is very short in duration (30 minutes or less at any given time), intermittent, and approximately 1-3 day at each well site. In addition, Hilcorp Alaska will implement mitigation and monitoring measure to reduce the potential impacts (Appendix A).

7.6.1 Baleen Whales

There are studies of baleen whales responses to other impulsive sounds, such as seismic activity (Section 7.1). Humpbacks and other large baleen whales have shown strong overt reactions to impulsive sounds, such as seismic operations, at received levels between 160 and 173 dB re 1 μPa rms (Richardson et al. 1986; Ljungblad et al. 1988; Miller et al. 2005; McCauley et al., 1998). However, baleen whales seem to be less tolerant of continuous sound (Richardson and Malme, 1993), often detouring around drilling activity when received levels are as low as 119 dB re 1 μPa (rms) (Malme et al. 1983; Richardson et al. 1985).

Based upon the information regarding baleen whale disturbance reactions and that baleen whales are rarely seen in the Petition region, some baleen whales may exhibit minor, short-term disturbance responses to underwater sounds from construction activities. Any potential impacts on baleen whale behavior would be localized within the activity area and would not result in population-level effects.

7.6.2 Toothed Whales

Although, behavioral responses have been observed in odontocetes during construction activity, odontocetes hear and communicate at frequencies well above the frequencies of construction activity noise (Wartzok and Ketten 1999). Beluga whales have a well-developed and well-documented sense of hearing. White et al. (1978) measured the hearing of two belugas whales and described hearing sensitivity between 1 and 130 kHz, with best hearing between 30 to 50 kHz. Awbrey et al. (1988) examined their hearing in octave steps between 125 Hz and 8 kHz, with average hearing thresholds of 121 dB re1 μPa at 125 Hz and 65 dB re 1 μPa at 8 kHz. Johnson et al. (1989) further examined beluga hearing at low frequencies, establishing that the beluga whale hearing threshold at 40 Hz was 140 dB re 1 μPa. Ridgway et al. (2001) measured hearing thresholds at various depths down to 330 yards at frequencies between 500 Hz and 100 kHz. Beluga whales showed unchanged hearing sensitivity at this depth. Finneran et al. (2005) measured the hearing of two belugas, describing their auditory thresholds between 2 and 130 kHz. Castellote et al. (2014) documented similar hearing abilities in wild beluga whales as those in captive. In summary, these studies indicate that beluga whales hear from approximately 40 Hz to 130 kHz, with maximum sensitivity from approximately 30 to 50 kHz. It is important to note that these audiograms represent the best hearing of belugas, measured in very quiet conditions. These quiet conditions are rarely present in the wild, where high levels of ambient sound may exist, such as in Cook Inlet. It is expected that while odontocetes such as beluga whales and harbor porpoise would be able to detect sound from the planned industrial activities, it is unclear whether the operations would mask the ability of these high-frequency animals to communicate. In addition, Hilcorp Alaska will implement mitigation and monitoring measure to reduce the potential impacts (Appendix A).

7.6.3 Pinnipeds

Blackwell et al. (2004) observed ringed seals during construction activities at Northstar Island (Prudhoe Bay, Alaska). Ringed seals did not show adverse reactions to r construction activities. Some seals were observed swimming near the island and as close as 46 m from the activity. The authors suggest that the seals near Northstar Island were most likely habituated to industrial sounds and more tolerant of disturbance than seals in remote areas. It is likely pinnipeds are more tolerant of noise associated with construction activity than cetaceans and are not likely adversely affected by such noise. In addition, Hilcorp Alaska will implement mitigation and monitoring measures to reduce the potential impacts (Appendix A).

8.0 DESCRIPTION OF IMPACT ON SUBSISTENCE USES

The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses.

8.1 RELEVANT SUBSISTENCE USES

The ADF&G conducted studies to document the harvest and use of wild resources by residents of communities on the east and west sides of Cook Inlet (Jones and Kostick 2016). Data on wild resource harvest and use were collected, including basic information about who, what, when, where, how, and how much wild resources are being used to develop fishing and hunting opportunities for Alaska residents. Tyonek was surveyed in 2013 (Jones et al., 2015), and Nanwalek, Port Graham, and Seldovia were surveyed in 2014 (Jones and Kostick 2016). Marine mammals were harvested by three (Seldovia, Nanwalek, Port Graham) of the four communities but at relatively low rates (Table 20; Figure 19). The harvests consisted of harbor seals, Steller sea lions, and northern sea otters (*Enhydra lutris*).

Table 20. Marine mammal harvest by Tyonek in 2013 and Nikiski, Port Graham, Seldovia, and Nanwalek in 2014

Village	Harvest (pounds per capita)	Households Attempting Harvest number (% of residents)	Number of Marine Mammals Harvested			
			Harbor Seal	Steller Sea Lion	Northern Sea Otter	Beluga Whale
Tyonek	2	6 (6 %)	6	0	0	0
Seldovia	1	2 (1 %)	5	0	3	0
Nanwalek	11	17 (7 %)	22	6	1	0
Port Graham	8	27 (18 %)	16	1	24	0

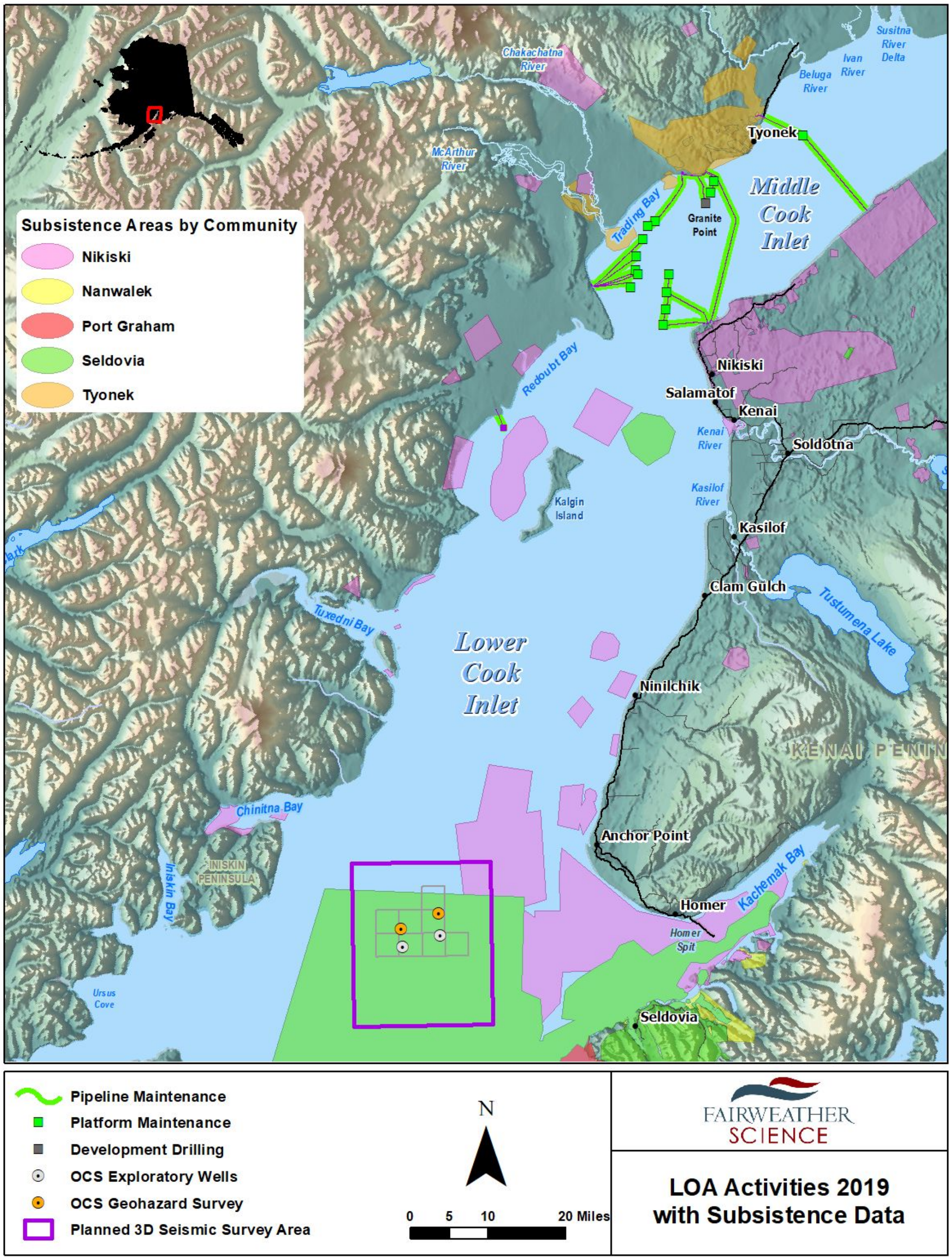

Figure 19. Subsistence use areas by community from ADF&G in the Petition region. Species are not differentiated in these data.

8.1.1 Beluga Whale

The Cook Inlet beluga whale has traditionally been hunted by Alaska Natives for subsistence purposes. For several decades prior to the 1980s, the Native Village of Tyonek residents were the primary subsistence hunters of Cook Inlet beluga whales. During the 1980s and 1990s, Alaska Natives from villages in the western, northwestern, and North Slope regions of Alaska either moved to or visited the south-central region and participated in the yearly subsistence harvest (Stanek 1994). From 1994 to 1998, NMFS estimated 65 whales per year (range 21-123) were taken in this harvest, including those successfully taken for food, and those struck and lost. NMFS has concluded that this number is high enough to account for the estimated 14 percent annual decline in population during this time (Hobbs et al. 2008). Actual mortality may have been higher, given the difficulty of estimating the number of whales struck and lost during the hunts. In 1999, a moratorium was enacted (Public Law 106-31) prohibiting the subsistence take of Cook Inlet beluga whales except through a cooperative agreement between NMFS and the affected Alaska Native organizations.

On October 15, 2008, NMFS published a final rule that established long-term harvest limits on the Cook Inlet beluga whales that may be taken by Alaska Natives for subsistence purposes (73 FR 60976). That rule prohibits harvest for a 5-year period (2008–2012), if the average abundance for the Cook Inlet beluga whales from the prior five years (2003–2007) is below 350 whales. The next 5-year period that could allow for a harvest (2013–2017), would require the previous five-year average (2008–2012) to be above 350 whales. Since the Cook Inlet beluga whale harvest was regulated in 1999 requiring cooperative agreements, five beluga whales have been struck and harvested. Those beluga whales were harvested in 2001 (one animal), 2002 (one animal), 2003 (one animal), and 2005 (two animals). The Native Village of Tyonek agreed not to hunt or request a hunt in 2007, when no co-management agreement was to be signed (NMFS 2008a).

The 2008 Cook Inlet Beluga Whale Subsistence Harvest Final Supplemental Environmental Impact Statement (NMFS 2008a) authorizes how many beluga whales can be taken during a 5- year interval based on the 5-year population estimates and 10-year measure of the population growth rate. Based on the 2008–2012 5-year abundance estimates, no hunt occurred between 2008 and 2012 (NMFS 2008a). The Cook Inlet Marine Mammal Council, which managed the Alaska Native Subsistence fishery with NMFS, was disbanded by a unanimous vote of the Tribes' representatives on June 20, 2012. No harvest has occurred since then and no harvest is likely in 2018.

Residents of the Native Village of Tyonek are the primary subsistence users in Knik Arm area (73 FR 60976). No households hunted beluga whale locally in Cook Inlet due to conservation concerns (Jones et al. 2015). The LOA activities should not have any effect because no beluga harvest has taken place since 2005 and beluga hunts are not expected during the ITR period.

8.1.2 Steller Sea Lion and Harbor Seal

The only non-ESA listed marine mammal available for subsistence harvest in Cook Inlet is the harbor seal (Wolfe et al. 2009). The listed Steller sea lions are occasionally taken. There is a low level of subsistence hunting for harbor seals in Cook Inlet (Wolfe et al. 2009). Seal hunting occurs opportunistically among Alaska Natives who may be fishing or travelling in upper Cook Inlet near the mouths of the Susitna River, Beluga River, and Little Susitna River. Higher marine mammal harvest occurs in the communities that are not accessible by the road system of Seldovia, Nanwalek, and Port Graham (Table 21).

Table 21. Steller Sea lion and harbor seal harvest by Tyonek in 2013 and Port Graham, Seldovia and Nanwalek in 2014.

Community	Harbor Seal			Steller Sea Lion		
	Percent Harvest	Total Harvest in Pounds	Percent Households Usage	Percent Harvest	Total Harvest in Pounds	Percent Households Usage
Tyonek[a]	100 (100%)	360	14 (14%)	Not Harvested	Not Harvested	Not Harvested
Seldovia[b]	67 (67%)	300	1 (1%)	Not Harvested	Not Harvested	Not Harvested
Nanwalek[b]	50 (50%)	1,225.3	71 (71%)	50 (50%)	1,242.9	25 (25%)
Port Graham[b]	38 (28%)	1,154	27 (27%)	3 (3%)	282.0	7 (7%)

[a]Tyonek information from Jones et al. 2015
[b]Nikiski, Port Graham, Seldovia, and Nanwalek information from Jones and Kostick (2016)

In Tyonek, harbor seals were harvested between June and September by 6 percent of the households (Jones et al. 2015). Seals were harvested in several areas, encompassing an area stretching 32.2 km (20 mi) along the Cook Inlet coastline from the McArthur River Flats north to the Beluga River. Seals were searched for or harvested in the Trading Bay areas as well as from the beach adjacent to Tyonek (Jones et al. 2015). In Seldovia, the harvest of harbor seals (5 total) occurred exclusively in December (Jones and Kostick 2016).

In Nanwalek, 22 harbor seals were harvested in 2014 between March and October, the majority of which occur in April. Nanwalek residents typically hunt harbor seals and Steller sea lions at Bear Cove, China Poot Bay, Tutka Bay, Seldovia Bay, Koyuktolik Bay, Port Chatam, in waters south of Yukon Island, and along the shorelines close to Nanwalek, all south of the Petition region (Jones and Kostock 2016).

According to the results presented in Jones and Kostick (2016) in Port Graham, harbor seals were the most frequently used marine mammal; Tribal members harvest 16 in the survey year. Harbor seals were harvested in January, February, July, August, September, November, and December. Steller sea lions were used noticeably less (1 animal harvested) and harvested in November and December.

8.1.3 Other Marine Mammals

There are no harvest quotas for other non-listed marine mammals found in Cook Inlet. The only data available for subsistence harvest of harbor porpoises, and humpback and killer whales in Alaska are in the marine mammal stock assessments. However, these numbers are for the Gulf of Alaska including Cook Inlet, and they are not indicative of the harvest in Cook Inlet specifically. Jones et al. (2015) and Jones and Kostick (2016) did not report subsistence harvest in Tyonek, Seldovia, Port Graham, or Nanwalek of harbor porpoise or humpback and killer whales. Therefore, because the proposed LOA activities would result in only temporary disturbances, it would not impact the availability of these other species for subsistence uses.

8.2 POTENTIAL IMPACTS ON AVAILABILITY FOR SUBSISTENCE USES

Section 101(a)(5)(A) requires NMFS to determine that the taking would not have an unmitigable adverse effect on the availability of marine mammal species or stocks for subsistence use. NMFS has defined ‘‘unmitigable adverse impact’’ in 50 CFR 216.103 as an impact resulting from the specified activity: (1) That is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) Causing the marine mammals to abandon or avoid hunting areas; (ii) Directly displacing subsistence users; or (iii) Placing physical barriers between the marine mammals and the subsistence hunters; and (2) That cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

The primary concern is the disturbance of marine mammals through the introduction of anthropogenic sound into the marine environment during LOA activities. Marine mammals could be behaviorally harassed and either become more difficult to hunt or temporarily abandon traditional hunting grounds. Areas used by the residents of Seldovia, Port Graham, and Nanwalek are located approximately 20 mi south of the southernmost boundary delineation and any associated zones of influence due to the generation of underwater sound during activities. Therefore, LOA activities are not thought to impact marine mammals in sufficient numbers to render them unavailable for subsistence harvest. In addition, mitigation measures would be implemented to ensure protection of beluga habitat. Because of the short-term, temporary, and localized nature of activities and on all the analyses and information presented above, impacts to any marine mammal harvest potential are expected to be negligible. While LOA activities may occur within the traditional area for hunting marine mammals, no relevant subsistence uses of marine mammals would be impacted by this action.

Presentations will be given at various local forums. Hilcorp Alaska is working with a contractor to update/verify an existing stakeholder list. Meetings and communication will be coordinated with subsistence, commercial and sport fishing groups/associations, Alaska Native Tribes, marine mammal co-management groups, local landowners, government and community organizations, and environmental NGO's.

Legitimate issues, questions, problems associated with Petition activities will be dealt with on a case-by-case basis. Hilcorp Alaska personnel and all associated contractors are instructed to be open and transparent regarding activities. If conflicts arise, Hilcorp Alaska will engage and track the proper parties to address and work to find resolution, if possible. Hilcorp Alaska has prepared a Stakeholder Engagement Plan (SEP) outlining the communities and a tentative schedule for the meetings. Meetings or communication with communities will be tracked and presented in the annual and final report to NMFS and other relevant agencies. The SEP is provided in Appendix B to the Petition, but it is important to note this is a "living document."

9.0 DESCRIPTION OF IMPACT ON MARINE MAMMAL HABITAT

The anticipated impact of the activity upon the habitat of the marine mammal populations, and the likelihood of restoration of the affected habitat.

A detailed description of exploration and production activities that are planned in Year 1 LOA (Figure 3) is provided in Section 1 and summarized in Table 1. The potential impacts to marine mammal habitat in Cook Inlet from the activities are discussed in the ITR Petition and in this section.

9.1 PHYSICAL IMPACTS ON HABITAT

9.1.1 Seafloor Disturbance

The sources of seafloor disturbance from activities included in the Year 1 LOA include boring during geotechnical surveys, drilling wells, and some maintenance activities on existing pipelines.

The boring equipment used for geotechnical surveys are generally small in diameter with only a few over the area to be surveyed, so the area of total disturbance is very small and temporary. The total area of disturbed sediment due to jack-up rig legs will depend on the rig design and diameters of the legs. BOEM estimated each setup of a jack-up rig results in approximately 2.5 acres of seafloor disturbance. The use of seafloor anchors causes physical compaction of the seafloor beneath the anchor.

9.1.2 Drilling Discharges

Exploratory drilling wastes include drilling fluids, known as mud, and rock cuttings will be circulated from downhole to the jack-up mud pit system. Non-hydrocarbon based drilling wastes will be discharged to the Cook Inlet under an approved APDES general permit or sent to an approved waste disposal facility. Hydrocarbon based drilling wastes will be delivered to an onshore permitted location for disposal. Hilcorp Alaska will follow BMPs and all stipulations of the applicable permits for this activity. The APDES general permit has determined that discharges authorized under this permit will not result in unreasonable degradation of the marine environment.

9.1.3 Other Discharges

All vessels with toilet facilities must have Type II or Type III marine sanitation devices (MSDs) that comply with 40 CFR 140 and 33 CFR 159 for sanitary wastes. A Type II MSD macerates waste solids so that the discharge contains <150 milligrams per liter (mg/L) of suspended solids and a bacteria count <200 per 100 milliliters (mL). Type III MSDs are more commonly used systems designed to retain or treat the sanitary waste until it can be disposed of at proper onshore facilities. State and local governments regulate domestic and gray water discharges that consist of materials discharged from sinks, showers, laundries, safety showers, eyewash stations, hand-wash stations, and galleys. Gray water discharges are not regulated outside the state's territory.

9.1.4 Petroleum Release

Large and small quantities of hazardous materials, including diesel fuel and gasoline, would be handled, transported, and stored following the rules and procedures described in supporting state and federal response and prevention plans belonging to Hilcorp Alaska, Harvest Alaska, and their contractors, for Cook Inlet.

Large and small quantities of hazardous materials, including diesel fuel and gasoline, would be handled, transported, and stored following the rules and procedures described in supporting state and federal response and prevention plans belonging to Hilcorp Alaska, Harvest Alaska, and their contractors, for Cook Inlet. Spills and leaks of oil or wastewater arising from the Petition activities that reach marine waters could result in direct impacts to the health of exposed marine mammals. Individual marine mammals could show acute irritation or damage to their eyes, blowhole or nares, and skin; fouling of baleen, which could reduce feeding efficiency; and respiratory distress from the inhalation of vapors (Geraci and St. Aubin 1990). Long-term impacts from exposure to contaminants to the endocrine system could impair health and reproduction (Geraci and St. Aubin 1990). Ingestion of contaminants could cause acute irritation to the digestive tract, including vomiting and aspiration into the lungs, which could result in pneumonia or death (Geraci and St. Aubin 1990).

Indirect impacts from spills or leaks could occur through the contamination of lower-trophic-level prey, which could reduce the quality and/or quantity of marine mammal prey. In addition, individuals that consume contaminated prey could experience long-term effects to health (Geraci and St. Aubin 1990).

9.1.5 Invasive Species

Vessels can impact habitat quality for marine mammals through the introduction of aquatic invasive organisms. Construction vessel traffic would arrive from Asia and could potentially transport non-native tunicates, green crab (*Carcinus maenas*), and Chinese mitten crab (*Eriocheir sinensis*) (ADF&G 2002), which impact food webs and can outcompete native invertebrates, resulting in habitat degradation.

All vessels brought into the State of Alaska or federal waters are subject to United States Coast Guard (USCG) 33 CFR 151 regulations, which are intended to reduce the transfer of aquatic invasive organisms. Management of ballast water discharge is regulated by federal regulations (33 CFR 151.2025) that prohibit discharge of untreated ballast water into the waters of the United States unless the ballast water has been subject to a mid-ocean ballast water exchange [at least 370.4 km (200 nm) offshore]. Vessel operators are also required to remove "fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations" (33 CFR 151.2035(a)(6). Adherence to the USCG 33 CFR 151 regulations would reduce the likelihood of Project-related vessel traffic introducing aquatic invasive species.

9.2 POTENTIAL IMPACTS FROM SOUND ON FOOD SOURCES

9.2.1 Zooplankton

Zooplankton is a food source for several marine mammal species, including humpback whales, as well as a food source for fish that are then prey for marine mammals. Population effects on zooplankton could therefore have indirect effects on marine mammals. The primary generators of sound energy associated with activities included in this LOA include seismic surveys, shallow hazard surveys, vessels, development drilling, and routine maintenance activities on the pipelines. Popper and Hastings (2009) reviewed information on the effects of pile driving and concluded that there are no substantive data on whether the high sound levels from pile driving or any man-made sound would have physiological effects on invertebrates. Any such effects would be limited to the area very near (1–5 m [3.2–16.4 ft]) the sound source and would result in no population effects due to the relatively small area affected at any one time and the reproductive strategy of most zooplankton species (short generation, high fecundity, and very high natural mortality).

No adverse impact on zooplankton populations would be expected to occur from these activities, due in part to large reproductive capacities and naturally high levels of predation and mortality of these populations. Any mortalities or impacts that might occur would be expected to be negligible compared to the naturally occurring high reproductive and mortality rates. Impacts from sound energy generated by vessels and dredging would be expected to have even less impact, as these activities produce much lower sound energy levels.

9.2.2 Benthos

No adverse impacts on benthic populations would be expected due in part to large reproductive capacities and naturally high levels of predation and mortality of these populations. Any mortalities or impacts that might occur because of operations are negligible compared to the naturally occurring high reproductive and mortality rates.

9.2.3 Fish

Fish are the primary prey species for marine mammals in Cook Inlet. Beluga whales feed on a variety of fish, shrimp, squid, and octopus (Burns and Seaman 1986). Common prey species in Knik Arm include salmon, eulachon and cod. Harbor seals feed on fish such as pollock, cod, capelin, eulachon, Pacific herring, and salmon as well as a variety of benthic species, including crabs, shrimp, and cephalopods. Harbor seals are also opportunistic feeders with their diet varying with season and location. The preferred diet of the harbor seal in the Gulf of Alaska consists of pollock, octopus, capelin, eulachon, and Pacific herring (Calkins 1989). Other prey species include cod, flat fishes, shrimp, salmon, and squid (Hoover 1988). Harbor porpoises feed primarily on Pacific herring, cod, whiting (hake), pollock, squid, and octopus (Leatherwood et al. 1982). Killer whales feed on either fish or other marine mammals depending on genetic type (resident versus transient respectively) (Shelden et al. 2003). Humpback whales feed on small schooling fishes, euphausiids, and other large zooplankton. Fish prey species in the North Pacific include Pacific herring, capelin, juvenile walleye pollock, and sand lance. Humpback also feed on eulachon, Atka mackerel, Pacific cod, saffron cod, Arctic cod, juvenile salmon, and rockfish (Hain et al. 1982). Minke whales feed on a variety of small schooling fish and euphausiids by using lung-feeding or bird-associated feeding strategies (summarized in Muto et al. 2017)

In general, fish perceive underwater sounds in the frequency range of 50 to 2,000 Hz, with peak sensitivities below 800 Hz (Popper et al. 2005). However, fish are sensitive to underwater impulsive sounds due to swimbladder resonance. As the pressure wave passes through a fish, the swimbladder is rapidly squeezed as the high-pressure wave, and then under pressure component of the wave, passes through the fish. The swimbladder may repeatedly expand and contract at the high SPLs, creating pressure on the internal organs surrounding the swimbladder.

Popper et al. (2005), in a review of 40 years of studies concerning the use of underwater sound to deter salmonids from hazardous areas at hydroelectric dams and other facilities, concluded that salmonids were able to respond to low-frequency sound and to react to sound sources within a few feet of the source. They speculated that the reason that underwater sound had no effect on salmonids at distances greater than a few feet is because they react to water particle motion/acceleration, not sound pressures. Detectable particle motion is produced within very short distances of a sound source, although sound pressure waves travel farther.

Hastings and Popper (2005) reviewed all pertinent peer-reviewed and unpublished papers on noise exposure of fish through early 2005. They proposed the use of SEL to replace peak SPL in pile driving criteria. This report identified interim thresholds based on SEL or sound energy. The interim thresholds for injury were based on exposure to a single pile driving pulse. The report also indicates that there was insufficient evidence to make any findings regarding behavioral effects associated with these types of sounds. Interim thresholds were identified for pile driving consisting of a single-strike peak SPL and a single strike SEL for onset of physical injury. A peak pressure criterion was retained to function in concert with the SEL value for protecting fishes from potentially damaging aspects of acoustic impact stimuli. The available scientific evidence suggested that a single-strike SPL of 208 dB and a single strike SEL of 187 dB were appropriate thresholds for the onset of physical injury to fishes, which can be applied for seismic sounds in addition to pile driving.

Following the Hasting and Popper (2005) paper, NMFS developed their version of the dual criteria that included the single strike peak SPL of 208 dB, but addressed the accumulation of multiple strikes or pulses through accumulation of sound energy by setting a criterion of 187 dB SEL. The accumulated SEL is calculated using an equal energy hypothesis that combines the SEL of a single strike to 10 times the 10-based logarithm of the number of pile strikes or seismic pulses.

Fish have been shown to react when engine and propeller sounds exceeds a certain level (Olsen et al. 1983; Ona 1988; Ona and Godo 1990). Avoidance reactions have been observed in fish such as cod and herring when vessel sound levels were 110–130 dB re 1 µPa rms (Olsen 1979; Ona and Godo 1990; Ona and Toresen 1988). Vessel sound source levels in the audible range for fish are typically 150–170 dB re 1 µPa/Hz (Richardson et al. 1995). The vessels used during the activities would be expected to produce levels of 170–175 dB re 1 µPa rms when in transit. Based upon the reports in the literature and the predicted sound levels from these vessels, there may be some avoidance by fish in the immediate area.

Several caged fish studies of the effects of pile driving have been conducted, and most have involved salmonids. Ruggerone et al. (2008) exposed caged juvenile coho salmon (93–135 millimeters) at two distance ranges (near 1.8–6.7 m and distance 15 m) to 0.5-m-diameter steel piles driven with a vibratory hammer. Sound pressure levels reached 208 dB re 1 µPa peak, 194 dB re 1 µPa rms, and 179 dB re 1 µPa^{2}s SEL, leading to a cumulative SEL of approximately 207 dB re 1 µPa^{2}s during the 4.3-hr period. All observed behavioral responses of salmon to pile strikes were subtle; avoidance response was not apparent among fish. No gross external or internal injuries associated with pile driving sounds were observed. The fish readily consumed hatchery food on the first day of feeding (day 5) after exposure. The study suggests that coho salmon were not significantly affected by cumulative exposure to the pile driving sounds or potentially to seismic pulses.

Hart Crowser, Inc. et al. (2009) similarly exposed caged juvenile (86–124 millimeters, 10–16 grams) coho salmon to sheet pile driving in Cook Inlet using vibratory and impact hammers. Sound pressures measured during the acoustic monitoring were relatively low, ranging from 177 to 195 dB re 1 µPa peak, and cumulative SEL sound pressures ranging from 179.2 to 190.6 dB re 1 µPa^{2}s. No measured peak pressures exceeded the interim criterion of 206 dB. Six of the 13 tests slightly exceeded the SEL criterion of 187 dB for fish over 2 grams. No short-term or long-term mortalities of juvenile hatchery coho salmon were observed in exposed or reference fish, and no short- or long-term behavioral abnormalities were observed in fish exposed to pile driving sound pressures or in the reference fish during post-exposure observations.

10.0 DESCRIPTION OF IMPACT FROM LOSS OR MODIFICATION TO HABITAT

The anticipated impact of the loss or modification of habitat on the marine mammal populations involved.

10.1 SEAFLOOR DISTURBANCE AND HABITAT ALTERATION

Seafloor disturbance, turbidity, and discharge from activities may impact marine mammal prey species and potentially the fitness of marine mammals. Turbidity may affect the prey species distribution and diversity as well as the ability of marine mammals to locate prey in the immediate area of the drilling activity. The discharge of drilling fluids and cuttings during drilling activities is unlikely to have large-scale effects on marine mammals, either directly through contact with marine mammals or indirectly by affecting their prey, because the effects would be restricted primarily to the areas immediately surrounding the drillsite and the areas of supporting anchors and chains. The presence of the drill rig is not expected to result in direct loss of marine mammal habitat, but it could result in a minimal loss of marine mammal foraging areas.

The use of the jack-up rigs disturbs the seafloor due to the placement and removal of stabilizers (i.e., the drilling rig legs on a jack-up rig). The area of disturbance will vary based on the specific drill rig used and Cook Inlet currents, but in most cases includes the area of disturbance from the mudline cellar, the anchoring system, displacement of sediments, and discharge of drilling waste will be small.

Highly localized minor impacts from seafloor disturbance from the LOA activities on benthic populations are expected due in part to large reproductive capacities and naturally high levels of predation and mortality of these populations. Seafloor disturbance from anchor handling activities is anticipated to fill in over time through natural movement of sediment. Disturbance associated with mudline cellar excavation or exploration/delineation wells is anticipated to temporarily impact a small area of habitat, which will be rapidly recolonized by benthic organisms.

Overall, seafloor disturbance and habitat alteration could have a few highly localized, short-term effects to a few marine mammals. Potential effects from seafloor disturbance are likely to limit the foraging quality of the disturbed area during drilling, and possibly for a few years afterward in some locations. These effects should be consistent with or less than what has been occurring throughout Cook Inlet since the first production platform was created in the 1960s. Seafloor disturbance would occur during the four phases of development; however, there should be no lingering effect on the area once the vessel or drilling rig has left.

Discharging drill cuttings or other liquid waste streams generated by the drilling could affect marine mammal habitat and prey. There have been no marine mammal deaths in the wild that can be conclusively linked to the direct exposure to organochlorines or other toxins (O'Shea 1999). The main impacts from drilling discharges would be temporary turbidity in the water column and localized alteration of the benthic environment around individual wellsites. The settling of drilling fluid and cutting discharge would result in physical disturbance of habitats through the smothering of benthic areas/species as well as the disturbance of pelagic species (Tetra Tech Inc. 2012). Because the food supply for marine mammals consists of benthic and pelagic species, this could have a localized impact on their food supply (Tetra Tech, Inc. 2012).

The amount of habitat affected in the LOA region will be small compared to that available to marine mammal species for foraging. Thus, any potential effects are expected to be localized and minor, affecting a small number of individuals with no population-level effects.

10.2 IMPACTS FROM SOUND ON FOOD SOURCES

Based on the size of Cook Inlet where feeding by marine mammals occurs versus the localized area of the marine activities included in the LOA, any missed feeding opportunities in the specific project activity will be minor based on the fact that other feeding areas exist elsewhere. Further, the planned activities are not located in the high use beluga whale feeding areas of the Susitna Delta and Knik Arm.

Ensonification from the activities should have no more than a negligible effect on marine mammal habitat because:

- No studies have demonstrated that seismic or drilling noise affects the life stages, condition, or amount of food resources (i.e., fish, invertebrates, eggs) comprising habitats used by marine mammals, except when exposed to sound levels within a few meters of the source or in a few very isolated cases.
- Where fish or invertebrates did respond to seismic or drilling noise, the affects were of temporary and of short duration (Popper et al. 2005). Consequently, disturbance to fish species would be short-term and fish would return to their pre-disturbance behavior once the activity ceases. Thus, the proposed activities would have little, if any, impact on marine mammals to feed in the area where work is planned.
- Each individual project activity area covers a small percentage of the potentially available habitat used by marine mammals in Cook Inlet allowing belugas and other marine mammals to move away from any project area-specific program sounds to feed, rest, migrate or conduct other elements of their life history.

Thus, the activities included in the LOA are not expected to have any permanent habitat-related effects that could cause significant or long-term consequences for individual marine mammals or their populations because operations will be limited in duration, location, timing, and intensity.

11.0 MEASURES TO REDUCE IMPACTS TO MARINE MAMMALS

The availability and feasibility [economic and technological] of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

The Applicant will implement a robust monitoring and mitigation program for marine mammals using NMFS-approved Protected Species Observers (PSOs) for LOA activities. Marine mammal monitoring and mitigation methods have been designed to meet the requirements and objectives which will be specified in the ITRs promulgated by NMFS. The Applicant recognizes some details of the monitoring and mitigation may change upon receipt of the LOA issued by NMFS. Specific mitigation measures will depend on the specific project.

11.1 DESCRIPTION OF EXCLUSION AND SAFETY ZONES

The Exclusion Zone (EZ) is defined as the area in which all operations are **shut down** in the event a marine mammal enters or is about to enter this zone based on distances to Level A or what can be effectively monitored for the species. Because of the low numbers of allowable Level B "takes" by harassment due to their critically endangered status, the Applicant will implement stringent monitoring and mitigation measures to minimize the likelihood of exposure beluga whales to sound exceeding Level B levels.

The Safety Zone (SZ) is an area larger than the EZ and is defined as the area within which operations may power down in the event a marine mammal enters, is about to enter or may be considered a Level B harassment. The SZ does not always match the Level B zone as it is based on what NMFS considers reasonable for detection of marine mammals by PSOs.

The Level B zone is a larger zone based on the distance to the 160 dB or 120 dB disturbance zone.

The distances for the EZ and SZ for the activities are summarized in Table 22 and described in the following text.

1) The distances to the Level A thresholds for the 3D seismic activity were calculated using the methods described in Section 6 and the Level B is based on Apache field-verified distance (81 FR 47239). NMFS has recommended that the EZ and SZ should be similar to what has been implemented by NMFS for the Atlantic Sea seismic programmatic MMPA authorization (82 FR 26244). The EZ is 500 m (1,640 ft) and the SZ is 1,500 m (0.93 mi). The Level B zone is 7,300 m (4.5 mi), although this may change based on results of the SSV.
2) The distances to the thresholds for the sub-bottom profiler were calculated using the methods described in Section 6. The EZ for all marine mammals is rounded up to 100 m (328 ft). The distance to the SZ for all marine mammals is 1,000 m (3,280 ft). The Level B zone is 3,000 m (1.86 mi).
3) The distances to the Level A thresholds for the water jet were calculated using methods described in Section 6 and the distance to the Level B is based on Austin (2017) measurements of 860 m (0.53 mi) to the 120 dB zone. The EZ for all marine mammals is rounded up to 15 m (49 ft). The SZ and Level B zone for all marine mammals is 860 m (0.53 mi).

Table 22. Radii of exclusion zone (EZ), safety zone (SZ), and level B zone for LOA activities.

Activity	Exclusion Zone (EZ) Radius	Safety Zone (SZ) Radius	Level B Zone Radius
3D seismic survey	500 m	1,500 m	7,300 m
Sub-bottom profilers	100 m	1,000 m	3,000 m
Water jet	15 m	860 m	860 m

11.2 SOUND SOURCE VERIFICATION SURVEY

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

11.3 AIRCRAFT MITIGATION MEASURES

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

11.4 SEISMIC AND GEOHAZARD SURVEY MITIGATION MEASURES

For the 3D survey, PSOs will be stationed on at least two of the project vessels (source and mitigation vessels). For the geohazard surveys, PSOs will be stationed on the survey vessel. PSOs will implement the following mitigation measures.

11.4.1 Clearing the Exclusion Zone

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

Per consultation with NMFS, during 3D seismic activity, Hilcorp will conduct daily aerial overflights to ensure that the SZ for the intended area of seismic activity for that day contains no beluga whales. If weather conditions prohibit aerial surveys, seismic operations may begin prior to completing the daily aerial survey; however, aerial surveys must be conducted as soon as weather permits.

11.4.2 Shut Down Procedure

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

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

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

11.4.3 Ramp Up and Power Up Procedures

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

- For 3D seismic surveys, airgun operations may be conducted at night if ramp up procedures are conducted at the beginning of each new line and airguns are shutdown between shooting of lines.
- During the ramp up, the EZ for the full airgun array will be maintained.
- Ramp up of the airguns will not be initiated, or will discontinue, if a marine mammal is sighted within or entering the EZ.

The following information has been included from NMFS' Biological Opinion to Lease Sale 244. Figure 20 shows a flow diagram indicating some seismic exploration mitigation measures under various scenarios described in mitigation measures 2c-2j in the NMFS Biological Opinion to Lease Sale 244.

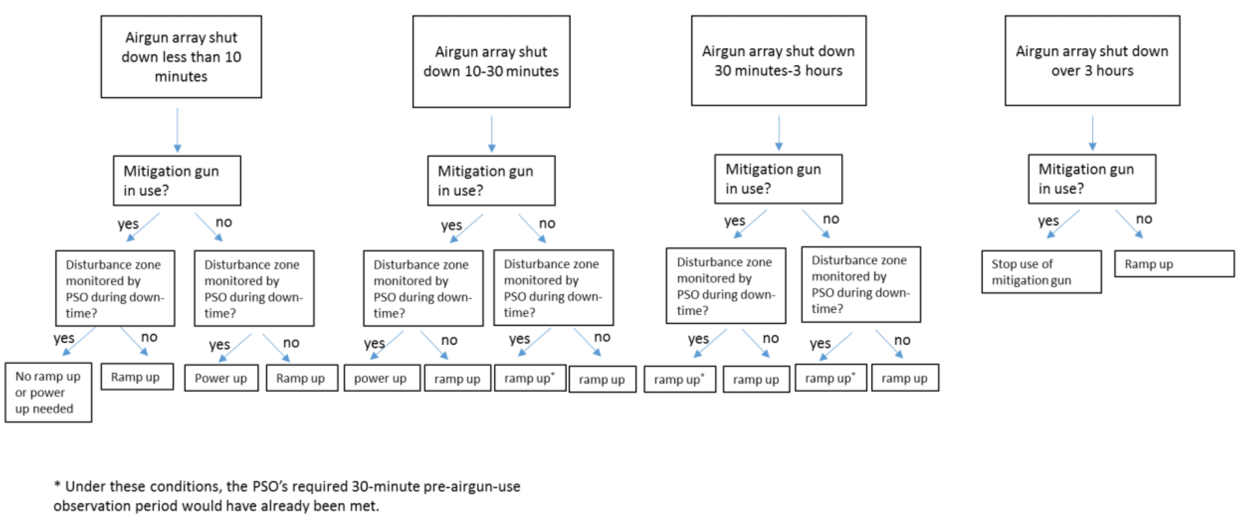

Figure 20. A flow diagram of suggested mitigation gun procedures in the NMFS Biological Opinion to Lease Sale 244.

11.4.4 Speed or Course Alteration

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

11.5 WATER JET MEASURES

A PSO will be present on the dive support vessel when divers are using the water jet. Prior to in-water use of the water jet, an SZ of 860 m (0.53 mi) around the DSV will be established. The water jet will be shut down if marine mammals are observed within the EZ.

12.0 ARCTIC PLAN OF COOPERATION

Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, you must submit either a plan of cooperation (POC) or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses.

Regulations at 50 CFR 216.104(a)(12) require IHA applicants for activities that take place in Arctic waters to provide a Plan of Cooperation or information that identifies what measures have been taken and/or will be taken to minimize adverse effects on the availability of marine mammals for subsistence purposes. NMFS regulations define Arctic waters as waters above 60° N. latitude. Much of Cook Inlet is north of 60° latitude. NMFS makes distinctions between waters in Cook Inlet and waters of the Chukchi and Beaufort Seas.

As presented in Section 8, harbor seals, Steller sea lions, and northern sea otters are harvested by three communities in lower Cook Inlet (Seldovia, Nanwalek, Port Graham) but at relatively low rates. There is a moratorium on harvesting of beluga whales. Because the marine mammal subsistence harvest is not substantial in the Petition region, a detailed Plan of Cooperation is not provided. Hilcorp Alaska has developed a SEP and will continue to implement this plan throughout the duration of the Petition. The SEP will help coordinate activities with local stakeholders and thus subsistence users, minimize the risk of interfering with subsistence hunting activities, and keep current as to the timing and status of the subsistence hunts. The Plan was provided in Appendix B of the ITR Petition.

Presentations have been and will continue to be given at various local forums. Hilcorp Alaska has developed an extensive stakeholder list. Meetings and communication will be coordinated with: commercial and sport fishing groups/associations, various Native fisheries and entities as it pertains to subsistence fishing and/or hunting, marine mammal co-management groups, Cook Inlet Regional Citizens Advisory Council, local landowners, government and community organizations, and environmental NGOs.

Because of the short-term, temporary, localized nature of activities, and relatively low marine mammal subsistence harvest, the Applicant concludes that impacts to any marine mammal harvest potential would be negligible.

13.0 MONITORING AND REPORTING

The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding. Guidelines for developing a site-specific monitoring plan may be obtained by writing to the Director, Office of Protected Resources.

13.1 MONITORING

13.1.1 Protected Species Observers

The Applicant will implement a robust monitoring and mitigation program for marine mammals using NMFS-approved PSOs for Year 1 activities. Marine mammal monitoring and mitigation methods have been designed to meet the requirements and objectives which will be specified in the ITRs promulgated by NMFS and the Year 1 issued LOA.

The specific objectives of the monitoring and mitigation program provide:

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

PSOs will be on watch during all daylight periods for project-specific activities. Generally, work is conducted 24-hrs a day, depending on the specific activity.

- For 3D seismic surveys, airgun operations will continue during the nighttime hours as long as ramp up procedures are conducted at the beginning of each new line and airguns are shut down between shooting of lines
- For the sub-bottom profiler, operations will generally be conducted during daylight hours, but may continue into the low visibility period as long as the profiler is operating prior to nightfall.
- Water jets are operated over a 24-hour period as they are limited to low tide conditions. Activities will not start during nighttime, but will continue if already started.

The PSOs will watch for marine mammals from the best available vantage point on the vessel or station. Ideally this vantage point is an elevated stable platform from which the PSO has an unobstructed 360° view of the water. The locations and numbers of PSOs is outlined below:

- For the 3D survey, 4 PSOs will be stationed on the source vessel (2 on watch at a time) and 2-4 PSOs will be stationed on another vessel.
- For the geohazard surveys when the sub-bottom profilers are used, 1-2 PSOs will be stationed on the source vessel.

- For water jet, 1 PSO will be stationed on the dive support vessel.

The PSOs will scan systematically with the naked eye and with binoculars. When a mammal sighting is made, the following information about the sighting will be carefully and accurately recorded:

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

An electronic database or paper form will be used to record and collate data obtained from visual observations.

13.2 REPORTING

Immediate reports will be submitted to NMFS if 30 or more beluga whales are detected over the course of annual operations in the SZ and EZ during operation of sound sources to evaluate and make necessary adjustments to the monitoring and mitigation.

If the number of detected takes for any marine mammal species is met or exceed, the Applicant will immediately cease survey operations involving the use of active sound sources (e.g., airguns, profilers, pingers, pile driving) and notify NMFS.

The results of the PSO monitoring, including estimates of exposure to key sound levels, will be presented in weekly, monthly, and 90-day reports. Reporting will address the requirements established by NMFS in the LOAs.

1. Weekly and monthly reports will be submitted during seismic surveys.
2. Annual reports will be submitted within 90 days after each activity starting from the date when the LOA was issued or from the date when the previous annual report ended.

The technical report(s) will include the list below.

- Summaries of monitoring effort: total hours, total distances, and distribution of marine mammals throughout the study period compared to sea state, and other factors affecting visibility and detectability of marine mammals;

- Analyses of the effects of various factors influencing detectability of marine mammals: sea state, number of observers, and fog/glare;
- Species composition, occurrence, and distribution of marine mammal sightings including date, water depth, numbers, age/size/gender categories (when discernable), group sizes, and ice cover;
- Analyses of the effects of seismic program:
    - Sighting rates of marine mammals during periods with and without project activities (and other variables that could affect detectability),
    - Initial sighting distances versus project activity,

- Closest point of approach versus project activity,
- Observed behaviors and types of movements versus project activity,
- Numbers of sightings/individuals seen versus project activity,
- Distribution around the vessels versus project activity,
- Summary of implemented mitigation measures, and
- Estimates of “take by harassment”.

13.3 DISCOVERY OF INJURED OR DEAD MARINE MAMMALS

In the event that personnel involved in activities covered by the authorization discover an injured or dead marine mammal, Hilcorp Alaska must report the incident to the NMFS Office of Protected Resources (OPR) and Alaska Regional Stranding Coordinator as soon as feasible. The report must include:

- Time, date, and location (latitude/longitude) of the first discovery;
- Species identification (if known) or description of animal;
- Condition of animal (including carcass condition if animal is dead);
- Observed behaviors of the animal, if alive;
- Photographs or video footage of the animal, if available;
- General circumstances under which animal was discovered.

13.4 VESSEL STRIKE

If the event of a ship strike of a marine mammal by a vessel involved in the activities covered by the authorization, Hilcorp Alaska must report the incident to the NMFS OPR and Alaska Regional Stranding Coordinator as soon as feasible. The report must include:

- Time, date, and location (latitude/longitude) of the incident;
- Species identification (if known) or description of animal involved;
- Vessel’s speed during and leading up to the incident;
- Vessels’ course/heading and what operations were being conducted, if applicable;
- Status of all sound sources in use;
- Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid the strike;
- Environmental conditions (e.g., wind speed and direction, Beaufort Sea state, could cover, visibility) immediately preceding the strike;
- Estimated size and length of animal that was strike;
- Description of the behavior of the marine mammal immediately preceding the strike;
- If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;
- Estimated fate of the animal (e.g., dead, injured by alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and
- To the extent practicable, photographs or video footage of the animal.

14.0 RESEARCH COORDINATION

Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects.

Observations of marine mammals, including any observed reactions to Year 1 operations will be recorded and reported to NMFS. Further, to ensure that there will be no adverse effects resulting from the planned seismic exploration, Hilcorp Alaska is coordinating with NMFS, USFWS, BOEM, and other state and federal agencies to assess measures that can be taken to eliminate or minimize any impacts from planned activities.

Prior to the start of the any Year 1 activities, Hilcorp Alaska will identify other monitoring programs in middle and lower Cook Inlet so that information on species sightings can be shared among programs to minimize impacts. Hilcorp Alaska is aware of scientific research programs that will be occurring in Cook Inlet in 2019, including two new recent ADF&G grants for continuing acoustic monitoring and photo identification of Cook Inlet beluga whales. Hilcorp Alaska will share sighting information with NMFS and ADF&G to continue to improve information on marine mammal distribution and abundance in lower Cook Inlet.

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