Endangered Species Act Section 7(a)(2) Biological Opinion

Action Agency:	Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, NOAA,
Activity:	Seismic Surveys of Cook Inlet, Alaska by Apache Alaska Corporation, 2016-2021
Consultation Conducted By:	National Marine Fisheries Service, Alaska Region
Consultation Number:	AKR-2016-9510
Date Issued:	3/2/16
Issued By:	Robert D. McLean

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1. INTRODUCTION

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1536(a)(2)) requires each Federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a Federal agency's action "may affect" a protected species, that agency is required to consult with the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 CFR §402.14(a)). Federal agencies are exempt from this general requirement if they conclude that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat, and NMFS or the USFWS concurs with that conclusion (50 CFR §402.14(b)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS and/or USFWS provide an opinion stating how the Federal agencies' actions will affect ESA-listed species and their critical habitat under their jurisdiction. If an incidental take is reasonably expected to occur, section 7(b)(4) requires the consulting agency to provide an Incidental Take Statement that specifies the impact of any incidental taking and includes Reasonable and Prudent Measures to minimize such impacts.

NMFS Office of Protected Resources, Permits and Conservation Division (NMFS PR1), requested formal consultation with NMFS Alaska Region (AKR) on a Federal rulemaking and issuance of a Letter of Authorization for marine mammal takes under the Marine Mammal Protection Act (MMPA) to cover Seismic Surveys of Cook Inlet, Alaska by Apache Alaska Corporation (Apache or applicant). The Corps likewise requested formal consultation on the issuance of a permit for the Apache seismic surveys under section 404 of the Clean Water Act and Rivers and Harbors Act. On April 3, 2015, the Corps transmitted to AKR its determination that it does not have permitting authority over placement of the proposed nodes under the Rivers and Harbors Act, but that it does have jurisdiction over the discharge of dredged or fill material associated with the placement and detonation of the deep and shallow charges below the high tide line of the Cook Inlet under the Clean Water Act. Apache has indicated that it does not intend to conduct any intertidal shallow shot work in 2016, which resulted in the Corps withdrawing their request for section 7 consultation. However, on January 20, 2016, AKR was informed by Apache via Arctic Slope Regional Corporation Energy Services (ASRC) (Stewart Seaberg, ASRC, pers. comm.) that they wished to retain the option of conducting shallow-shot work in the intertidal zone from 2017-2021. Therefore, we have included that activity as part of the action for those years.

This document conveys NMFS AKR's Biological Opinion on the effects of the action in accordance with section 7(a)(2) of the ESA. Specifically, this opinion considers the project as described in NMFS PR1's regulations for *Taking Marine Mammals Incidental to Seismic Surveys in Cook Inlet, Alaska* (in press), and analyzes the effects of the Cook Inlet Seismic Surveys and related operations on the endangered Cook Inlet beluga whale (*Delphinapterus leucas*), western DPS of Steller sea lions (*Eumetopias jubatus*), and humpback whale (*Megaptera novaeangliae*) and designated critical habitat for the Cook Inlet beluga whale and western DPS Steller sea lion.

The opinion and Incidental Take Statement were prepared by NMFS in accordance with section 7(b) of the (ESA) and implementing regulations at 50 CFR 402.

The opinion and ITS are in compliance with the Data Quality Act (44 U.S.C. 3504(d)(1) *et seq*.) and underwent pre-dissemination review.

1.1 Background

This opinion considers the effects of Apache's proposed seismic exploration operations in Cook Inlet from March 1, 2016 through February 28, 2021. These actions have the potential to affect the endangered Cook Inlet beluga whale and its critical habitat, the endangered Western DPS Steller sea lion and Steller sea lion critical habitat, and the endangered humpback whale. This opinion is based upon information provided from the following sources:

- Amended description of the action received 2/10/2015 from ASRC Energy Services.
- ASRC Energy Services. 2014. Biological Assessment Cook Inlet, Alaska, August 2014. Prepared for Apache Alaska Corp. 75pp +appendices.
- Federal Register. Takes of Marine Mammals Incidental to Specified Activities; Taking of Marine Mammals Incidental to Seismic Survey in Cook Inlet, Alaska. 79:13626-13644.
- Biological Assessment for the Apache Alaska Corporation's Cook Inlet 3-D Seismic Program in Cook Inlet, Alaska (SAExploration, Inc 2011).
- NMFS's proposed regulations for *Taking Marine Mammals Incidental to Seismic Surveys in Cook Inlet, Alaska* (80 FR 9510, February 23, 2015).
- Environmental Assessment for Alaska Apache Corporation (October 2011).
- 90 Day Report on Apache's 2012 3D seismic program in Cook Inlet (Lomac-MacNair et al. 2013).
- Proposed rule for *Taking Marine Mammals Incidental to Seismic Surveys in Cook Inlet, Alaska* (80 FR 9510, February 23, 2015).
- Draft Final Rule for *Taking Marine Mammals Incidental to Seismic Surveys in Cook Inlet, Alaska* (80 FR 9510, February 23, 2015).
- Conservation Plan for the Cook Inlet Beluga Whale (October 2008).
- 2008 Status Review and Extinction Risk Assessment of Cook Inlet Belugas (*Delphinapterus leucas*).
- 2008 Supplemental status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*).
- 2008 Final Supplemental Environmental Impact Statements for the Cook Inlet Beluga Whale Subsistence Harvest.
- Recovery Plan for Eastern and Western Distinct Population Segments of Steller Sea Lions (March 2008).
- Final Recovery Plan for the Humpback Whale, *Megaptera novaeangliae*, November, 1991.
- Published scientific studies.
- Reports from previous seismic operations in Cook Inlet.
- Unpublished data and reports from NMFS and the State of Alaska, and
- Local and traditional knowledge from Alaska Native community residents.

A complete record of this consultation is on file at NMFS's Anchorage, Alaska office.

1.2 Consultation History

NMFS authorized incidental take for previous similar actions taken by Apache from 2012 through 2014 and evaluated the effects in previous Biological Opinions. On July 11, 2014, NMFS PR1 received a petition from Apache Alaska Corporation (henceforth Apache) seeking promulgation of regulations permitting non-lethal unintentional taking of small numbers of beluga whales, killer whales, gray whales, western DPS Steller sea lions, harbor seals and harbor porpoises incidental to seismic oil and gas exploration operations and associated activities in Cook Inlet for the period beginning March 1, 2016 extending through February 28, 2021[1]. On October 8, 2014, NMFS PR1 requested initiation of ESA consultation on the action of promulgating the requested regulations. Concurrently, the Corps sought consultation related to its granting of permits in accordance with Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act related to detonation of seismic charges in the intertidal zone.

On February 6, 2015, NMFS received a modification to the description of the action from ASRC Energy Services on behalf of Apache, indicating that up to 567 shallow shots (charges buried approximately 0.3 m (1 ft) deep) may be detonated in the intertidal zone (between the high tide line [HTL] and the mean low low water mark [MLLW]) of the east coast of Cook Inlet between Grey Cliffs and Moose Point. In addition, there may be up to 1603 charges set off at 10 m depths in the intertidal zone.

On April 3, 2015, Corps staff informed AKR that the Corps had determined that it does not have regulatory authority over this action with respect to the Rivers and Harbors Act, but that it does have regulatory authority pursuant to the Clean Water Act over activities that involve the discharge of dredged or fill material associated with the placement and detonation of the deep and shallow charges below the high tide line of the Cook Inlet. On November 9, 2015, the Corps informed AKR that this action no longer included use of explosives in the intertidal zone and the Corps indicated it was withdrawing from this consultation. On January 20, 2016, Apache informed AKR that it wished for shallow shot work to remain a part of the project description, although no shallow shot work would be conducted during 2016.

This Biological Opinion focuses on the proposed action as described in the August 2014 Biological Assessment (ASRC 2014) for Apache's proposed seismic activities, proposed rule for Taking Marine Mammals Incidental to Seismic Surveys in Cook Inlet, Alaska (80 FR 9510, February 23, 2015), and the final rule for Taking Marine Mammals Incidental to Seismic Surveys in Cook Inlet, Alaska (in press).

2. DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

[1] The original request for an MMPA letter of authorization and the associated Federal Register Notice (80 FR 9510) did not include a request for take of small numbers of humpback whales. But a subsequent request for section 7 consultation made a determination that this action was likely to adversely affect humpback whales. The final MMPA regulations for this action will consider humpback whales.

NMFS PR1 submitted a request for an ESA section 7 consultation to AKR to analyze the effect of issuing permits and/or regulations authorizing Seismic Surveys of Cook Inlet, Alaska (Figure 1) by Apache on Cook Inlet beluga whales humpback whales and Western DPS Steller sea lions. Details of this project are described in ASRC (2014), except BA section 2.3.3.2 which was amended (see section 1.2). The description of the action is derived from ASRC (2014). In some places, that document provides incomplete or unclear explanations of the mitigation measures and other mechanisms incorporated into the design of the action to minimize the impacts from the take of listed species. Therefore, in the Terms and Conditions of the Incidental Take Statement, AKR bolsters and/or clarifies what mitigation measures are required to minimize take and be in compliance with this opinion.

The project is proposed to begin in the spring of 2016, depending on weather conditions and permit stipulations. The proposed work would be seasonal and could occur approximately eight to nine months annually, depending on ice conditions in Cook Inlet[2]. Apache expects to conclude operations by February 28, 2021. Apache will work within operational timing windows as indicated in Figure 2. In-water airgun arrays will be active for approximately 8-12 hours per day.

2.1 Purpose of Action

Apache has acquired over 850,000 acres of oil and gas leases from the State of Alaska in and around Cook Inlet (Figure 1) with the primary objective to explore for and develop oil fields. Prior to any development, Apache must first determine if and where any viable oil fields are located. Apache intends to continue using 3-D seismic imaging technology for surveying the waters of Cook Inlet.

2.2 Project and Action Areas

2.2.1 Project Area

Apache holds offshore, onshore, and tideland leases within the Cook Inlet (Figure 1). The seismic surveys would involve in-water seismic sources. The project area encompasses approximately 5,684 km^2 (2,195 mi^2) of intertidal and offshore areas. Water depths within which the seismic surveys would occur are 0-128 meters (0-420 ft).

2.2.2 Action Area

The action area is defined by the ESA as all areas to be affected directly or indirectly by the federal action [50 CFR 402.02]. The action area is typically larger than the project area and extends out to a point where no measurable effects from the project occur. The acoustic energy associated with project seismic operations will have the largest footprint of direct effects, and no indirect effects were identified that would extend beyond the geographic extent of the area affected by project seismic activities. Apache conducted a sound source verification (SSV) study for its similar work completed in 2012, the results of which indicated that sound from the maximum size 2,400 in^3 airgun would produce 160 dB at a distance of 9.5 km from the source (Austin and Warner 2012). The 9.5 km radius has been adopted and incorporated as the

[2] Typically, December, January and February would be difficult months during which to conduct seismic surveys due to ice conditions in Cook Inlet. But this can vary from year to year.

minimum monitoring distance for marine mammals, because 160dB is the level at which marine mammals may be harassed by the acoustic effects of the project. Therefore, the action area for this project is identified as all waters of Cook Inlet within 9.5 km of potential sound source locations (Figure 1).

The action area includes much of central Cook Inlet, generally spanning south-southwest from Fire Island to a point south of the vicinity of the Beluga River to the vicinity of Redoubt Point and continuing in a thin strip south to the vicinity of Anchor Point. NMFS uses generic sound exposure thresholds to determine when an activity produces sound sufficient to affect marine mammals (70 FR 1871, January 11, 2005). These acoustic thresholds identify the levels at which different categories of noise (impulsive or continuous) may result in harm or harassment. For mid-frequency cetaceans (e.g., beluga whales), the harassment threshold for impulsive sounds, including those generated by airguns used during seismic surveys, is recognized at 160 decibels referenced to 1 microPascal (notated as 160 dB re: 1 μPa_{rms} [hereafter noted as 160 dB]), and the harm/injury threshold is 180 dB re: 1 μPa_{rms} hereafter noted as 180 dB). For pinnipeds (e.g., western DPS Steller sea lions) the harassment and harm thresholds are 160 dB and 190 dB re: 1 μPa_{rms} (hereafter noted as 190 dB), respectively. In the near term, the guidance will apply only to level A harmful takes. It remains unknown whether we will receive new guidance on level B take before the completion of this project.

We recognize that these acoustic thresholds are imperfect and responses to sounds vary among individual marine mammals and depend on a variety of factors, including previous experiences with noise, natural avoidance behaviors, activity (feeding, migrating, etc.) at the time of noise exposure, and characteristics of the noise. NMFS is considering new acoustic guidelines to delimit when harassment occurs as defined by the MMPA. Until that process is completed, we continue to rely on these thresholds as there is evidence that they are conservative and represent the best available science.

2.3 Description of Proposed Action

Apache will survey up to 5,684 km^2 (2,195 mi^2) using nodal autonomous recording systems and the patch shoot method to collect data (ASRC 2014). The seismic operation will be active 24 hours per day (including vessel movement and placement and retrieval of instruments), but in-water airgun activity will average 8-12 hours per day and will generally occur around the slack tide or low current periods. Airguns could be active at any point during a 24 hour cycle, however, depending upon tides and other local conditions. Within Cook Inlet, multiple watercraft, pingers, nodal recorders, a 10 in^3 mitigation airgun, and airgun arrays with 440 in^3 and 2,400 in^3 displacement will be used to obtain the desired data. Pingers are ship-borne devices that emit an acoustic signal used to determine the location of the autonomous seismic nodes. A hull or pole mounted pinger system will be used to determine the exact location of the nodes. The two instruments used in this technique are a transceiver (operating at 33-55kHz with a maximum source level of 188 dB re 1 µPa at 1 meter) and a transponder (operating at 35-50kHz with a maximum source level of 188 dB re 1 µPa at 1 meter) Onshore and intertidal areas will be surveyed using shot holes drilled to 10 m and filled with 4 kg of explosive. Operations that use the 440 in^3 airgun array will occur in waters less than 2 m (6 ft) in depth, and will use a two-vessel “ping-pong” shooting technique whereby the vessels alternate taking shots. Offshore

operations will use the 2,400 in^3 airgun arrays and the ping-pong technique (ASRC 2014, pages 1-11).

Section 2.3.3.2 of Apache's BA for this proposed action was modified and communicated to AKR on February 10, 2015, to exclude the implementation of a SSV study if intertidal shallow shots became necessary, and to include the use of up to 567 shallow shots (detonated at 0.3 m depths) and 1603 charges detonated at 10 m depths within the intertidal zone of Cook Inlet. Charges would be comprised of 0.45 kg (1.0 pound) and 4 kg (8.8 pounds) Orica OSX Pentolite Explosive respectively (or similar explosive). The number of proposed intertidal explosions was obtained from the Corps' February 5, 2015 request for concurrence with their determinations for the effects of this project on listed species. Subsequently, Apache determined to exclude intertidal shallow shots from this project's description for 2016, but to retain it for 2017-2021.

Onshore/Intertidal Components (modified from original BA)

The onshore source effort will be shot holes. These holes are drilled every 50 m (165 ft) along source lines orientated perpendicular to the receiver lines and parallel to the coast. To access the onshore drill sites, Apache would use a combination of helicopter portable and tracked vehicle drills. At each source location, Apache will drill to the prescribed hole depth of approximately 10 m (35 ft) and load it with 4 kilograms (kg) (8.8 pounds [lbs]) of explosive (likely Orica OSX Pentolite Explosive). The hole will be capped with a "smart cap" that will make it impossible to detonate the explosive without the proper blaster. At the request of NMFS, Apache conducted SSV of the onshore shot hole to determine if underwater received sound levels exceeded the NMFS thresholds. The results of the SSV verified received sound levels did not exceed NMFS thresholds, therefore, onshore sources are not discussed further.

Marine mammal monitoring during the intertidal operations will have at least three Protected Species Observers (PSOs) monitoring for marine mammals prior to and during transition zone detonations (one in a vessel, one on land and an aerial observer). At the 10 m (35 ft) depth detonations, PSOs will monitor 3.5 km (2.2 mi) radius for marine mammals. The 3.5 km (2.2 mi) distance will be measured from the waterline closest to the seaward-most shot. PSOs will observe from vantage points which allow good visibility, and monitor for 30 minutes prior to any intertidal detonations. No detonation will occur until this zone has been clear of marine mammals for 30 minutes. PSOs will communicate to the shot operator any sightings of marine mammals approaching or within the monitoring area, and have the authority to stop operations. Detonations will not begin or resume until the marine mammal has exited the 3.5 km (2.2 mi) monitoring zone or until the zone has been clear for 30 minutes. All shot hole detonations will occur only during daytime operations.

In the event that the planned charge depth of 10 m (35 ft) is unattainable due to loose sediments collapsing the bore hole, Apache may detonate "shallow" shots at 0.3 m (1 ft) depth, below the high tide line in the area between Grey Cliffs and Moose Point. Each of these "shallow" shots will consist of four charges arranged in a 0.91 m (3.0 ft) diameter

circle and buried 0.3 m (1 ft) below the surface of the mudflats. Each of the four charges will be no greater than 0.45 kg (1.0 lb). During these detonations, Apache will monitor for marine mammals, as described above, and will not conduct any shot hole detonations if a marine mammal is present within the 3.5 km monitoring zone.

At the request of NMFS, Apache previously conducted SSV for detonations in onshore shot holes to determine if underwater received sound levels exceeded levels at which harassment of marine mammals would be expected (i.e., MMPA Level B take thresholds). The results of the SSV verified received sound levels did not exceed that threshold. Therefore, onshore acoustic sources are not discussed further.

2.3.1 Duration of Action

Apache anticipates completing a portion of the seismic acquisition each year. In-water airguns will only be active for approximately two to three hours during each of the slack tide periods. There are four slack tide periods in a 24-hour period; therefore, airgun operations will be active during approximately 8-12 hours per day, if weather conditions allow. Apache anticipates that the maximum sized patch of water that can be covered by airgun array transects in a day is about 78 km^2 (13 transects of 13 km length, each spaced 500 m apart).

Apache proposes to conduct both daytime and nighttime operations. Nighttime operations will be initiated only if a mitigation gun (described in section 2.3.3 below) has been continuously operational and there has been continuous protected species observer (PSO) monitoring since the time that seismic operations ended (up to a maximum duration of three hours of mitigation airgun operations). PSOs are not required to visually monitor during seismic operations at night. Vessel captain and crew will watch for marine mammals and follow mitigation procedures (described below) to the extent practicable. Ramp-up from a shutdown will not occur during nighttime operations. After a shut-down during poor daytime observation conditions, seismic activity will be suspended until the full 160 dB disturbance zone is visible.

Apache will not operate the source vessel (airgun array) within the Susitna Delta Exclusion Zone from 15 April through 15 October in any year. This time period represents the peak use of the Susitna Delta region by beluga whales for foraging and possibly for breeding, with an approximate two-week buffer on either side to allow for timing fluctuations of whale usage. The Susitna Delta Exclusion Zone provides a buffer between waters ensonified by the source vessel and an area recognized as supporting large concentrations of beluga whales during salmon runs between spring and fall. Keeping the sound from airguns outside of the Susitna Delta Exclusion Zone during this period should reduce the potential for seismic signals greater than 160 dB from reaching congregations of whales using this important foraging (and potential breeding) area.

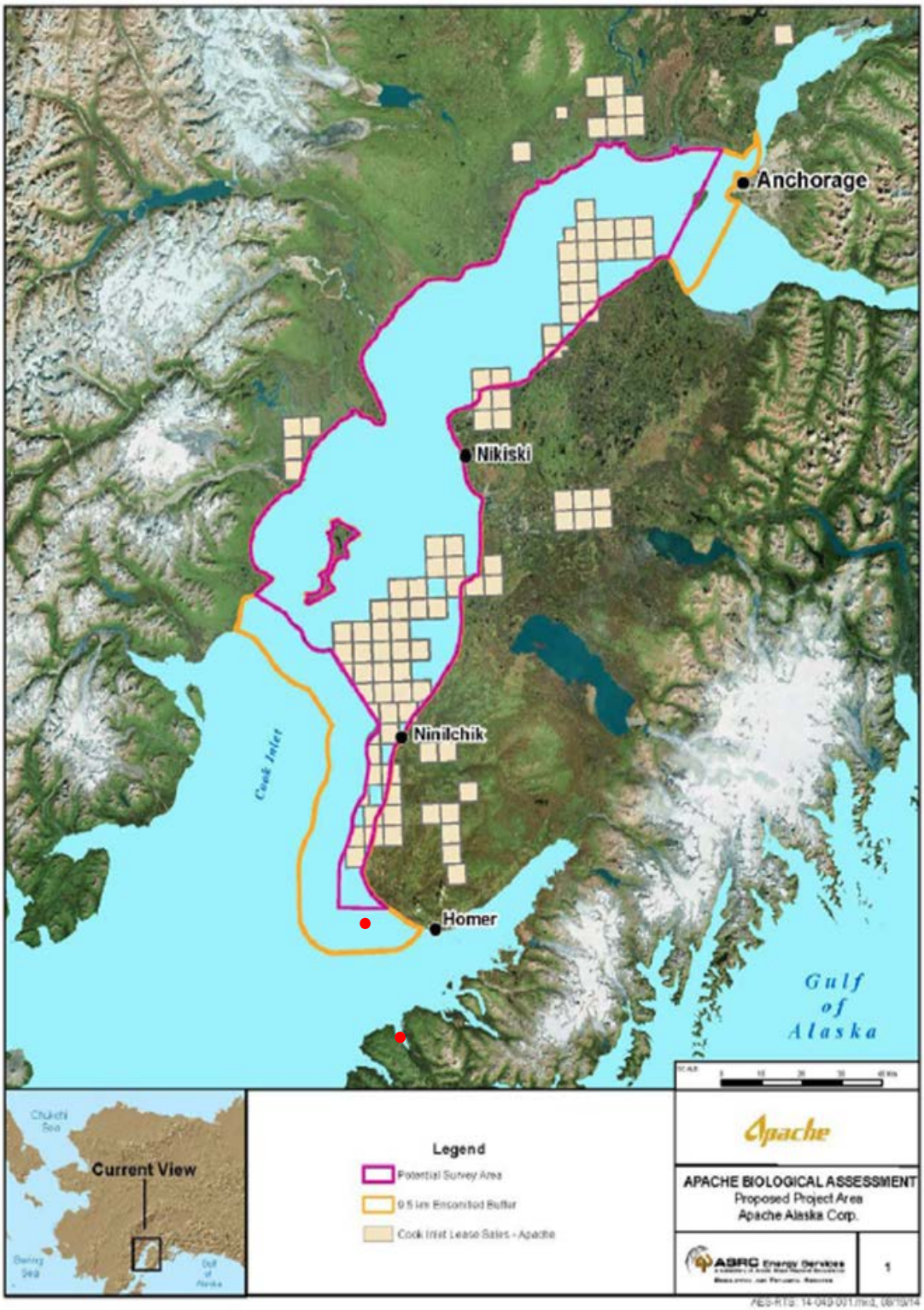

Figure 1. Apache lease holdings, potential survey area, and area within which MMPA level B Harassment may occur as a result of this project. Marine waters between the gold lines represent the 5684 km^2 action area. Two red dots note Steller sea lion sightings from NMFS systematic aerial surveys from 2004-2014.

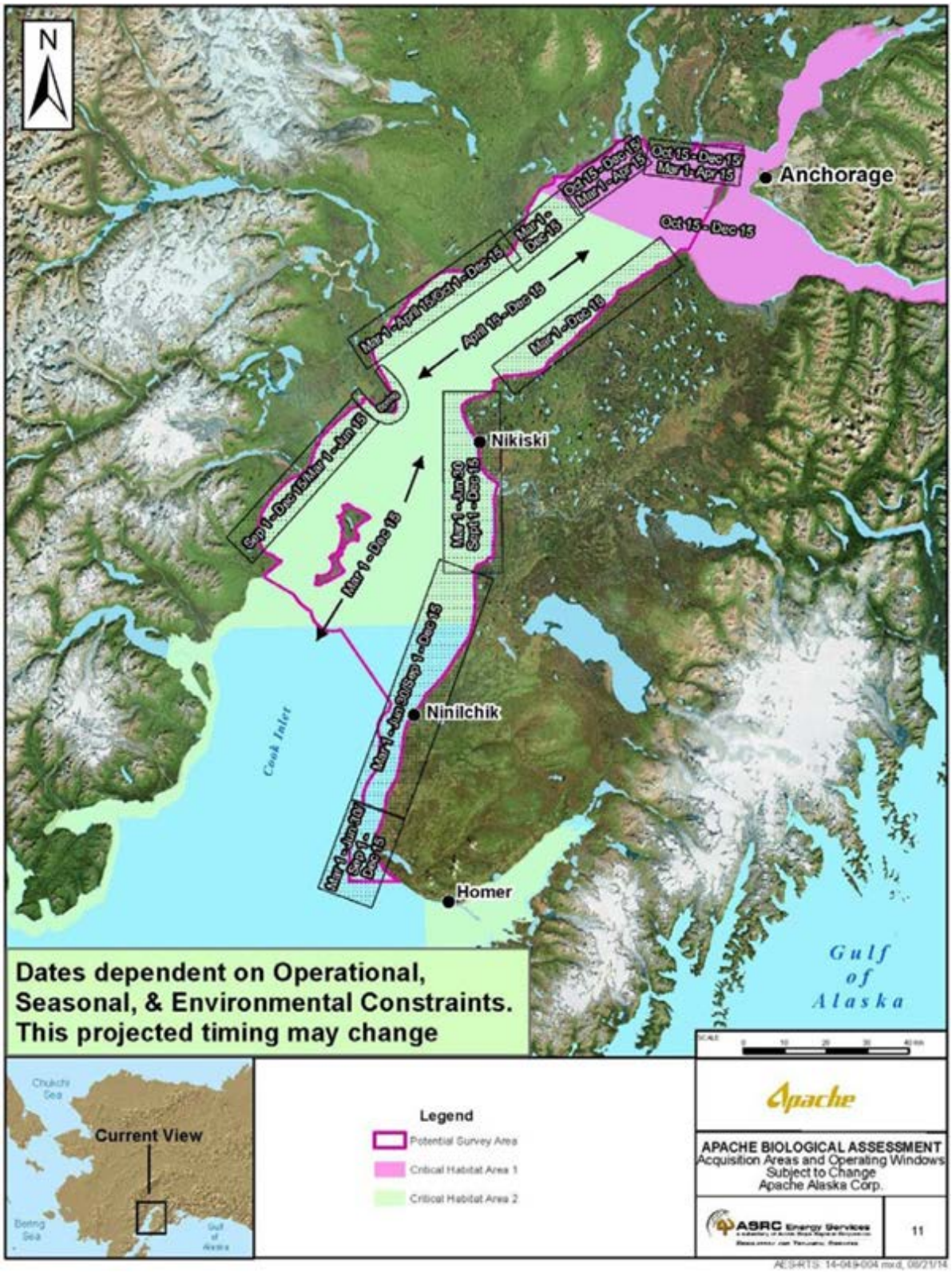

Figure 2. Temporal intervals during which Apache proposes seismic activities within specified geographic areas. From ASRC (2014) page 17, Figure 11.

2.3.2 Equipment

The proposed action uses standard seismic surveying equipment. Such equipment includes vessels of several sizes and uses; airguns to produce the sound waves necessary to penetrate the seafloor; hydrophones ("nodal recorders") to record the echoes back from the seafloor; positioning sensors to accurately locate the recorders on the seafloor; and support aircraft and watercraft.

Fuel Storage Facilities

Any fuel storage will be located away from aquatic habitats and positioned in modern containment enclosures. The capacity of the containment will be 110 percent of the total volume of the fuel stored in the containment enclosures. All fuel storage sites will be equipped with additional absorbent material and spill clean-up tools. Any transfer or bunkering of fuel for offshore activities will either occur dockside or comply with United States Coast Guard (USCG) bunkering at sea regulations.

Aircraft

The aviation support will be in the form of fixed wing and rotary wing aircraft. These will be used for support, transport, and/or marine mammal monitoring during the proposed project. Rotary winged aircraft may be used for long-lining equipment, while fixed wing aircraft would be used for personnel, equipment transport and aerial monitoring for marine mammals.

Vessels

The M/V *Peregrine Falcon*, M/V *Arctic Wolf*, M/V *Miss Diane I*, M/V *Mark Steven*, M/V *Maxime*, M/V *Dreamcatcher*, and M/V *Westward Wind*, or similar vessels, will serve as the primary offshore acquisition platforms. The onshore crew will be housed in commercial facilities local near the project site. Offshore staff will be housed on the vessels, which are certified for housing 24-hour crews. Detailed descriptions of each vessel can be found in ASRC (2014).

Airguns

Apache will use two synchronized source vessels during each survey. The source vessels, M/V *Peregrine Falcon* and the M/V *Arctic Wolf* (or similar vessels), will be equipped with compressors and 2,400 in^3 airgun arrays (or smaller, if feasible). The M/V *Peregrine Falcon*, or similar, will be equipped with a 440 in^3 shallow water source which it can deploy at high tide in the intertidal area in less than 1.8 m (6 ft) of water.

Table 1. Projected broadband maximum source levels (dB re: 1 μPa_{rms}) for the pinger and each airgun array. When multiple values exist (e.g., broadside vs endfire), the largest (and thus most conservative) value is used.

Source type	Max Source Level
Pinger	188 dB
10 in^3 airgun	206.4 dB
440 in^3 airgun	224.8 dB
2,400 in^3 airgun	237.8 dB

Nodal Recorders (Nodes)
The recording system is an autonomous system "nodal" (i.e., no cables), made up of at least two types of nodes; one for the land and one for the intertidal and marine environment. For the land operator, a single component sensor land node will be used (see ASRC 2014, Figure 5). The intertidal and marine zone operators will use a submersible multi-component system made up of three velocity sensors and a hydrophone (See ASRC 2014, Figure 6). These systems have the ability to record continuous data. Inline receiver intervals for the node systems will be 50 m (165 ft). The nodes are deployed in patches for the seismic source and deployed for up to 15 days. The deployment length is limited by battery length and data storage capacity. As the patches are acquired, the node lines will be moved either side to side or inline to the next patch's location.

2.3.3 Patch Shooting Process

The method that Apache will employ to gather the seismic data is called patch shooting. This type of seismic surveying requires the use of multiple vessels for node layout/pickup, recording, and sourcing. Patch shooting can be broken down into four steps per patch: node deployment, node positioning, seismic source shots, and node retrieval. These steps are repeated multiple times in different locations until the entire area has been surveyed.

Node Deployment
Operations begin by deploying lines of nodes (the receivers) off the back of the layout vessels onto the seafloor. Inline spacing between nodes on a single line will be 50 m (165 ft); a rope connects one node to another. Node lines will be laid parallel to each other and perpendicular to the shoreline. The node lines will be separated by either 402 or 503 m (1,320 or 1,650 ft). The node vessels will lay the entire patch on the seafloor prior to the air gun activity.

A single patch will consist of 6–8 node lines. Individual vessels are capable of carrying up to 400 nodes. With three node vessels operating simultaneously, a patch can be laid down in a single 24 hour period, weather permitting. Vessels will lay the nodes on the seafloor in periods of low current, or in the case of the intertidal area, during high tide. A sample patch is depicted in Figure 3. With three node vessels operating simultaneously, a patch can be laid down in a single 24-hour period, weather permitting.

Node Positioning
Once the nodes are in place on the seafloor, locating the exact position of each node is required. There are several techniques used to locate the nodes on the seafloor, depending on the depth of the water. In very shallow water, the node positions are either surveyed by a land surveyor when the tide is low, or the position is accepted based on the position at which the navigator has laid the unit.

In deeper water, a technique called Ultra-Short Baseline (USBL) will be used. This technique uses a hull or pole mounted pinger to send a signal to a transponder which is attached to each node. The transponders are coded and the crew knows which transponder corresponds with which node prior to the layout. The transponder's response (once pinged) is added together with several other responses to create a suite of ranges and bearings between the pinger boat and the node. Those data are then calculated to precisely position the node. In good conditions, the nodes

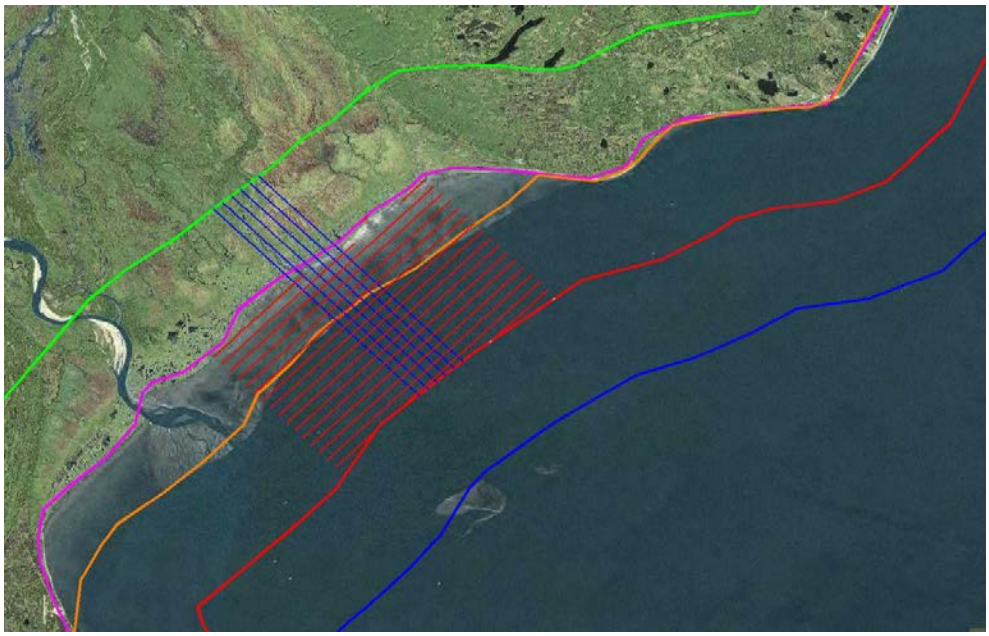

Figure 3. Patch Shooting. A single patch, six lines of nodes (blue) and 16 source lines (red) depicted by the red and blue lines running perpendicular to each other.

can be interrogated as they are laid out. It is also common for the nodes to be pinged after they have been laid out. The pinger that will likely be used is a Sonardyne Shallow Water Cable Positioning system. The two instruments likely to be used are a Scout USBL Transceiver (or similar) that operates at a frequency of 33-55 kilohertz (kHz) at a max source level of 188 dB re 1 µPa at 1 m; and a LR USBL Transponder (or similar) that operates at a frequency of 35-50 kHz at a source level of 185 dB re 1 µPa at 1 m.

Seismic Source Shots

Source lines are orientated perpendicular to the node lines and parallel to the beach. The two source vessels will traverse source lines of the same patch using a shooting technique called ping/pong. The ping/pong methodology will have the first source boat commence the source effort. As the first airgun pop is initiated, the second gun boat is sent a command and begins a countdown to pop its guns 12 seconds later than the first vessel. The first source boat would then take its second pop 12 seconds after the second vessel has popped and so on. The vessels manage their speed to cover approximately 50 m (165 ft) between pops. The objective is to generate source positions for each of the two arrays close to a 50 m (165 ft) interval along each source line in a patch. Vessel speeds range from 2-4 knots. The source effort will average 8-12 hours per day.

Both source vessels will be equipped with a 10 in^3 mitigation gun. A mitigation gun is used to sustain the sound of air guns in the water when the 440 or 2,400 in^3 arrays are not in operation to deter whales and pinnipeds from approaching the vessel. The mitigation gun is designed to alert marine mammals to the presence of seismic survey vessels in the area, which allows the animals the opportunity to move or remain away from the vessel and the active sound source. If the mitigation gun remains in operation, a full ramp-up of the air gun will not be required. This gun is a separate system on a davit system to deploy separate from the arrays. Table 1 provides

the maximum broadband source levels for each of the guns. Each source line is approximately 12.9 km (8 mi) long.

A single vessel is capable of acquiring a source line in approximately one hour. With two source vessels operating simultaneously, a patch of approximately 3,900 source points can be acquired in a single day assuming a 10-12 hour source effort.

Node Retrieval

When the data from the patch of nodes have been acquired, the node vessels pick up the patch and roll it to the next location. The pickup effort takes approximately 18 hours.

2.3.4 Mitigation Measures Proposed by the Applicant

ASRC (2014) indicates that the applicant will implement the following mitigation measures. Apache has incorporated these mitigation measures into its project design in an effort to reduce impacts to Cook Inlet beluga whales and western DPS Steller sea lions. AKR notes that these measures will also reduce the likelihood of adverse effects to humpback whales. The following are those proposed by Apache. Additional discussion of these measures appears in sections 2.3.4.2 through 2.3.4.7. The complete set of required mitigation measures appear in the Incidental Take Statement accompanying this Biological Opinion.

1. Vessel based monitoring during daytime airgun operations by dedicated Protected Species Observers.
2. Initiation of nighttime seismic operations only if a mitigation gun has been continuously operational from the time that the PSO monitoring ended. Seismic activity will not ramp up from an extended shutdown during nighttime operations.
3. After a shut down during night operations, seismic activity will be suspended until the following day and the full 160 dB disturbance zone is visible.
4. To avoid injurious Level A take, Apache will power down (section 2.3.4.4) or shut down (section 2.3.4.5) operations when any cetacean approaches or enters the 180 dB exclusion zone or any pinniped approaches or enters the 190 dB exclusion zone[3].
5. Power-down procedures include discontinuation of use of airgun arrays and beginning the operation of the 10 in^3 mitigation gun intended to prevent Level A take and minimize level B take.
6. Shut-down procedures include discontinuation of all airgun operations and pingers to avoid level A take within the 180/190 dB exclusion zone and minimize level B take within the 160 dB disturbance zone. Shut down will occur within several seconds (of a "one shot" period) of the determination that a marine mammal is either in or about to enter the 160 dB disturbance zone. AKR notes that any animal that enters its respective exclusion zone (Table 3) while the airgun array(s) is operating will be considered to have been taken.
7. Prior to restarting seismic operations after shut-downs, as well as after $\geq$ 10 minute gaps in airgun array operations, PSOs must confirm that all listed marine mammals have left the 160 dB disturbance zone, or have not been seen within that zone for 15

[3] AKR notes that any marine mammal that enters their respective 160 dB disturbance or 180/190 dB exclusion zone (Table 3) will be considered to have been taken.

minutes (for Steller sea lions, harbor seals, and harbor porpoise) or for 30 minutes (for beluga whales and killer whales[4]).

8. Prior to restarting seismic operations after power downs, PSOs must confirm that no listed marine mammals have been visible within or near the 160 dB disturbance zone for 30 minutes prior to initiating ramp-up procedures, unless the mitigation gun has been firing for less than three hours since power-down occurred. However, if the animals that triggered a power-down are observed by a PSO to have left the 160 dB disturbance zone, ramping up may commence as soon as the animals have left the 160 dB disturbance zone. AKR interprets "near" the disturbance zone to mean that, in the opinion of the PSO, the marine mammal will likely enter the 160 dB disturbance zone and be taken unless the animal changes heading or the vessel alters course to successfully keep the marine mammal out of the 160 dB disturbance zone.
9. The restarting of seismic operations following power-downs and shut-downs will adhere to ramp-up procedures (section 2.3.4.3). Ramp up procedures (section 2.3.4.3) include gradual increase of airgun array volume at a rate of no more than a 6 dB increase in volume 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 160 dB disturbance zone for the full airgun array must remain constantly monitored by PSOs and assurance that the area has remained void of listed marine mammals throughout ramp-up procedures must be obtained by PSOs prior to operations.
10. Vessel may change velocity and heading to avoid a situation in which marine mammals enter the 160 dB disturbance zone, the 180 dB cetacean exclusion zone, or the 190 dB pinniped exclusion zone. These actions may occur in conjunction with power-down or shut-down operations in an effort to avoid permitted or unpermitted take.

For a complete list of these and the additional mitigation measures AKR has included to minimize the impact of the potential taking of listed species, see the Terms and Conditions (section 10.7) in the Incidental Take Statement.

2.3.4.1 Exclusion and Disturbance Zones

ASRC (2014) uses the term "safety zone" and "safety radius" interchangeably with other terms. In order to avoid confusion, we use the term "disturbance zone" to refer to the area ensonified to a level $\geq$160 dB but <180 dB for cetaceans and $\geq$160 dB but <190 dB for pinnipeds. The term "exclusion zone" refers to the area ensonified to a level $\geq$180 dB for cetaceans and $\geq$190 dB for pinnipeds. The term "Susitna Delta Exclusion Zone" refers to the area defined by the union of a 10 mi (16 km) buffer of the Beluga River thalweg[5] seaward of the MLLW line, a 10 mi (16 km) buffer of the Little Susitna River thalweg seaward of the MLLW line, and a 10 mi (16 km) seaward buffer of the MLLW line between the Beluga River and Little Susitna River.

In order to avoid marine mammal Level A takes (i.e., injury), Apache proposes to power-down or shut-down airguns and positioning pingers in the event any marine mammal approaches or

[4] The ITS Terms and Conditions add humpback whales to this list of species

[5] A thalweg is the line that defines the deepest channel along the length of a streambed.

enters the exclusion zone. If a cetacean enters the area ensonified to ≥180 dB, or a pinniped enters the area ensonified to ≥190 dB, then MMPA Level A take has occurred even if there are subsequent actions taken to reduce noise-induced injury. Level A take is not authorized by NMFS PR1's proposed action.

In order to avoid or minimize marine mammal Level B takes (i.e., harassment), Apache proposes to monitor the 160 dB disturbance zone for one or more beluga whales as well as groups of five or more harbor porpoises or killer whales. When these marine mammals are observed within, or about to enter the 160 dB disturbance zone, airgun operations will be powered down or shut-down immediately. If a marine mammal enters the area ensonified to ≥160 dB, then Level B take has occurred, even if there are subsequent actions taken to reduce noise-induced harassment.

As discussed in Austin and Warner (2012) (Appendix B of ASRC (2014)), the distances (or radii) of the 160, 180, and 190 dB isopleths were modeled for the first Apache IHA application (Warner et al., 2011). In-field SSV of the received levels for the 440 in^3 and 2,400 in^3 airgun configurations were conducted in 2012 to verify the distances to the 160, 180 and 190 dB isopleths (Table 2). Comprehensive results are provided in ASRC (2014) Appendix B, C, and D. The modeled 160 dB disturbance zones were used to estimate probability of occurrence for marine mammals in this document; however, the 160, 180, and 190 dB isopleths (based on the SSV) will be used for monitoring during the seismic survey (Table 3), except that for the Pinger, the indicated modeled threshold distances will be used, having assumed a simple spreading loss of 20 log R (where R is radius) with a source level of 188 dB.

The area of Cook Inlet that is expected to be ensonified to at least 160 dB represents the action area. As discussed in detail in Appendix A of ASRC (2014), received sound levels for determining the radii within which Level A and Level B take would occur were obtained from the results of a field validation test conducted by JASCO (Warner et al. 2011). The largest airgun array configuration Apache would use (2,400 in^3) was considered by the modeling study to provide conservative estimates of noise footprints; smaller arrays may be used and may produce smaller footprints. The predicted distances to the 160, 180, and 190 dB sound level thresholds for different depths (nearshore/offshore) using the pinger, 10 in^3, 440 in^3, and 2,400 in^3 airguns are presented in Table 3.

Prior to each previous year's in-water program, Apache has been required to conduct a SSV to determine the 190, 180 and 160 dB monitoring zones for each airgun array size, and use the data instead of the computer model for determining the appropriate exposure threshold radii. For the sound source verification study completed in 2012, the results indicated that the maximum 160 dB monitoring zone for the 2,400 in^3 airgun was 9.5 km (Table 2; Austin and Warner 2012) rather than the 6.41 km predicted by the model (Appendix A of ASRC (2014)). For the 2012 surveys, Apache monitored an area 9.5 km out from the source vessels. The 9.5 km radius has been adopted and incorporated as the minimum monitoring distance for marine mammals, and will be accomplished through various monitoring techniques (e.g., aerial, boat, and shore-based observers). Passive acoustic monitoring will provide a means for monitoring portions of this zone between local sunset and sunrise.

Table 2. Summary of measured and modeled distances (in meters) to indicated sound level thresholds from airgun arrays. 190 dB corresponds to the threshold for injury to Steller sea lions. 180 dB corresponds to the threshold for injury to cetaceans. 160 dB corresponds to the harassment threshold for all marine mammals.

	190 dB		180 dB		160 dB	
Source	Measured	Modeled	Measured	Modeled	Measured	Modeled
Pinger	--	1	--	3	--	25
10 in^3 airgun[1]	10	10	10	33	280	330
440 in^3 array nearshore[2]	100	---	310	--	2,500	--
440 in^3 array offshore[3]	--	64	--	260	--	2,300
2,400 in^3 array (nearshore)[4,5]	380	510	1,400	1,420	9,500	6,410
2,400 in^3 array (offshore)[4,5]	290	360	910	1,070	8,700[6]	4,910

[1]Also referred to as the mitigation gun. Modeled values are pre-season estimates from Austin and Warner (2012). Measured distances are empirical fits to SPL_{rms90} versus distance data for offshore line.
[2]Measured threshold distance from Austin and Warner (2012). Values shown are the greatest of the 90th percentile fit for broadside or endfire directions on the nearshore line.
[3]Measured threshold distance from Austin and Warner (2012). Values shown are the greatest of the 90th percentile fit for broadside or endfire directions on the offshore line.
[4]Modeled threshold distances from Austin and Warner (2011) at 25m or 45 m depth, whichever was greater. Maximum of onshore, offshore and parallel shore modeled distances are shown.
[5]Measured threshold distances are empirical fits to SPL_{rms90} versus distance data (Warner et al. 2011).
[6]Extrapolated value based on a linear fit to the data at 5 km range, excluding absorptive effects. Direct measurement by hydrophone failed.

Table 3. Threshold distances for the Pinger, 10 in^3 mitigation airgun, 440 in^3 and 2400 in^3 airgun arrays. Distances are maximized over direction and environment and are based on the 90th percentile fits. The 90th percentile distances correspond to exclusion and disturbance zone radii for marine mammals, as indicated. Pinger exclusion zones assume a simple spreading loss of 20 log R (where R is radius) with a source level of 188 dB.

SPL_{rms90} Threshold	90th Percentile Distance (m)			
	Pinger	10 in^3	440 in^3	2400 in^3
190 (level A pinniped exclusion zone)[1]	1	10	100	380
180 (level A cetacean exclusion zone)[2]	3	10	310	1400
160 (level B marine mammal disturbance zone)[3]	25	280	2500	9500

[1]Each pinniped observed at less than the indicated distance during operational volumes of the indicated sound source will be considered to have been subjected to level A take under the MMPA and will count as one take each time the individual enters the area so ensonified.
[2]Each cetacean observed at less than the indicated distance during operational volumes of the indicated sound source will be considered to have been subjected to level A take under the MMPA and will count as one take each time the individual enters the area so ensonified.
[3]Each marine mammal observed at less than the indicated distance during operational volumes of the indicated sound source will be considered to have been subjected to level B take under the MMPA and will count as one take each time the individual enters the area so ensonified.

2.3.4.2 Monitoring

Boat-based Monitoring

Three vessels will employ PSOs to identify marine mammals during all daytime hours of airgun operations: the two source vessels (*M/V Peregrine Falcon* and *M/V Arctic Wolf*, or similar) and one support vessel (*M/V Dreamcatcher*, or similar). A sufficient number of PSOs will be aboard to monitor the 180 dB cetacean exclusion zone / 190 dB pinniped exclusion zone and 160 dB disturbance zone (typically six PSOs total – two on each source vessel and two on the support vessel; additional PSOs may be required during periods when passive acoustic monitoring is taking place).

When marine mammals are observed within or near the 180 dB cetacean exclusion zone / 190 dB pinniped exclusion zone or 160 dB disturbance zone, appropriate mitigation measures will be implemented to prevent/minimize potential behavioral or physical effects.

If a cetacean enters the area ensonified to ≥180 dB, or a pinniped enters the area ensonified to ≥190 dB, then Level A take has occurred even if there are subsequent modifications to seismic survey activity. Level A take is not authorized. Likewise, if any marine mammal enters the area ensonified to ≥160 dB, then Level B take has occurred, even if there are subsequent modifications to seismic survey activity.

Mitigation measures will be communicated by the PSO on the source vessel directly to the airgun operators and vessel captain/crew.

PSOs will be hired by Apache. Apache will provide NMFS PR1 the curriculum vitae and references for all PSOs. PSOs will follow a schedule so observers will monitor marine mammals near the seismic vessel during all ongoing operations and air-gun ramp-ups. The vessel-based PSOs will monitor for the presence of marine mammals within the exclusion and 160 dB disturbance zones during all periods of seismic efforts with sufficient light for effective monitoring. PSOs will monitor for the presence of marine mammals within the exclusion and 160 dB disturbance zones for a minimum of 30 minutes prior to the planned start of airgun or pinger operations.

Vessel-based PSOs will normally be on duty in shifts no longer than four hours with two hour minimum breaks between shifts to minimize observer fatigue. The vessel crew will also be instructed to assist in detecting marine mammals and implementing mitigation requirements (if practical). Before the start of the seismic survey, the crew will be given additional instruction on how to do so. Apache personnel will have direct responsibility for initiating mitigation measures only when a PSO is not on duty (e.g., nighttime operations).

The source and support vessels are suitable platforms for marine mammal observations. When stationed on the flying bridge, the observer will have an unobstructed view around the entire vessel. If surveying from the bridge, the observer's eye level will be about 6 m (20 ft) above sea level. During operations, the PSO(s) will scan the area around the vessel systematically with reticle binoculars (e.g., 7 × 50 or equivalent) and with the naked eye (corrected to 20/20 vision). Laser range finders (Leica LRF 1200 laser rangefinder or equivalent) will be available to assist

with distance estimation. They are useful in training observers to estimate distances visually, but are generally not useful in measuring distances to animals directly.

All observations and mitigation measures will be recorded in a standardized format. Otherwise, data will be entered into Apache's existing database using a notebook computer operating software that allows for conversion to Microsoft Excel or Microsoft Access. The accuracy of the data entry will be verified by computerized validity data checks as the data are entered and by subsequent manual checking of the database. These procedures will allow initial summaries of data to be prepared and submitted to AKR during and after field operations, and will facilitate transfer of the data to statistical, graphical, or other programs for further processing and archiving. Results from the vessel-based visual observations will provide:

- The basis for real-time mitigation (airgun shut-down, power-down, and ramp-up).
- Data on the occurrence, distribution, and activities of marine mammals in the area where the seismic study is conducted.
- Information to compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity.
- Data on the behavior and movement patterns of marine mammals seen at times with and without seismic activity.

Apache has incorporated additional mitigation measures into the project, as described below.

Aerial Surveys

When practicable, Apache proposes to utilize helicopter or fixed-wing aircraft to conduct aerial surveys of the project area prior to the commencement of operations in order to identify locations of beluga whales. Apache proposes to conduct daily aerial surveys as required. As logistically feasible, each daily survey will be scheduled to occur at least 30 minutes and no more than 120 minutes prior to seismic-related activities (including node deployment or retrieval or airgun operations). Daily aerial surveys will also occur on days that there may be no seismic activities. Aerial surveys are proposed to occur along and parallel to the shoreline throughout the project area as well as the eastern and western shores of central and northern Cook Inlet. Aerial survey aircraft will fly at an altitude of 305 m (1,000 ft) when practical and weather conditions permit. Aircraft will attempt to maintain a radial distance of 457 m (1,500 ft) from observed marine mammals. Aircraft will avoid direct approaches of marine mammals in a head-on manner. They will avoid flying directly over, or passing the shadow of the aircraft over marine mammals. Using these operational requirements, sound levels underwater are not expected to reach NMFS harassment thresholds (Richardson et al. 1995; Blackwell and Greene 2002).

Results from the aerial and shore-based observations will provide:

- The basis for real-time mitigation (airgun power-down, shut-down, and ramp-up).
- Data on the occurrence, distribution, and activities of marine mammals in the area where the seismic study is conducted.
- Information to compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity.
- Data on the behavior and movement patterns of marine mammals seen at times with and without seismic activity.

Shore-based Monitoring

In addition to use of vessel-based PSOs, Apache proposes to utilize a shore-based station when possible. If used in lieu of vessel-based observers, shore-based observers will position themselves such that they can see marine mammals at least as far away as the edge of the 160 dB disturbance zone; if necessary, the PSO would be outfitted with big-eye binoculars and a theodolite to track and chart the marine mammal observations. The PSO will scan the area prior to, during, and after the airgun operations. The PSO would be in contact with the other PSOs on the vessels, as well as the source vessel operator via radio to be able to communicate the sighting of a marine mammal approaching or observed within the project area.

2.3.4.3 Ramp-up Procedure

A ramp-up procedure gradually increases airgun volume at a specified rate. Apache will use the ramp-up procedure at the start of airgun operations, after a power-down, shut-down or any period of 10 minutes or more without airgun operations. Ramp-up rate will not exceed an increase of 6 dB per 5-minute period. Ramp-up will begin with the smallest gun in the array. During the ramp-up, the 160 dB disturbance zone for the full airgun array will be monitored for marine mammals.

If the complete 160 dB disturbance zone has not been visible for at least 30 minutes prior to the start of operations, ramp-up will not commence unless the mitigation gun has been continuously operating during the interruption of seismic survey operations. Ramp-up from a complete shut-down may only occur when the entire 160 dB disturbance zone is visible. Ramp-up of the airguns will not be initiated if a marine mammal is observed within or near the 160 dB disturbance zone.

During ramp-up, if a marine mammal is observed within a 160 dB disturbance zone, power-down or shut- down procedures will be implemented.

2.3.4.4 Power-down Procedures

Apache proposes to power down (or possibly shut down) airguns or positioning pingers in the event any marine mammal approaches or enters the applicable 180 or 190 dB exclusion zone. NMFS requires monitoring of the 160 dB disturbance zone specifically for one or more belugas as well as groups of five or more harbor porpoises or killer whales. When these marine mammals are observed within, or about to enter the 160 dB disturbance zone, airgun operations will be powered down (or shut down if necessary) immediately.

A power down procedure involves reducing the number of airguns in use such that the radius of the 180 dB (or 190 dB) exclusion zone is decreased to the extent that marine mammals are not in the 160 dB disturbance zone. In contrast, a shutdown procedure occurs when all airgun activity is suspended. During a power down, a mitigation airgun, typically the 10 in^3 is operated. Operation of the mitigation gun allows the exclusion zone radii to decrease to 10 m and 33 m for the 190 dB and 180 dB isopleths, respectively, and to 330 m for the 160 dB disturbance zone. If a marine mammal is detected outside the 180/190 dB exclusion zone or the 160 dB disturbance zone, but is likely to enter that zone, the airguns may be powered down before the animal is within the respective zone in an effort to avoid taking the animal. Likewise, if a marine mammal is already

within the 160 dB disturbance zone when first detected, the airguns may be powered down immediately if this is a reasonable alternative to a complete shutdown (see section 2.3.4.5)[6]. If a marine mammal occurs within the 180/190 dB exclusion zone, the airguns will be shut down immediately and level A takes will be immediately reported to NMFS.

Following a power-down, ramp-up procedures will not begin until the marine mammal has cleared the 160 dB disturbance zone. The animal will be considered to have cleared the 160 dB disturbance zone if it:

- is visually observed to have left the zone,
- has not been seen within the zone for 15 minutes in the case of pinnipeds and small odontocetes, including Steller sea lions, harbor seals, and harbor porpoise, or
- has not been seen within the zone for 30 minutes in the case of species with longer dive durations (beluga whales and killer whales).

2.3.4.5 Shut-down Procedures

The description of shutdown procedure and protocol is inconsistent within the body of the BA and the associated Appendix C Marine Mammal Monitoring and Mitigation Plan. Here we present the action as described in section 5.1.2.4 of the BA (ASRC 2014).

A shut-down occurs when all airgun activity is suspended. The operating airgun(s) and/or pinger will be shut down completely if a marine mammal approaches the applicable 180/190 dB exclusion zone (Table 3). The shutdown procedure will be accomplished within several seconds (of a "one shot" period) of the determination that a marine mammal is either in or about to enter the 180/190 dB exclusion zone.

When a marine mammal is observed within or approaching a180/190 dB exclusion zone or 160 dB disturbance zone and a power-down does not keep it out of the 160 dB disturbance zone of the mitigation airgun, PSOs will initiate a shut-down by commanding "Shut down, shut down, shut down" to the seismic operators and vessel captain, whether by voice or radio. Personnel on the source vessels will respond that they are shut down. PSOs on the source vessels will record shut-down request (order) time and implementation time (both to the second). In the event that the marine mammal is observed by a PSO to have left the 180/190 dB exclusion zone or the 160 dB disturbance zone within 10 minutes of shutting down, Apache proposes to restart seismic operations at full volume. In the event that the marine mammal is determined to be within a 180/190 dB exclusion or 160 dB disturbance zone, PSOs will maintain the shut-down for the specified duration (15 minutes for pinnipeds and harbor porpoise and 30 minutes for large odontocetes). If the shutdown of seismic operations is ten or more minutes in duration, a full ramp-up will be implemented following the defined ramp-up procedure.

[6] AKR notes that any marine mammal that occurs within the 180 dB (for cetaceans) or 190 dB (for pinnipeds) exclusion zone is considered taken (i.e. Level A take as defined in the MMPA) despite subsequent power down or shut-down actions. Likewise, any marine mammal that occurs within the 160 dB disturbance zone is considered taken (i.e. level B take as defined in the MMPA) despite subsequent power down or shut-down actions.

Following a shut-down, airgun activity will not resume until all marine mammals are outside the 160 dB disturbance zone. The animal will be considered to have cleared the 160 dB disturbance zone if it:

- is visually observed to have left the zone,
- has not been seen within the zone for 15 minutes in the case of pinnipeds and small odontocetes, including Steller sea lions, harbor seals, and harbor porpoise, or
- has not been seen within the zone for 30 minutes in the case of species with longer dive durations (beluga whales and killer whales).

After a shut-down during night operations, seismic survey activities will be suspended until after sunrise and the entire160 dB disturbance zone is visible and monitored for at least 30 minutes prior to initiating ramp-up procedures. Ramp-ups following shut-downs during daylight when visibility conditions prevent adequate visual monitoring for marine mammals will not commence until the entire 160 dB disturbance zone is visible for at least 30 minutes prior to initiating ramp-up procedures.[7]

2.3.4.6 Vessel Speed or Course Alterations

If a marine mammal appears likely to enter the 160 dB disturbance zone, the vessel may adjust its speed and/or course, when practical and safe to do so, to avoid Level B take. If a marine mammal is within the 160 dB disturbance zone, and appears likely to enter the 180 dB exclusion zone, level B take has occurred, but vessel speed and course may be altered to avoid Level A take when doing so it is practical and safe. These actions can be used in coordination with a power-down or shut-down procedure, if practical.

2.3.4.7 Other Protections

The following section describes mitigation measures from ASRC (2014) intended to reduce the impacts of noise on belugas and their prey species.

- There will be no airguns used as an energy source within 1.6 km (1 mi) of the mouth of any stream listed by the ADF&G on the Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes, unless approved by ADF&G on a case-by-case basis. *Although the applicant identifies this as a mitigation measure, AKR does not consider the 1.6 km (1 mi) setback from river mouths in the analysis of impacts to belugas whales, beluga critical habitat, and sea lions because the measure provides for case-by-case exemptions to this setback. In the absence of a firm setback requirement, NMFS must assume in this opinion that airguns will occur within 1 mile of the mouths of all anadromous streams.*
- Airgun arrays will be discharged at depths greater than 2 m (~ 6.6 ft) to avoid interference or injury to out-migrating juvenile salmonids.
- The seismic program will be conducted in a relatively small area at one time and the airguns will only be active for approximately two to three hours during each of the slack tide periods (8-12 hours per 24 hour period), thereby confining noise levels to one

[7] Note: AKR provides clarification and modifications to power-down, shut-down and ramp-up procedures/protocols in our Incidental Take Statement.

location for short time periods spaced throughout a 24-hour day resulting in affecting a small proportion of the available habitat in Cook Inlet for prey species or their habitats.

- Seismic activity from the proposed Cook Inlet Seismic Program will cover only a small portion of the action area at one time; therefore, covering a small percentage of the potentially available habitat used by Cook Inlet beluga whales, allowing them to move away from any seismic activity to feed, rest, migrate or conduct other elements of their life history.

2.3.4.8 Protections used in the past and not contemplated in the 2014 BA

Apache incorporated a passive acoustic monitoring (PAM) program as part of its 2012 operations, with the purpose of enhancing detections of marine mammals. The original PAM plan envisioned the use of a bottom-mounted telemetry buoy to broadcast acoustic measurements using a radio-system link back to a monitoring-vessel. However, upon deployment at the beginning of the 2012 season, the buoy failed to remain upright in strong tidal currents and ice, which immersed and damaged the telemetry equipment. Apache made the decision to discontinue the use of the buoy for safety reasons. Instead, Apache used a single omni-directional hydrophone lowered from the side of the mitigation vessel. The PAM operators performed real-time monitoring on the bridge of the vessel using an Acoustic Data Acquisition and Monitoring System (ADAMS) and a laptop computer that displayed and recorded the acoustic data. There were two PAM operators working on rotating 6-hour schedules who visually monitored a scrolling spectrogram display and listened to the data stream through headphones. Monitoring continued as much as was feasibly practical throughout the survey, which included times when the airguns were not operating.

There were occasions when the PAM was shut down due to required movement of the monitoring vessel, harsh sea conditions that could damage the PAM equipment, or other equipment issues. There were a total of 69.25 hours when the airguns were operating that the PAM was not in use (Austin and Zeddies 2012). More details about the PAM program are available in Marine Mammal Monitoring and Mitigation 90-day report for 2012 activities (Lomac-MacNair et al. 2013), and in the passive acoustic monitoring summary report (Austin and Zeddies 2012). During the entire 2012 survey season, Apache's PAM equipment yielded six confirmed marine mammal detections, one of which was a Cook Inlet beluga whale. Apache did not propose to use PAM for its 2016-2021 operations.

3. APPROACH TO THE ASSESSMENT

3.1 Introduction to the Biological Opinion

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. The jeopardy analysis considers both survival and recovery of the species. The adverse modification analysis considers the impacts to the conservation value of the designated critical habitat.

"To jeopardize the continued existence of a listed species" means to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). As NMFS explained when it promulgated this definition, NMFS considers the likely impacts to a species' survival as well as likely impacts to its recovery. Further, it is possible that in certain, exceptional circumstances, injury to recovery alone may result in a jeopardy Biological Opinion (51 FR 19926, 19934 ((June 2, 1986)).

This opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat. [8]

3.1.1 Approach to the Assessment

Biological opinions are constructed around several basic sections that represent specific requirements placed on the analysis by the ESA and implementing regulations. These sections contain different portions of the overall analytical approach described here. This section is intended as a basic guide to the reader on the other sections in this Biological Opinion and the analyses that can be found in each section. Every step of the analytical approach described below will be presented in this Biological Opinion in either detail or summary form.

Description of the Proposed Action: This section contains a basic summary of the proposed federal action and any interrelated and interdependent actions. This description forms the basis of the first step in the analysis where we consider the various elements of the action and determine the stressors expected to result from those elements. The nature, timing, duration, and location of those stressors define the action area and provide the basis for our exposure analyses.

Status of the Species: This section provides the reference condition for the species and critical habitat at the listing and designation scale. These reference conditions form the basis for the determinations of whether the proposed action is likely to jeopardize the continued existence of species or result in the destruction or adverse modification of critical habitat. Other key analyses presented in this section include critical information on the biological and ecological requirements of the species and critical habitat and the impacts to species and critical habitat from existing stressors.

[8] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

Environmental Baseline: This section provides the reference condition for the species and critical habitat within the action area. By regulation, the baseline includes the impacts on the species and critical habitat of all past and present actions and future federal actions for which consultation has been completed (except the effects of the proposed action). This section also contains summaries of the impacts from stressors that will be ongoing in the same areas and times as the effects of the proposed action (future baseline). This information forms part of the foundation of our exposure, response, and risk analyses.

Effects of the Proposed Action: This section details the results of the exposure, response, and risk analyses AKR conducted for listed species and elements, functions, and areas of critical habitat.

Cumulative Effects: This section summarizes the impacts of future non-federal actions reasonably certain to occur within the action area, as required by regulation. Similar to the rest of the analysis, if cumulative effects are expected, AKR determines the exposure, response, and risk posed to individuals of the species and features of critical habitat.

Synthesis and Integration: In this section of the Biological Opinion, AKR presents the summary of the effects identified in the preceding sections and then details the consequences of the risks posed to individuals and features of critical habitat to the species or Distinct Population Segment at issue. Finally, this section concludes whether the proposed action is likely to jeopardize the continued existence of a species or destroy or adversely modify designated critical habitat.

Legal and Policy Framework

The purposes of the ESA, "…*are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a) of this section*." To help achieve these purposes, the ESA requires that, "*Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [designated critical] habitat*…"

Jeopardy Standard and Destruction or Adverse Modification Standard

The "jeopardy" standard has been further interpreted in regulation (50 CFR 402.02) as a requirement that federal agencies ensure that their actions are not reasonably expected to *reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution*.[9] It is important to note that the purpose of the analysis is to determine whether appreciable reductions are reasonably expected, but not to precisely quantify the amount of those reductions. As a result, our assessment often focuses on

[9] For purposes of this opinion, NMFS interprets this definition consistent with the court's opinion in *National Wildlife Federation v. NMFS*, 524 F.3d 917 (9th Cir. 2008). NMFS's jeopardy analysis considers how the proposed action may affect the likelihood of survival of the species and how it may affect the likelihood of recovery of the species.

whether a reduction is expected, but not on detailed analyses designed to quantify the absolute amount of reduction or the resulting population characteristics (abundance, for example) that could occur as a result of proposed action implementation.

The parameters of productivity, abundance, and population spatial structure are important to consider because they are predictors of extinction risk and recovery potential. The parameters reflect general biological and ecological processes that are critical to the survival and recovery of the listed species, and these parameters are consistent with the "reproduction, numbers, or distribution" criteria found within the regulatory definition of jeopardy (50 CFR 402.02).

For critical habitat, NMFS does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the analysis with respect to critical habitat. NMFS will evaluate "destruction or adverse modification" of critical habitat by determining if the action appreciably diminishes the value of critical habitat for the conservation of the species.

Additional requirements on the analysis of the effects of an action are described in regulation (50 CFR 402) and our conclusions related to "jeopardy" and "destruction or adverse modification" generally require an evaluation of the direct and indirect consequences of the proposed action, related actions, and the overall context of the impacts to the species and habitat from past, present, and future actions as well as the condition of the affected species and critical habitat [for example, see the definitions of "cumulative effects," "effects of the action," and the requirements of 50 CFR 402.14(g)]. Recent court cases have reinforced the requirements provided in section 7 regulations that NMFS must evaluate the effects of a proposed action within the context of the current condition of the species and critical habitat, including other factors affecting the survival and recovery of the species and the functions and value of critical habitat.

Consultations conclude with the issuance of a Biological Opinion or a concurrence letter. Section 7 of the ESA and the implementing regulations (50 CFR 402) and associated guidance documents (*e.g.*, USFWS and NMFS 1998) require Biological Opinions to present: (1) a description of the proposed federal action; (2) a summary of the status of the affected species and its critical habitat; (3) a summary of the environmental baseline within the action area; (4) a detailed analysis of the effects of the proposed action on the affected species and critical habitat; (5) a description of cumulative effects; and (6) a conclusion as to whether it is reasonable to expect the proposed action is not likely to appreciably reduce the species' likelihood of surviving or recovering in the wild by reducing its numbers, reproduction, or distribution or result in the destruction or adverse modification of the species' designated critical habitat.

4. STATUS OF THE SPECIES

The Cook Inlet beluga whale, western DPS Steller sea lion, and humpback whale are the only threatened or endangered species under NMFS's jurisdiction likely to occur in the action area. The Cook Inlet DPS of beluga whale was listed as endangered under the ESA on October 22, 2008 (73 FR 62919), and critical habitat was designated April 11, 2011 (76 FR 20180).

The Steller sea lion was listed as a threatened species in 1990 (55 FR 49204; November 26, 1990). Critical habitat was designated in 1993 (58 FR 45269). In May 1997, NMFS reclassified

Steller sea lions as two distinct population segments (DPS) under the ESA based on genetic studies and phylogeographical analyses from across the sea lions' range (62 FR 24345;). The eastern DPS was listed as threatened; the western DPS was listed as endangered. In December, 2013, the eastern DPS was delisted (78 FR 66140).

In December 1970, the humpback whale was listed as endangered under the Endangered Species Conservation Act of 1969 (35 FR 18319). When the Endangered Species Act (ESA) was passed in 1973, the humpback whale was automatically incorporated onto the ESA's List of Endangered and Threatened Wildlife and Plants with an endangered designation, along with all other previously listed large whale species (Fleming and Jackson 2011). On April 21, 2015, NMFS published a proposed rule to revise the listing status of humpback whales (80 FR 22304). This proposal would divide the globally listed endangered species into 14 distinct population segments (DPS), remove the current species-level listing, and in its place list two DPS's as endangered (Arabian Sea DPS and Cape Verde Islands/Northwest Africa DPS) and two DPS's as threatened (Central America DPS and Western North Pacific DPS). The range of the western North Pacific DPS includes waters in the action area.

4.1 Species and Critical Habitat Not Considered Further in this Opinion

NMFS PR1 determined that this action may affect, but is not likely to adversely affect Cook Inlet beluga whale critical habitat (Figure 4) or western DPS Steller sea lion critical habitat. The action area occurs throughout the majority of Cook Inlet beluga critical habitat; it does not include most waters of Knik and Turnagain Arms, nor does it include nearshore waters of western Cook Inlet south of Redoubt Point. The closest Steller sea lion critical habitat is the buffer around the major haulout at Nagahut Rocks off the southwestern tip of the Kenai Peninsula. In this section, we explain why NMFS AKR concurs with these determinations. The applicable standard to find that a proposed action is "not likely to adversely affect" listed species or critical habitat is that all of the effects of the action are expected to be insignificant, discountable, or completely beneficial (50 CFR 402.02). Insignificant effects relate to the size of the impact and are those that one would not be able to meaningfully measure, detect, or evaluate, and should never reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur. Beneficial effects are contemporaneous positive effects without any adverse effects to the species.

4.1.1 Cook Inlet Beluga Whale Critical Habitat

Cook Inlet beluga whale critical habitat (Figure 7) includes two geographic areas in Cook Inlet comprising 7,809 km^2 (3,013 mi^2) of marine waters. These areas are bounded on the upland by Mean High Water (MHW) datum. Critical habitat does not extend into the tidally-influenced channels of tributary waters of Cook Inlet, with the exceptions noted in the descriptions of each critical habitat area.

Area 1 comprises 1,918 km^2 of marine habitat in Cook Inlet and encompasses all marine waters of Cook Inlet north of a line from the mouth of Threemile Creek (61°08.5′ N., 151°04.4′ W.) connecting to Point Possession (61°02.1′ N., 150°24.3′ W.), including waters of the Susitna River south of 61°20.0′ N., the Little Susitna River south of 61°18.0′ N., and the Chickaloon River north of 60°53.0′ N.

Area 2 comprises 5,891 km^2 of Cook Inlet and encompasses all marine waters of Cook Inlet south of a line from the mouth of Threemile Creek (61°08.5′ N., 151°04.4′ W.) to Point Possession (61°02.1′ N., 150°24.3′ W.) and north of 60°15.0′N., including waters within two nautical miles seaward of MHW along the western shoreline of Cook Inlet between 60°15.0′ N. and the mouth of the Douglas River (59°04.0′ N., 153°46.0′ W.). Area 2 also includes all waters of Kachemak Bay east of 151°40.0′ W. and waters of the Kenai River below the Warren Ames Bridge at Kenai, Alaska.

Consistent with the proposed rule (74 FR 63080, December 2, 2009), portions of military lands were not included in this critical habitat designation. Section 4(a)(3)(B)(i) of the ESA allows for an exemption from critical habitat of military lands if the Integrated Natural Resources Management Plan (INRMP) provides benefit for the listed species. NMFS concluded that the Army's INRMP provides benefit for the Cook Inlet beluga whale and exempted the Eagle River Flats area from the critical habitat designation. This also included the lower reaches of Eagle River. NMFS also exempted the Port of Anchorage from the final rule in consideration of national security interests.

4.1.2 Cook Inlet Beluga Critical Habitat Primary Constituent Elements

The Cook Inlet beluga whale critical habitat final rule (76 FR 20180) included designation of five Primary Constituent Elements (PCEs) that were deemed essential to the conservation of the CI beluga whale. These attributes are:

- Intertidal and subtidal waters of Cook Inlet with depths <30 feet (MLLW) and within five miles of high and medium flow anadromous fish streams.
- Primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole.
- Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.
- Unrestricted passage within or between the critical habitat areas.
- Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.

Critical Habitat PCE1: Intertidal and subtidal waters of Cook Inlet with depths <30 feet (MLLW) and within five miles of high and medium flow anadromous fish streams.
The proposed action will allow seismic impulses >160 dB within waters that comprise PCE1. However, the sound itself will not affect the waters comprising this PCE beyond the introduction of sound waves to the water. ASRC (2014) discusses the potential for alteration of this PCE due to the temporary disturbance and resuspension of sediments in the water column caused by the placement and removal of either 12.7 cm or 45 cm diameter seismic nodes on the seafloor, including areas of substrate within 1 mile of anadromous fish streams. However, due to the extremely small areal extent of this disturbance, the dynamic nature of the substrate within Cook Inlet, and the high ambient silt levels throughout much of Cook Inlet, we conclude that the effects of this action on this PCE due to node placement and removal will be short-term and too small to detect; therefore, they are insignificant.

Critical Habitat PCE2: Primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole.
Little is known about how noise affects fish (Hastings and Popper 2005; DFO 2004); salmon have been found to respond to low frequency sounds such as those created by the proposed action, but only at very short ranges, within distances of a few feet from the sound source.

Sound from this action may affect primary prey species included in Critical Habitat PCE2. Most notably, airgun arrays may operate within 1.6 km of anadromous fish streams, where smolt of primary prey species may occur at high concentrations. Furthermore, ASRC (2014) notes that there may be exemptions made to this proposed 1.6 km buffer by ADF&G without ASRC (2014) specifying under what conditions those exemptions may be requested or granted. Therefore, we cannot use the 1.6 km buffer as grounds for determining that the proposed action will not affect PCE 2.

The types of noises produced by seismic surveys in the proposed action could behavioral effects on fish. Typical behavioral responses of fish to introduced sound, such as sound from seismic surveys, include: balance disturbance (i.e., staying in normal orientation); disoriented swimming behavior; increased swimming speed; disruption or tightening of schools; disruption of hearing; interruption of important biological behaviors (e.g., feeding, reproduction); shifts in the vertical distribution (either up or down); and occurrence of alarm and startle behaviors (BOEM 2015).

Fish sensitivity to impulse sound such as that generated by seismic operations varies depending on the species of fish. Cod, herring and other species of fish with swim bladders are considered to be more sensitive to sound vibrations than fish species that lack swim bladders. An alarm response in these fish is elicited when the sound signal intensity rises rapidly compared to sound rising more slowly to the same level (Blaxter and Hoss 1981). A recent study of feeding herring schools off of Northern Norway demonstrated no observed reaction in swimming speed, swimming direction, or school size that could be attributed to an approach by an active seismic vessel shooting a 3D seismic survey (Pena et al. 2013). They attributed the unanticipated lack of response to the strong motivation for feeding combined with the slow approach of a distant seismic stimulus (Pena et al. 2013). We expect any such effects on fish to be minimal and temporary and will not diminish a marine mammal species' or stock's foraging success.

In their detailed review of studies on the effects of airguns on fish and fisheries, Dalen et al. (1996) concluded that airguns can have deleterious effects on fish eggs and larvae out to a distance of 16 ft. (5.0 m), but that the most frequent and serious injuries are restricted to the area within 5.0 ft. (1.5 m) of the airguns. Most investigators and reviewers (Gausland 2003, Thomson and Davis 2001, Dalen et al. 1996) have concluded that even seismic surveys with much larger airgun arrays than are used in this survey have no impact to fish eggs and larvae discernible at the population or fisheries level.

Sound pressure levels greater than 150 dB are expected to cause temporary behavioral changes for fish, such as a startle or stress response. Although these sound pressure levels are not expected to cause direct injury to a fish, the functional effect of impaired sensory ability could potentially reduce survival, growth, and reproduction, increase predation, and alter foraging and reproductive behaviors. However, it is also likely that fish will avoid approaching sound sources

within ranges that may cause harm (McCauley et al. 2003). The seismic sound near each anadromous fish stream will only be sufficient to cause behavioral changes on a temporary basis. This change will be of sufficiently short duration that NMFS concludes such behavioral effects will not have measurable population level effects on beluga primary prey species.

Physiological effects to even very young fish from this proposed action will be limited to waters affected by particle motion rather than sound waves. The effects of particle motion are limited to within a few meters of the sound source for seismic airgun arrays of 3000-4000 in^3 displacement (see discussion at 6.2.1; prey availability). Only a small fraction of the potentially available habitat in Cook Inlet will occur within several meters of this action's airgun arrays. Therefore, only a small fraction of beluga primary prey species run the risk of being physiologically impacted by "noise" (in this case, particle motion) from this proposed project at levels sufficient to cause harm.

AKR also notes that the airgun arrays will be located at least 2 m below the surface and will be directing their sound impulses downward (ASRC 2014), helping to reduce the likelihood of causing physiological damage to smolt swimming near the surface.

Furthermore, we have no evidence to suggest that Pacific cod, walleye pollock, saffron cod, and yellowfin sole will inhabit waters sufficiently close to the airgun arrays to be harmed by particle motion in numbers sufficient to cause population-level effects in those species. Therefore, we have concluded that this action will have only insignificant effects on this PCE because it will not have measurable effects on any anadromous fish populations or on the Pacific cod, walleye pollock, saffron cod, or yellowfin sole populations in Cook Inlet.

Critical Habitat PCE 3: Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.
The only stated source of contamination to Cook Inlet beluga whale critical habitat resulting from this project is from accidental releases from the acoustic survey and observer vessels. The maximum amount of accidentally-released contamination is limited to the fuel capacity of these vessels. The probability that this action will release contaminants into the water in amounts sufficient to affect Cook Inlet beluga whale critical habitat is extremely small because: 1) Cook Inlet has a large tidal exchange with a high degree of mixing, There is a significant net outflow of water from the inlet due to large riverine inputs, 3) project vessels have a small fuel capacity, and 4) there is a low probability that the vessels will release a significant volume of fuel into Cook Inlet waters. Therefore we have determined that the effects of this action on Cook Inlet beluga whale critical habitat PCE 3 will be both insignificant and discountable.

Critical Habitat PCE 4: Unrestricted passage within or between the critical habitat areas.
Seismic airgun arrays such as the ones proposed in this project have large radii within which sound exceeds level B take thresholds. If airgun arrays were to operate contemporaneously with other sound sources, it is reasonable to assume that there will be occasions when belugas could be temporarily restricted in their passage within critical habitat where the water ensonified to >160 dB reaches from shore to shore. This is especially true in the waters between the Port of Anchorage area and Point Mackenzie; waters that are within the Susitna Delta Exclusion Zone. In a worst case scenario, belugas may be prevented from passage within critical habitat for a

maximum of six hours, as the seismic array operates for 2-3 hours before and after a slack tide period near the northeastern most portion of their action area.

If anthropogenic noise from multiple sources is produced in geographically narrow areas such that shore-to-shore sound is capable of causing MMPA level A injury or level B harassment, then these multiple noise sources may have additive or synergistic effects upon the beluga whales that may hinder or preclude access to essential portions of their critical habitat. Such synergistic effects are cited as a threat of major concern to Cook Inlet belugas in the Draft Cook Inlet Beluga Whale Recovery Plan (NMFS 2015). The likelihood of this happening is unknown, but could be easily avoided. See Term and Condition 3.13.

Absent other sound sources that would produce additive or synergistic effects on beluga whales by ensonifying the same waters with multiple sources of sound capable of causing MMPA level A injury or level B harassment, we have determined that this project alone will not significantly restrict the passage within or between critical habitat areas. In most cases, belugas will be able to avoid the waters ensonified by this project

Therefore, we have determined that this project will have insignificant effects on this PCE. We note that we have also determined that, in order to minimize the amount of beluga take caused by this action, steps must be taken to avoid this project contributing to additive or synergistic effects that cause take. Term and Condition 3.13 requires Apache to maintain a 10-mile buffer between the perimeter of the 160-dB ensonified area created by its sound sources to the perimeter of a 160-dB ensonified area created by other entities with MMPA and/or ESA authorization.

Critical Habitat PCE 5: Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.
The seismic program will temporarily and spatially increase in-water noise levels within much of Cook Inlet. The quality of habitat will be affected primarily from the low frequency, impulsive noise from airguns, which will shoot intermittently over the course of the program, but vessels and aircraft are also sources of noise.

Monitoring data of in-water pile driving using vibratory and impact hammering from the POA expansion project, a significant source of in-water noise in upper Cook Inlet, do not indicate habitat abandonment. Despite several years of ongoing construction at the POA, beluga whales have continued to use lower Knik Arm. Unusual behavioral changes were not observed during pile driving (ICRC 2009, 2010). Additionally, onshore observations identified no unusual responses. Subsurface responses, such as changed vocalizations, were not detectable (Cornick and Saxon-Kendall 2009; Širović and Kendall 2009; Cornick et al. 2010). Sightings of belugas within and adjacent to areas where pile-driving and other construction activities took place at the POA indicate belugas that entered Knik Arm did not avoid the area.

When the airguns are operating, the seismic source shots from the airguns would occur for about 2.5 hours around each of the four daily slack tides within a specific patch, averaging 10-12 hours of shooting per 24 hour period. Only one patch will be surveyed at a time and, using the largest airgun array (2,400 cui), noise would dissipate below the 160 dB harassment threshold after 9.5 km. Assuming a nodal patch requires a block of transects covering 6 x 9.5 km, we calculate that

a maximum of 672 km^2 will be ensonified to at least 160 dB per nodal patch[10], which could conceivably be surveyed in less than one 24 hour period. This equates to ensonification to ≥160 dB of about 12 percent of the 5,684 km^2 action area in a fully-operational day, or about 8.6 percent of the total critical habitat area (7,809 km^2). These estimates were not corrected for the sound source information from the SSVs, and therefore may over or underestimate the total ensonified area (the actual area cannot be determined until additional SSV data are obtained). Ensonification of critical habitat will occur for 10-12 hours per 24 hour period, and while any given location in the action area may be ensonified multiple times, we have no evidence indicating that anthropogenic sound from previous actions of a very similar nature in Cook Inlet caused any abandonment of critical habitat by beluga whales.

4.1.3 Summary of the Effects of the Action on Steller Sea Lion Critical Habitat

There is no overlap between the action area for this proposed seismic survey and Steller sea lion critical habitat. The closest point of approach between the action area and Steller sea lion critical habitat is near the middle of the opening to Katchemak Bay, resulting from the buffer around the major haulout at Nagahut Rocks off the southwestern tip of the Kenai Peninsula. Because no critical habitat for the Steller sea lions exists within the action area, we have determined that it is extremely unlikely and therefore discountable that this action will affect such critical habitat.

4.1.4 Conclusion on effects to Critical Habitat

Based on the preceding sections, AKR concurs that the proposed action is not likely to adversely affect critical habitat for Cook Inlet beluga whales or Steller sea lions, and effects on critical habitat will not be considered further in this Biological Opinion.

[10] Assumes 6 x 13 km transect patch ensonified for 9.5 km around the border of that block. Our estimate uses an ensonified zone of 25 x 30 km minus the 78 km^2 that falls within a rectangle of 25 x 30 km, but outside of the ensonified area located in each corner of that rectangle (i.e. the difference in the area of a circle of radius 9.5 and a square with sides of 19 is 78).

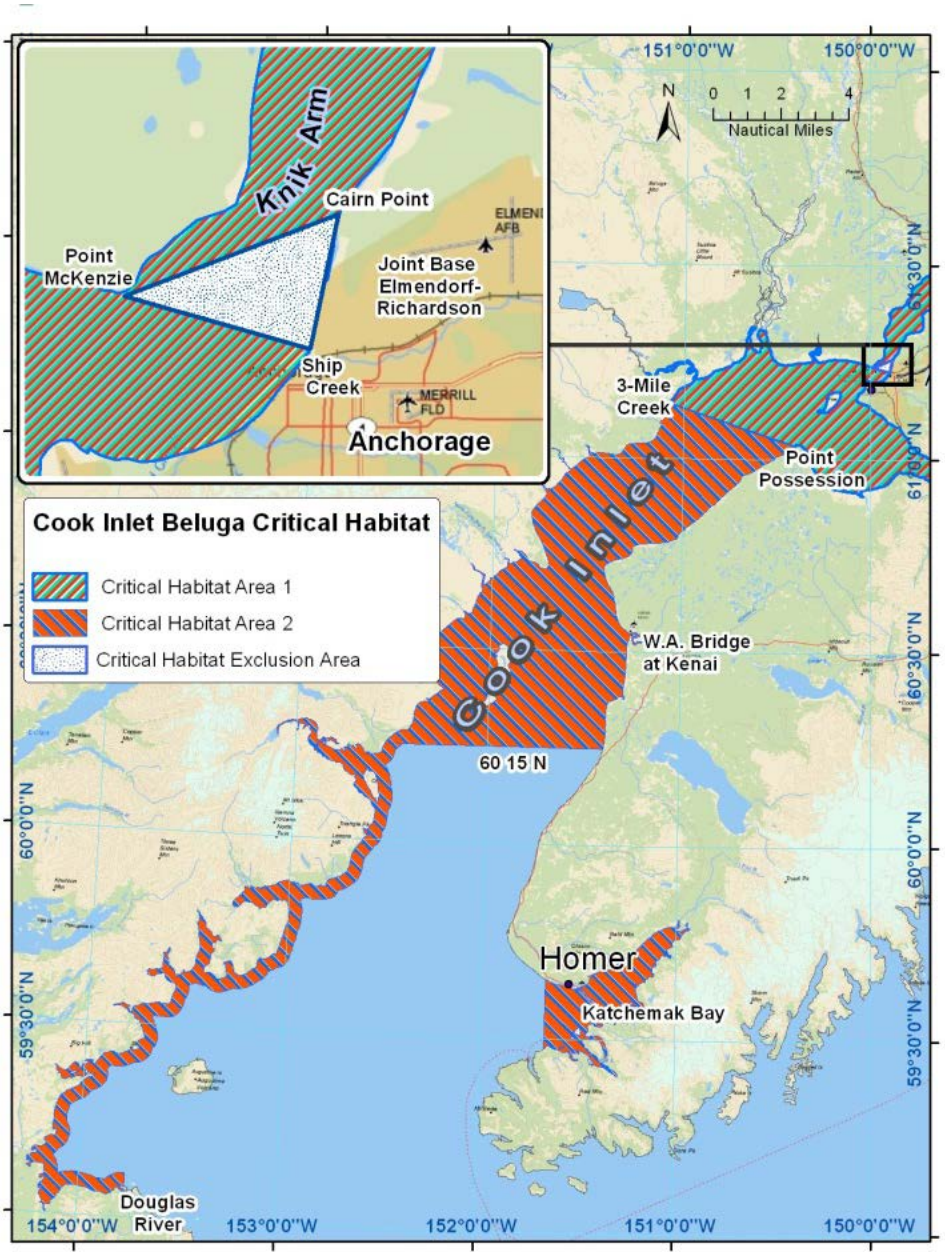

Figure 4. Critical habitat for the Cook Inlet beluga whale.

4.2 Climate Change

There is widespread consensus within the scientific community that atmospheric temperatures are increasing at an unprecedented rate, a trend that is expected to continue for at least the next several decades (Watson and Albritton 2001, Oreskes 2004). There is also consensus within the scientific community that this warming trend will alter current weather patterns and patterns associated with climatic phenomena, including the timing and intensity of extreme events such as heat waves, floods, storms, and wet-dry cycles. Warming of the Earth's climate is unequivocal, as is evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and increases in global average sea level (Pachauri and Reisinger 2007).

The Intergovernmental Panel on Climate Change (IPCC) estimated that average global land and sea surface temperature has increased by 0.6°C (±0.2°) since the mid-1800s, with most of the change occurring since 1976. This temperature increase is greater than what would be expected given the range of natural climatic variability recorded over the past 1,000 years (Crowley 2000). The IPCC reviewed computer simulations of the effect of greenhouse gas emissions on observed climate variations that have been recorded in the past and evaluated the influence of natural phenomena such as solar and volcanic activity. Based on its review, the IPCC concluded that natural phenomena are insufficient to explain the increases in land and sea surface temperature, and that most of the warming observed over the last 50 years is likely to be attributable to human activities (Stocker et al. 2013, IPCC 2014).

Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century (Watson and Albritton 2001).Climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the foreseeable future (Houghton 2001, McCarthy 2001, Parry 2007). Climate change would result in increases in atmospheric temperatures, changes in sea surface temperatures, increased ocean acidity, changes in patterns of precipitation, and changes in sea level (Stocker et al. 2013).

The indirect effects of climate change for listed marine mammals would result from changes in the distribution of temperatures suitable for many stages of their life history, the distribution and abundance of prey, and the distribution and abundance of competitors or predators.

The physical environment of Cook Inlet is shifting towards increasingly long ice-free seasons. Alaska has experienced the greatest warming of any region in the United States (Karl et al. 2009) and Cook Inlet has experienced a reduction in duration of seasonal sea ice.

Cook Inlet is a dynamic environment which experiences continual change in its physical and structural composition; there are extreme tides, strong currents, and a tremendous volume of silt input from glacial scouring. For example, an experienced and knowledgeable Alaska Native beluga hunter observed that the Susitna River (an area frequented by beluga whales, especially during anadromous fish runs) has filled in considerably during the past 40 – 50 years (pers. comm. P. Blatchford 1999 via B. Smith, NMFS). This hunter told of one persistent channel in the river that was more than 40 ft deep, but is now filled with sediment. Since beluga whales are still seen in the area today, they must be able to adapt to physical changes in their habitats.

The climate in Cook Inlet is driven by the Alaska Coastal Current (a low salinity river-like body of water that flows through the Pacific Ocean and along the coast of Alaska with a branch that flows into Cook Inlet) and the Pacific Decadal Oscillation (PDO). PDO is similar to El Nino except it lasts much longer (20 – 30 years in the 20th century) and switches between a warm phase and a cool phase. Phase changes of the PDO have been correlated with changes in marine ecosystems in the northeast Pacific; warm phases have been accompanied by increased biological productivity in coastal waters off Alaska and decreased productivity off the west coast of Canada and the US, whereas cold phases have been associated with the opposite pattern.

The change in water temperature may in turn affect zooplankton biomass and composition. Plankton is mostly influenced by changes in temperature, which may affect their metabolic and

developmental rates, and possibly survival rates (Batten and Mackas 2007). Data collected by Batten and Mackas (2007) demonstrated that mesozooplankton (planktonic animals in the size range 0.2 – 20 mm) biomass was greater in warm conditions, and that zooplankton community composition varied between warm and cool conditions, thus potentially altering their quality as a prey resource. In Cook Inlet, mesozooplankton biomass has increased each year from 2004 to 2006; however, sampling from late 2006 to early 2007 suggests biomass values are decreasing; a change most certainly driven by changes in climate (Batten and Mackas 2007). Therefore, changes in temperature effect changes in zooplankton, which in turn may influence changes in fish composition, and hence, alter the quality and types of fish available for beluga whales. While El Nino events have the potential to affect sea surface temperatures, the effects from the 1998 El Nino warming event in lower Cook Inlet were lessened by upwelling and tidal mixing at the entrance to Cook Inlet (Piatt et al. 1999). It is likely that the physical structure of Cook Inlet and its dominance by freshwater input act to buffer these waters from periodic and short-term El Nino events.

Beluga whale use of Cook Inlet, and particularly, feeding habitat in Cook Inlet, has been correlated to the presence of tidal flats and associated bathymetry. Their preference for shallow waters found in Knik Arm, Turnagain Arm, and the Susitna Delta undoubtedly relates to feeding strategy, as has been reported for beluga whales in Bristol Bay (Fried et al. 1979). Frost et al. (1983) theorized beluga whales' feeding efficiencies improve in relatively shallow channels where fish are confined or concentrated. Some have hypothesized that these feeding habitats are being lost through the deposition of glacial materials. The senescence of these habitats will likely reduce the capacity of Upper Cook Inlet to provide the needs for this population. At this time however, the data are insufficient to assess effects (if any exist) from environmental change on Cook Inlet beluga whale distribution, abundance, survival or recovery.

4.3 Cook Inlet Beluga Whales

A detailed description of the Cook Inlet beluga whales' biology, habitat and extinction risk factors may be found in the Proposed Listing Rule (72 FR 19854, April 20, 2007), the 2008 Status Review and Status Review Supplement (Hobbs et al. 2008; Hobbs and Shelden 2008), and the Conservation Plan (NMFS 2008a). Subsequent to the ESA listing and pursuant to ESA section 4(b)(2), NMFS designated critical habitat for the Cook Inlet beluga whales in April, 2011 (76 FR 20180).

The action area encompasses a large proportion of the Cook Inlet belugas whale range and designated critical habitat. There may be times when the entire population is located within the action area. As previously discussed, the most recent (2014) Cook Inlet beluga whale population estimate was 340 individuals, and the 1994-2012 population trend is -0.6 percent per year. Cook Inlet belugas are also exhibiting marked reduction in the size of their summer range (Rugh et al. 2010, Allen and Angliss 2014 Shelden et al. in press). Both natural and anthropogenic stressors may affect the Cook Inlet beluga whale population (NMFS 2008a). Natural stressors include changes in availability of prey, strandings, predation, parasitism, disease and environmental changes such as climate change and Pacific Decadal Oscillations. Anthropogenic factors include historic subsistence harvest, coastal zone development, fisheries interactions, research, noise, oil and gas development, vessel traffic, pollution and contamination, poaching, and tourism (Table

4) (NMFS 2008a). The level of impact is not known for all of these factors, and it is possible that multiple stressors may interact in an additive or synergistic manner (NMFS 2008a).

Beluga whales are not uniformly distributed throughout Cook Inlet; they are predominantly found in nearshore waters, and concentrate in Upper Cook Inlet in summer. Where beluga whales must compete with people for nearshore habitats, coastline development leads to the direct loss of this preferred habitat. Alteration of habitat may also occur due to the presence of bridges, boat traffic, in-water noise, and activities that affect prey availability or water quality. Most beluga habitat in Cook Inlet remains essentially intact; however, extensive sections of Turnagain Arm and Anchorage shorelines have been developed (e.g., rip rap lining the shoreline as a result of road or railroad construction); Knik Arm supports the largest port and military base in the state; and there are numerous offshore oil and gas platforms ranging from between the Forelands to just north of Tyonek.

4.3.1 Description and Taxonomy

The beluga whale is a small, toothed whale in the family Monodontidae, a family it shares with only the narwhal. Beluga whales are known as "white whales" because of the adults' white coloration. Beluga calves are born dark to brownish gray and lighten to white or yellow-white with age. Adult Cook Inlet beluga whales average between 12 and 14 ft in length, although Native hunters have reported some may reach lengths of 20 ft (Huntington 2000). Adult beluga males may weigh up to 3,300 pounds while females are typically smaller, weighing up to 3,000 pounds (Nowak 2003). The cervical vertebrae in beluga whales are not fused, allowing them to turn and nod their heads. Instead of a dorsal fin, beluga whales have a tough dorsal ridge. They also have a relatively small head, fluke, and flippers.

4.3.2 Range

To identify Cook Inlet beluga habitat use, particularly in winter, NMFS researchers placed satellite positioning tags on 18 beluga whales between 1999 and 2002. Those tagged whales remained in Cook Inlet, indicating that belugas occupy Cook Inlet year round and do not display the seasonal migrations that northern beluga populations display (Hobbs et al. 2005). Given the best scientific information available, NMFS determined the Cook Inlet beluga whales comprise a DPS which is confined to waters of Cook Inlet, and does not include beluga whales found in waters beyond Cook Inlet. Thus, the range of Cook Inlet beluga whale DPS has been defined as the waters of Cook Inlet north of a line from Cape Douglas to Cape Elizabeth (72 FR 19854, April 20, 2007).

During the 1970s, the summer distribution of Cook Inlet beluga whales included the upper, mid, and parts of lower Cook Inlet, in both coastal and offshore waters (Harrison and Hall 1978; Murray and Fay 1979). An August 1979 survey observed beluga whales throughout Cook Inlet (Calkins 1989). Calkins (1983) indicated that belugas were "seen throughout the year in the central and lower Inlet, with heaviest use occurring in the central area". Others reported seeing hundreds of belugas continuously throughout Cook Inlet in the 1970s and 1980s, including areas where few are now found (Pers. Comm. S. Foster 1995, via B. Mahoney, NMFS). Local knowledge and other historical evidence show that prior to the 1990s belugas were regularly seen in lower Cook Inlet waters, both nearshore and offshore (Huntington 2000; Rugh et al. 2000). Summer opportunistic sightings of belugas as recently as 1996 in Kamishak Bay in Lower Cook

Inlet were made during intermittent herring surveys flown between late April and early June from 1979-2002 (Pers. Comm. T. Otis, ADF&G 2008 via J. Wilder, FWS). This information indicates that these areas were important habitats when the beluga population was larger. These observations provide evidence that belugas (lone animals up to 60 whales) formerly frequented Iniskin Bay, Iliamna Bay, and Kamishak Bay in Lower Cook Inlet in spring and summer.

Dedicated marine mammal surveys of Lower Cook Inlet by Speckman and Piatt (2000) in late July through August 1995-1999 documented no beluga sightings south of Kalgin Island in any of the five years. Annual aerial abundance surveys by NMFS have shown that beluga whales are no longer regularly observed in Lower Cook Inlet in summer (last NMFS observation was in 2001; Rugh et al. 2005a, 2010). TEK of Alaska Natives and systematic aerial survey data document a contraction of the summer range of Cook Inlet beluga whales (Huntington 2000; Rugh et al. 2010). While beluga whales were once abundant and frequently observed in the mid and lower Inlet during summer, they are now primarily concentrated in Upper Cook Inlet during that time period, with up to 85% of the entire population associated with the Susitna Delta (Shelden et al. in press).

It is unknown if the current contracted distribution is a result of changing habitat (Moore et al. 2000), predator avoidance (Shelden et al. 2003), or a shift of a reduced population into preferred habitat areas that offer the most abundant prey, the most favorable feeding topography, and the best calving areas (Rugh et al. 2010; Goetz et al. 2007). Regardless, the result is a greater proximity to Anchorage and a smaller range. While the overall range of the population has contracted within Cook Inlet as the population has declined, whales continue to inhabit predictable locations and in patterns clearly related to time of year and the appearance of seasonally important prey resources. The contraction of the range of this population northward into the upper Inlet makes it far more vulnerable to catastrophic events with the potential to kill a significant fraction of the population. If and when the Cook Inlet beluga population begins to increase, a reoccupation of mid and lower Inlet habitats during the summer months may be the first indication of recovery.

In 2012, the NMFS annual aerial surveys to estimate the abundance of the Cook Inlet beluga whale population documented belugas in Trading Bay and near the West Forelands and the MacArthur River. This was the first sighting of belugas during the annual surveys in this region since 2001, and the first time consistent sightings have been made since 1995 (Shelden et al. 2012).

4.3.3 Distribution and Movements

Beluga whales generally occur in shallow, coastal waters, often in water barely deep enough to cover their bodies (Ridgway and Harrison 1981). Little information is available on the beluga whale distribution in Cook Inlet prior to 1970; however, in the 1970s and 1980s, beluga sightings occurred across much of lower and upper Cook Inlet (Calkins 1984).

Belugas remain in Cook Inlet year-round, as evidenced by satellite tagging studies (Hobbs et al. 2005), monthly aerial surveys conducted between June 2001 and June 2002 (Rugh et al. 2004), systematic aerial surveys (Rugh et al. 2000, 2005a, 2005b, 2006, 2007; Shelden et al. 2008, 2009, 2010, 2011, 2012), boat and land based observations (Speckman and Piatt 2000; McGuire

et al. 2008, 2009, 2011a, 2011b), TEK of Alaskan Natives (Huntington 2000), and opportunistic reports (Rugh et al. 2000; Vate-Brattstrom et al. 2010; NMFS unpubl. data).

Although beluga whales remain year-round in Cook Inlet, they demonstrate seasonal movement within the Inlet; they concentrate in upper Cook Inlet at rivers and bays in summer and fall, but tend to disperse offshore and move to mid Inlet in winter (Hobbs et al. 2005), although some belugas remain in Upper Cook Inlet throughout the year (Goetz et al. 2012). There is also obvious and repeated use of certain habitats by Cook Inlet beluga whales. Belugas have consistently been documented in Knik Arm, Turnagain Arm, Chickaloon Bay and the Susitna Delta (Beluga River to Little Susitna River) areas of the upper Inlet (Rugh et al. 2005a; NMFS 2008a; McGuire et al. 2008, 2009, 2011; NMFS unpubl. data).

As early as 2010, Rugh et al. (2010) reported range contraction in this species concurrent with observed population declines. Since then, Shelden et al. (in press) looked at beluga distribution from 2009-2014. Summer range continued to contract farther north (to 1,787 sq. km compared to 2,800 in 1998-2008) and remained centered around the Susitna River delta with 85% of the population found in that area, compared to half of the population during the earlier time periods reported in Rugh et al. (2010).

Waters near the Susitna River Delta are particularly important as calving and nursery grounds. From 2005 to 2015, the first neonates of the year were always seen in within Susitna Delta waters. In addition, the first recorded observation of a Cook Inlet beluga whale giving birth occurred on July 20, 2015 in the Susitna Delta near the mean lower low water line. From 2005-2015, most groups of belugas with neonates among them were associated with the Susitna Delta (McGuire et al. 2016). During winter, the highest beluga presence detected through passive acoustic monitoring occurred at the Beluga River in the Susitna Delta Exclusion Zone (one of 13 sites monitored within Cook Inlet, with the Little Susitna River (also within the Susitna Delta Exclusion Zone) unmonitored during winter (Castellote et al. 2015). Of the 13 sites monitored, the Little Susitna and Beluga Rivers were the two most heavily-used foraging locations on an annual basis (Castellote et al. 2015).

The timing and location of eulachon (*Thaleichthys pacificus*) (a.k.a. hooligan or smelt) and salmon runs have a strong influence on belugas' spring and summer movements. Beluga whales are regularly observed in the upper Inlet beginning in late April or early May, coinciding with eulachon runs in the Susitna River and Twenty Mile River in Turnagain Arm. In the summer, whales tend to concentrate near the Susitna Delta feeding on the various salmon runs, and are generally first observed in Knik Arm in May. In 2011 and 2012, LGL Alaska Research Associates (LGL) received reports of belugas in or near the Kenai River in May and June[11]. In 2012, LGL documented belugas in the Kenai River in early May as part of their photo-identification study. In late March of 2015, LGL received reports of 10 belugas in the Kenai River near the lower Kenai Bridge on or about March 27, 24 belugas (including 6-8 calves) below the bridge on March 31, 17 belugas (including 5-6 calves) at an undetermined point in the Kenai River on April 3[12].

[11] T. McGuire, LGL Alaska Research Associates, pers. comm. to M. Migura, NMFS, January 25, 2013
[12] T. McGuire, LGL Alaska Research Associates, pers. comm. to B. Mahoney, NMFS, January 6, 2016

In addition to frequenting the Susitna Delta and corresponding rivers and flats throughout the summer, belugas may remain in the upper Inlet into the fall and appear to use the smaller streams along the west side of the Inlet, following first the eulachon and Chinook salmon runs and later in the summer the Coho salmon runs. Intensive use of Knik Arm by belugas in the fall also coincides with the Coho run. During the fall the belugas also use Chickaloon Bay and areas of the west side near Tyonek. Data from 14 satellite tagged beluga whales and TEK supports varying degrees of beluga use of streams on the west side of Cook Inlet from the Susitna Delta south to Chinitna Bay during late summer and fall (Huntington 2000; Hobbs et al. 2005). As recently as September 2007, 25-30 belugas were observed in Chinitna Bay by Kachemak Bay Research Reserve staff (Pers. Comm. S. Baird, KBRR, 2008 via M. Migura, NMFS) suggesting that some belugas still visit Lower Cook Inlet in the fall.

Prior to satellite tagging data in 2000-2003, the winter distribution of this stock was poorly understood, in part because winter aerial surveys were limited in detecting beluga whales in the ice flows of upper Cook Inlet (Rugh et al. 2004). Eight dedicated aerial surveys in Cook Inlet between February 12 and March 14, 1997 (Hansen and Hubbard 1999) resulted in only a few beluga whale sightings. Conversely, satellite data showed tagged whales used Knik and Turnagain Arms for much of the tracked time (August-March), venturing as far south as Redoubt Bay (October), Kalgin Island (January), and East Foreland (December-January) (Hobbs et al. 2005).

The available information indicates that Cook Inlet belugas move throughout much of the Inlet in the winter months. They concentrate in deeper waters in mid Inlet past Kalgin Island, with occasional forays into the upper Inlet, including the upper ends of Knik and Turnagain Arms. Although the beluga whales move into the mid to lower Inlet during the winter, ice cover does not appear to limit their movements. Their winter distribution does not appear to be associated with river mouths, as it is during the warmer months. The spatial dispersal and diversity of winter prey likely influences the wider beluga winter range throughout the mid Inlet.

Apache's marine mammal monitoring program[13] reported Cook Inlet belugas in all months of its 2012 operations (May-September). Cook Inlet belugas were most often seen in the coastal waters (<1 km from shore) and in river mouths along the western side of Cook Inlet in Trading Bay. More Cook Inlet belugas were observed in river mouths associated with the Susitna Delta (including the Beluga River, Theodore River, Lewis River, Ivan River, and Susitna River) than the other regions. Apache's observations from its aerial surveys support other data that emphasize the importance of the Susitna Delta to Cook Inlet belugas during May-September (Figure 5).

4.3.4 Biology and Behavior

Beluga whales are extremely social animals that typically interact together in close, dense groups. Groups of 10 to more than 100 whales have been observed in Cook Inlet. It is unknown if these represent distinct social divisions but Reeves et al. (2002) mentioned that beluga groups are often of the same sex and age class. Traditional knowledge also suggests that beluga whales maintain family groups (Huntington 2000).

[13] Apache's marine mammal monitoring program and the information presented in their 90 day report (Lomac-MacNair et al. 2013).

Sexual maturity can vary from 4 to 10 years for females and 8 to 15 years for males. While mating is assumed to occur sometime between late winter and early spring, there is little information available on the beluga whale mating behavior. Beluga whales typically give birth to a single calf every two to three years, after a gestation period of approximately 14 months. Young beluga whales are nursed for two years and may continue to associate with their mothers for a considerable time thereafter (Reeves et al. 2002). Most calving in Cook Inlet is assumed to occur from mid-May to mid-July (Calkins 1983), although Native hunters have observed calving from April through August (Huntington 2000). Alaska Natives described calving areas as the northern side of Kachemak Bay in April and May, off the mouths of the Beluga and Susitna Rivers in May, and in Chickaloon Bay and Turnagain Arm during the summer (Huntington 2000). The warmer waters from these freshwater sources may be important to newborn calves during their first few days of life (Katona et al. 1983; Calkins 1989). Surveys conducted from 2005 to 2007 in the upper Inlet by LGL, Inc., documented neither localized calving areas nor a definitive calving season, since calves were encountered in all surveyed locations and months (April-October) (McGuire et al. 2008). The warmer, fresher coastal waters may also be important areas for beluga whales' seasonal summer molt.

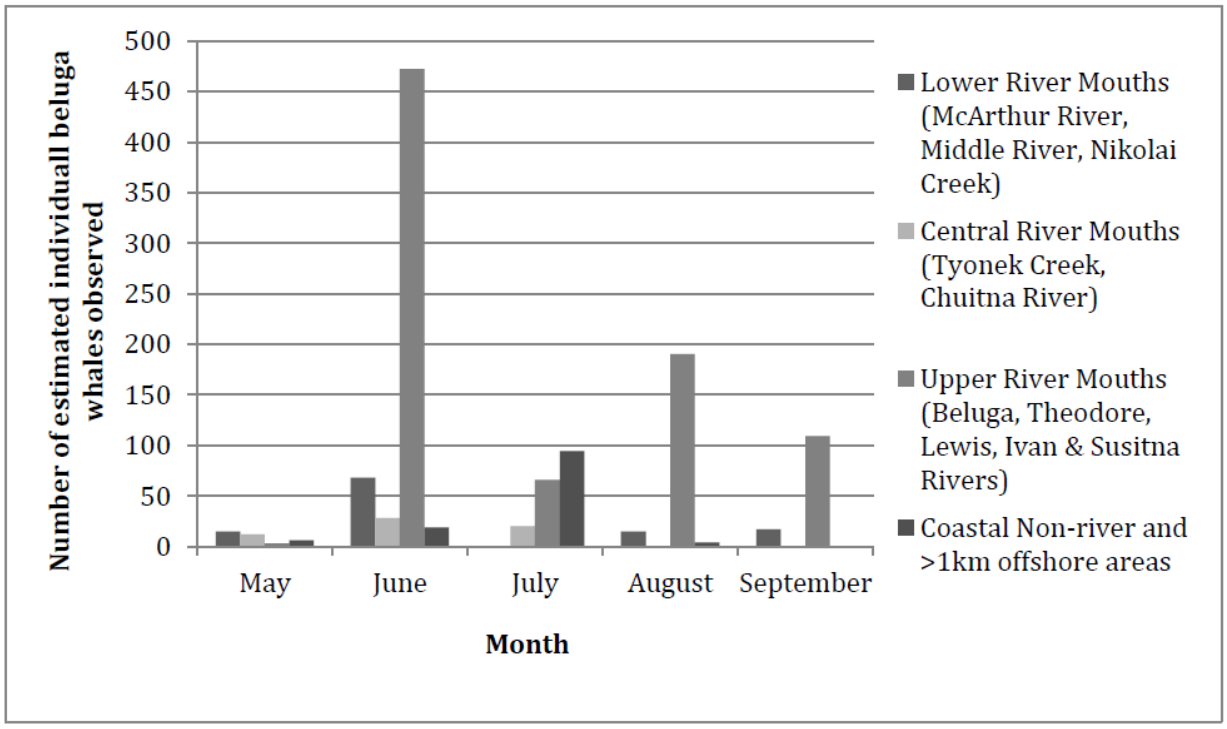

Figure 5. Beluga whale seasonal habitat use in mid to upper Cook Inlet (around project area 2) observed from Apache's aerial overflights in 2012. Reproduced from Lomac-MacNair et al. (2013).

Beluga whales are thought to live for more than 30 years, although recent discoveries may lead scientists to double this estimate of lifespan. Beluga whales normally swim about 2 to 6 miles per hour, but when pursued, can attain a speed of 14 miles per hour. While they usually surface to breathe every 30 to 40 seconds, radio-tracking studies show that they also routinely dive for periods of 9.3 to 13.7 minutes and to depths of 66 to 1,140 ft, presumably to feed (Nowak 2003). However, data from belugas tagged in Cook Inlet indicated that over 50 percent of the dives

were two meters or less in depth and lasted two minutes or less, though there were deeper (5-50 m) and longer (>21 minutes) dives recorded (Goetz et al. 2012).

Beluga vision is reported to be well developed; they appear to have acute vision both in and out of water and, as their retinas contain both rod and cone cells, are believed to see in color (Herman 1980). Beluga whales are also known to be among the most adept users of sound of all marine mammals and use sound rather than sight for many important functions. Most sound reception takes place through the lower jaw, which is hollow at its base and filled with fatty oil. Sounds are conducted through the lower jaw to the middle and inner ears, then to the brain. A study conducted with a captive beluga showed that the most efficient hearing pathway is from the rostrum tip, and may indicate that there are acoustic fat channels which begin at the beluga rostrum tip that effectively guide sound to the inner ear (Mooney et al. 2008). To date, belugas are the only odontocetes known to hear from the rostrum tip. This feature probably gives belugas higher directional hearing characteristics than other odontocetes. It is possible that the unfused vertebrae, and thus the highly movable head, of belugas have allowed for adaptations of highly directional hearing.

These whales hear over a large range of frequencies, from about 40 Hertz (Hz) to approximately 150 kiloHertz (kHz) (Au 1993), although their hearing is most acute at middle frequencies between about 10 kHz and 75 kHz (Fay 1988). Figure 6, adapted from Anderson et al. 2007, shows the estimated hearing threshold curve for a beluga whale (the minimum intensity of sound audible to whales ate each frequency). At lower frequencies (around 40 Hz), the beluga hearing threshold is about 140 dB re: 1 μPa. At the beluga peak hearing sensitivity of about 40 kHz, the hearing threshold is about 40 dB re: 1 μPa.

Beluga whales conduct communication and echolocation at relatively high frequencies where they have a lower hearing threshold and greater hearing sensitivity. Studies have shown beluga whales to emit communication calls with an average frequency range from about 2.0 to 5.9 kHz. Echolocation is generally conducted at frequencies greater than 40 kHz. Beluga whales generally produce signals with peak frequencies of 40 to 120 kHz during echolocation, and the intensity of the signal can change with location and background noise levels (Au et al. 1985). Complementing their excellent hearing, beluga whales have one of the most diverse vocal repertoires of all marine mammals. They are capable of making a variety of vocalizations (e.g., whistles, buzzes, groans, roars, trills, peeps, etc.), explaining the nickname conferred upon them by sailors: sea canaries.

4.3.5 Feeding Behavior and Habitat

Both scientific research and Alaska Native traditional ecological knowledge indicate beluga whales can move hundreds of miles to exploit changes in prey distribution (i.e., beluga whales follow their prey). Cook Inlet beluga whales are opportunistic feeders and feed on a wide variety of prey species, focusing on specific species when they are seasonally abundant. Their movements are currently confined almost entirely to Cook Inlet, and thus their seasonal movements in pursuit of prey are smaller and more restricted than for most other beluga populations.

Spring prey of Cook Inlet beluga whales includes eulachon and gadids (e.g., Pacific cod, saffron cod, and walleye pollock). Eulachon first enter the upper Inlet in April, with two major spawning

migrations occurring in the Susitna River in May and July. The early run is estimated at several hundred thousand fish and the later run at several million (Calkins 1989). Pacific cod prefer waters 100-400m deep in the Bering Sea and Gulf of Alaska, while saffron cod occur in coastal waters of less than 50 m depth in the western Alaska, venturing into tidally influenced portions of rivers and streams (Cohen et al. 1990). Walleye pollock are generally demersal from 30 to over 400 m depth, with diurnal vertical migrations and dense spawning congregations at 50-250 m depth, generally from January to March (Cohen et al. 1990).

In the summer, as eulachon runs begin to diminish, Cook Inlet beluga whales rely heavily on salmon as prey, often congregating at the mouths of rivers in Upper Cook Inlet with substantial salmon runs. Beluga whale hunters in Cook Inlet reported one whale having 19 adult Chinook salmon in its stomach (Huntington 2000). In July 2005, NMFS (unpubl. data) observed a 4.3 m (14 ft 3 in) male with 12 Coho salmon, totaling 27.9 kg (61.5 lbs), in its stomach.

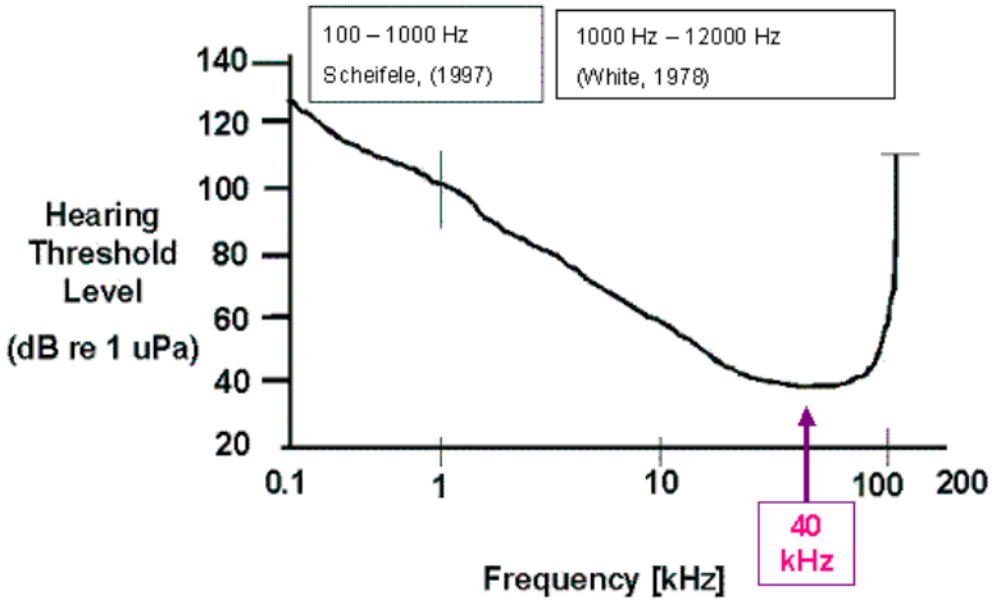

Figure 6. Hearing Range and Threshold for the Beluga Whale (from Anderson et al. 2007).

In the fall, as anadromous fish runs begin to decline, most beluga whales return to deeper waters of Lower Cook Inlet to prey upon gadid fish species found in deeper waters as well as in nearshore bays and estuaries. Their winter diet includes cod species observed in the spring diet (Pacific cod, saffron cod, and walleye pollock), as well as other bottom-dwellers (e.g., Pacific staghorn sculpin, starry flounder, yellowfin sole and likely small halibut). This variable is consistent with other beluga populations.

In the winter, Cook Inlet beluga whales concentrate in deeper waters in mid Inlet south of Kalgin Island and make deep feeding dives, likely in pursuit of flatfish and gadids and sculpins. The narrowing of the Inlet in this area and the presence of Kalgin Island just south of the Forelands may result in upwelling and eddies which concentrate nutrients and may provide a biologically productive still-water refuge for a number of species, including crustaceans (Calkins 1983, 1989). The Kalgin Island area may serve as a late-winter staging area for eulachon prior to migration to their natal streams in upper Cook Inlet. If these fish and crustaceans are generally

present in this area during late winter, they may be an important food source for beluga whales in the winter, and the Kalgin Island area may be important winter feeding habitat for belugas.

Based on the movements and feeding distribution of beluga whales, it is apparent that beluga movements are not simply explained by when and where the most fish are. Beluga whales do not always feed at the streams with the largest runs of fish; for example, beluga whales today are seen less frequently at the mouth of the Kenai River despite large salmon returns to the river. Dense concentrations of prey appear essential to beluga whale feeding success, but the relationship between beluga whale concentrations, salmon concentrations, and anthropogenic disturbance is not fully known. Waters off of the Kenai River are highly disturbed by commercial fishing activities during salmon runs, possibly explaining why this once heavily used river has fallen into relative disuse by belugas.

In upper Cook Inlet, beluga whales concentrate offshore from several important salmon streams and appear to use a feeding strategy which takes advantage of the bathymetry in the area. The channels formed by the river mouths and the shallow waters may act as a funnel for salmon as they move past waiting beluga whales. Therefore, bathymetry and fish density may be more important than sheer numbers of fish in their feeding success. If true, this would imply Cook Inlet beluga whales do not simply go where the fish are, but are partially dependent on particular feeding habitats with appropriate topography.

Beluga whales exhibit high site fidelity and may persist in an area with fluctuating fish runs or may tolerate certain levels of disturbance from boats or other anthropogenic activities during intense feeding periods. There is repeated use of several areas of Upper Cook Inlet Inlet for summer and fall feeding by beluga whales. The primary "hotspots" for beluga feeding areas include the Big and Little Susitna Rivers, waters between Eagle Bay and the Eklutna River, waters off the Twentymile River, and Chickaloon Bay. There are also reports of belugas heading up streams during salmon runs and possibly during eulachon runs. Undisturbed access to these areas and the maintenance of travel corridors between these areas is important in maintaining the quality of Cook Inlet beluga whale critical habitat and in avoiding jeopardy to, and promoting recovery of, this endangered species.

4.3.6 Breeding and Calving Habitat

Very little is known about beluga whale breeding behavior, and it is difficult to identify beluga breeding habitat with any certainty. The known presence of pregnant females in late March, April, June, and July (Mahoney and Shelden 2000; Vos and Shelden 2005, NMFS unpubl. data) suggests breeding may occur in late spring into early summer. Gestation is 14-14.5 months with a single calf typically born in the late spring or during summer.

The shallow waters of Upper Cook Inlet may play an important role in reproduction. Since newborn beluga whales do not have a thick blubber layer, they benefit from the warmer water temperatures in the shallow tidal flat areas of Upper Cook Inlet where fresh water inputs exist. It is likely these habitats are used as beluga nurseries (Katona et al. 1983; Calkins 1989). Alaska Natives described calving areas within Cook Inlet as the northern side of Kachemak Bay in April and May, off the mouths of the Beluga and Susitna Rivers in May, and in Chickaloon Bay and Turnagain Arm during summer (Huntington 2000).

Knik Arm is used extensively in the summer and fall by cow/calf pairs. Surveys by LGL (Funk et al. 2005; McGuire et al. 2011) noted a relatively high ratio of calves to adults in the uppermost part of Knik Arm. The mouth of Knik Arm has been reported to be transited in the summer and fall by cow/calf pairs headed towards the Knick Arm headwaters (Cornick and Kendall 2008). McGuire et al. (2008) photographically identified 37 distinct beluga whales with calves in Upper Cook Inlet during 2005-2007. Since calves were seen in all areas of their study (Susitna Delta, Knik Arm, Chickaloon Bay/Southeast Fire Island, and Turnagain Arm), they were unable to determine distinct calving areas (McGuire et al. 2008, 2011). However, when corrected for effort, Knik Arm had the largest number of calf sightings within the areas observed.

4.3.7 Population Abundance and Trends

The Cook Inlet beluga whale population has probably always numbered fewer than several thousand animals, but in recent decades, has declined significantly from its historical abundance (NMFS 2008a). It is difficult, however, to accurately determine the magnitude of decline due to the paucity of information on the beluga whale population that existed in Cook Inlet prior to development of the region, or prior to modern subsistence whaling in Cook Inlet by Alaska Natives. With no reliable abundance surveys conducted prior to the 1990s, scientists estimate historical abundance based on what little data exist. Relying on a survey conducted in portions of Cook Inlet during 1979, Calkins (1989) estimated a population of 1,293 beluga whales. This overall abundance estimate provided by Calkins represents the best available information on historical abundance. For management purposes, NMFS currently considers 1,300 beluga whales as a reasonable estimate of historical abundance.

Comprehensive, systematic aerial surveys of beluga whales in Cook Inlet began in 1994 with the goal of determining the overall abundance and population trend for the species (Figure 7). A decline in abundance of around 47 percent, from an estimate of 653 whales to 347 whales, was documented between 1994 and 1998 (Hobbs et al. 2000). After measures were established in 1999 to regulate subsistence harvests, NMFS expected that the population would grow at an annual rate between 2 and 6 percent. Abundance estimates from aerial surveys (1999 – 2008) indicate this level of growth did not occur. This lack of growth led to the ESA listing in 2008. Looking at the population estimates for the past 10 years (2002 – 2012), NMFS has documented a population decline of 0.6 percent per year. Surveys since hunting was regulated in 1999 document a population decline of 1.3 percent per year. The 2012 population abundance estimate was 312 whales (Hobbs et al. 2012). The 2014 population abundance estimate was 340 whales, and the 1994-2012 population trend is -0.6 percent per year.

While a precise comprehensive statistical assessment of population trend since 1979 is not possible given differences in survey methods and analytical techniques prior to 1994, a straight comparison of the 1979 estimate (1,293 belugas) with the 2014 estimate (340 belugas) would indicate a roughly 74 percent decline over 34 years, but with no consistent measure of variance around the estimates. NMFS has committed to conducting systematic abundance surveys which monitor population status and growth over time, such that a statistically significant change in abundance and trend would be detected over a 10 year time period.

4.3.8 Population Viability Analysis and Extinction Risk Assessment

In October 2008, the NMML published the 2008 Supplemental Status Review and Extinction Risk Assessment of Cook Inlet Beluga Whales (*Delphinapterus leucas*) (Hobbs and Shelden 2008). The Supplemental Review included an update of a November 2006 (Hobbs et al. 2006) and April 2008 (Hobbs et al. 2009) Status Reviews and responded to issues raised by a panel of independent experts regarding the earlier Status Reviews. The conclusions of the Supplemental Review were:

- The contraction of the range of this population northward and westward into Upper Cook Inlet makes it far more vulnerable to catastrophic events which have the potential to kill a significant fraction of the population.
- The population is not growing at 2 percent to 6 percent per year as had been anticipated upon cessation of unregulated hunting.
- The population is discrete and unique with respect to the species, and if it should fail to survive, it is highly unlikely that Cook Inlet would be repopulated with belugas. This would result in a permanent loss of a significant portion of their range.
- The importance of seasonal anadromous fish runs in Cook Inlet to belugas is evident. The bulk of their annual nutrition is acquired during the summer months.
- Belugas in Cook Inlet are unique in Alaska given their summer habitat is in close proximity to the largest urban area in the state.
- While the impact of disease and parasitism on this population has not been quantified, this population is at greater risk because of its small size and limited range such that a novel disease could spread easily through this population.
- The PVA shows a 26 percent probability of extinction in 100 years and 70 percent probability of extinction in 300 years. These figures derive from the model assuming one predation mortality per year and a 5 percent annual probability of an unusual mortality event killing 20 percent of the population.
- It is likely that the Cook Inlet beluga population will continue to decline or go extinct over the next 300 years unless stressors preventing its recovery are reduced or eliminated.

The Supplemental Review also reaffirmed NMFS's earlier position that the Cook Inlet beluga whale stock is discrete and significant in terms of the ESA, and constitutes a species under the definitions of the ESA. The Review included a PVA model that was the most-detailed of any such models for Cook Inlet beluga whales, being age and gender based, and focused on the behavior of a declining population at sizes less than 500 whales. Small population effects, demographic stochasticity, Allee effects, predation mortality, and unusual mortality events were modeled explicitly. The PVA employed 20 sub-models with 11 various assumptions: different predation levels, unusual mortality events, Allee effects, habitat loss, counting/survey errors, and other factors. For each sub-model, 100,000 trials were run to provide a statistical distribution of the stochastic and deterministic variables of the model in order to allow for analysis. The PVA results were then used in the Extinction Risk Analysis (ERA) to estimate the probabilities for the stock to become extirpated within certain time frames. The ERA found that, for the sub-model judged to be the best approximation for the current population, the extinction probability was 26 percent within 100 years.

An important outcome of the ERA was that the extinction probabilities increased dramatically when predation was set for more than one beluga whale mortality per year. We do not have

adequate data to accurately evaluate the removal levels from this stock due to killer whale predation or other factors, but annual mortalities could very easily exceed this threshold. This finding has particular significance in assessing the cumulative risks to the Cook Inlet beluga whales. The Environmental Baseline section has discussions on factors (stressors) known to be, or thought to be, impacting this population within the action area.

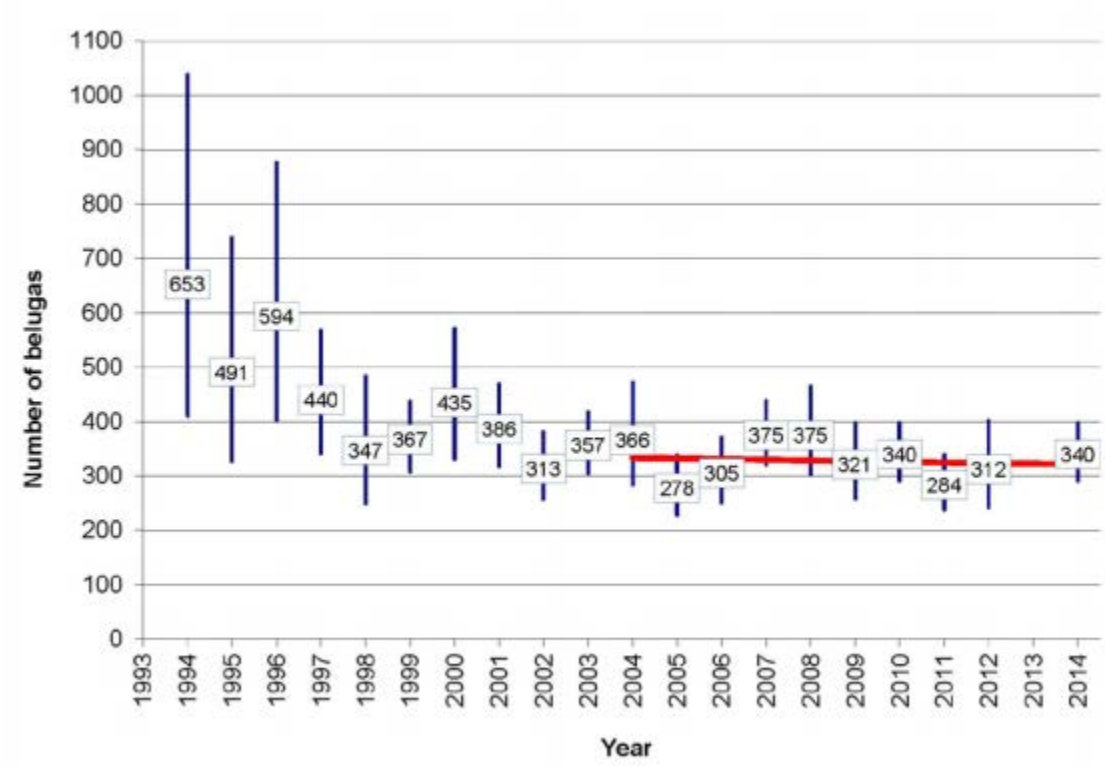

Figure 7. Abundance estimates for Cook Inlet beluga whales with 95 percent confidence intervals for revised coefficients of variation (CVs) (vertical bars). From 1994 to 1998, when the harvest was unrestricted, the annual rate of decline was -13.7 percent (SE = 0.045) per year. In the years since a hunting quota has been in place (1999-2014), the rate of decline was -1.3 percent (SE = 0.7 percent) per year. The 10-year trend (2004-2014) was -0.4 percent (SE = 1.3 percent) per year.

In 2008, NMFS published a Conservation Plan for the Cook Inlet Beluga Whale (NMFS 2008a). The Cook Inlet Beluga Whale Recovery Plan, now in draft format, (NMFS 2015) will supplant this document as a guide for achieving the recovery of this species. Both documents outline reasonable actions which the best available science indicates are required to recover and/or protect this species. Prior to the publication of the recovery plan, NMFS has already implemented several actions intended to enhance the recovery of Cook Inlet belugas. However, there are still gaps in the knowledge and understanding of the factors limiting their recovery. The goal of the Cook Inlet beluga whale recovery plan is to restore the Cook Inlet beluga whales to a healthy, viable population that no longer warrants protection under the ESA. The draft recovery plan outlines criteria for when recovery or reclassification to threatened status are met. It recommends specific actions that will help achieve recovery.

4.3.3 Cook Inlet Beluga Whale Additional Information

Additional information regarding Cook Inlet beluga whales can be found in the NMFS Stock Assessment Report at http://www.nmfs.noaa.gov/pr/sars/pdf/ak2014_final.pdf, as well as on the AKR web site at: https://alaskafisheries.noaa.gov/pr/ci-belugas.

4.4 Western DPS Steller sea lions

A detailed description of the Steller sea lions' biology, habitat, threats and recovery factors may be found in the Steller Sea Lion Recovery Plan (NMFS 2008b) and in the Alaska 2013 SAR at: http://www.nmfs.noaa.gov/pr/sars/pdf/ak2014_final.pdf, as well as on the AKR web site at: https://alaskafisheries.noaa.gov/pr/steller-sea-lions.

As with the Cook Inlet beluga whale, it is likely that multiple factors are influencing the recovery of western DPS Steller sea lions (Allen and Angliss 2013). Factors may include food web interactions, predation (killer whale and shark), subsistence harvest, incidental take by fisheries, illegal shooting, entanglement in marine debris, disease, parasitism, toxic substances, anthropogenic disturbances (aircraft, vessels), nutritional stress due to a reduction in prey and climate change. However, the proposed project is located outside Steller sea lion critical habitat, there are no haul-outs or rookeries in the action area, and Steller sea lions are rarely observed in the action area; therefore, existing anthropogenic activity in the action area has not likely had an adverse effect on western DPS Steller sea lions.

Overall, the abundance of western DPS Steller sea lions is increasing, but there have also been localized areas of decline. Within the action area, one group of 20 Steller sea lions was observed off Anchor Point in 1996 by NOAA aerial observers. This is the only Steller sea lion observation recorded by NMFS observers in the action area on annual or biennial aerial surveys since 1994 (NMFS unpublished data). Four Steller sea lions were reported by Apache observers in 2012, and an average of 0.5 animals per year (from 2003-2013) were reported to NMFS by other observers (NMFS unpublished data).

4.4.1 Species Description and Taxonomy

Steller sea lions belong to the family Otariidae, which includes fur seals (*Callorhinus ursinus*). Steller sea lions are the largest otariid and show marked sexual dimorphism with males 2-3 times larger than females. The average standard length is 282 cm (9 ft.) for adult males and 228 cm (7.5 ft.) for adult females; while the average weigh for adult males is 566 kg (1,248 lbs.) and adult females is 263 kg (580 lbs.; NMFS 2008b). The pelage is light buff to reddish brown and slightly darker on the chest and abdomen. Naked parts of the skin are black (King 1954). Adult males have long, coarse hair on the chest, shoulders, and back; the chest and neck are massive and muscular. Newborn pups are about 1 m (3 ft.) long, weigh 16-23 kg (35-51 lbs.), and have a thick, dark-brown coat that molts to lighter brown after six months (NMFS 2008b).

4.4.2 Range

The range of the Steller sea lion extends across the North Pacific Ocean rim from northern Japan, the Kuril Islands and Okhotsk Sea, through the Aleutian Islands and Bering Sea, along Alaska's southern coast, and as far south as the California Channel Islands (NMFS 2008b; Figure 8). The eastern DPS includes sea lions born on rookeries from California north through Southeast

Alaska; the western DPS includes those animals born on rookeries from Prince William Sound westward with a boundary set at 144°W (NMFS 2008b).

The western DPS Steller sea lion occurs in Cook Inlet, primarily south of Anchor Point around the offshore islands and along the west coast of the inlet in the bays (Chinitna Bay, Iniskin Bay, etc.; Rugh et al. 2005a). The occasional individual animal may wander into Cook Inlet river mouths during summer periods to seek seasonal runs of prey such as salmon or euchalon. No haulouts occur in upper Cook Inlet and Steller sea lions are rarely observed north of Nikiski (Rugh et al. 2005a; LGL 2006). Since 2004, NMFS systematic aerial surveys of Cook have documented one group of 20 Steller sea lions within the action area on June 10, 2006 (NMFS unpubl. data). Opportunistic sightings reported to NMFS have only sporadically documented single Steller sea lions in Knik or Turnagain Arms and an average of 0.5 animals per year (from 2003-2013) were reported to NMFS by other observers within the action area (NMFS unpublished data).

During Apache's 2012 operations, Steller sea lions were observed on three separate occasions in Cook Inlet. Sightings occurred in May (one animal), June (two animals), and August (one animal) (Lomac-MacNair et al. 2013). All the Steller sea lion sightings were made by vessel-based observers when there was no seismic airgun activity occurring. During an aerial survey in June 2012, the observers documented approximately 75 pinnipeds hauled out on the banks of the Beluga River (north of the operational area). Because the observers were unable to clearly identify the species from air, the sighting was noted as "unidentified pinnipeds", but there was some speculation that they could be Steller sea lions given they appeared larger and lighter in color than harbor seals observed in the area at the same time (Lomac-MacNair et al. 2013). Lacking evidence beyond speculation on the identity of unidentified pinnipeds, AKR considers it unlikely that these animals were Steller sea lions.

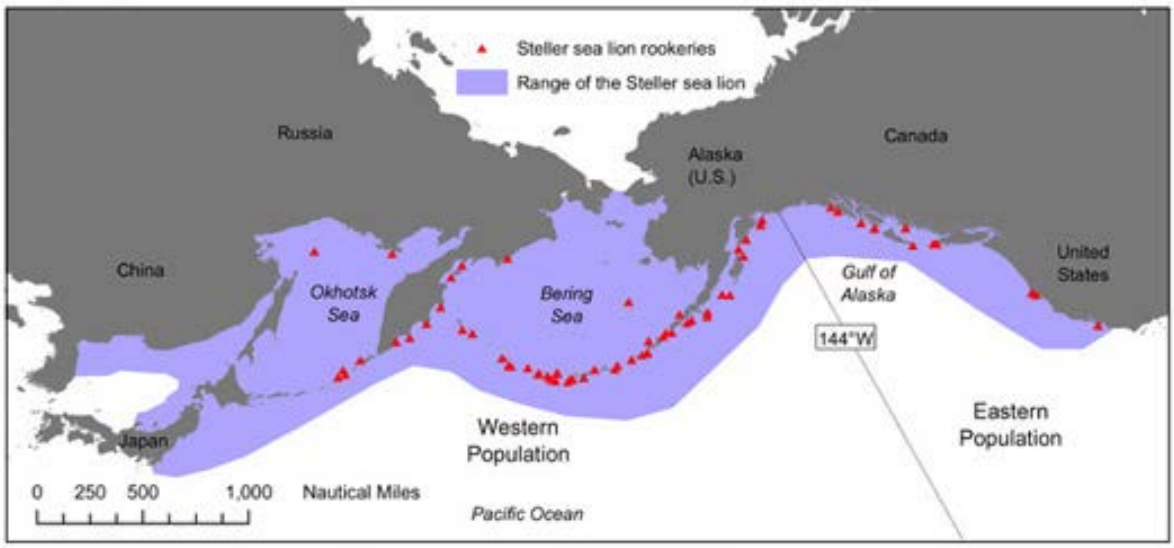

Figure 8. Range of the Steller sea lion.

4.4.3 Hearing

Steller sea lions have similar hearing thresholds in-air and underwater as other otariids. In-air hearing ranges from 0.250 - 30 kHz, with a region of best hearing sensitivity from 5 - 14.1 kHz (Muslow and Reichmuth 2010). An underwater audiogram shows the typical mammalian U-

shape. The range of best hearing underwater was from 1 to 16 kHz. Higher hearing thresholds indicating poorer sensitivity were observed for signals below 16 kHz and above 25 kHz (Kastelein et al. 2005).

4.4.4 Threats

It is likely that multiple factors are affecting western DPS Steller sea lion population trends (NMFS 2008b). These factors may include food web perturbations, predation (by killer whales and sharks), nutritional stress due to competition for prey related to commercial fisheries and regime change, incidental take by commercial fisheries, subsistence harvest, illegal shooting, entanglement in marine debris and fishing gear, disease, parasitism, toxic substances, and anthropogenic disturbance (aircraft, vessels).

4.4.5 Population Abundance and Trends

The 2014 Stock Assessment Report for the western DPS of Steller sea lions indicates an abundance estimate of 55,422 individuals in this stock (Russia and US surveys combined) (Allen and Angliss 2013). The minimum population estimate for the U.S. portion of the Stock for 2013 is 48,676. Population trend of western DPS Steller sea lions from 2000-2012 varies regionally, from -7.23 percent per year in the Western Aleutians to 4.51 percent per year in the eastern Gulf of Alaska. Currently, the overall western DPS of Steller sea lions is estimated to be increasing at about 1.67 percent per year from 2000-20012 for non-pups, and 1.45 percent per year for pups (Allen and Angliss 2013).

4.4.6 Steller Sea Lion Critical Habitat

NMFS designated critical habitat for Steller sea lions on August 27, 1993 (58 FR 45269, Figure 9). Critical habitat for the Steller sea lion includes a 20 nautical mile buffer around all major haul-outs and rookeries, as well as associated terrestrial, air and aquatic zones, and three large offshore foraging areas. Portions of the southern reaches of lower Cook Inlet are designated as critical habitat, including waters south and west of the mouth of Cook Inlet. Steller sea lion critical habitat does not occur within the action area for this project.

4.4.7 Additional Information

ASRC (2014) contains additional information on the status, seasonal distribution, and abundance of western DPS Steller sea lions. Additional information can also be found in the NMFS Stock Assessment Reports at: http://www.nmfs.noaa.gov/pr/sars/pdf/ak2014_final.pdf. A detailed description of the Steller sea lions' biology, habitat, threats and recovery factors may be found in the Steller Sea Lion Recovery Plan (NMFS 2008b), as well as on the AKR web site at: http://alaskafisheries.noaa.gov/pr/steller-sea-lions.

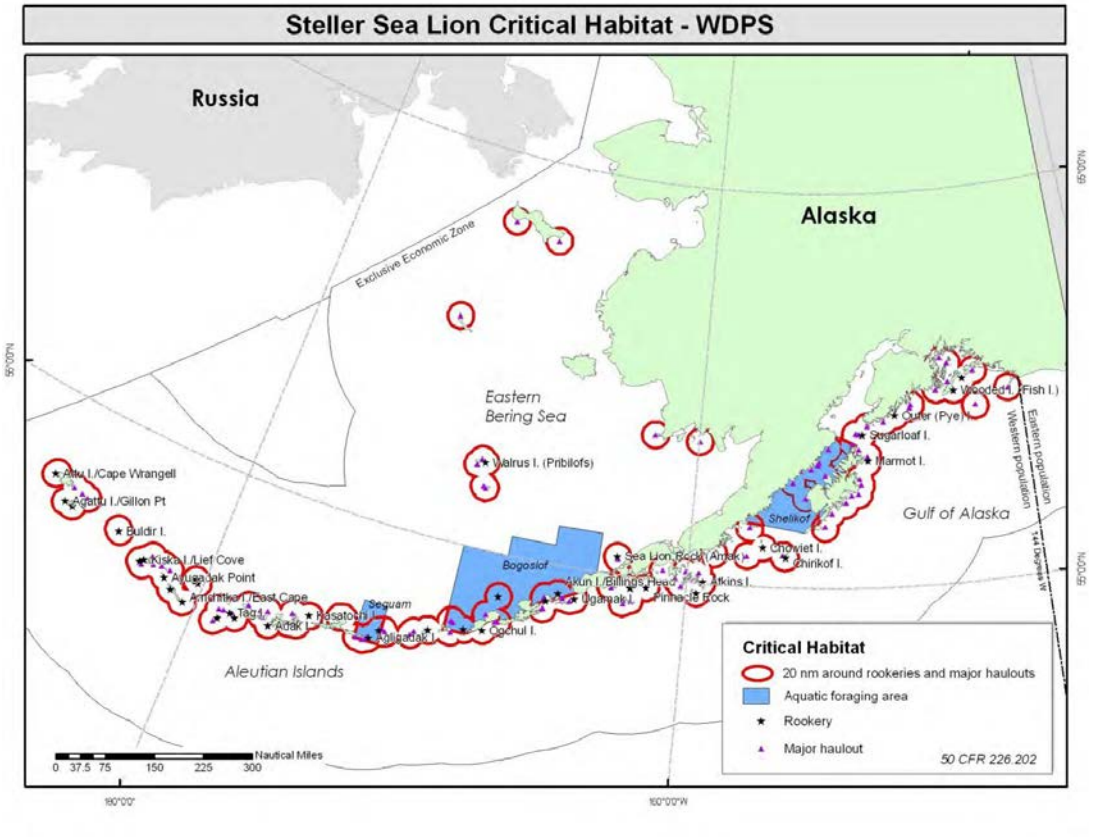

Figure 9. Steller sea lion critical habitat west of 144ºW.

4.5 Humpback Whales

The worldwide population of humpback whales is at least 80,000. The best estimate for humpback whale abundance (excluding calves) for all feeding and wintering areas in the North Pacific is 21,808 (Barlow et al. 2011). The abundance estimates for the entire Central North Pacific stock is 7,469, of these, 2,845 are included in the Gulf of Alaska feeding area (Allen and Angliss 2013). The smaller Western North Pacific Stock is thought to contain 732 animals (Allen and Angliss 2013).

Mobley et al. (2001) estimated a population growth trend of 7 percent per year for 1993-2000 using data from aerial surveys that were conducted in a consistent manner for several years across all of the Hawaiian Islands and were developed specifically to estimate a trend for the Central North Pacific stock. Mizroch et al. (2004) estimated survival rates for North Pacific humpback whales using mark-recapture methods and a model fit to data from Hawaii for the years 1980-1996. This indicated an estimated population increase of 10 percent per year (95 percent C.I. of 3-16 percent). Zerbini et al. (2006) estimated a 6.6 percent per year increase for humpback whales in shelf waters of the northern Gulf of Alaska from 1987-2003 (95 percent CI: 5.2-8.6 percent). The annual population growth rate for the Western North Pacific stock is less robust, but is estimated at 6.5 percent.

According to the recovery plan for this species (NMFS 1991), threats include: ship strikes, fisheries interactions (including gear entanglement), subsistence hunting, acoustic disturbance,

competition with humans for resources, and habitat degradation due to pollution and coastal development. There is no designated critical habitat for this species in Alaska.

4.5.1 Species Description and Taxonomy

The humpback whale is one of the larger rorqual whales. Adult males average 14 m (46 ft.) in length and adult females average 15 m (49 ft.) in length. Humpback whales are sexually mature at 4-7 years.

4.5.2 Range

Humpback whales are distributed globally, wintering in tropical and subtropical waters and feeding in the high latitudes on small schooling fish and euphausiids. In Alaska, humpback whales of the Central North Pacific stock are found from southeastern Alaska, north and west through the Gulf of Alaska, Bering Sea, and into the southern Chukchi Sea. The Central North Pacific stock can be found throughout southeast Alaska in the summer, as well as in central and western portions of the Gulf of Alaska. The eastern portion of the range of the Western North Pacific humpback whale stock contains the proposed action area. This stock summers from Prince William Sound west to Kamchatka, Russia and Hokkaido, Japan. Most of the humpback whales that summer in Alaskan waters are thought to winter on the wintering grounds surrounding the Hawaiian Islands. Humpbacks also winter around Baja, Mexico and in Southeast Asian waters.

The 2013 NMFS stock assessment reports for these humpback whale stocks do not mention Cook Inlet as an area of high humpback whale density. Rather, within the Gulf of Alaska region, it states that high densities of humpback whales are found in the Shumagin Islands, south and east of Kodiak Island, and from the Barren Islands through Prince William Sound. Humpback whales feed in the summer in higher latitude waters and migrate to tropical or subtropical waters to breed and give birth in the winters (Allen and Angliss 2013).

4.5.3 Occurrence in the Action Area

Humpback whales do not normally occur in the proposed Action Area. Nevertheless, AKR is aware of at least one humpback whale having been observed and possibly taken (by harassment and/or injury) by Apache's seismic operations on April 25, 2014 by the M/V Peregrine Falcon operating a 1,760 in^3 airgun array at full volume. The humpback whale was first observed 1.5 km from the sound source at a time when all whales within 1.84 km of the sound source would have been exposed to MMPA Level A take (sound impulses in excess of 180 dB). Although seismic operations were shut down immediately upon observing this animal, the whale apparently had been exposed to full volume seismic impulses during the time it transited from 1.84 km to 1.5 km from the sound source. Assuming seismic shots were fired at 15 second intervals, and the whale traveled directly towards the source at the average cruising speed of a humpback whale (4.0 km/hr) (Noad and Cato 2007), then this whale would have been exposed to at least 19 shots while it was within the exclusion zone prior to shut-down; 19 shots exceeding the 180 dB threshold for Level A take.

Other humpback whales have been observed near or just south of the action area. There have been multiple observations of humpback whales in the action area (Figure 10) and there is strong

evidence that one or two humpback whales have already been taken by recent seismic activity. We will therefore consider the effects of the proposed action on humpback whales in the remainder of this Biological Opinion, along with effects on Cook Inlet beluga whales and western DPS Steller sea lions.

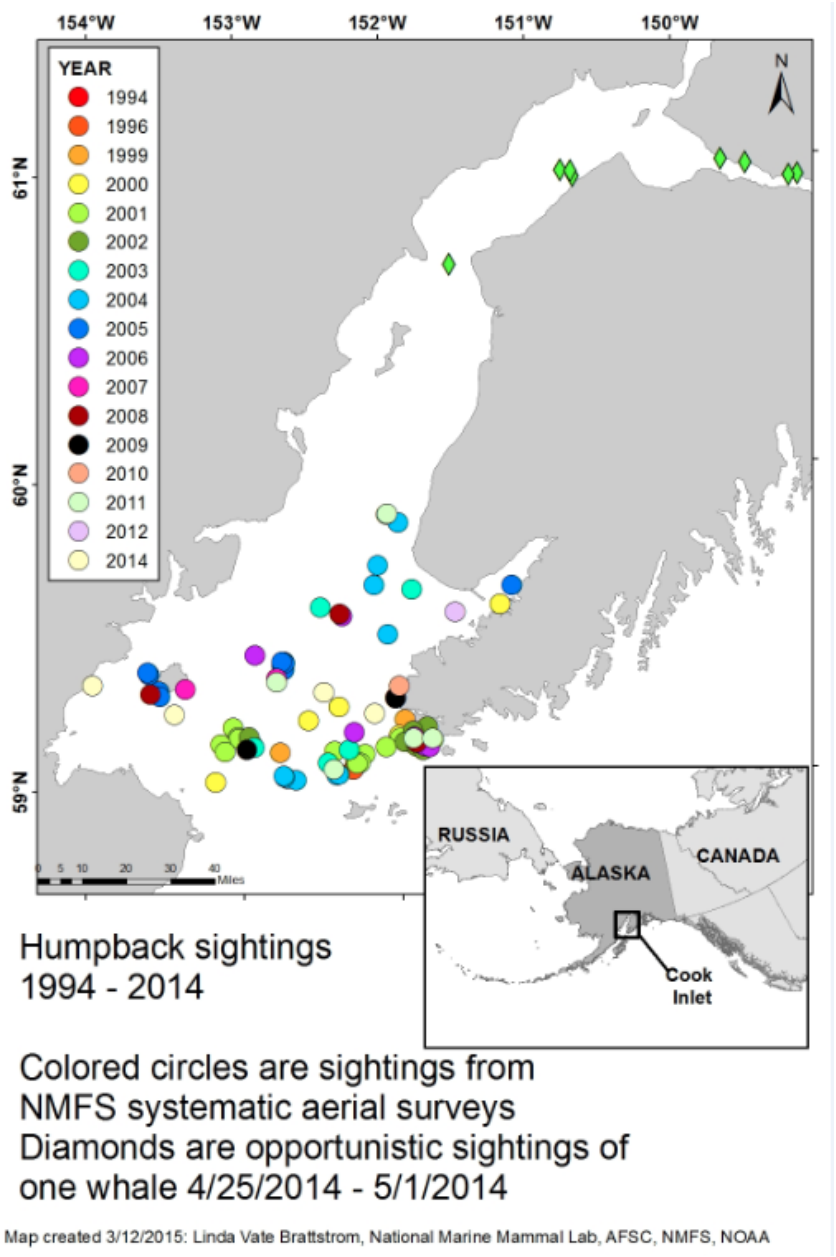

Figure 10. Documented observations of humpback whales in Cook Inlet since 1994. Green diamonds indicate opportunistic sightings of one whale, or possibly of an adult whale and calf, from April 25, 2014 through May 1, 2014.

4.5.4 Additional Information

Additional information can also be found in the NMFS Stock Assessment Reports at: http://www.nmfs.noaa.gov/pr/sars/pdf/ak2014_final.pdf. The humpback whale page at http://alaskafisheries.noaa.gov/pr/humpback contains links to the species recovery plan, stock assessment reports over time, a global review of humpback whales, additional information on strikes and entanglements, and other Biological Opinions and rules and notices that considered humpback whales.

5. ENVIRONMENTAL BASELINE

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

The upper Cook Inlet region is the major human population center of Alaska; in 2013, the population of the Municipality of Anchorage was 300,950, the Matanuska-Susitna Borough population was 95,192, and the Kenai Peninsula Borough population was 57,147 (U.S. Census Bureau website, January 31, 2015 at http://quickfacts.census.gov/qfd/states/02/02020.html).

Many existing development projects with potential impacts upon Cook Inlet waters are shown in Figure 11.

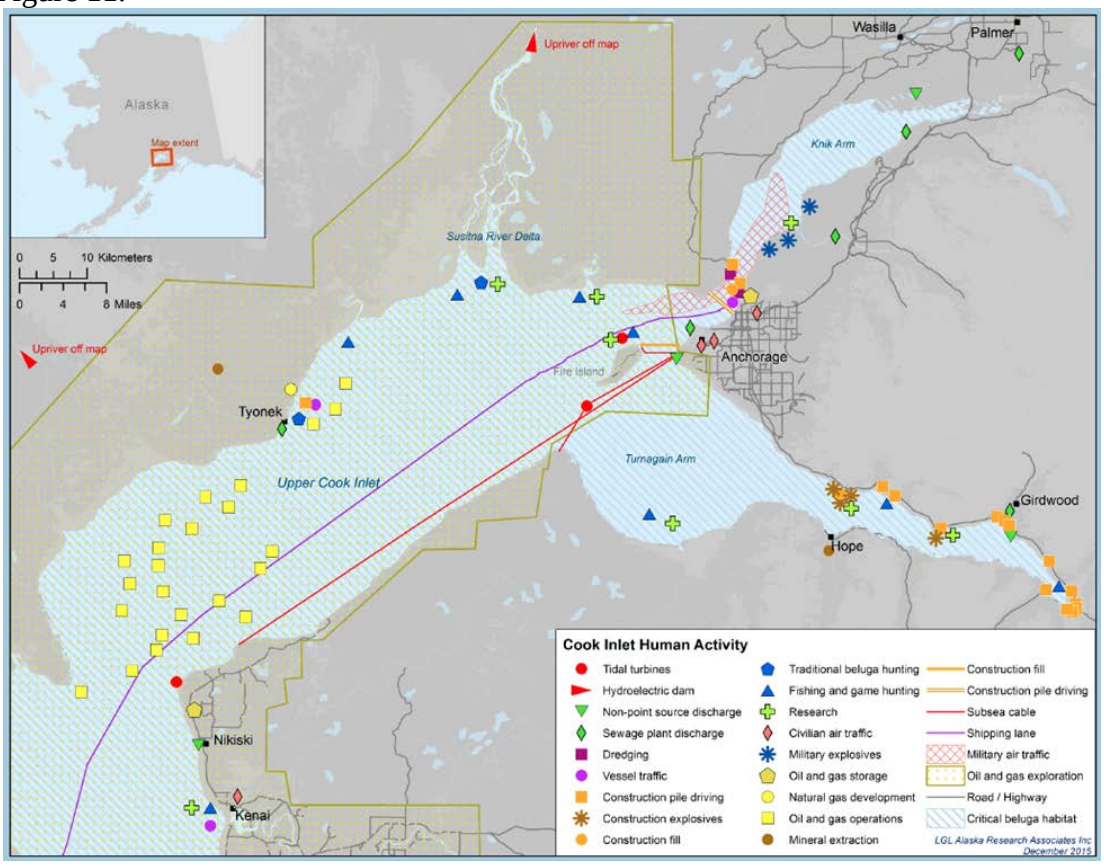

Figure 11. Development and anthropogenic activities in Cook Inlet Area (LGL 2015, unpublished data).

Cook Inlet beluga whales, Western DPS Steller sea lions, and humpback whales may be affected by natural and anthropogenic events or conditions occurring in the Cook Inlet region, including: coastal development, ship strikes, noise pollution, water pollution, prey reduction, intentional lethal take, research, and environmental change. While a number of known and potential threats and stressors have been identified, there is not enough known about the effect of each to determine its impact. In addition, these species may be affected by multiple threats at any given time, compounding the impacts of the individual threats (NMFS 2008a, 2008c).

5.1 Stressors to Listed Species in Cook Inlet

The Cook Inlet Beluga Whale Draft Recovery Plan (NMFS 2015) evaluated environmental baseline threats to the species, with indicators regarding degree of past mortality caused by each stressor, likelihood of each stressor to have adverse effects on the species, and the significance of each threat to the species (Table 4).

Table 4. Synopsis of environmental baseline threats to Cook Inlet beluga whales that are entirely or partially anthropogenic in nature.

Threat Type	Past Mortality?	Likely to adversely affect?	Significance of threat to population[1]
Coastal development	None known	Yes	Medium
Marine-based oil and gas development	None known	Yes	Low
Transmission lines	None known	Unknown	Low
Ambient noise	None known	No	Low
Oil and Gas industrial noise	None known	Unknown	Low
Vessel noise	None known	Unknown	Low
Seismic exploration noise	None known	Yes	High
Aircraft noise	None known	Unknown	Low
Coastal development noise	None known	Unknown	Medium
Water quality	None known	Unknown	Low
Contaminants	None known	Unknown	Low
Stormwater runoff	None known	Unknown	Unknown
Aircraft de-icing	None known	Unknown	Unknown
Ballast water	None known	Unknown	High
Point-source releases	None known	Yes	High
Fishery interactions	None known	Unknown	Medium/High
Incidental take in fisheries	None known	No	Low
Poaching or illegal harassment	None known	Unknown	Medium
Subsistence harvest	High	Yes	Low
Live strandings	Moderate	Yes	High
Predation	Low	Yes	High
Ship strikes	Suspected	Yes	Medium
Research	Low	Yes	Low
Environmental change	None known	Unknown	Unknown

[1]Represents level of relative concern expressed in Draft Cook Inlet Beluga Recovery Plan (NMFS 2015).

These same stressors may be assumed to be acting upon western DPS Steller sea lions and humpback whales in the action area. The sections below focus on baseline effects of various activities on Cook Inlet beluga whales since belugas are the most common listed species in the action area.

5.2.1 Coastal Development

Southcentral Alaska is the State's most populated and industrialized area. Many cities, villages, ports, airports, treatment plants, oil and gas platforms and refineries, highways, and railroads are situated adjacent to, and in some cases in, Cook Inlet (Figure 11). This development has resulted in both the loss and alteration of near shore beluga habitat and changes in habitat quality due to vessel traffic, noise, and pollution. There is concern that increased development may prevent beluga whales from reaching important feeding and breeding areas. Frequent use of shallow, near shore and estuarine habitats makes beluga whales particularly prone to regular interaction with human activities (Perrin 1999), and thus belugas area likely to be affected by those activities.

Port Facilities

Port facilities in Cook Inlet are found at Anchorage, Port Mackenzie, Tyonek, Drift River, Nikiski, Kenai, Anchor Point, and Homer.

The Port of Anchorage (POA) is Alaska's largest seaport and the main port of entry for southcentral and interior regions. It is a deep draft facility which exists along eastern lower Knik Arm in an area that is heavily used by beluga whales. Operations began at the POA in 1961 with a single berth. Since then, the POA has expanded to a five-berth terminal that moves more than four million tons of material across its docks each year (POA 2009). Construction associated with the current Marine Terminal Development Project has been ongoing on a seasonal basis since 2006, and has included both in-water and out-of-water activities. In the most recent completed MMPA authorization for port development, the Port was authorized to take 34 beluga whales by harassment. During the 2009 construction work at the POA, 23 beluga whales were reported taken; in 2010, 13 were reported taken; in 2011, 4 were reported taken. One Steller sea lion was observed at the POA in June 2009. However, rapid implementation of mitigation measures avoided the occurrence of take, and the animal left the area without incident. Because Steller sea lions are rarely observed in upper Cook Inlet, the POA did not request, nor did NMFS recommend, authorization to take Steller sea lions.

NMFS AKR is currently engaged in Section 7 consultation regarding the Port of Anchorage's test pile program, in which they will evaluate the sound attenuation resulting from several mitigation techniques. This is being done in anticipation of a large scale POA upgrade that will add two new terminals, two new petroleum, oil, and lubricant berths, and extend and stabilize the northern portion of the port. We expect hundreds of sheet and cylindrical piles to be driven at the port in accomplishing these upgrades (CH2MHill pers. comm. August 26, 2015).

Varying amounts of POA maintenance dredging have occurred annually since 1965. The current operations and maintenance plan at the POA authorizes the Corps to dredge to -35 ft MLLW. The footprint dredged at the POA fluctuates annually, varying from 95 acres in 1999 to 117 acres in 2004. Over the past several years the average size of the dredged footprint has been about 100

acres. The amount of dredging required to maintain the POA also varies from year to year, with a maximum of about 2.1 million cubic yards of material dredged in 2004. Maintenance dredging is conducted by one or more dredges and lasts from mid-May through November, depending on the weather. Two to five barge trips per day transport about 1,500 cubic yards of material from each dredge to the disposal site (USACE 2008). Dredging along coastal waterways has been identified as a concern with respect to the Saint Lawrence beluga whales (DFO 1995). There, dredging of up to 785,000 cubic yards of sediments re-suspended contaminants into the water column, resulting in impacts to the beluga whales. The Saint Lawrence Beluga Whale Recovery Plan contains recommendations to reduce the dredge amount and to develop more environmentally sound dredging techniques (DFO 1995). While the volume of dredging in Cook Inlet is comparable to St. Lawrence, the material in Cook Inlet does not appear to contain harmful levels of contaminants (USACE 2005, 2008).

Port MacKenzie is along western lower Knik Arm and development began in 2000 with the construction of a barge dock. The first shipments arrived in July 2001. Additional construction has occurred since then and Port MacKenzie currently consists of a 500-foot bulkhead barge dock, a 1,200 ft. deep-draft dock with a conveyor system, a landing ramp, and more than 8,000 acres of adjacent uplands; however, plans call for a bulk loading facility with deep-draft capability. The facility is currently undergoing repairs resulting from sheared sheet piles and subsequent loss of much of the Port's fill through tidally-driven erosion.

The Drift River facility in Redoubt Bay is used primarily as a loading platform for shipments of crude oil. The docking facility there is connected to a shoreside tank farm and is designed to accommodate tankers in the 150,000 deadweight-ton class.

Nikiski is home to several privately owned docks (including those belonging to oil and gas companies). Activity at Nikiski includes the shipping and receiving of anhydrous ammonia, dry bulk urea, liquefied natural gas, petroleum products, sulfuric acid, caustic soda, and crude oil.

5.2.2 Marine Development

Oil and gas development in Cook Inlet provides natural gas to the State's largest population centers. Platforms, pipelines, and tankers represent potential sources of spills. Transmission lines for electricity and communications cross Cook Inlet in a few locations, but are not considered to be a notable threat. Due to their infrequent occurrence in Cook Inlet, Western DPS Steller sea lions and humpback whales likely experience insignificant impacts from the existing marine development in this area.

<u>Oil & Gas Development</u>
Lease sales for oil and gas development in Cook Inlet began in 1959 (ADNR 2014). Prior to the lease sales, there were attempts at oil exploration along the west side of Cook Inlet. By the late 1960s, 14 offshore oil production facilities were installed in upper Cook Inlet, indicating that most of the Cook Inlet platforms and much of the associated infrastructure is over 40 years old.

Today, there are a total of 16 platforms in Cook Inlet (ADNR 2014) and 387 active oil and gas leases, totaling approximately 1,102,563 acres of State leased land of which 423,167 acres are

onshore and 679,396 acres are offshore (ADNR 2014). ADNR plans to conduct annual Cook Inlet area wide oil and gas lease sales during the next five years.

The U.S. Bureau of Ocean Energy Management (BOEM) is responsible for oil and gas leasing in federal waters of Cook Inlet. From October 23-December 8, 2014, BOEM gathered public comments on Cook Inlet Lease Sale 244 in preparation for development of an environmental impact statement (BOEM 2014).

Significant oil and gas development in Cook Inlet takes place within the action area of the proposed Cook Inlet Seismic Program (Figure 12). Stanley et al. (2011) provide USGS point estimates for undiscovered volumes of hydrocarbons in Cook Inlet as follows:

- 19.04 trillion cubic feet of natural gas
- 599 million barrels of oil
- 46 million barrels of natural gas liquids

Oil and gas development will likely continue in Cook Inlet; however, the overall effects on the Cook Inlet beluga whale are unknown (NMFS 2008a). Potential impacts from oil and gas development on the Cook Inlet beluga whale include increased noise from seismic activity, vessel traffic, air traffic, drilling; discharge of wastewater and drilling muds; habitat loss from the construction of oil and gas facilities; and contaminated food sources and/or injury resulting from an oil spill or natural gas blowout (NMFS 2008a).

As previously mentioned, noise from seismic exploration and mapping activities are affecting the acoustic environment of Cook Inlet. Seismic surveys use high energy, low frequency sound in short pulses delivered several times per minute to map the underlying geology (Richardson et al. 1995). These short pulses of sound increase noise levels for miles around the seismic activity. Airguns have been previously used in Cook Inlet for seismic exploration (JASCO 2007) and will be used for this proposed action. Vessel and air traffic are required for support during oil and gas development. Oil produced on the western side of Cook Inlet is transported by tankers to the refineries on the east side. Refined petroleum products are then shipped elsewhere. Liquid natural gas is also transported via tankers once it is processed (ADNR 2009). Offshore drilling is generally conducted from drilling vessels or platforms.

Preparatory Geological and geophysical work has begun in advance of laying pipes for transport of natural gas from Alaska's North Slope to Nikiski. This Alaska Liquid Natural Gas (AKLNG) work in Cook Inlet involved use of a 60 cubic inch airgun, high and low frequency sub-bottom profilers and vibracoring equipment during the ice-free season of 2015 and 2016. Pipeline trenching and placement and Nikiski pipeline terminal port construction and associated dredging may begin as early as 2017.

Underwater Transmission Lines

In 2009, Alaska Communications Systems Group, Inc. (ACS) installed a fiber optic cable from Florence, Oregon to Anchorage, Alaska to improve communication between Alaska and the rest of the United States. The portion the fiber optics cable that is located in the action area is the submarine cable that extends from Nikiski on the Kenai Peninsula to Point Woronzof in Anchorage. Potential impacts from the fiber optic cable included a temporary increase in vessel

traffic and noise during the installation of the cable. During installation, vessels generally operated at speeds of 1-2 knots as the cable was buried 1.2 m (3.9 ft) below the seafloor (ACS 2008). After installation, the fiber optic cable rests along the seafloor with a minimal footprint. As a result, the direct loss of habitat was minimal and did not likely have an adverse effect on beluga whales.

5.2.3 Ambient Noise and Noise Pollution

Beluga whales rely heavily on sound to meet basic biological needs such as communicating, foraging and navigating (Richardson et al. 1995), especially in the turbid waters of Cook Inlet. In general, Cook Inlet is a noisy environment and noise has the potential to disrupt beluga whales' ability to meet these basic biological needs. Noise sources in Cook Inlet that could be found in the action area include ambient sound (e.g. flow noise, wind), large and small vessels, aircraft, oil and gas exploration and production, and construction activities (e.g. dredging and pile

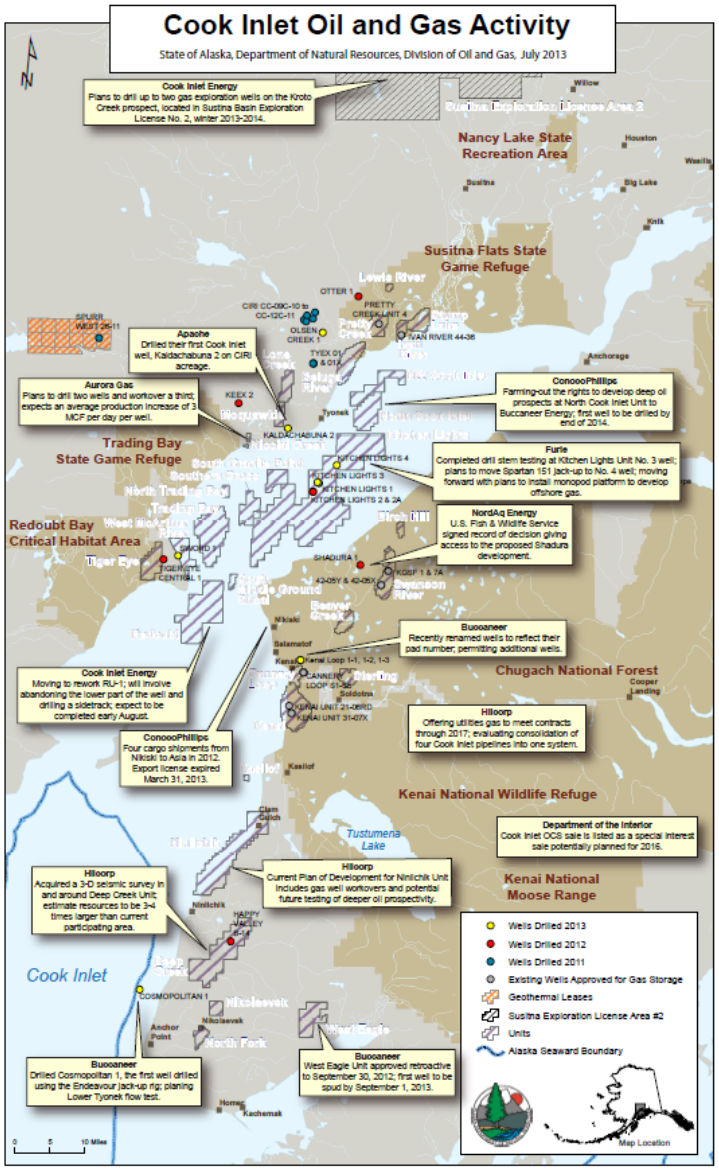

Figure 12. Oil and Gas operations in the Cook Inlet region. From: http://dog.dnr.alaska.gov/GIS/Data/ActivityMaps/CookInlet/CI_OilandGasActivity_20130724.pdf.

driving; NMFS 2008a). Noise studies in Cook Inlet have focused on areas in upper Cook Inlet, many outside the action area (Blackwell and Greene 2002; Blackwell 2005; URS 2007; SFS 2009; Širović and Kendall 2009); however, these studies can give a good indication of anticipated noise in other areas of the Inlet.

Ambient noise is environmental background noise that includes sources such as wind, waves, ice, current, and tidal flow (Richardson et al. 1995). Sound levels from ambient noise vary at different locations in Cook Inlet. Blackwell and Greene (2002) recorded ambient noise levels at five locations in Cook Inlet in areas known to have high concentrations of beluga whales and at three locations near anthropogenic activities. The mouth of the Little Susitna River and Birchwood are known to have some of the highest concentration of beluga whales and were found to have the lowest levels of ambient noise. Table 5 provides a summary of anthropogenic noise sources occurring in Cook Inlet, including some activities outside the action area.

Oil and Gas Exploration and Production Noise

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

Blackwell and Greene (2002) recorded underwater noise produced at Phillips A oil platform at six locations at distances ranging from 0.3-19 km. The highest recorded sound level was 119 dB at a distance of 1.2 km (Table 4). The noise from the oil platform was operating not drilling noise, and was generally below 10 kHz. In general, noise from the platform itself is thought to be very weak because of the small surface area (the four legs) in contact with the water (Richardson et al. 1995) and that the majority of the machinery is on the deck of the platform which is above the water surface. However, noise carried down the legs of the platform likely contributed to the high levels documented by Blackwell and Greene (2002). While much of the sound energy in this noise fell below the hearing thresholds of beluga whales, some noises between two and 10 kHz were measured as high as 85 dB as far out as 19 kilometers from the source. This noise is audible to beluga whales.

Seismic surveys

Although this proposed activity is restricted to State waters, it will ensonify portions of federal waters in Cook Inlet. Seismic exploration in Cook Inlet is associated with both State and federal offshore tracts. A seismic program occurred near Anchor Point in the fall of 2005. Geophysical seismic operations were conducted in 2007 in Cook Inlet near Tyonek, the Forelands area, areas off Anchor Point, and areas west of Clam Gulch. Other small seismic surveys were also conducted in Cook Inlet in 2012.

Geophysical seismic activity has been described as one of the loudest man-made underwater noise sources, with the potential to harass or harm marine mammals, including beluga whales. The acoustics study by Blackwell and Greene (2002) did not address marine geophysical seismic activity in Cook Inlet, although it does occur. Seismic surveys use high energy, low frequency sound in short pulse durations to determine substrates below the seafloor, such as oil and gas deposits (Richardson et al. 1995). These short pulses of sound increase noise levels near the seismic activity. Airguns have been previously and are presently being used in Cook Inlet for

Table 5. Received levels and frequencies of some noise sources in Cook Inlet.

Source	Received Level (dB re 1 µPa)	Distance	Frequency (kHz)
Ambient Noise[1]			
Mouth of Little Susitna River	100	-	-
Between Fire Island and the mouth of Susitna River	113	-	-
Birchwood (Knik Arm outside action area)	95	-	-
Mouth of Eagle River (Knik Arm outside action area)	118	-	-
North of Point Possession	120	-	-
Anchorage Airport (ANC)	105	-	-
Joint Base Elmendorf-Richardson (JBER)	119	-	-
Port of Anchorage (POA)	113	-	-
Vessel Noise[1]			
Cargo-freight – Northern Lights (docked)	126	100-400 m	Generally < 1 kHz
Cargo-bulk carrier – Emerald Bulker (with 2 tugs)	134	>200 m	
Tug – Leo (pushing gravel barge Katie II)	149	100 m	
Small boat – Boston Whaler (drive by)	138	13 m	
Small rubber boat - Avon (drive by)	142	8.5 m	
Aircraft Noise[1]			
ANC	118.4 ± 5.7[2]	-	Generally < 2 kHz
JBER	128.0 ± 9.0	-	
DC-10	124[3]	-	
Landing Military Jet	134	-	
Oil and Gas Drilling Noise[1]			
Phillip A Oil Platform	119 [3]	1.2 km	< 10 kHz

[1]Blackewell and Greene 2002
[2]Mean and standard deviation
[3]Maximum values

seismic exploration. Apache's seismic program conducted in 2012 involved source levels up to 237 dB associated with the use of 2,400 in^3 airguns. Apache conducted the first portion of its marine seismic surveys in Cook Inlet between May and September 2012. In 2012, there was a total of 1,841.7 hours of seismic activity, 1252.6 hours using the 2,400 in^3 airguns. During their 2012 surveys, Apache was authorized up to 30 takes by acoustic harassment of Cook Inlet beluga whales and 20 takes of western DPS Steller sea lions. Apache reported zero observed takes of either Cook Inlet belugas or Steller sea lions during its 2012 operations (Lomac-MacNair et al. 2013). To accomplish this, in 2012 Apache implemented the previously described mitigation measures which, over the course of the season, meant there were five delays in clearing the 160 dB disturbance zone, six shut-downs, one power-down, one shut-down followed by a power-down, and one speed and course alteration (Lomac-MacNair et al. 2013).

Vessel Traffic Noise

Vessel traffic includes large shipping, commercial and support vessels, commercial fishing vessels, and personal water craft. Vessel traffic can produce noise disturbance to beluga whales. Blackwell and Greene (2002) recorded underwater noise produced by both large and small vessels near the POA. The Leo tugboat produced the highest broadband levels of 149 dB at a distance of approximately 100 m, while the docked Northern Lights (cargo freight ship)

produced the lowest broadband levels of 126 dB at 100-400 m. Ship noise was generally below 1 kHz. Apache's 2012 program required the use of eleven vessels which added noise to the environment.

Aircraft Noise

Cook Inlet also experiences significant levels of aircraft traffic. The Anchorage International Airport (ANC) is directly adjacent to lower Knik Arm and has high volumes of commercial and cargo air traffic. Joint Base Elmendorf Richardson (JBER) also has a runway near and airspace directly over Knik Arm. Lake Hood and Spenard Lake in Anchorage are heavily used by recreational seaplanes. Other small public runways are found at Birchwood and Goose Bay in Knik Arm; Merril Field; Girdwood; the Kenai Municipal Airport; Ninilchik; Homer; and Seldovia. Apache's 2012 monitoring program included an aerial survey component which involved helicopters and fixed wing airplanes.

Even though sound is attenuated by the water surface, Blackwell and Greene (2002) found aircraft noise can be loud underwater when jet aircraft are directly overhead. They recorded aircraft noise underwater near ANC and JBER, outside of the action area. Recordings included 15 commercial aircraft and 11 F-15 military jets. Eleven of the 15 commercial aircrafts and two of the 11 military jets were detectable underwater due to sound transmission across air and water. Results indicated that aircraft and ambient noise levels at JBER were higher than at ANC. The sound energy recorded from the aircrafts were generally broadband and below 2 kHz.

Richardson et al.(1995) observed that beluga whales in the Beaufort Sea will dive or swim away when low-flying (less than 500 m) aircraft passed directly above them. However, beluga survey aircraft flying at approximately 244 m (800 ft) in Cook Inlet caused little or no change in beluga swim directions (Rugh et al. 2000). This is likely because beluga whales in Cook Inlet have habituated to routine small aircraft over flights. Beluga whales may be less sensitive to aircraft noise than vessel noise, but individual responses may be highly variable and depend on previous experiences, beluga activity at the time of the noise, and characteristics of the noise.

Coastal Development Noise

Construction noise in Cook Inlet is associated with activities such as dredging and pile driving. The majority of construction activities have taken place near Anchorage; therefore, most of the studies documenting construction noise in Cook Inlet have occurred outside of the action area. Additionally, these studies have focused on pile driving activities because of the major concerns of potential harassment to beluga whales from in-water noise produced by this activity. As a result there is very little to no documentation of noise levels from other construction activity in Cook Inlet. Only one study recorded dredging noise near the Port of Anchorage (POA) (SFS 2009).

Noise levels from construction activities are presented in Table 6. Small and/or private docks also may utilize pile driving as a part of their expansions or repairs, e.g., the OSK dock in Nikiski was approved to be upgraded and expanded in 2012. Repair of sewage lines and construction of dock facilities are expected to occur during the time that this project takes place; activities that will introduce noise to the marine environment. The Knik Arm Crossing may begin construction in the foreseeable future, and will introduce noise into the environment via

pile driving and the numerous required support vessels. In addition, noise from traffic using the bridge could create an ongoing noise source with acoustic impacts upon Cook Inlet waters.

Table 6. Summary of construction activity noise levels found in Cook Inlet

Study	Pile	Vibratory	Impact	Dredging
Blackwell 2005	91 cm (36 in) diameter	162 and 164 dB re 1 µPa at 56 m[1]	190 and 189 164 dB re 1 µPa at 62 m[1]	-
URS 2007	35 cm (14 in) diameter	120 - 168 dB re 1 µPa at 600 and 10 m respectively	160 -177 164 dB re 1 µPa at 300-19 m respectively	-
SFS 2009	76 cm (30 in) diameter	144 dB_{RMS} at 35 m	-	156.9 dB re 1 µPa at 30m
SFS 2009	sheet	141 dB_{RMS} at 757 m	167 dB_{RMS} at 301 m	-
Širović and Kendall 2009	unknown	183.2 ± 4.8[2] dB re 1 µPa at 1 m	196.9 ± 6.1 dB re 1 µPa at 1 m	-

[1]Depths of the hydrophone ranged from 1.5-10m respectively
[2]Standard deviation

5.2.4 Water Quality and Water Pollution

Potential sources of pollutants in Cook Inlet could include 1) discharge from industrial activities excluding wastewater treatment facilities; 2) discharge from community wastewater treatment facilities; 3) runoff from urban, agriculture and mining; and 4) accidental spills or discharge from oil and gas production (Moore et al. 2000; NMFS 2008a). Main sources of pollutants found in Cook Inlet likely include the 10 wastewater treatment facilities, stormwater runoff, airport deicing, military training at Eagle Bay and discharge from oil and gas development (Moore et al. 2000; NMFS 2008a).

Upper Cook Inlet was designated as a Category 3 on the Clean Water Act Section 303(d) list of impaired water bodies by the ADEC (2010). Waterbodies are considered Category 3 when there is insufficient information to determine whether the water quality standards are attained (ADEC 2010). Lower Cook Inlet is not listed as an impaired waterbody; however, it was included in the Southcentral Alaska Coastal Survey that focused on coastal bays and estuaries. This survey included the Alaska Peninsula, Kodiak archipelago, Cook Inlet, the Kenai Peninsula and Prince William Sound. The ADEC determined that the overall condition of Southcentral Alaska coastal waters were rated as good based on examining water quality, sediment quality and fish tissue contaminants collected from 55 sites in the area (ADEC 2010).

<u>Wastewater discharge</u>
Ten communities currently discharge treated municipal wastes into Cook Inlet. Wastewaters entering these plants may contain a variety of organic and inorganic pollutants, metals, nutrients, sediments, bacteria and viruses, and other emerging pollutants of concern (EPOCs). Wastewater from the Municipality of Anchorage, Nanwalek, Port Graham, Seldovia, and Tyonek receive primary treatment, wastewaters from Homer, Kenai, and Palmer receive secondary treatment, and wastewaters from Eagle River and Girdwood receive tertiary treatment.

Wastewater treatment facilities undergo primary, secondary or tertiary treatment prior to being discharged into a body of water. Primary treatment involves sedimentation. In general, this includes removing 30-50 percent of the solid particulate from the wastewater prior to discharge (Viessman and Hammer 1998). In addition to sedimentation, secondary treatment involves adding a biological component to remove the remaining organic matter. Tertiary treatment involves both primary and secondary treatment as well as additional processes to increase the water quality of the discharge (Viessman and Hammer 1998).

The Village of Tyonek wastewater treatment facility provides primary treatment prior to wastewater discharge. Tyonek operates on a gravity fed sewer that drains into a community septic tank. Every spring and fall, the solids are transferred to a sludge lagoon for dewatering. The liquid effluent is then discharged into Cook Inlet. The village uses approximately 60 gallons of water per day, most of which ends up as discharged liquid effluent.

The Anchorage John M. Asplund Wastewater Treatment Facility (AWTF) is the largest wastewater facility in Alaska and is located in upper Cook Inlet. AWTF provides primary treatment only and removes approximately 80 percent of solids prior to discharge (Anchorage Waste Water Utility [AWWU] 2014). The facility was built in 1972, upgraded in 1982 (28 million gallons per day [mgd]) and then again in 1989 (58 million mgd). The Environmental Protection Agency (EPA) issues a waiver to AWTF for secondary treatment and allows the direct discharge of wastewater into Cook Inlet near Point Woronzof once the wastewater has undergone primary treatment. AWTF is allowed to discharge primary treated wastewater due to the levels of sediment they are able to extract and the extreme tides and currents of Cook Inlet (AWWU 2014). Once the sediment is removed from the wastewater, the sludge is incinerated.

The City of Kenai wastewater facility is one of the larger wastewater treatment facilities in Cook Inlet. The Kenai wastewater treatment facility discharges secondary treated wastewater from its treatment plant directly into Cook Inlet and the sludge is taken to the Soldotna landfill (EPA 2007a). The facility's design flow is 1.330 mgd with an average daily flow of 0.573 mgd (EPA 2007a). The City of Kenai is planning to upgrade the facility by 2018 (ADEC 2014).

Wastewater discharge from oil and gas development could increase pollutants in Cook Inlet. Discharge includes but are not limited to drilling fluids (muds and cuttings), produced water (water phase of liquid pumped from oil wells), and domestic and sanitary waste (EPA 2007b). Under the NPDES permit issued by EPA, oil and gas facilities are required to monitor the effluent for pollutants and meet standards specified in the permit before it is discharged into Cook Inlet (EPA 2007b).

Contaminants found in Belugas

Studies conducted in upper Cook Inlet, in areas of high concentrations of beluga whales, found levels of polychlorinated biphenyls (PCB's), pesticides, petroleum hydrocarbons in the water column and sediment were below detectable limits and levels of heavy metals were below management levels (KABATA 2004; NMFS 2008a; USACE 2008).

Becker et al. (2000) compared tissue samples taken from harvested Cook Inlet beluga whales from two Arctic Alaskan populations, Greenland, Arctic Canada and the St. Lawrence Estuary beluga population. They compared levels of PCB's, chlorinated pesticides, heavy metals and other elements between populations. The results indicated that the Cook Inlet population had the

lowest concentrations of PCB's, pesticides, cadmium and mercury of all these populations, but had higher concentrations of copper than the other Arctic populations. Becker et al. (2000) suggested the difference in toxin levels was likely related to a difference in source (geographic or food web) and age distribution of the animals. A follow up study conducted by Becker et al. (2010) did not find significant changes in contaminant levels in the Cook Inlet beluga whale population with the inclusion of additional samples collected over the past decade; however, they did identify and document increasing levels of chemicals of emerging concern (e.g. polybrominated diphenyl ether, hexabromocyclododecane and perfluorinated compounds) in the Cook Inlet population. Although the levels of contaminants found in the Cook Inlet beluga whale population are lower than levels found in other populations, the effects of these contaminants on this population are unknown (Becker et al. 2000; NMFS 2008a).

Stormwater Runoff

Stormwater pollutants may include street and aircraft deicer, oil, pesticides and fertilizers, heavy metals and fecal coliform bacteria. WMS and DOT&PF are responsible for identifying, monitoring and controlling pollutants in stormwater. Stormwater from other communities in the action area (e.g., Kenai) may also contribute to pollutants that enter Cook Inlet. The effects of stormwater on the Cook Inlet beluga whale have not been studied and are unknown (NMFS 2008a).

Numerous releases of petroleum hydrocarbons have been documented from the Port of Anchorage (POA), Joint Base Elmendorf Richard (JBER), and the Alaska Railroad Corporation (ARRC). The POA transfers and stores petroleum oils, as well as other hazardous materials; and since 1992, all significant spills and leaks have been reported. Past spills have been documented at each of the bulk fuel facilities within the POA and also on JBER's property (POA 2003). JBER is listed on the National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, because of known or threatened releases of hazardous substances, pollutants, or contaminants. Spills have also been reported at the ARRC rail yard. In 1986, petroleum seeped into Ship Creek from the nearby rail yard and several oil spills occurred in 2001 (U.S. Army 2010). Freight handling activities have historically caused numerous surface stains and spills at the rail yard.

Aircraft De-icing

Airport deicing contributes to the levels of pollutants found in Cook Inlet. Deicing and anti-icing of aircraft and airfield surfaces are required by the Federal Aviation Administration to ensure the safety of passengers. Deicing and anti-icing chemicals are used from October through May and may be used on aircraft, tarmacs, and runways. Depending on the application, deicing material is comprised of different chemicals. Ethylene glycol and propylene glycol are used on aircraft for anti-icing and deicing purposes, whereas potassium acetate and urea are used to deice tarmacs and runways. Much of the deicing material or their breakdown products eventually enter Cook Inlet. No studies exist analyzing the potential impacts on beluga whales from these deicing agents.

The Ted Stevens Anchorage International Airport (ANC) and JBER airport are the largest airports in Cook Inlet. Other smaller airports exist throughout the Cook Inlet watershed, including Merrill Field, Lake Hood and Lake Spenard (NMFS 2008a).

Ballast Water Discharges

Discharges of wastes from vessels are regulated by the United States Coast Guard. Potential discharges include oily waste, sewer water, gray water (e.g., shower water), ballast water that may contain invasive marine species, and garbage. Gray water and sewer water, provided that they are free from oil waste, may be discharged in the open sea. However, by law, no discharges of any kind are allowed within three miles of land.

Ships can potentially release pollutants and non-indigenous organisms into Cook Inlet through the discharge of ballast water. It is a recognized worldwide problem that aquatic organisms picked up in ship ballast water, transported to foreign lands, and dumped into non-native habitats, are responsible for significant ecological and economic perturbations costing billions of dollars. The National Ballast Information Clearinghouse reported that more than five million metric tons of ballast water was released in Cook Inlet, from Homer to Anchorage, between 1999 and 2003. Invasive species were found just off the POA in a 2004 survey by the Smithsonian Environmental Center. The effect of discharged ballast water and possible invasive species from such discharges on western DPS Steller sea lions and Cook Inlet beluga whales and their habitat is unknown.

Point Source Contaminant Spills/Releases

Research has shown that while cetaceans are capable of detecting oil they do not seem to avoid it (Geraci 1990). The paucity of data on oiled beluga whales makes it difficult to predict effects of spills on the whales. Oil spills that occur in or upstream of Cook Inlet beluga whale habitat could result in the whales experiencing direct contact with the oil, with possible effects to skin and/or respiratory systems. Cook Inlet beluga whales could be affected through residual oil from a spill even if they were not present during the oil spill due to the highly mobile nature of oil in water and the extreme tidal fluctuations in Cook Inlet (NMFS 2008a). Prey contamination is also likely, but the effect of contaminated prey on belugas remains unknown. Spill clean-up efforts could also result in displacement of whales from essential feeding areas.

Polycyclic aromatic hydrocarbons (PAHs), a group of contaminants found in petroleum products, combined with other contaminants, may cause cancer in beluga whales (Kingsley 2002) and are otherwise a concern with respect to the conservation and recovery of the Cook Inlet beluga whale. Cook Inlet belugas appear to be bioaccumulating PAHs from the environment and prey (Reynolds 2010). PAHs, however, generally do not easily dissolve in water and the fast currents and assimilative capacity of Cook Inlet could reduce any PAH-impacts on water quality that might result in the event of a petroleum spill.

Oil has been implicated in the deaths of pinnipeds (St. Aubin 1990). Pinnipeds exposed to oil at sea through incidental ingestion, inhalation, or limited surface contact do not appear greatly harmed by the oil; however, pinnipeds found close to the source or who must emerge directly in oil appear substantially more affected.

Toxic substances, such as oil, may be a contributing factor in the decline of the western DPS Steller sea lion population (NMFS 2008b). Sea lions exposed to oil through inhalation, dermal contact and absorption, direct ingestion, or through the ingestion of prey may become heavily contaminated with PAHs. The Exxon Valdez oil spill occurred after the current Steller sea lion population decline began, although this spill almost certainly contributed further to the decline;

mortalities from toxic contamination are strongly linked to this spill. Twelve sea lion carcasses were found in Prince William Sound and 16 carcasses were found near Prince William Sound, along the Kenai coast, and at the Barren Islands. Elevated PAH levels were present in animals found dead shortly after the spill (NMFS 2008b).

While construction of an oil/gas facility may result in a small amount of habitat loss, an oil spill in Cook Inlet could result in widespread habitat degradation impacting beluga whales and putting the population at risk. Individuals from the western DPS of Steller sea lions and listed humpback whales within Cook Inlet may also be put at risk due to such a spill, but population level effects would be far less likely, unless the spill was sufficiently large to impact areas outside Cook Inlet. The degree of risk posed by natural gas leaks is unknown.

As of October 31, 2012, the State of Alaska assumed primacy for Clean Water Act administration and enforcement. From 1984-1994, approximately 10,500 gallons of oil spilled from oil platforms and four gas blowouts have occurred since 1962 (ADNR as discussed in Moore et al. 2000). Offshore oil spill records in Cook Inlet during 1994-2011 (ADNR 2011) show only three spills during oil exploration: two oil spills at the UNOCAL Dillion Platform in June 2011 (two gallons) and December 2001 (three gallons); and one oil spill at the UNOCAL Monopod Platform in January 2002 (one gallon). During the same time, 71 spills occurred offshore during oil production. Most spills ranged from 0.0011-1 gallon (42 spills), while three spills exceeded 200 gallons: 210 gallons in July 2001 (Cook Inlet Energy Stewart facility); 250 gallons in February 1998 (King Salmon Platform); and 504 gallons in October 1999 (UNICOL Dillion Platform). All 71 crude oil spills from the offshore platforms, both exploration and production, totaled less than 2,140 gallons spread across 17 years. Effects of these spills upon listed species are unknown.

5.2.5 Fisheries Interactions

Fishing is a major industry in Alaska. As long as fish stocks are sustainable, subsistence, personal use, recreational and commercial fishing will continue to take place in Cook Inlet. Several fisheries occur in Cook Inlet waters and have varying likelihoods of competing with beluga whales for fish due to differences in gear type, species fished, timing, and location of the fisheries. Given that beluga whales concentrate in upper Cook Inlet during summer (Rugh et al. 2010), fisheries that occur in those waters during spring and summer could have a higher likelihood of interacting with beluga whales. As a result there may be continued prey competition, risk of ship strikes, potential harassment, potential for entanglement in fishing gear and potential displacement from important foraging habitat for the Cook Inlet beluga whales. NMFS and the ADF&G will continue to manage fish stocks and monitor and regulate fishing in Cook Inlet to maintain sustainable stocks.

Subsistence and personal use fishing are only allowed for Alaskan residents. Personal use fisheries require a valid Resident Sport Fishing License whereas subsistence fisheries do not (ADF&G 2011a). Popular recreational streams within the action area include anadromous streams along the west coast of Cook Inlet (NMFS 2008a; ADF&G 2011b). Eulachon harvest locations within the action area include areas from the Chuitna to the Susitna and Little Susitna rivers (NMFS 2008a; ADF&G 2011b). Groundfish (e.g., halibut, lingcod and rockfish) may also be harvested within the action area. Additionally, littleneck, butter and razor clams are harvested along Cook Inlet intertidal areas (NMFS 2008a). Potential impacts on the Cook Inlet beluga

whale from subsistence, personal use and recreational fishing include operations of small watercrafts in the mouths of streams and in shallow waters, harassment, and displacement from important habitat, ship strikes and prey competition (NMFS 2008a). The overall impacts from subsistence, personal use and recreational fishing on the recovery of the Cook Inlet population is low (NMFS 2008a).

Commercial Fisheries

Cook Inlet is comprised of several commercial fisheries, all of which require permits. The commercial fisheries in Cook Inlet are divided into the upper and lower Cook Inlet (ADF&G 2011c, d). Portions of upper Cook Inlet district management areas are within the proposed Cook Inlet seismic program action area. The upper Cook Inlet commercial fishing region consists of all waters north of Anchor Point Light and is further divided into the Northern (north of the West and East Foreland) and Central Districts (south of the Forelands to Anchor Point Light). Species commercially harvested in upper Cook Inlet include all five pacific salmon species (drift and set gillnet), eulachon or smelt (dipnet), Pacific herring (gillnet), and razor clams (hand-digging); however, sockeye salmon are the most economically valuable (Shields 2010; ADF&G 2011c).

In 2013, approximately 2.7 million salmon were harvested commercially in upper Cook Inlet, which is just under the average annual harvest from 1966-2012 (2.9 million salmon) (Shields and Dupuis 2013). Approximately 95.4 tons of smelt (100 tons is the maximum allowable harvest), 35.6 tons of herring and 381,000 pounds of razor clams were commercially harvested in 2013 (Shields and Dupuis 2013).

Potential impacts from commercial fishing on Cook Inlet beluga and humpback whales include harassment, gear entanglement, ship strikes, reduction of prey and displacement from important habitat. Between 2007 and 2011, there was one mortality of a Western North Pacific humpback whale in the Bering Sea/Aleutian Islands pollock trawl fishery and one in the Bering Sea/ Aleutian Islands flatfish trawl; results of adverse interactions with gear. Average minimum annual mortality from observed fisheries was 0.40 humpbacks from this stock (Allen and Angliss 2013). There are no known occurrences of fishery-related take of humpback whales in the proposed action area.

An observer program for the Cook Inlet salmon set and drift gillnet fisheries was implemented in 1999 and 2000 in response to the concern that there may be significant numbers of marine mammal injuries and mortalities that occur incidental to these fisheries. Observer coverage in the Cook Inlet drift gillnet fishery was 1.75 percent and 3.73 percent in 1999 and 2000, respectively. The observer coverage in the Cook Inlet set gillnet fishery was 7.3 percent and 8.3 percent in 1999 and 2000, respectively (Manly 2006). There were no mortalities of Steller sea lions observed in the set or drift gillnet fisheries in either 1999 or 2000 (Manly 2006).

The likelihood of lethal incidental take of a Western DPS Steller sea lion, beluga or humpback whale from commercial fishing is low; however, the likelihood of prey reduction substantially impacting the recovery of the Cook Inlet beluga whale population is high (NMFS 2008a; page 62, Table 4). Commercial fisheries may compete with beluga whales in Cook Inlet for salmon and other prey species. There is strong indication that these whales are dependent on access to relatively dense concentrations of high value prey throughout the summer months. A significant

reduction in the amount of available prey may impact the energetics of Cook Inlet belugas and delay recovery.

The Alaska Department of Fish and Game has management responsibility for most of the commercial fisheries in Cook Inlet, with the exception of halibut and a few federally managed fisheries in Lower Cook Inlet. The state-managed fisheries in the upper and mid Inlet include salmon (both set and drift gillnet), herring (gillnet), a recently reopened dip net fishery for eulachon (a.k.a. hooligan or smelt), and a razor clam fishery. The largest fisheries in Cook Inlet, in terms of participant numbers and landed biomass, are the State-managed salmon drift and set gillnet fisheries concentrated in the Central and Northern Districts in the upper and mid Inlet. Even though all five types of Pacific salmon are caught in Upper Cook Inlet, sockeye salmon is the primary target of the salmon commercial fisheries. Times of operation change depending upon management requirements, but in general the drift fishery operates from late June through August, and the set gillnet fishery during June through September. Salmon fishery effort varies between years, and within-year effort can be temporally and spatially directed through salmon management regulations. While the number of permits fished in Cook Inlet salmon gillnet fisheries has been relatively constant, the actual number of fish caught has fluctuated greatly during the past 20 years (ranging from a high of 10.6 million in 1992 to a low of 1.8 million in 2000). The 2007 commercial harvest of salmon in upper Cook Inlet was 3.6 million, slightly higher than the 10 year average of 3.5 million harvested salmon. Chinook salmon returns to much of Alaska's waters have declined precipitously in recent years. Returns of these salmon in Cook Inlet have been hard-hit, leading to closures to both sport and commercial fisheries in 2012.

The sac roe herring fisheries are located in four subdistricts of the upper and mid Inlet (Upper, West, Kalgin Island, and Chinitna Bay subdistricts); however, the Upper subdistrict fishery is the most productive one. In 2007, the herring catch was 26,000 pounds. The commercial razor clam fishery off the west side of the Inlet is the only remaining commercial fishery for razor clams in Alaska and takes about 400,000 pounds per year (Pers. Comm. J. Fox, ADF&G 2008).

There has been a sporadic fishery for eulachon since 1978 (taking between 300-100,000 pounds in 1978, 1980, 1998 and 1999). NMFS made recommendations to the Board of Fisheries (BOF) to discontinue this fishery effective in 2000, in part due to the lack of data on the eulachon runs into the Susitna River, and due to the absence of any evaluation of the effect of this fishery on beluga whales in terms of disturbance/harassment or competition for these fish. Additionally, it was noted beluga whales may be heavily dependent on the oil-rich eulachon early in the spring (preceding salmon migrations) and that large eulachon runs may occur in only a few upper Inlet streams. The commercial fishery for eulachon was reopened in 2005, but is restricted to hand-operated dip nets in saltwater between the Chuit River and the Little Susitna River, with a total harvest of 100 tons or less. From 2006-2013, commercial harvest of eulachon has ranged from 39.1 to 100.8 tons harvested on 3-11 permits (Shields and Dupuis 2013).

Recreational, Personal Use, and Subsistence Fisheries

It is difficult to overestimate the popularity of recreational fishing in Alaska, as evidenced by the combat fishing conditions that people tolerate during salmon runs and the large number of charter fishing operations. There are many recreational fishing opportunities, primarily for salmon, including the hundreds of drainages feeding into Cook Inlet. Some of the more

important salmon streams within the action area include the Susitna, Little Susitna, and Kenai Rivers. Ship Creek is the most popular fishing location in the Anchorage area. In 2005, anglers fishing in the Anchorage area represented four percent of the total statewide sport fishing effort. In lower Cook Inlet, recreational fishing for groundfish such as halibut, rockfish and lingcod are also popular. While pursuit of shellfish is also popular along many Cook Inlet beaches, razor clam (*Siliqua patula*) populations near Ninilchik have declined precipitously in recent years.

Personal use gill net fisheries occur in Cook Inlet and have been subjected to many changes since 1978 (Ruesch and Fox 1999), which are summarized in Brannian and Fox (1996). Dipnetting salmon is a summer ritual for many resident Alaskans. Since 2003, dipnetters on the Kenai River have harvested between 130,000 and 540,000 sockeye salmon (http://www.adfg.alaska.gov/index.cfm?adfg=PersonalUsebyAreaSouthcentralkenaiSalmon.main).

Fishing for eulachon is popular in Turnagain Arm, with no bag or possession limits. The two most significant areas where eulachon are harvested in personal use fisheries are the Twentymile River (and shore areas of Turnagain Arm near Twentymile River) and the Kenai River. Other areas where eulachon are harvested include the Big and Little Susitna River and their tributaries, the Placer River, and shoreline areas of Turnagain Arm and Cook Inlet north of the Ninilchik River. Annual harvests have ranged from 2.2 to 5 tons over the past decade. The personal use harvest of eulachon is possibly under-reported as some participants may confuse their harvests as being subsistence and not personal use. No subsistence records are kept for eulachon or herring harvests (ADF&G 2004).

5.2.6 Direct Mortality

There are several means by which listed species may die or be killed within the proposed action area. This section summarizes the known and potential human and natural causes of direct mortality.

Subsistence Harvest

The MMPA provides an exemption from its prohibitions that allows for the harvest of marine mammals by Alaska Natives for subsistence purposes and for traditional handicrafts. There are no reported takes of humpback whales by subsistence hunters in Alaska or Russia for the 2007-2011 period (Allen and Angliss 2013). Subsistence hunters in Alaska are not authorized to take humpback whales, and no takes have been reported (Allen and Angliss 2013). Average annual subsistence take of western DPS Steller sea lions from 2004-2008 (the only time for which region-wide estimates are available) was 136.9, with an additional average of 35.3 struck and lost animals (Allen and Angliss 2013). This take estimate excludes animals taken on St. Paul Island, where limited data suggest a mean annual take of 199 animals. We are unaware of subsistence take of Steller sea lions in the proposed action area.

The effect of past subsistence harvest practices on the Cook Inlet beluga whale population was significant. While a harvest occurred at unknown levels for decades, the subsistence harvest levels increased substantially in the 1980s and 1990s.

Figure 13 summarizes Cook Inlet beluga whale subsistence harvest from 1987 to 2011 (CIMMC 1996, 1997; Angliss and Outlaw 2008; NMFS 2008c; NMFS unpubl. data). The known subsistence harvest by Alaska Natives during 1995-1998 averaged 77 beluga whales annually.

The harvest, which was as high as 20 percent of the population in 1996, was sufficiently high to account for the 14 percent annual rate of decline in the population during the period from 1994 through 1998 (Hobbs et al. 2000). The reported and estimated harvest rates (including estimates of whales that were struck or shot, and lost, indicated those harvest levels were unsustainable. In 1999 there was no harvest as a result of a voluntary moratorium by the hunters that spring. In 2000, subsistence harvest management of Cook Inlet beluga whales required a cooperative agreement between NMFS and affected Alaska Native organizations for an allowable harvest. Since 2000, only five Cook Inlet belugas have been harvested for subsistence purposes, the last one in 2005. Currently, no Alaska Native organization has an approved MMPA co-management agreement with NMFS regarding Cook Inlet beluga whales.

Poaching and Illegal Harassment

Due to their distribution within the most-densely populated region in Alaska and their approachable nature, the potential for poaching beluga whales in Cook Inlet exists, but is not known to occur; no poaching incidents have been confirmed to date. NMFS maintains an enforcement presence in upper Cook Inlet, but effective enforcement of such a large area is difficult. NMFS Enforcement has investigated several reported incidences of harassment of Cook Inlet beluga whales, but there have been no resulting convictions.

Incidental Take by Fisheries

The term incidental take in regards to commercial fishing typically refers to the catch or entanglement of animals that were not the intended target of the fishing activity. Marine mammal injury or mortality reports incidental to commercial fishing operations in Cook Inlet have been obtained from fisheries reporting programs (self-reporting or logbooks), observer programs, and reports in the literature. The only reports where beluga whales were fatally taken incidental to the commercial salmon gillnet fishing in Cook Inlet are from the literature. Murray and Fay (1979) stated that salmon gillnet fisheries in Cook Inlet caught five beluga whales in 1979. Incidental take rates by commercial salmon gillnet fisheries in the Inlet were estimated at three to six beluga whales per year during 1981 – 1983 (Burns and Seaman 1986). Neither report, however, differentiated between the set gillnet and drift gillnet fisheries. There have been sporadic reports over the years of a single beluga whale becoming entangled in fishing nets (drift net and set gillnet); however, mortalities could not be confirmed.

NMFS placed observers in the commercial Cook Inlet salmon drift net and upper and lower Inlet set gillnet fisheries in 1999 and 2000. During the two years of observations, only three beluga whale sightings occurred and no beluga whale injuries or mortalities were reported. Furthermore, during the period 1990 through 2000, fishermen's voluntary self-reports indicated no beluga whale mortalities from interactions with commercial fishing.

In the spring of 2012, a young beluga whale was found dead in an educational subsistence fishing net. While histopathology analysis determined the animal likely drowned, there were other health issues documented that may have been a contributing factor (NMFS unpubl. data). Other than this recent interaction, NMFS is unaware of any beluga whales injured or killed in Cook Inlet due to personal use, subsistence, or recreational fisheries. The current rate of direct mortality from commercial fisheries in Cook Inlet appears to be insignificant and should not delay recovery of these whales.

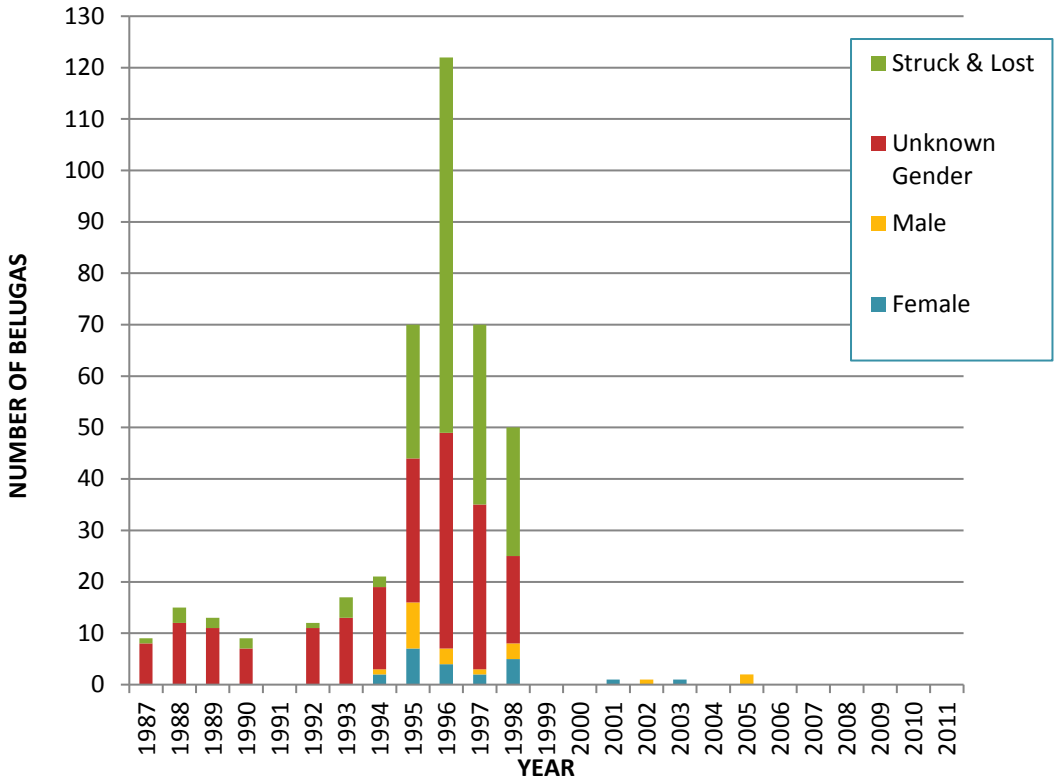

Figure 13. Summary of known Cook Inlet beluga whale subsistence harvest from 1987-2011.

Stranding

Beluga whale strandings in upper Cook Inlet are not uncommon, with most reported in Turnagain Arm. More than 700 whales stranded in upper Cook Inlet since 1988 (NMFS unpubl. data). Mass strandings (involving two or more whales) primarily occur in Turnagain Arm and Knik Arm, and often coincided with extreme tidal fluctuations ("spring tides") and twice coincided with a killer whale sighting (NMFS unpubl. data). NMFS 2006 status review (Hobbs et al. 2006) recognized that stranding was a constant threat to Cook Inlet beluga whale recovery and determined this declining population could not easily recover from multiple mortalities that resulted from a mass stranding event.

Prolonged stranding events that last more than a few hours may result in significant mortalities. Over the past 10 years the average number of dead-stranded Cook Inlet beluga whales was approximately 10 whales per year. Between 267 - 285 beluga whales were confirmed to have live-stranded since 1999. The annual abundance estimates continue to confirm a declining whale population and stranding events may represent a significant threat to the conservation and recovery of this stock.

Predation

Although infrequent, it has been documented that killer whales prey upon beluga whales in Cook Inlet (witnessed and determined through necropsies). Few killer whales are reported in Upper Cook Inlet. However, given the small population size of the Cook Inlet beluga whales, predation may have a significant effect on recovery. On average, one Cook Inlet beluga whale is estimated to be killed per year by killer whales (Shelden et al. 2003). Killer whale predation effects were also addressed in status reviews conducted by NMFS in 2006 and 2008 where the models

demonstrated that killer whale predation on an annual basis could significantly impact recovery. In addition to directly reducing the beluga population, killer whale presence in upper Cook Inlet may also affect the resident beluga population by increasing the number of live stranding events. Witnesses reported killer whales in Turnagain Arm during the live stranding events in August 1999 (58 – 70 whales) and September 2000 (15 – 20 whales), and one witness reported observing the death of a beluga by a killer whale in September 2008. Since 2001, there have only been three recorded occurrences of killer whales preying upon Cook Inlet beluga whales. However, the rate at which preyed-upon beluga carcasses become beached and are subsequently reported is unknown. Presumably, the carcasses of preyed-upon belugas are often sufficiently stripped of blubber that the remainder of the carcass sinks. NMFS considers killer whale predation to be a potentially significant threat to the conservation and recovery of Cook Inlet beluga whales.

5.2.7 Ship Strikes

Potential impacts from vessel traffic on the Cook Inlet beluga whale include ship strikes, increased noise levels, and displacement from important habitat. Ship strikes with large vessels are not likely to occur or significantly affect beluga whales because large ships travel at slower speeds and in a direct route. However, ship strikes with smaller vessels are more likely to occur and have a greater impact on the belugas because small vessels tend to travel at higher speeds and often change direction (NMFS 2008a). Among larger whales, Humpback whales are the most frequent victims of ship strikes, typically occurring with vessels travelling faster than 9 knots. Steller sea lions are assumed to be sufficiently agile to avoid most injurious ship strikes in Cook Inlet.

Most of Cook Inlet is navigable and used by various classes of water craft. There are eight port facilities and numerous improved and unimproved small boat launches located in Cook Inlet. Commercial shipping occurs year round, with containerships transiting between the Seattle/Puget Sound areas and Anchorage. Other commercial shipping includes bulk cargo freighters and tankers. Currently, with the exception of the Fire Island Shoals, Port MacKenzie, and POA, no other large-vessel routes or port facilities in Cook Inlet occur in high value beluga whale habitat. Beluga whales are regularly observed in and around the POA (Rugh et al. 2005a; Cornick and Kendall 2008; POA 2009) passing near or under vessels (Blackwell and Greene 2002), indicating that these animals may have a high tolerance of large vessel traffic.

Many commercial fishing vessels operate throughout Cook Inlet, with intensive use of some areas during salmon runs and herring spawning. Sport fishing and recreational vessels travel between Anchorage and several popular fishing streams that enter Upper Cook Inlet. Vessels are also present in Cook Inlet as support vessels for development activities.

While ship strikes have not been definitively confirmed in a Cook Inlet beluga whale death, in October 2007 a dead whale washed ashore with “wide, blunt trauma along the right side of the thorax” (NMFS unpubl. data), which was suggestive of a ship strike as the cause of a fatal injury. Cook Inlet beluga whales with propeller scars have been observed (Burek 1999; McGuire et al. 2009, 2011a). High-speed vessels operating among beluga whales (e.g., near river mouths during salmon runs) increase their probability of striking a beluga. Small boats and jet skis, which are becoming more abundant in Cook Inlet, are also able to quickly approach and disturb whales.

5.2.8 Research

Research on Cook Inlet beluga whales and their habitat within Cook Inlet can also cause disturbance. Research often requires the use of boats and/or planes to conduct surveys, adding to the vessel traffic, noise, and pollution near the action area. Research conducted in the action area includes aerial surveys, satellite tagging, land- and boat based visual surveys, and passive acoustic monitoring. The information below summarizes research that has occurred or is occurring in Cook Inlet.

Aerial surveys conducted by NMFS occurred every June, July and/or August from 1993-2012, and now occur biennially. The primary goal of these surveys is to document abundance and distribution of beluga whales in Cook Inlet (Rugh et al. 2000, 2005a, 2005b, 2006, 2007; Shelden et al. 2008, 2009, 2010, 2012). Aerial surveys were also conducted every one to two months between June 2001 and June 2002 (Rugh et al. 2004). A small fix-winged aircraft is used to conduct the surveys and maintains an altitude of 244 m (800 ft; Rugh et al. 2005a; Hobbs et al. 2009). Aerial surveys fly at altitudes of 800 ft to reduce in-water noise from the aerial survey plane.

Between 1999 and 2002, NMFS placed satellite tags on 18 beluga whales in upper Cook Inlet (Hobbs et al. 2005). Shortly after a tagging event in 2002, a beluga whale was reported dead. NMFS was unable to recover the carcass and therefore could not visually identify and confirm that it was one of the tagged belugas; however, eight days after tagging, the flipper band identifying the whale as a tagged animal was recovered from the carcass. Data from the tag only transmitted for 32 hours. A review of data from other tags during the same field season were analyzed and indicated two other whales' tags transmitted data for less than 48 hours with similar dive patterns; these whales were also assumed to have died shortly after tagging.

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

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

Several development projects (ongoing and planned) have conducted research or monitored the presence of Cook Inlet belugas and marine mammals in their respective action area. For instance, the Knik Arm Bridge and Toll Authority (KABATA) collected baseline environmental data on

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

Although research could have an effect on beluga whales, it is anticipated that research will continue to increase because there are many remaining data gaps on the biology and ecology of the Cook Inlet beluga (NMFS 2008a). It will become increasingly important, however, that research that may adversely affect Cook Inlet belugas directly contributes to the management and conservation of the species.

6. EFFECTS OF THE ACTION

Here we consider the specific aspects of the Seismic Program that are likely to adversely affect Cook Inlet beluga whales, western DPS Steller sea lions and humpback whales. These effects include both direct and indirect effects (effects occurring later in time).

Components of the seismic program would result in impacts that would co-occur in space and time with western DPS Steller sea lions, Cook Inlet beluga whales and humpback whales. In this section, we describe the probable risks of the seismic program on individuals of these species, and then integrate those risks to identify potential consequences to the populations. We examine the best scientific and commercial data available to determine whether and how these individuals and populations are likely to respond given the adverse impacts associated with the seismic program. We measure risks to individuals using their "fitness," the ability to survive and reproduce. In particular, we examine the scientific data available to determine if an individual's probable responses to the action's effects are likely to have consequences for the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When individual animals exposed to an action's effects are expected to experience reductions in fitness, we would expect reductions in the abundance, reproduction rates, or growth rates (or increase the variance in these measures) of the population those individuals represent. On the other hand, when animals are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations (i.e., reduce the likelihood of survival or recovery of a listed species).

In determining whether individual Cook Inlet beluga whales, Western DPS Steller sea lions or humpback whales would be affected, it is necessary to analyze when, where, and how an animal would be exposed to the various activities associated with the seismic program. Many biological aspects of these species are not well known or understood. During the analysis, we make several assumptions about their habitats, hearing abilities, and behaviors to reach the conclusions. For most situations, there is some information to apply, but for those with little to no data, we take a

precautionary approach to avoid Type II errors, errors in which we would mistakenly conclude that an animal was not adversely affected when it was adversely affected.

6.1 Direct Effects of the Action

Direct effects defined under the ESA are immediate effects caused by the proposed action and occurring concurrent with the proposed action. The proposed seismic program may directly affect Cook Inlet belugas, Western DPS Steller sea lions, and humpback whales by introducing noise into the environment, increasing the potential for direct injury from ship strikes, increasing the number of vessels in Cook Inlet and thus the potential for oil spills from vessels, and creating temporary habitat disturbance.

Parente et al. (2007) suggested humpback whales have been displaced from feeding and breeding areas along the Brazilian coast as a result of increased seismic activity. It is not known if seismic surveys in or near the action area have affected humpback whales in this manner, but there is evidence that humpback whale behavior was likely affected by previous seismic surveys in Cook Inlet, as evidenced by a contemporaneous movement into, and report of temporary stranding of one or two humpback whales in Turnagain Arm (Mandy Migura, NMFS. Pers. Comm. 2015).

6.1.1 Noise

Marine mammals use hearing and sound transmission to perform vital life functions. Introducing sound into their environment could disrupt 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 airgun noise and other noise associated with the Cook Inlet Seismic Program are audible depend 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 sounds from anthropogenic noise, such as airguns, explosions, aircraft, and vessels, on marine mammals might include one or more of the following: habitat degradation, habitat abandonment, hindering the ability to communicate and detect prey, masking of natural sounds, behavioral disturbance, and temporary or permanent hearing impairment, or non-auditory physical effects (Richardson et al. 1995).
Since 1997, NMFS has been using generic sound exposure thresholds to determine when an activity in the ocean produces sound potentially resulting in impacts to a marine mammal and causing MMPA Level B take by harassment (70 FR 1871) (i.e. the zone of responsiveness and zone of masking). NMFS has used 160 dB as a threshold level of sound intensity for Level B take for impulse sounds under the MMPA. New thresholds to improve and replace the current generic exposure level thresholds may be considered in the future, but new criteria have not been finalized (Southall et al. 2007). The current Level A (injury) threshold for impulse noise (e.g., seismic airgun shots) under the MMPA is 180 dB for cetaceans (whales, dolphins, and porpoises) and 190 dB for pinnipeds (seals, sea lions) (i.e. the zone of hearing loss, discomfort, or injury). These criteria were established before information was available about minimum received levels of sound that would cause auditory injury in cetaceans. The criteria are not frequency specific and therefore the decibel level thresholds may be lower than levels that would actually induce the indicated level of take; they are intended to be precautionary levels (Southall et al. 2007).

There are reviews of research and literature which suggest that the 160 dB behavioral harassment and 180 dB injury levels currently accepted by NMFS might be significantly below the noise levels that actually harass or injure beluga whales (Abgrall et al. 2008). Southall et al. (2007) estimated that beluga whales subjected to single pulse or multiple pulse events would theoretically not be injured until sound pressure levels reach 230 dB or greater, well above NMFS's 180 dB threshold. For behavioral disturbances from multiple pulse events, Southall et al. (2007) provided a severity scale which suggests that mid-frequency cetaceans, such as beluga whales, do not display responses that would likely affect vital rates (foraging, reproduction, or survival) until sounds were much higher than 160 dB.

In Cook Inlet, marine mammals compete acoustically with natural and anthropogenic sounds. Human-induced noises include large and small vessels, aircraft, oil and gas drilling, marine seismic surveys, pile driving, shore based activities, dredging, filling, and other events. The effects of human-caused noise and associated increased background noises on beluga whales and Steller sea lions depend on several factors including the intensity, frequency, and duration of the noise, the location and behavior of the animal, and the nature of the acoustic environment. High frequency noise diminishes more rapidly than low frequency noises. Sound also dissipates more rapidly in shallow waters and over soft bottoms (sand and mud). Much of Cook Inlet is characterized by its shallow depth, sand/mud bottoms, and high background noise from currents and glacial silt (Blackwell and Greene 2002), thereby making it a poor environment for propagating acoustics.

The distances to which sounds are audible depend on source level and frequency, ambient noise levels, physical habitat characteristics (e.g., water temperature, depth, substrate type), and sensitivity of the receptor (Richardson et al. 1995). Impacts to beluga whales and sea lions exposed to loud sounds include possible mortality (either directly from the noise or indirectly based on the reaction to the noise), injury and/or disturbance ranging from severe (e.g., permanent abandonment of vital habitat) to mild (e.g., startle).

Seismic survey activities could cause behavioral harassment; however, neither physical injury nor mortalities (often described as Level A takes) are anticipated due to the nature of the operations (e.g., use of observers on vessels, land, and in aircraft), and the mitigation measures (e.g., shut-down and power-down procedures in place to prevent take when animals are observed approaching ensonified zones).

In general, noise associated with seismic surveys has the potential to harass beluga whales, Steller sea lions, and humpback whales that may be present around the specific action area. Sound Source Verification studies conducted in Cook Inlet waters indicate that airgun arrays such as the ones proposed for use in this project will produce sound considered by NMFS to be of sufficient intensity ($\geq$160 dB) to cause harassment of marine mammals approximately 9.5 km from the sound source (ASRC 2014). Marine mammals use sound for vital life functions, and introduction of sound from this project into their environment could be disrupting to those behaviors at distances up to 9.5 km from the source. Disruption may manifest as a reduction in: 1) ability of animals to obtain sound-based information about their environment; (2) ability to communication; (3) remote detection of prey; and (4) detection of predators. In addition,

introducing seismic exploration-related sound into the environment may cause hearing impairment, non-auditory physiological effects, or behavioral effects.

Hearing Impairment

Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very loud sounds. Hearing impairment is measured in two forms: temporary threshold shift (TTS) and permanent threshold shift (PTS).

TTS is the mildest form of hearing impairment that can occur during exposure to loud sound (Kryter 1985). It is usually not considered physical injury, as TTS-compromised hearing typically 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).

Because noise from the seismic survey would not be a one-time exposure, as with most human development and exploration activities, a time component must be incorporated into any effects analysis. Experiments with marine mammals show a nearly linear relationship between sound exposure level and duration of exposure: the longer an animal is exposed, the lower the level required to produce TTS (Kastak and Schusterman 1999; Schlundt et al. 2000; Nachtigall et al. 2003). Using auditory evoked potentials (AEP) methods, Natchigall et al. (2004) found TTS of approximately 4 to 8 dB following nearly 50 minutes of exposure to the same frequency noise (center frequency 7.5 kHz) at 160 dB (193-195 dB re: 1 μPa2-s [SEL]). TTS recovery occurred within minutes or tens of minutes.

PTS 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). 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 receivers ear (Ketten 1994). PTS is presumed to be likely if the hearing threshold is reduced by 40 dB (i.e., 40 dB of TTS) (Southall et al. 2007). PTS has never been induced in marine mammals despite some hearing threshold studies exposing beluga whales to pulses up to 208 dB (Finneran et al. 2002), 28 dB louder than NMFS's current Level A (injury) harassment threshold. In Cook Inlet in 2014, at least 29 marine mammals experienced level A or level B take due to Apache's seismic survey operations (Table 7).

Non-Auditory Physiological Effects

Non-auditory physiological effects or injuries that theoretically might occur in beluga whales, Steller sea lions, or humpback whales exposed to strong underwater sound include stress, neurological effects, resonance effects, decompression sickness, and organ or tissue damage.

Table 7. Summary of the number of individual marine mammals observed within the 160 dB disturbance zone and 180 dB (cetacean) and 190 (pinniped) exclusion zone (Lomac-MacNair et al. 2014).

Marine Mammal Species	Total No. of Observed Exposures in DZ	Total No. of Observed Exposures in EZ	Total No. of Observed Exposures
Beluga Whale	12	-	**12**
Killer Whale	-	-	**-**
Harbor Porpoise	4	2	**6**
Steller Sea Lion	-	-	**-**
Harbor Seal	9	-	**9**
Humpback Whale	-	2	**2**

Romano et al. (2004) demonstrated that belugas exposed to seismic water gun and (or) single pure tones (SPLs up to 201 dB) resembling sonar pings showed increased stress hormone levels of norepinephrine, epinephrine, and dopamine. However, in two studies, exposure of captive beluga whales to playbacks of drilling noise did not result in increased levels of (stress-related hormones) (API 1986; Thomas et al. 1990). Wright et. al (2007) concluded that anthropogenic noise, either by itself or in combination with other stressors, can reduce the fitness of individual marine mammals and decrease the viability of some marine mammal populations. The available literature suggests stress hormone levels may be affected by noise exposure, but that the results are highly variable and dependent (in part) upon factors such as the duration, frequency, and intensity of sound, the species of marine mammal, the individual's response, and the amount of control the individual has over the stressor. The physiological effects of any elevation in hormone levels are equally variable.

Studies have also demonstrated that reactions of animals to sounds could result in physical injury. It has recently been reported that stranded deep diving marine mammals displayed physical attributes similar to the bends (e.g., in vivo gas bubble formation) (Fernandez et al. 2004, 2005). Marine mammals may experience these symptoms if surfacing rapidly from deep dives in response to loud sounds. However, because Cook Inlet is generally a shallow water estuary, marine mammals found there are not considered deep divers, and due to proposed mitigation measures, non-auditory physiological impacts, other than stress, are not expected.

Behavioral Effects

Behavioral responses of marine mammals to noise are highly variable and depend on a suite of internal and external factors which in turn results in varying degrees of significance (Southall et al. 2007). Internal factors include: (1) individual hearing sensitivity, activity pattern, and motivational and behavioral state (e.g., feeding, traveling) at the time it receives the stimulus; (2) past exposure of the animal to the noise, which may lead to habituation or sensitization; (3) individual noise tolerance; and (4) demographic factors such as age, sex, and presence of dependent offspring. External factors include: (1) non-acoustic characteristics of the sound source (e.g., if it is moving or stationary); (2) environmental variables (e.g., substrate) which

influence sound transmission; and (3) habitat characteristics and location (e.g., open ocean vs. confined area). There are no consistent observed threshold levels at which beluga whales respond to an introduced sound. Beluga whale responses to sound stimuli have been noted to be highly dependent upon behavioral state and motivation to remain or leave an area. Few field studies involving stationary industrial sounds have been conducted on beluga whales. Reactions of belugas in those studies varied. For example, in Awbrey and Stewart (1983) (as summarized in Southall et al. [2007]), recordings of noise from SEDCO 708 drilling platform (non-pulse) were projected underwater at a source level of 163 dB. Beluga whales less than 1.5 km from the source usually reacted to onset of the noise by swimming away (Received Levels (RL) approximately 115.4 dB). In two instances groups of whales that were at least 3.5 km from the noise source when playback started continued to approach (RLs approximately 109.8 dB). One group approached within 300 m (RLs approximately 125.8 dB) before all or part turned back. The other group submerged and passed within 15m of the projector (RL approximately 145.3 dB). TTS experiments have also documented behavioral responses by trained belugas. These responses included reluctance to return to experimental stations when exposed to watergun pulse sounds projected 4.5m from the subject at approximately 185.3 dB (171 dB re 1 μPa2-s [SEL]) (Finneran et al. 2002) and behavioral changes when exposed to sounds from the explosion simulator at approximately 200 dB (177 dB re 1 μPa2-s [SEL]) (Finneran et al. 2000). In a non-pulse exposure experiment (i.e., 1 second tones), belugas displayed altered behavior when exposed to 180-196 dB (180-196 dB re 1 μPa2-s [SEL]) (Schlundt et al. 2000).

Many marine mammals, including beluga whales, perform vital functions (e.g., feeding, resting, traveling, socializing) on a diel (i.e., 24 hr) cycle. Repeated or sustained disruption of these functions is more likely to have a demonstrable impact than a single exposure (Southall et al. 2007). However, it is possible that marine mammals exposed to repetitious sounds from the proposed seismic program may become habituated or tolerant after initial exposure to these sounds, as demonstrated by belugas' tolerance to vessels (Richardson et al. 1995; Blackwell and Green 2002). Habituation is found to be common in marine mammals faced with introduced sounds in their environment. For example, bowhead whales (*Balaena mysticetus*) have continued to use pathways where drilling ships are working (RLs: 131 dB) so that they can continue their eastward migration (Richardson et al. 1995). Harbor porpoise, dolphins, and seals have become habituated to acoustic harassment deterrent devices such as pingers and seal bombs after repeated exposure (Mate and Harvey 1987; Cox et al. 2001). Beluga whales appear to be relatively tolerant of intensive fishing vessel traffic in Bristol Bay, Alaska, and beluga whales are commonly seen during the summer at the POA, even during periods of intensive construction (Cornick and Kendall 2008; Cornick and Saxon-Kendall 2009; Cornick et al. 2010).

Masking of whale calls or other sounds potentially relevant to whale vital functions may occur. Southall et al. (2007) defines auditory masking as the partial or complete reduction in the audibility of signals due to the presence of interfering noise with the degree of masking depending on the spectral, temporal, and spatial relationships between signals and masking noise as well as the respective received levels. Masking occurs when the background noise is elevated to a level which reduces an animal's ability to detect relevant sounds. Belugas are known to increase their levels of vocalization as a function of background noise by increasing call repetition and amplitude, shifting to higher frequencies, and changing structure of call content (Lesage et al. 1999; Scheifele et al. 2005). Another adaptive method to combat masking was

demonstrated in a beluga whale which reflected its sonar signal off the water surface to ensonify an object on which it was trained to echolocate (Au et al. 1985)..

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) and low power output arrays with peak source levels of approximately 235 dB. 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 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 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).

In 2014, a total of 57 beluga whale groups (n = ~170 estimated individuals) were observed from vessel and land platforms during Apache's Cook Inlet Seismic Survey. More beluga whale groups (n = 41 groups) were observed during non-seismic periods (2,273.0 hr PSO effort) than during seismic periods (n = 16 during 716.8 hr effort) Lomac-MacNair et al. (2014). In 2015, SAExploration conducted seismic surveys in Cook Inlet similar to what is contemplated in this proposed action, but using a smaller displacement airgun array (1,760 cubic inch). No beluga whale, humpback whale or Steller sea lion takes were recorded by visual observers, but one level B take of one or more beluga whales was recorded by passive acoustic monitoring (PAM) equipment on July 29th (SAExploration, pers. Comm. 8/20/15). This demonstrates that PAM systems are able to detect takes that visual observers miss.

6.1.1.2 Effects from Airgun Noise

Marine mammals close to underwater detonations of high explosives can be killed or severely injured, and the auditory organs are especially susceptible to injury (Ketten et al 1993; Ketten 1995). However, explosives are no longer used in marine waters for commercial seismic surveys or (with rare exceptions) for seismic research; they have been replaced by airguns and other non-explosive sources. Airgun pulses are less energetic and have slower rise times, and there is no direct evidence that they have caused serious physical injury, death, or stranding of any marine mammal, including beluga whales, even in the case of large airgun arrays.

Studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers (Richardson and Würsig 1997; Goold and Fish 1998). 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; Southall et al. 2007). If a marine mammal does react to an underwater sound by changing its behavior, the impacts of the change are unlikely to affect vital rates for those affected

individuals. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on the animals could be significant (e.g., Weilgart 2007). Displacement from important feeding/breeding areas are not anticipated from the proposed seismic activity since the majority of the primary feeding and suspected breeding areas are located outside of the action area. The exception to this being the Susitna Delta area, likely the most important patch of feeding habitat for this species. Mitigation measures were proposed to minimize the effects of this project on this essential habitat, including surveying of this area after peak feeding and breeding periods (May-September). The proposed mitigation measures are not considered sufficient, however, to minimize the effects of this action on whales using essential habitat between the Beluga River and Little Susitna River, an area which includes the Susitna Delta. The mitigation measures were considered insufficient because they referenced mean high water (MHW) as the line from which the temporal exclusion zone would be drawn. However, the extreme tides and low relief of the area are such that, at low tide, the whales would be forced miles seaward from the MHW line. Thus we have calculated the Susitna Delta Exclusion Zone based on a buffer drawn seaward of the mean lower low water (MLLW) line. The Incidental Take Statement contains a more precise description and depiction of the Susitna Delta Exclusion Zone.

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, 2002, 2005). Like other cetaceans, captive beluga whales sometimes exhibit an increased number of vocalization events after exposure to intense sound. The captive belugas were subsequently reluctant to station at the test site for subsequent exposures (Finneran et al. 2002). However, the animals tolerated high received levels of sound (peak–peak level >200 dB re 1 μPa) before exhibiting defiant behavior (Richardson et al. 1995). One can reasonably assume that wild belugas would choose to avoid sounds of lower intensity than those that resulted in defiant behaviors of captive belugas.

There is evidence of belugas avoiding airgun arrays at a distance of 10-20 km (6.21 to 12.42 mi) (Miller et al. 2005). These operations used two arrays of 24 airguns per array. We note that these arrays are somewhat larger than the 16 airguns arrays proposed for this action. We also note that some belugas approached within 1.6 km (1 mi).

Transmission of sound from 1 foot-deep detonations of seismic explosives through saturated intertidal substrates into the water column are not well studied or understood. However, some applicable local measurements have been made. The 2010 Draft Environmental Impact Statement for Resumption of Year-Round Firing Opportunities at Fort Richardson, Alaska (DEIS), associated with the JBER live fire activities at Eagle River Flats, indicates that 120 mm HE Mortar, detonated at or near the soil surface in what appear to be mudflats generated noise that traveled through land and then water and fell below 160 dB at 976 meters from the blast site. The charge carried by that mortar is between 4.5 pounds and 7.9 pounds (2 kg to 3.6 kg); similar in weight to the charges proposed for Apache's intertidal charges. However, the mortar rounds for which noise was measured exploded 500 meters inland from the water line.

The area where Apache is working has substrates that are rockier than that of Eagle River, which would lengthen the distance that the noise travels. The bathymetry in the area at which Apache proposes intertidal seismic survey work is different from that of the Eagle River area, which could also affect the distance that the noise travels. In addition, explosive energy from the mortar

rounds has an upward direction while the Apache charges are designed to direct their explosive energy downward, further increasing the distance that the noise would travel through substrate. Taken together, these factors suggest that the noise from Apache's charges would potentially travel a distance greater than 1 km (mortar rounds did not exceed 160 dB Level B disturbance threshold at 1 km). Apache proposes to monitor a 3.5 km disturbance zone around shallow shot sites, suspending detonations if listed marine mammals encroach upon this zone, which, based upon the above information, is amply conservative.
Numerous studies have shown that marine mammals' reactions to seismic vessels are highly variable, and are dependent upon many parameters Although 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 under what appear to humans to be similar conditions. It is apparent that we do not yet understand what parameters dictate how marine mammals will react to a given noise, and what accounts for the observed variation in reactions. NMFS acoustic criteria are therefore conservative.

Behavioral Responses of Cook Inlet Beluga Whales

Airgun-induced masking of marine mammal calls and other natural sounds are expected to be limited in geographic extent. 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). However, the observation of an increased rate of vocalization, or of changes in call frequency, duration or volume upon introduction of intense anthropogenic noise is an indication that marine mammals are attempting to overcome acoustic masking (Weilgart 2007). Upon cessation of the introduced noise, marine mammals often cease calling entirely for prolonged periods of time, sometimes weeks or months. (Weilgart 2007).

Seismic pulses are low in frequency relative to most sounds that are important for belugas (e.g., echolocation signals, communication calls, killer whale sounds). Therefore, the issue of auditory masking for beluga whales is largely mitigated by the small frequency overlap between sounds produced by airguns (<1 kHz) and those important to beluga whales (0.26-20 kHz for calls, 40-60 kHz and 100-120 kHz for echolocation sounds) (Blackwell and Greene 2002).

In auditory studies that exposed captive beluga whales to strong, pulsed sounds similar in duration to those typically used in seismic surveys, the belugas exhibited changes in behavior (Finneran et al. 2000, 2002, 2005). Sometimes the belugas vocalized after such exposure and were reluctant to return to the test site for subsequent exposures (Finneran et al. 2002). However, some animals have tolerated high received levels of sound (peak–peak level >200 dB) before exhibiting aversive behaviors (Richardson et al. 1995).

Examples from scientific studies and opportunistic sightings suggest that belugas tolerate in-water noise. Whether this tolerance is borne of necessity or choice is unknown. Cook Inlet beluga whales have continued to use habitat in Knik Arm despite heavy disturbance and underwater noise from maritime operations, maintenance dredging, aircraft operations, and pile driving for the Port of Anchorage expansion. This beluga whale behavior may, however, be taken as evidence of a possible high motivation to reach important habitat in Knik Arm, rather than as an indication that the noise is not bothersome to the whales. Some beluga whales repeatedly exposed to noise may habituate to the sounds and, upon subsequent exposures, may not change

their behavior or distribution when exposed to those sounds. However, repeated exposure to sounds capable of causing TTS can lead to PTS.

Apache's boat and land-based monitoring program in 2014 (Lomac-MacNair et al. 2014) documented behavior when whales were first observed, regardless of airgun activity (Figure 14). Of 55 Cook Inlet beluga sightings reported by Lomac-MacNair et al. (2013), 17 were made when the airguns were operational. All the behaviors documented without airgun activity were also documented when the airguns were operational and included (in order of most frequently observed to least frequently observed behavior): traveling, milling, unknown behavior when whales were too far, swimming, foraging, and diving (Figure 14). It is possible that some individual Cook Inlet beluga whales avoided areas actively or recently surveyed by Apache in 2012; however there was no information provided to suggest there was a significant or meaningful alteration of behavior. The end-of-season or "90 Day" report of Apache's 2014 seismic program (Lomac-MacNair et al. 2014) compared the location (closest approach distance) of beluga whales relative to the seismic vessel. These data clearly indicated there were more and closer sightings of belugas when there was no seismic activity than when there was seismic activity, and avoidance at distances out to 5 km from the array (Figure 15), but no relationship beyond this is apparent. However, beluga whales' fidelity to feeding, molting, and calving areas, coupled with the exhibited tolerance of individual belugas to in-water noise, indicates that they will likely continue to access these sites once the surveys in the area are completed.

NMFS's aerial survey documented the consistent presence of Cook Inlet belugas near the West Foreland and MacArthur River in Trading Bay in June 2012. Belugas have not been observed in this general area during the NMFS surveys since 2001, and no consistent sightings have been documented since 1995 (Shelden et al. 2012). NMFS has no evidence explaining the cause of the circumstances resulting in beluga whale sightings in this area in June 2012. We can posit several potential explanations for this occurrence, including: the natural behavior of the beluga whales which have historically been documented in the Trading Bay region; the presence of available and adequate food sources in the MacArthur River area in June 2012; or an acoustic or other perceived barrier affecting the belugas' movements into the uppermost portions of Cook Inlet (i.e., critical habitat area 1) as a result of Apache's 2012 seismic program. While there is no evidence demonstrating a causal relationship between the circumstances present in 2012 and one of the possible explanations identified above, even if we assumed that this repeated sighting of belugas near the West Foreland/Trading Bay areas during June 2012 was the result of the seismic program, there was no indication that the displacement was permanent, and we consider any effects from one isolated incidence of displacement to be insignificant.

Seismic arrays do not always displace beluga whales. Sometimes whales approach within what NMFS considers to be the zone in which harm occurs. Figure 16 indicates that in 2014, about 4 groups of beluga whales occurred less than 500 m from the Apache source vessel during seismic operations (0.0014 groups per hour of effort x 3029.2 total hours of observation effort) (Lomac-MacNair et al. 2014). If these events occurred during operation of the 1760 in^3 airgun array, that would represent 4 groups of belugas subjected to Level A take (Level A take isopleth for 1760 in^3 array for cetaceans = 1840 m). This report indicates there were no Level A takes of Cook Inlet beluga whales (Table 7) in that year because mitigation actions were taken immediately upon observation of whales in this zone. However, by the time the whales were observed, unauthorized take had already occurred.

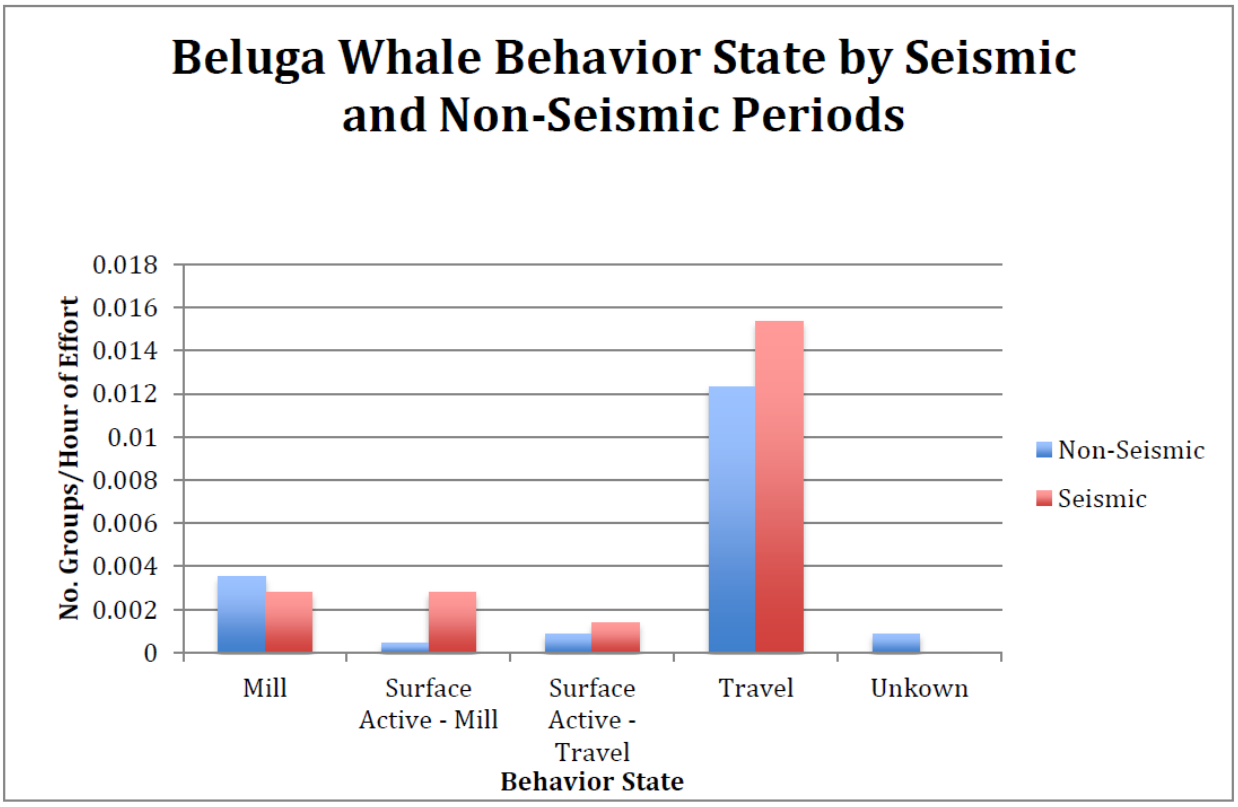

Figure 14. Initial behaviors of Cook Inlet belugas observed during times with and without seismic airgun activity by Apache during 2014 operations. Reproduced from Lomac-MacNair et al. (2014). 3029.2 hours of effort were expended in obtaining this data.

The occurrence of Cook Inlet belugas in such close proximity to harmful seismic sound sources supports the need for passive acoustic monitoring at night, when visual monitoring would be ineffective in preventing conflicts between listed marine mammals and harmful sources of sound.

Hearing Impairment in Cook Inlet Beluga Whales

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 kilometers of the airguns. A single airgun pulse might therefore need to have a received level of approximately 196-201 dB 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 result in TTS. 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). It is not currently known how this may affect TTS threshold. More data are needed in order to determine the received levels at which belugas 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 the distance between array and whale initially decreases upon approach, and subsequently increases as whale and/or boat move away from each other (e.g., Erbe and King 2009).

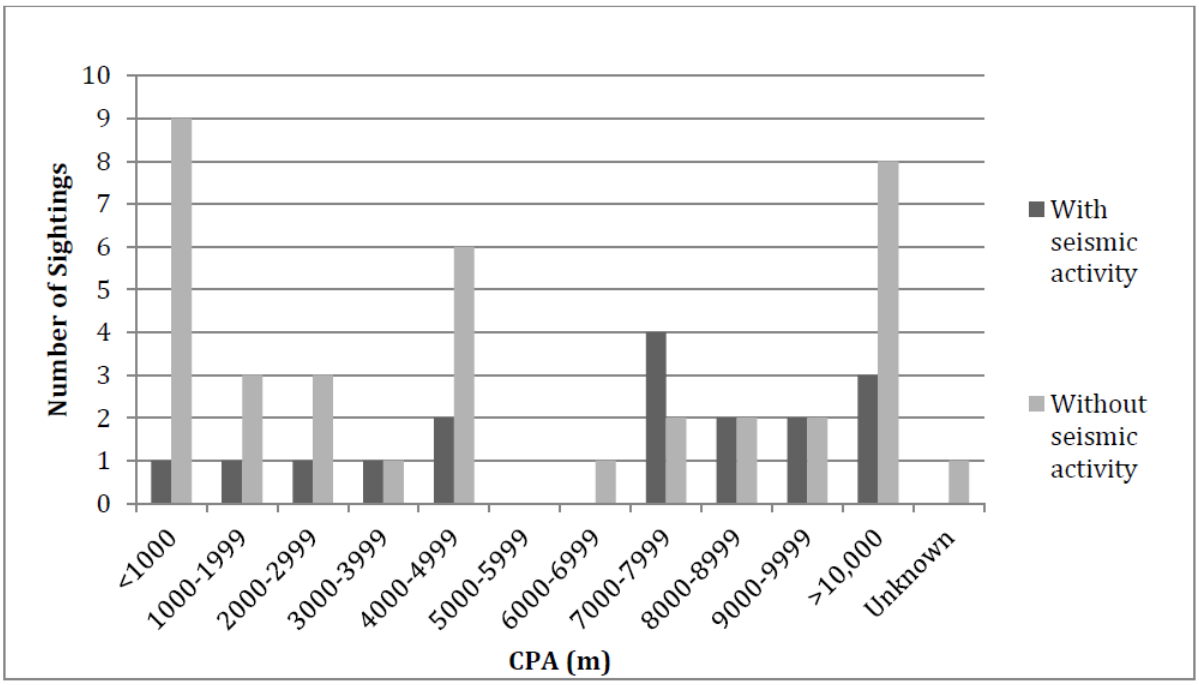

Figure 15. Closest point of approach (CPA) by belugas to the source vessel(s) during 2012. The closest point of approach (CPA) by belugas to the source vessel(s) during times with and without seismic airgun activity during 2012. Reproduced from Lomac-MacNair et al. (2013).

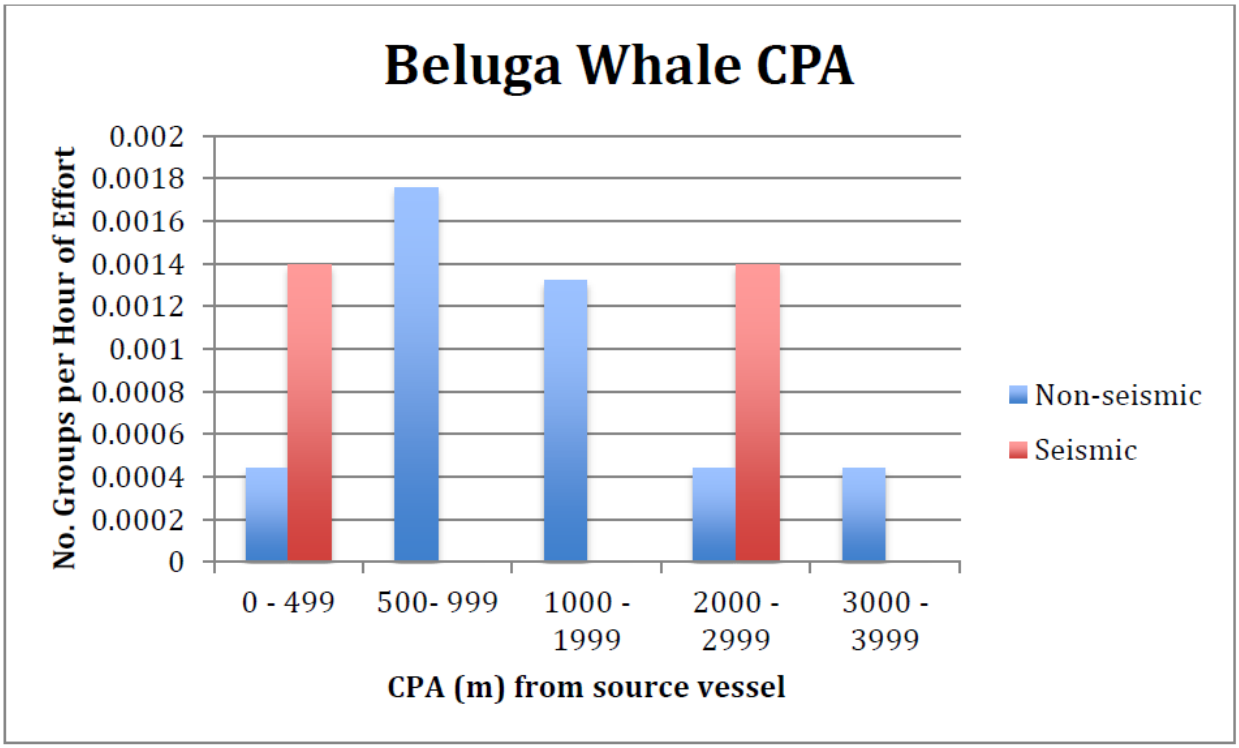

Figure 16. Closest point of approach (CPA) by belugas to the source vessel(s) with and without seismic airgun activity during 2014, with 3029.2 hours of observational effort expended. Reproduced from Lomac-MacNair et al. 2014.

Behavior Response of Steller Sea Lions

While there are no published data on seismic airgun array effects on sea lions, 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 Sea during 1996–2002 provided information regarding behavior of arctic seals exposed to seismic pulses (Miller et al. 2005; Moulton and Lawson 2002). These seismic projects usually involved arrays of 560 to 1500 cui. displacement. 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 a few hundred meters, and many seals remained within 100 to 200 m (328 to 656 ft) of the seismic vessels transect line 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. The only evidence that ringed or bearded seals were displaced from the area by the operations was that fewer of them were seen at the surface during the operation of the airgun arrays.

The extremely low density of Western DPS Steller sea lions within the action area leads NMFS to conclude that the incidence of take of this species will be very low. Mitigation measures will likely reduce take during daylight hours, but will be ineffective in reducing take at night.

Hearing Impairment in Steller Sea Lions

The auditory response of pinnipeds to underwater pulsed sounds has been examined in only one study. Finneran et al. (2005) 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: 1μPa2s). However, this action will produce received levels above 183 dB re: 1 μPa peak-to-peak (SEL 163 dB re: 1μPa2s) for a relatively small radius around the sound source. This small radius combined with the extremely low density of Western DPS Steller sea lions suggests that while hearing impairment is possible, it is highly unlikely.

Hearing in Humpback Whales

Humpback whales produce a variety of vocalizations ranging from 0.02 to 10 kHz (Winn et al. 1970, Tyack and Whitehead 1983, Silber 1986, Thompson et al. 1986, Richardson et al. 1995, Au 2000, Frazer and Mercado III 2000, Erbe 2002, Au et al. 2006). As is the case for all baleen whales, direct data on humpback whale hearing sensitivity is not available. Houser et al. (2001) produced a mathematical model of humpback whale hearing sensitivity based on the anatomy of the humpback whale ear. Based on the model, they concluded that humpback whales would be sensitive to sound in frequencies ranging from 0.7 to 10 kHz, with a maximum sensitivity between 2 to 6 kHz. Sounds produced by airgun arrays are broadband with most of the energy below 1 kHz (ASRC 2014). Therefore, humpbacks would certainly be able to hear a portion of the energy produced by seismic airgun arrays, although available information does not allow us to conclude what portion of that energy may fall within the most sensitive portion of humpbacks' hearing range.

Behavioral Response of Humpback Whales

The intense pulses produced by seismic surveys clearly have the potential to cause direct or behaviorally mediated physiological harm at close distances (Gordon et al. 2003), but more subtly at longer distances there exists the potential of disturbing animals and altering important behaviors, as well as masking acoustic signals and negatively affecting communication. For example, the number of singing humpback whales was found to decrease significantly with increasing received level of seismic survey noise (Cerchio et al. 2014). Miller et al. (2000) documented lengthening of humpback songs for those individuals that did not cease singing in response to LFA signals, and also suggested a compensation mechanism to increase redundancy similar to that suggested for blue whale calls (Di Iorio and Clark 2010). While Cerchio et al. (2014) note that the response of reduced singing has implications on the breeding display (and potentially upon breeding success) of humpbacks, it would be highly speculative to assume that this species behavior is not altered by seismic survey noise outside of the breeding season. There is no known information regarding response of humpback whales to seismic survey noise on their summer feeding grounds. However, we note again the level A exposure of a humpback whale or possibly a humpback mother and calf pair to Apache's seismic survey efforts in 2014, and the anecdotal report of a humpback that appeared to be stranded in Turnagain arm shortly after that level A exposure occurred. While humpbacks do not regularly occur throughout upper Cook Inlet, they are far more likely to co-occur with seismic survey efforts towards the southern portions of the action area.

Summary of Airgun Noise Effects

Seismic-related activities will occur 24 hours per day. Airgun arrays will be active for approximately 2.5 hours during each of the slack tide periods (typically four slack tide periods per 24 hour period); therefore, airgun arrays may be operating for 10-12 hours per day. Monitoring and mitigation measures implemented during seismic surveys are designed to detect cetaceans and other marine mammals near the airgun array and avoid exposing them to sound pulses that may cause hearing impairment. However, past performance indicates that visual monitoring is not always effective at detecting marine mammals before they enter level B zones of harassment (160 dB) or Level A zones of harm (180 dB for cetaceans and 190 dB for pinnipeds. Visual monitoring would be particularly ineffective at mitigating the acoustic effects of seismic surveys occurring at night (between local sunset and local sunrise). Seismic ramp-up procedures will occur after an extended shut-down of the airgun arrays. Although the effectiveness of this mitigation technique remains equivocal, in theory, it warns animals of impending intense sound such that animals near the airguns can move away from the source before the sound source reaches full level.

The noise from the seismic program and effects this activity would have on ambient underwater noise will be temporary. Seismic pulses would occur for only about 2 or fewer hours per slack tide period. Cetaceans are not expected to be regularly or often exposed to sound levels at or above 180 dB, due in part to proposed mitigation. Likewise, pinnipeds are not expected to be regularly or often exposed to sound levels at or above 190dB. Therefore, AKR anticipates that TTS, if it does occur, would not last more than a few minutes and would not likely result in impacts to vital life functions such as communication and foraging.

The seismic program is not scheduled to occur in particularly essential beluga whale feeding and nursery areas of upper Cook Inlet in the summer, when over 95 percent of the beluga population

is concentrated in a small portion of its range. Although areas in the Susitna Delta are scheduled to be surveyed, the proposed timing of these surveys is limited in time and space to protect vital foraging and reproductive activities of the Cook Inlet beluga whales. From 15 April through 15 October, no airgun operations will occur in the Susitna Delta Exclusion Zone. We conclude that an exclusion zone extending from the MHW line to 10 mi (16 km) seaward of MLLW, and extending from the Beluga River to the Susitna River is likely to sufficiently protect whales using the Susitna Delta from acoustic-related impacts during their use of this most essential foraging and reproductive habitat. Additionally, Apache has committed to conducting aerial surveys of river mouths prior to commencing operations in those areas to reduce the potential for disturbing feeding whales at river mouths, and Apache has not included the high value areas of Knik Arm and Turnagain Arm as part of the seismic survey area.

The temporary exclusion of habitat for use by marine mammals as a result of noise from the moving seismic source vessels remains likely. However, marine mammal avoidance behaviors are expected to be short in duration, both because the source vessel will be moving and the airgun arrays will operate only during slack tide or low current periods. Whales displaced from high value habitats are expected to return shortly after cessation of airgun array operations. Mitigation measures are incorporated into the project description in an effort to reduce impacts to protected species.

However, this action, if it occurs near other sources of notable anthropogenic noise capable of harassing marine mammals, is likely to have synergistic effects upon listed species that may hinder or preclude access to portions of their habitat. Such synergistic effects are cited as a threat of major concern to Cook Inlet belugas in the Draft Cook Inlet Beluga Whale Recovery Plan. Examples of other such sources include, but are not limited to pile driving at the Port of Anchorage or at Port MacKenzie, or other seismic surveys. Coordination between parties possessing MMPA Incidental Harassment authorizations or Letters of Authorization from NMFS could preclude such synergistic effects from taking place.

As a result of this action alone, NMFS expects only temporary displacement from habitat of small numbers of beluga whales and even fewer western DPS Steller sea lions and humpback whales.

6.1.1.3 Effects from Vessel Noise

Vessels will be used for support and transport during Apache's Cook Inlet Seismic Program. Vessel noise that is continuous in nature will be transmitted through water. Marine mammal responses to vessels are generally associated with noise and depend on changes in the engine and propeller speed (Richardson et al. 1995). As with aircraft, visual cues may contribute to marine mammals' reactions to nearby vessels (Richardson et al. 1995). Acoustic data for vessels proposed for use during construction of the proposed Knik Arm Bridge indicate that ships ranging in length from 55 to 85 m (180 to 279 feet) produce sound ranging from 170 to 180 dB. Sound from a vessel of that size would attenuate below 125 dB between 86 m and 233 m (282 and 764 feet) from the source. All of the vessels used in the proposed seismic program will be smaller than 55 m; the largest vessel proposed for the seismic program is 135 x 30 ft (41 x 9 m) and will likely be quieter than the vessels proposed for the bridge construction.

Beluga responses to vessel noise

Odontocetes 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). Beluga whale responses to vessel noise vary greatly from tolerance to extreme sensitivity depending on whale activities and experience, habitat, boat type, and boat behavior (Richardson et al. 1995). Reactions may include behavioral responses, such as altered headings or avoidance (Blane and Jaakson 1994; Erbe and Farmer 2000); fast swimming; changes in vocalizations (Lesage et al. 1999, Scheifele et al. 2005); and changes in dive, surfacing, and respiration patterns.

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 versus 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. Blane and Jaakson (1994) observed avoidance behavior by belugas in the presence 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 (2002) observed beluga whales in close proximity of the Northern Lights cargo-freight ship docked with motors running (126 dB) at the POA, suggesting that the belugas were at least temporarily tolerating the stationary ship's noise.

Belugas in the MacKenzie Estuary appeared to react less to a stationary dredge as opposed to a moving one, despite similar noise levels created by the vessels (Fraker 1977). Because of the frequency of marine traffic in their habitats, Cook Inlet beluga whales are likely familiar with the acoustic signatures of large and small vessels. Belugas are frequently observed in and around the Port of Anchorage, the Port MacKenzie dock, and the small boat launch adjacent to the outlet of Ship Creek (Blackwell and Greene 2002; NMFS 2008a; Markowitz et al. 2005; Funk et al. 2005). For example, Blackwell and Greene (2002) reported that Cook Inlet beluga whales did not appear to be bothered by the sounds from a passing cargo freight ship. Despite increased shipping traffic and maintenance operations (e.g., dredging) beluga whales continue to utilize waters within and surrounding the POA (Markowitz and McGuire 2007; NMFS 2008a).

Steller sea lion responses to vessel noise

There are few data published on pinniped responses to vessel activity, most of the information is anecdotal (Richardson et al. 1995). Generally, sea lions in water show tolerance to close and frequently approaching vessels and sometimes show interest in fishing vessels. They are less tolerant when hauled out on land; however, they rarely react unless the vessel approaches within 100-200 m (330-660 ft; Richardson et al. 1995). The risk of vessel activity threatening the recovery of Steller sea lions has been ranked low in the Steller Sea Lion Recovery Plan (NMFS 2008b).

Humpback whale response to vessel noise

Response of humpback whales to vessel noise is inconsistent across space and time (Scheidat et al. 2004). Increases in swim speed or changes in direction of travel are common reactions of humpbacks to approaching vessels, with normal behavior resuming shortly after the vessel has passed. Other animals may approach vessels or show no reaction. Scheidat et al. (2004) stated that physiological reactions to the presence of vessels occurred before behavioral changes were apparent to human observers. In a study of the effects of vessel noise on humpback whales summering in Alaska, Baker and Herman (1989) demonstrated a number of significant responses including increases in dive durations and orientation away from the path of moving boats, often at ranges of up to 3-4 km (1.8-2.5 mi).

Summary of responses to vessel noise

Noise associated with vessel activity will temporarily increase in the action area during Apache's Cook Inlet Seismic Program as a result of the operation of eight vessels. To minimize the effects of noise associated with vessel activity on beluga whales, western DPS Steller sea lions, and humpback whales in the area, Apache will follow NMFS's Marine Mammal Viewing Guidelines and Regulations (NMFS 2008d) and will alter heading or speed to prevent approaching within viewing guideline distances from protected species. The addition of noise due to vessels associated with the seismic program would not be outside the present experience of belugas, sea lions, or humpback whales in Cook Inlet, although vessel noise levels may increase locally. Given the large number of vessels in Cook Inlet (and the apparent habituation to vessels by Cook Inlet belugas), vessel noise associated with the proposed action is expected to have no more than an insignificant effect upon Cook Inlet beluga whales, western DPS Steller sea lions, and humpback whales.

6.1.1.4 Effects from Aircraft Noise

Helicopters will be used for support and transport during Apache's Cook Inlet Seismic Program. Noise associated with aircraft may affect marine mammals in the action area; however, a large amount of acoustic energy is reflected when sound is transmitted from air to water (Richardson et al. 1995; Blackwell and Greene 2002). Underwater received sound levels from noise associated with aircraft depends on the aircraft altitude, aspect and strength of the source; the marine mammal's depth; and propagation characteristics of the waterbody (e.g., water depth and bottom characteristics; Richardson et al. 1995). Sound is generally reflected at angles greater than 13 degrees and does not penetrate the water beyond that angle. This is particularly true during calm sea conditions, deep water, or shallow water with a non-reflective bottom (Richardson et al. 1995).

Marine mammal responses to aircraft noise depend on the type of aircraft, flight pattern, altitude and the activity of the animal (Richardson et al. 1995); however, visual cues may also play a role in marine mammal's reactions to nearby aircraft (Richardson et al. 1995).

Beluga responses to aircraft noise

Responses to aircraft by odontocetes may include changes in surfacing intervals, diving patterns, direction, behavioral states and temporary displacement (Richardson et al. 1995; Patenaude et al. 2002; Smultea et al. 2007). Beluga whale responses to aircraft are variable (Richardson et al. 1995). Some belugas reacted to aircraft flying at altitudes of 500 m (1,640 ft) by diving, while

others did not respond. More often, belugas responded when aircraft flew at altitudes of 150-200 m (490-690 ft). Responses to aircraft at this altitude included longer dives, shorter surfacing intervals and displacement (Bel'koich 1960; Kleinenburg et al. 1964). Belugas engaged in foraging appeared less disturbed than individual whales. Individual whales often dove in the presences of the aircraft. Patenaude et al. (2002) observed beluga whale responses to both a helicopter (Bell 212) and a fixed-winged aircraft (Twin Otter). Belugas responded more often to the helicopter than the fixed-winged aircraft. Responses to the helicopter included sudden dives, change in direction, change in behavioral state and displacement. Responses to the helicopter occurred more frequently when the helicopter flew at altitudes less than 150 m (490 ft) and a lateral distance of less than 250 m (820 ft). When the fixed-winged aircraft flew directly overhead at altitudes of less than 182 m (600 ft), beluga responses included abrupt dives, change in swimming speed and behavioral states.

Steller sea lion responses to aircraft noise

The majority of observations of pinnipeds reacting to aircraft noise are associated with haul-out sites on land or ice. There are very few data describing the reactions of pinnipeds in water to aircraft (Richardson et al. 1995). In the presence of aircraft, pinnipeds hauled out for pupping or molting generally became alert and then escaped into the water. The greatest reactions from hauled out pinnipeds were observed when low flying aircraft passed directly above the animal(s) (Richardson et al. 1995).

Western DPS Steller sea lions have been observed rushing into the water at haul-out sites in the presence of an aircraft (Calkins 1979; NMFS 2008b); however, immature or pregnant females entered the water more often than territorial males and females with pups (Calkins 1979). Withrow et al. (1985, as reported in Richardson et al. 1995) observed a large group of Steller sea lions rush from the beach into the water in response to a Bell 205 helicopter approximately 1.6 km (1 mi) away.

Humpback whale response to aircraft noise

As with watercraft, humpback whales react inconsistently to aircraft. Reactions are thought to depend upon whale group size and composition (Richardson et al. 1995), with larger groups tending to be less reactive, but with all-adult groups being more reactive. Humpback whales have been observed to react to aircraft at 305 m altitude, but elsewhere showed no reaction to aircraft at half that height (Shallenberger 1978).

Summary of responses to aircraft noise

Noise associated with aircraft activity will temporarily increase in the action area during Apache's Cook Inlet Seismic Program. Although noise associated with aircraft activity could cause hauled out Steller sea lions to rush into the water, it is not likely large numbers of Steller sea lions will be affected by the aircraft noise because there are no known haul-out sites or rookeries in the action area. Additionally, Apache will follow NMFS's Marine Mammal Viewing Guidelines and Regulations, and has committed to altitude restrictions (staying above 1000 ft) and avoiding flying directly over marine mammals. Thus, aircraft noise associated with the proposed project is expected to be insignificant, and the probability of take occurring as a result of aircraft noise is expected to be discountable for Cook Inlet beluga whales, western DPS Steller sea lions, and humpback whales in the action area.

6.1.1.5 Summary of Direct Effects from Noise

Components of the planned monitoring and mitigation measures for the seismic program are designed to avoid exposing them to sound that could potentially cause hearing impairment (e.g., visual monitoring within and beyond power-down and shut-down zones) and minimize disturbance (e.g., avoidance of Susitna Delta Exclusion Zone). In addition, mitigation guns will be used operating on the assumption that mitigation gun noise will encourage marine mammals to vacate an area prior to operational acoustic output from airgun arrays.

The proposed mitigation measures reduce the risk of exposing beluga whales, western DPS Steller sea lions, and humpback whales to noise exceeding 180/190 dB; however, it is possible that undetected beluga whales, and to a lesser degree Steller sea lions or humpback whales, could be exposed to noise greater than or equal to 180/190 dB. Apache requested MMPA authorization for 30 Cook Inlet beluga and 20 Steller sea lion behavioral harassment (Level B) takes for 2013 and 2014. Due to mitigation and monitoring measures, Apache reported no takes of either Cook Inlet belugas or western DPS Steller sea lions during those years. Visual observers for SAExploration, likewise, reported no takes of beluga whales in 2015, but PAM operators reported one instance of beluga take that was undetected by visual observers.

Apache reported they observed two humpback whales within the 180 dB cetacean exclusion zone during seismic operations, indicating Level A take of these animals (Lomac-MacNair et al. 2014). Assuming seismic shots were fired at 15 second intervals, and the whales traveled directly towards the source at the average cruising speed of a humpback whale (4.0 km/hr) (Noad and Cato 2007), then this whale would have been exposed to at least 19 shots while it was within the exclusion zone prior to shut-down; 19 shots exceeding the 180 dB threshold for unauthorized Level A take. Apache intends to continue the mitigation and monitoring methods for 2016-2021 activities. Temporary behavioral disturbances, TTS, compromised communications, and localized displacements are the most likely effects to occur.

6.1.2 Direct Injury

Ship Strikes

Vessel traffic in Cook Inlet will temporarily increase to support the seismic program. However, there will only be eight additional vessels necessary for this project. The increase in vessel activity will occur throughout the project area. Vessel collisions can result in possible serious injuries or death. Beluga whales may display avoidance reactions when approached by watercraft, particularly small, fast-moving craft that can maneuver quickly and unpredictably.

Larger vessels that do not alter course or speed around these whales seem to cause little, if any, reaction (NMFS 2008a). Beluga whales are regularly observed in and around the Port of Anchorage (Rugh et al. 2005a; Cornick and Kendall 2008; Cornick and Saxon-Kendall 2009; POA 2009; Cornick et al. 2010) passing near or under vessels (Blackwell and Greene 2002), indicating that these animals may have a high tolerance of large vessel traffic. However, smaller boats that travel at high speed and change direction often present a greater threat and can elicit a more pronounced reaction from the whales.

From 1978-2011, there have been 25 documented whale fatalities resulting from ship collisions (Neilson et al. 2012); 86 percent of vessel strikes in Alaska involved humpback whales. In most

cases, the fate of struck whales remains unknown, but 17 humpback whales are known to have been struck and killed, while three others suffered severe injuries (Neilson et al. 2012). Most of these collisions occurred in southeast Alaska, well outside of the proposed action area.

Despite the regularity of vessel movement in and out of Cook Inlet, ship strikes have not been definitively confirmed as causing a Cook Inlet beluga whale death (NMFS 2008a), although such a death is suspected in at least one instance. Because of their slower speed and linear movement, large vessels, such as those to be used in the seismic program, are not expected to pose a substantial threat to Cook Inlet beluga whales (NMFS 2008a) or to western DPS Steller sea lions.

Project vessels will be operating at a slow speed (2-4 kts) and in a purposeful manner transiting to and from work sites in as direct a route as possible. Marine mammal monitoring observers will alert vessel captains as animals are detected to ensure safe and effective measures are applied to minimize whale impacts. If necessary to avoid a collision (and to reduce the potential for a marine mammal entering the 180 dB zone), the captains may alter course and speed to avoid a collision or encounter with a marine mammal.

Falling/Ascending Nodes

Given the low density of all protected marine mammals in Cook Inlet and the mitigation measures associated with this project, the probability that a marine mammal may be taken by a falling or ascending node is extremely small.

6.1.3 Water Pollution

Oil spills are a significant concern with regard to offshore oil and gas production, petroleum product shipment, and general vessel traffic. The operation of marine vessels during the seismic program will increase the risk of marine fuel spills from leaks or breaks in vessel fueling equipment, vessel collisions or sinking, mechanical or structural failures, or human errors such as leaving valves open. Onshore storage of fuel will also present a risk for a spill of fuel or other hazardous materials; however, storage sites will be positioned away from waterways and lakes, and located in modern containment enclosures with a capacity 125 percent the total volume of stored fuel. Standard best management practices will be in place to reduce the potential for these accidents to occur.

6.1.4 Substrate Disturbance

While it is difficult to quantify the importance of various habitats in terms of Cook Inlet beluga whale health, conservation, and recovery, certain areas appear to be particularly important. The topography and water depth in river mouths is believed to be very important to beluga feeding. Beluga whales use the shallow water and river channels to aid in chasing and trapping fish. Although much of the nearshore area to be surveyed is shallow, it is available to beluga whales and assumed to provide some habitat values. Beluga whales generally move up to Upper Cook Inlet in the summer, and disperse more across the mid inlet and along the western shore in fall and winter. As previously discussed, Steller sea lions' and humpback whales' use of the habitats in the action area is rare.

The seismic program will likely cause minor disturbance of Cook Inlet beluga whale critical habitat as a result of the placement and removal of nodes on the seafloor. However, since Cook

Inlet is a large and dynamic system, habitat disturbance from the nodes being placed on the seafloor is insignificant, and the probability of lasting effects is discountable. Furthermore, node placement will be localized as seismic activity will only operate in a small area (a patch) at a time, and will be scheduled around windows of opportunity (see Figure 2) to reduce the potential for significant impacts to individuals or groups of marine mammals.

6.1.5 Predation

Killer whales are the only natural predators of beluga whales and western DPS Steller sea lions in Cook Inlet (Allen and Angliss 2013). Beluga whale stranding events have also been associated with the presence of killer whales, and Native hunters believe that beluga whales intentionally strand themselves in order to escape killer whale predation (Huntington 2000). Killer whale predation has been reported to have the potential to significantly impact Cook Inlet beluga whale and western DPS Steller sea lion populations (Heise et al. 2003; Shelden et al. 2003), but we are unaware of any reports of predation on humpback whales by killer whales in Cook Inlet.

Prior to 2000, NMFS estimated that killer whales accounted for one beluga mortality per year. There were 18 reported killer whale sightings in upper Cook Inlet from 1985-2002 (Shelden et al. 2003), and 15 sightings from 2001 through 2015. From 2001-2012, three Cook Inlet beluga whales were reported as preyed upon by killer whales (NMFS unpublished data). During 15,000 hours of land-based observations from LGL's beluga monitoring projects in Cook Inlet, Alaska (covering areas from Knik and Turnagain Arms south to Ladd Landing), there were no additional killer whale observations recorded (T. McGuire, LGL, pers. comm. August 2, 2011).

The anecdotal reports of stranded beluga whales during times when killer whales were in the area, and the TEK that indicates belugas intentionally strand themselves to avoid killer whale predation suggest that Turnagain Arm and Knik Arm serve as refuge from predators. Preventing access to these habitats (e.g. by creating sonic barriers) may increase the likelihood of predation events occurring.

6.1.6 Stranding

There is no conclusive evidence of cetacean strandings or deaths at sea as a result of exposure to seismic surveys, but a few cases of stranding in the general areas where a seismic survey was ongoing have led to the suggestion of a possible link between seismic surveys and strandings. In one case, the suggestion of a link between seismic surveys and strandings of humpback whales in Brazil (Engel et al. 2004) were not well founded (IAGC 2004; IWC 2007). In September 2002, there was a stranding of two Cuvier's beaked whales in the Gulf of California, Mexico, when the L-DEO seismic vessel R/V *Maurice Ewing* was operating a 20-airgun, 8,490-in^3 airgun array in the general area. The evidence linking the stranding to the seismic survey was inconclusive and not based on any physical evidence (Yoder 2002). The ship was also operating its multi-beam echo sounder at the same time, but this had much less potential than the aforementioned naval sonars to affect beaked whales, given its downward-directed beams, much shorter pulse durations, and lower duty cycle. Nonetheless, the Gulf of California incident and the beaked whale strandings near naval exercises involving use of mid-frequency military tactical sonar suggest a need for caution in conducting seismic surveys in areas occupied by beaked whales until more is known about effects of seismic surveys on those species (Hildebrand 2005). However, it is unlikely that effects such as gas-bubble disease seen in beaked whales, which are

deep-diving cetaceans, would be the same for the relatively shallow diving Cook Inlet beluga whales.

Heide-Jorgensen et al. (2013) reported the deaths of narwhales, a toothed cetacean in the same family as the beluga whale, due to entrapment in sea ice in Baffin Bay, Canada. They postulate from the general proximity in space and time of these strandings that there was a causal connection with seismic surveys operating in the Bay. While the seismic operations at issue were reported to be within 200km of the whales, the authors stated that "there is little doubt that the pulses were audible to narwhals". They were unable to establish a clear relationship between these events, but recommended extreme caution in conducting seismic surveys in or in close proximity to narwhal summering grounds and migratory routes.

Finally, there is anecdotal evidence that a humpback whale may have been temporarily stranded in Cook Inlet following exposure of a humpback (possibly the same whale) to level A take from Apache's seismic operations in April of 2014.

6.2 Indirect Effects of the Action

Indirect effects defined under the ESA are effects from the proposed action that occur later in time (after the cessation of the activity), but are still reasonably certain to occur. Such effects may include reduction in prey availability due to effects of seismic surveys on prey populations in Cook Inlet. We cannot foresee other indirect effects that are not inter-related or interdependent upon this project.

6.2.1 Prey Availability

There are two sensory systems that enable fish to monitor the vibration based information of their surroundings. The two sensory systems, the inner ear and the lateral line, constitute the acoustico-lateralis system. Although the hearing sensitivities of very few fish species have been studied to date, Popper and Carlson (1998) and the Department of the Navy (2001) found that fish generally perceive underwater sounds in the frequency range of 50–2,000 Hz, with peak sensitivities below 800 Hz.

Fish are sensitive to underwater impulsive sounds due to swim bladder resonance. As the pressure wave passes through a fish, the swim bladder is rapidly squeezed as the high pressure wave, and then the under pressure component of the wave, passes through the fish. The swim bladder may repeatedly expand and contract at the high sound pressure levels, creating pressure on the internal organs surrounding the swim bladder. Literature relating to the impacts of sound on marine fish species can be divided into the following categories: (1) Pathological effects; (2) physiological effects; and (3) behavioral effects. Pathological effects include lethal and sub-lethal physical damage to fish; physiological effects include primary and secondary stress responses; and behavioral effects include changes in exhibited behaviors of fish.

Behavioral changes might be a direct reaction to a detected sound or a result of the anthropogenic sound masking natural sounds that the fish normally detect and to which they respond. The three types of effects are often interrelated in complex ways. For example, some physiological and behavioral effects could potentially lead to the ultimate pathological effect of mortality. Hastings and Popper (2005) reviewed what is known about the effects of sound on

fishes and identified studies needed to address areas of uncertainty relative to measurement of sound and the responses of fishes.

The level of sound at which a fish will react or alter its behavior is usually well above the detection level. Fish have been found to react to sounds when the sound level increased to about 20 dB above the detection level of 120 dB (Ona 1988); however, the response threshold can depend on the time of year and the fish's physiological condition (Engas et al. 1993).

Information on effects of sound upon prey items of the Cook Inlet beluga whale, western DPS Steller sea lion or humpback whale is limited. No seismic survey-related acoustic impact studies have been conducted to date on the fish species most likely present during the summer months in Cook Inlet, but studies have been conducted on Atlantic cod (*Gadus morhua*) and sardine (*Clupea* sp.). Davis et al. (1998) cited various studies and found no effects to Atlantic cod eggs, larvae, and fry when received levels were 222 dB. But effects were found upon larval fish when they were within about 5.0 m (16 ft) from the sound source (air guns with displacement volumes between 49,661 and 65,548 cm^3 [3,000 and 4,000 in^3]). Similarly, effects to sardine were greatest on eggs and two-day-old larvae, but these effects were greatest at 0.5 ft (1.6 ft), and were limited to within 5.0 m (16 ft) of the sound source. Greenlaw et al. (1988) found no evidence of gross histological damage to eggs and larvae of northern anchovy (*Engraulis mordax*) exposed to seismic air guns, and concluded that noticeable effects would result only from multiple, close exposures. This suggests that acoustic injury to prey results from particle motion (which is typically very localized) rather than from sound waves.

Based on these results, the smaller displacement volumes of the seismic equipment to be used in this survey would not damage larval fish or any other marine mammal prey resource in Cook Inlet in significant numbers; the vast majority of susceptible prey fish will not occur within the very short distances at which particle motion may cause injury or mortality. Therefore we have determined that this action poses an insignificant risk to the prey species of Cook Inlet beluga whales, western DPS Steller sea lions, and humpback whales.

6.3 Interrelated and Interdependent Effects

Interrelated actions are actions that are part of a larger action and depend on the larger action for their justification. Interdependent actions are actions that have no independent utility apart from the proposed action (50 CFR 402.02).

6.3.1 Future Oil and Gas Development of Cook Inlet

If oil and gas are discovered by the proposed Cook Inlet Seismic Program in the action area, additional oil and gas development will likely take place. This development will likely make use of existing infrastructure found in the action area and any associated development with a Federal nexus would require federal authorization that is subject to consultation with NMFS to reduce any impacts on listed and protected species. Future oil and gas development could result in the input of additional noise and risk of contamination into the environment of Cook Inlet beluga whales, Steller sea lions, and humpback whales. Extraction of additional fossil fuels is also likely to exacerbate climate change with unknown consequences for these listed species.

6.3.2 Future Oil Spills

If, in the future, Apache or another company undertakes oil and gas development because of seismic data obtained as part of this project, there will almost certainly be an increased potential for oil spills in Cook Inlet, due to the wells themselves, transfer facilities, or increased ship traffic. However, the probability of an oil spill from future Apache operations cannot be determined because it remains unknown whether viable quantities of oil or gas will be discovered and such development is pursued. Regardless of the outcome, seismic exploration will certainly not result in a decrease in anthropogenic threats to listed marine mammals in Cook Inlet, especially Cook Inlet beluga whales.

6.4 Exposure Analysis

The primary concern associated with the impacts of the proposed action on the listed species is effects due to noise. There remains uncertainty about the potential impacts of sound on marine mammals, on the factors that determine response and effects, and especially on the long-term cumulative consequences from increasing noise in the world's oceans from multiple sources (NRC 2005). Anthropogenic noise can result in take of marine mammals through temporary or permanent hearing impairment or loss, discomfort or injury. It can also result in take when it masks other sounds that inhibit the marine mammals' ability to communicate, detect threats, or echolocate. Beluga whales can adjust their echolocation and communication frequencies to compensate for masking sounds, but it is more difficult to mitigate for sounds that mask approaching predators. Erbe (2000) predicted low speed vessels could mask killer whale sounds at a range of 1 km, possibly increasing vulnerability of Cook Inlet beluga whales and western DPS Steller sea lions to predation. However, we have no evidence that seismic activity makes these listed species more vulnerable to predation. In addition, the incidence of killer whale predation on marine mammals in upper Cook Inlet is believed to be low.

The tendency of beluga whales to congregate increases the likelihood of exposure of large numbers of individuals in a short amount of time. Studies have estimated 100 or more beluga whales may occur in Knik Arm at one time; approximately thirty-five percent of the total population. The Susitna Delta is heavily used by Cook Inlet belugas when salmon runs there are at their peak. Rugh et. al (2010) reported that over 95 percent of all Cook Inlet beluga whales are found north of a line between the Beluga River and Pt. Possession during summer. The applicant's avoidance of essential habitats during periods of heavy use by beluga whales reduces the likelihood of exposing listed marine mammals to harmful levels of underwater noise.

Take is less obvious, but may still occur, when exposure to anthropogenic sounds affects energetics, productivity, reproduction, and recruitment. NMFS is currently developing more comprehensive guidance on sound levels likely to cause injury and behavioral disruption to marine mammals. Until formal guidance is available, NMFS uses the following conservative thresholds of underwater sound pressure levels from broadband sounds that cause behavioral disturbance (MMPA Level B take thresholds):

- impulsive sound: 160 dB re 1 μPa_{rms}
- continuous sound: 120 dB re 1μPa_{rms}

NMFS uses the following conservative thresholds of underwater sound pressure levels that cause injury (MMPA Level A take thresholds):

- 180 dB re 1μPa_{rms} for whales
- 190 dB re 1μPa_{rms} for pinnipeds

Far-field Effects

There remains some concern over undetectable or difficult-to-detect far-field effects of anthropogenic noise on marine mammals, manifested as animal reactions well beyond the border of 160 dB disturbance zones. The number of animals that may exhibit such far-field effects is probably dependent on many factors as reaction to sound is often context specific and may depend upon species, sound propagation characteristics in the regional marine system at that time, animal group size, location, age and gender (Ellison et al. 2011, McCauley et al. 2000, Richardson et al. 1986, Wartzok et al. 2004). There is concern that whales may not approach feeding areas if that would necessitate travelling closer to, or past areas of intense anthropogenic noise. The beluga is a species that has shown long-distance avoidance of seismic vessels in the St. Lawrence River in eastern Ontario, Canada. Aerial surveys conducted in the southeastern Beaufort Sea in summer found that sighting rates of belugas were significantly lower at distances 10–20 km compared with 20–30 km from an operating airgun array (Miller et al. 2005). The low number of beluga sightings by marine mammal observers on the source vessel supports the assertion that belugas avoided the sound from the 2250 in^3 airgun array; however, it is unclear if the observed movement of the belugas was a direct consequence of the seismic surveys or related to the natural offshore migration at that time of year. More recent seismic monitoring studies in the same area seem to confirm that the apparent displacement effect on belugas extends farther than has been shown for other small odontocetes exposed to airgun pulses (e.g., Harris et al. 2007).

However, as described previously, Cook Inlet belugas may exhibit more apparent tolerance to noise or disturbance in feeding areas than other belugas, and have remained in these areas despite significant disturbance (e.g., the continued occupation of the Susitna Delta by feeding beluga whales despite their being actively pursued and hunted during past subsistence harvests). This persistent use may speak to the unusually high value of this habitat to the beluga whales such that the whales are compelled (calorically forced) to tolerate the disturbance, rather than their heightened tolerance of disturbance relative to other beluga populations. Apache's observance of the Susitna Delta Exclusion Zone, as defined in the Incidental Take Statement for this Biological Opinion, should sufficiently mitigate effects of this action on whales within that essential habitat zone.

Beluga whales' reaction to sound stimuli is often a product of recent experiences associated with loud noise, and is not solely a reaction to the noise itself (Wartzok et al. 2004; Southall et al. 2007). Therefore, lack of seismic exploration activity within the Susitna Delta Exclusion Zone during the high beluga whale-use period will minimize stress to the animals and negative associations between that valuable habitat and harassment due to seismic survey noise. Given the proposed project's mitigation measures, it is unlikely that noise associated with this seismic survey will cause beluga whales to abandon valuable Susitna Delta habitat, or alter their feeding or breeding behavior to a degree that would result in measurable population-level effects.

Ambient vs. Anthropogenic Noise

It is likely the reactions of listed species to in-water noise do not tightly follow the 120/160/180 dB cetacean, or 120/160/190 dB pinniped step function that NMFS currently recognizes as the

thresholds for take by continuous-noise harassment, impulsive-noise harassment, and injury, respectively. This is especially true when one considers that ambient underwater sound levels in the Cook Inlet can meet or exceed 120 dB threshold. Ambient noise in Cook Inlet, recorded as high as 132 dB (Blackwell and Greene 2002), is typically comprised of physical noise from wind, waves at the surface, currents, ice, and atmospheric noise. It may also include sounds produced by marine mammals, fish, and invertebrates. We note, however, that ambient noise in Cook Inlet is also frequently below 120 dB, and it may be that these quiet periods are especially important to belugas to carry on their necessary life functions (e.g. echolocation for feeding, communication associated with breeding).

Despite the high ambient noise level of Cook Inlet, anthropogenic noise associated with this project is likely to adversely affect Cook Inlet beluga whales, western DPS Steller sea lions, and humpback whales due to the high intensity noise from the seismic survey equipment. Reactions of these listed species to seismic survey noise are expected to vary, with some individuals exhibiting a pronounced response or experiencing harm of biological significance (e.g. disruption of mating, PTS, abandonment of important habitat, reduced foraging efficiency, reduced ability to detect and avoid predators), most individuals exhibiting a moderate response, typically with difficult- to- measure biological consequences (changes in direction of travel, travel velocity, vocalization frequency, and/or breathing patterns), and some individuals exhibiting no detectable response.

Changes in Habitat Use

Field observations (Funk et al. 2005) have noted higher percentages of calves within beluga groups in Knik Arm than in the Susitna River area. Traditional ecological knowledge (TEK) has also identified upper Knik Arm as a traditional nursery site. The presence of juveniles and calves in Knik Arm indicates that the whales are able to swim past anthropogenic sound sources (e.g., noise from port construction and operations, vessel traffic, military training activities, aircraft, etc.) to access habitats in Eagle Bay, Goose Bay, and other potential nursery areas in Knik Arm.

Morton and Symonds (2002) describe the effects of acoustic harassment devices on killer whales in Johnstone Strait near Vancouver Island. Operation of those devices resulted in a marked decrease in the numbers of killer whales in the area. The harassment devices operated at 10 kHz, a frequency that would be particularly sensitive to mid-frequency cetaceans such as killer whales and beluga whales. However, when the use of the devices ended, killer whale occurrence re-established to baseline levels. The rapid response to the cessation of noise exhibited by killer whales is a trait we expect to be shared by Cook Inlet beluga whales. We similarly find that any diminished use of habitat in the action area due to seismic survey noise associated with this proposed action is likely to be temporary, reverting to normal use upon cessation of seismic survey activities. We therefore conclude that there is a low probability that whales would abandon or fail to reoccupy any portion of their habitat upon the cessation of seismic activity.

Changes in Behavior

Behavioral changes that could result from exposure to the proposed action may include avoiding the sound source by navigating around it, or altered swimming velocity or breathing patterns while passing through the ensonified area. Anthropogenic disturbance may evoke reactions similar to those associated with the appearance of a predator. High levels of predation risk (or human disturbance) may indirectly affect survival and reproduction by causing prey (e.g. beluga

whales or Steller sea lions) to divert a large proportion of time and energy away from resource acquisition, so that body condition deteriorates and survival and reproductive success are reduced (Frid and Dill 2002). Similar effects can be induced by human activity that causes beluga whales or Steller sea lions to divert time and energy away from feeding or other critical life functions.

For the beluga whales, communication effects could be partially mitigated by their ability to adjust their call frequencies to circumvent the masking effects of seismic survey noise. Beluga whales have been found to adjust their echolocation clicks to higher frequencies in the presence of background noise as well (Au et al. 1985).

The areas most affected by noise from the proposed seismic surveys do not include primary feeding habitats, except where there is limited overlap with the Susitna Delta Exclusion Zone. Otherwise, the ensonified area is comprised of non-primary feeding habitat, waters used for transit between areas of high value, and resting habitats. Survey areas that do not ensonify high value habitats to 160 dB are not likely to cause a detectable loss of productivity. We note that the observations from the POA monitoring and TEK indicate that some level of Cook Inlet beluga whale use of important habitats continues despite the presence of disturbing stimuli. Beluga hunters report that the whales did not leave the feeding areas off the Susitna River during the spring even as their hunt progressed. It is unknown whether persistent use of these areas in the presence of masking anthropogenic noise makes the animals more vulnerable to predation or increases deleterious stress hormones. It is also unknown whether any animals driven away from essential habitat due to anthropogenic activities experience reduced productivity due to reduced foraging efficiency or caloric intake. It is also unknown whether the presence of anthropogenic noise may discourage some animals from moving into essential habitats in the first place, with the anthropogenic noise creating something akin to a sonic barrier. We have no data to indicate whether these effects exist, but a precautionary approach would indicate that the notion of a sonic barrier could exist, and avoiding the creation of such a barrier should be avoided.

Our assessment of possible behavioral response to the proposed action also considered site fidelity by beluga whales. Site fidelity likely exists among Cook Inlet beluga whales, especially to several upper-Inlet sites during the ice-free months, but few data exist regarding any demographic divisions within this population. Fidelity to habitat patches is strong within some other beluga populations (e.g., St. Lawrence), and less so with other populations such as the Eastern Beaufort Sea beluga whale stock. Rugh et al. (2010) found Cook Inlet beluga distribution has changed during recent decades, and suggested this may be due to their reduced numbers, which results in whales selecting only the most productive habitat areas, manifesting as a reduction in range. Rugh et al. (2010) compared the phenomenon to the draining of a basin. While any reduction in use of mid and lower Cook Inlet habitat might be offset by decreased intra-specific competition for high quality habitat in the extreme upper inlet, range restriction in endangered species is generally not regarded as a sign that the species is recovering.

6.5 Risk Analysis

Numerous studies on the ecology of populations have demonstrated the relationship between a population's productivity, population level, and distribution, and a population's risk of extinction. In the absence of behavioral responses that reduce a population's productivity,

numbers, or distribution, the information available leads us to conclude that exposure to the Apache seismic operation activities are likely to elicit short-term responses in Cook Inlet beluga whales and western DPS Steller sea lions. The activities, as described, are not known to have any long-term, adverse consequences for the biology or ecology of the individuals exposed. However, the opposite can also be said; there is no information that leads us to conclude a complete lack of long-term consequences. We expect at least some temporary displacement from the immediate area around seismic operations that is not likely to be life threatening. We conclude that, with the implementation of the project mitigation measures and the Incidental Take Statement's terms and conditions, this project will not likely affect the recovery of these listed species.

We expect the effects of this project will be temporary in nature (e.g., TTS, behavior changes). Therefore, we expect that there is little risk that the issuance of an IHA for Apache's seismic exploration operations would reduce the likelihood of Cook Inlet beluga whales surviving or recovering in the wild.

We expect the level of harassment take for Steller Sea lions to be very low relative to the size of the population. from Apache's proposed activities to be considerably lower than the 75 western DPS Steller sea lions that NMFS PR1 proposed to authorize each year (80 FR 9510); The risk of adverse impact to western DPS Steller Sea lions in the action area is very small, given the rarity of this listed species in these waters (0.5 animals per year in Cook Inlet reported to NMFS, none seen in the action area during NMFS aerial surveys since 1996, and at most 4 animals seen in a given year by Apache-affiliated observers). We are unaware of reported interactions between humans and western DPS Steller sea lions in Cook Inlet beyond those described in ASRC (2014), where harassment of the animals by seismic activity was avoided due to implementation of mitigation measures.

While there is evidence that a humpback whale adult and calf experienced seismic airgun array sound greater than 180 db (sufficient to cause harm), aerial survey data indicates that such an event occurring in the first place was unlikely. With the implementation of mitigation measures and non-discretionary terms and conditions outlined in this Biological Opinion, we conclude that a repeat of this most unusual and unexpected event is unlikely to reoccur.

6.6 Summary of Effects of the Action upon Listed Species

Sound

Due to the potential for exposure of Cook Inlet beluga whales, western DPS Steller sea lions, and humpback whales to noises at or above 160 dB, AKR concurs with the determination that noise from the use of airgun arrays and other seismic equipment associated with the proposed seismic program may affect, and is likely to adversely affect these species. The effects from seismic equipment noise could be exacerbated if it occurs in proximity to other anthropogenic noise sources such as pile driving at the Port of Anchorage or Port McKenzie or other seismic surveys. We have determined that the risk of take caused by vessel noise absent the operation of seismic exploration equipment to be both insignificant and discountable.

Aircraft associated with this action will undertake sufficient mitigation measures to minimize disturbance to listed species in Cook Inlet. The stated horizontal and vertical distances that will

be maintained from observed animals leads us to conclude that aircraft will result in only insignificant additional levels of disturbance beyond that caused by existing aircraft traffic in the region.

Injury

While belugas exhibit some signs of vessel interaction in Cook Inlet (prop scars, possible blunt trauma), the project vessels will be implementing mitigation measures (e.g. constant watch during daylight hours by qualified PSOs, slow vessel velocity, no abrupt changes in course or heading except to avoid interactions with protected species). Therefore, NMFS AKR concludes that the probability of injury due to vessel interaction is discountable. The probability of a listed marine mammal adversely interacting with seismic nodes is also discountable.

Pollution

Increased vessel activity in the action area from the proposed Cook Inlet Seismic Program will temporarily increase the risk of accidental oil spills. Accidental oil spills may occur when a vessel leaks fuel or lubricants. They may also occur when unintentional spills occur at onshore storage or transfer facilities. Such spills have been few in number and small in volume thus far in Cook Inlet oil and gas operations. Therefore, based on history and existing operating procedures, we have determined that there will be insignificant impacts from an oil spill on beluga whales, western DPS Steller sea lions, or humpback whales in the action area. Furthermore, the chance of an oil spill of sufficient size to affect Cook Inlet beluga whales, western DPS Steller sea lions, or humpback whales occurring in association with the seismic program is expected to be discountable. The pollution that will result from normal operation of project vessels is determined to be insignificant.

Substrate Disturbance

The proposed action has the potential to affect beluga whales through the disturbance of their habitat within the action area. Any habitat disturbance resulting from the placement and removal of the nodes will be temporary as the dynamic nature of Cook Inlet substrate will quickly erase any signs of node placement upon their removal. Therefore, we expect the habitat disturbance caused by this action will be insignificant to the Cook Inlet beluga whales, western DPS Steller sea lions, and humpback whales.

Predation

The proposed action has the potential to mask the sounds of approaching killer whales; the primary predator of beluga whales and a notable predator of western DPS Steller sea lions. In addition, the beluga conservation plan and draft recovery plan state that activities restricting or deterring access to the northern portions of Cook Inlet beluga whale designated critical habitat could reduce calving success, impair the ability to secure prey, and increase susceptibility to predation by killer whales (NMFS 2008a). However, the areas where belugas typically go to escape killer whale predation (the shallow areas of Knik Arm and Turnagain Arm) are outside the seismic survey area. Thus, we expect that the action will not prevent beluga access to Knik Arm or Turnagain Arm, provided access to those areas is not precluded by a combination of effects resulting from the proposed action and other sound-producing actions such as pile driving at the Port of Anchorage, Port MacKenzie, or seismic exploration by other vessels in the area. Given the low predation rates and few killer whale sightings in upper Cook Inlet in recent years, and the likelihood that beluga whales will have unrestricted access to predator avoidance habitat,

we conclude that the effects of the proposed action will have a discountable effect upon Cook Inlet beluga whales resulting from predation by killer whales.

We likewise consider the potential effects of this action upon predation of western DPS Steller sea lions to be insignificant and discountable due to the very low numbers of that species in the action area, and very low probability of Steller sea lions encountering killer whales within the action area as a result of this action. There is no record of killer whale predation upon the few humpback whales that venture into Cook Inlet, therefore the likelihood of this proposed action affecting predation upon humpback whales in the action area is considered discountable and insignificant.

Strandings

There is limited anecdotal evidence that airguns may have caused strandings of marine mammals in Cook Inlet. Stranding is part of the natural history of Cook Inlet beluga whales. While preying upon fish in shallow waters near river mouths, belugas occasionally strand when the local extreme tides recede. There is also anecdotal evidence that belugas may strand when killer whales are in the area. Stranding most commonly occurs on exposed mudflats in Knik and Turnagain Arms. Apache will not be conducting seismic operations in Knik and Turnagain Arms. Therefore, we conclude that the proposed action will have a discountable probability of causing strandings of Cook Inlet beluga whales. Stranding of Steller sea lions is not an issue of concern, but stranding of humpbacked whales is. There are conflicting reports of whether one or two humpback whales stranded near in space and time to seismic operations in April 2014, shortly after two humpback whales were exposed to level A take. It is difficult to draw well-supported conclusions about a single event in which none of the affected animals were either instrumented or well monitored. However, the project description, with its proposed mitigation measures, presents a precautionary approach to avoiding take of any listed marine mammal during daylight hours. In addition, PSOs will remain vigilant in their watch for this large and rather easily seen whale. Therefore, we have determined the likelihood of this rare-to-Cook Inlet-species stranding due to seismic exploration resulting from this project is discountable.

7. CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR 402.02 as: “those effects of future State or private activities not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation.” Cumulative effects are defined differently under the ESA than they are under NEPA (USFWS and NMFS 1998).

Reasonably foreseeable future federal actions and potential future federal actions that are unrelated to the proposed action are not considered in the analysis of cumulative effects because they would require separate consultation pursuant to section 7 of the ESA. Most structures and major activities within the range of the Cook Inlet beluga whale require federal authorizations from one or more agencies, such as the Corps, Environmental Protection Agency (EPA), the Bureau of Ocean Energy Management (BOEM) and NMFS. Such actions require consultation under the ESA on their effects to listed species, and are therefore not addressed here as cumulative impacts.

Although there are a number of actions without a federal nexus that may represent threats to the Cook Inlet beluga whale, the degree of impact from many of these threats on an individual and population is poorly understood (NMFS 2008a). Therefore, AKR recognizes that it is difficult to determine the overall cumulative effects these threats have on the Cook Inlet beluga whale. The following discussion describes the cumulative effects based on the best scientific and commercial data available. The actions described below could result in additional pollutants, vessel traffic, gas and oil spills, displacement from or loss of habitat and could contribute to the cumulative effects of the proposed Cook Inlet Seismic Program.

As with the Cook Inlet beluga whale, cumulative effects to western DPS Steller sea lions are likely a function of many factors yet the degree of effect from many of these factors is poorly understood (NMFS 2008b). The proposed project is located outside Steller sea lion critical habitat, there are no haul-outs or rookeries in the action area with large concentrations of western DPS Steller sea lions. In addition, western DPS Steller sea lions are rarely observed in the action area. Therefore, the cumulative effects discussed below from activities likely to take place in the action area will not contribute measurably to adverse effects on western DPS Steller sea lions. Likewise, humpback whales experience many potential stressors throughout their range but they are rarely observed in the action area, and we expect that the cumulative effects discussed below from activities likely to take place in the action area will not contribute measurably to adverse effects on humpback whales.

7.1 Fisheries Interactions

Fishing is a major industry in Alaska. As long as fish stocks are sustainable, subsistence, personal use, recreational and commercial fishing will continue to take place in Cook Inlet. As a result, there will be fishing-related potential prey competition, risk of ship strikes, potential harassment, potential for entanglement in fishing gear and potential displacement from important foraging habitat for the Cook Inlet beluga whales. NMFS and the ADF&G will continue to manage fish stocks and monitor and regulate fishing in Cook Inlet to maintain sustainable stocks. The effects of fishing-related vessel traffic on Cook Inlet beluga whale access to prey and feeding habitat remains unassessed.

7.2 Oil and Gas Development

Most of the existing oil and gas development in Cook Inlet occurs in the action area and it is likely that future oil and gas development in Cook Inlet will continue to take place in the action area. Impacts from oil and gas development include increased noise from seismic activity, well drilling, and vessel and air traffic; discharge of wastewater; habitat loss from the construction of oil and gas facilities; and contaminated food sources and/or injury due to petroleum releases. The risk of these impacts may increase as oil and gas development increases; however, new development will be subject to environmental analyses and, in all foreseeable circumstances, will entail an ESA section 7 consultation due to an existing Federal nexus.

Support vessels are required for transport of people and supplies to oil and gas development facilities and tankers are required to transport products to market. These support and transport vessels result in increased noise in the action area and increased risk of pollution and spills. The probability of a tanker spill is very small, but the effects of such a spill could be huge, as

evidenced by other tanker and transport vessel spills that have occurred in Alaska in recent decades.

7.3 Coastal Development

Coastal development may result in the loss of habitat, increased vessel traffic, increased pollutants, and increased noise associated both with construction and with the subsequent activities facilitated by the project. In the action area, mining and alternative (i.e. tidal) energy projects are under consideration. The POA is currently expanding its facilities and Port MacKenzie is scheduled to expand its facilities. These port facilities may have an effect on beluga whales in the action area due to increased vessel traffic passing through the area on their way to the ports. However, section 7 consultation for port expansion (port of Anchorage) and repair (Port MacKenzie) are underway or have been recently completed.

Chuitna Coal Project

Analysis of the proposed Chuitna Coal Project has appeared in other Cook Inlet-based Biological Opinions. However, we cannot foresee this project going forward without undergoing a section 7 consultation, and therefore it does not meet the definition of cumulative effects as defined in the Act, and we will not include it in our cumulative effects analysis

ORPC Alaska Tidal Energy Projects

ORPC is proposing two tidal energy projects in Cook Inlet. The first tidal energy project would be located on the west side of Fire Island (near Anchorage) and the second project would be located adjacent to the East Foreland in the vicinity of Nikiski on the Kenai Peninsula (ORPC 2011). The tidal energy projects would require the installation of an array of turbine generator units and transmission cables on the seafloor to harness the tidal energy. The tidal energy will be converted to electrical energy at stations on land. These projects are still in preliminary testing and environmental monitoring phases (ORPC 2010, 2011). There may be a Federal nexus associated with such a project, but that is uncertain at this time.

7.4 Pollution

As the population in urban areas continue to grow, an increase in the amount of pollutants that enter Cook Inlet is likely to occur. Hazardous materials may be released into Cook Inlet from vessels and aircraft. There is a possibility an oil spill could occur from vessels traveling within the action area, or that oil will migrate into the action area from a nearby spill.

Pollutants can pass from streets, construction and industrial areas, and airports into Cook Inlet and beluga habitat within the action area. Wastewater discharge, gas, oil, and coastal development projects also contribute to pollutants that enter Cook Inlet through discharge. These activities will continue to take place in Cook Inlet; therefore, it would be expected that pollutants could increase in Cook Inlet. However, the EPA and ADEC will continue to regulate the amount of pollutants that enter Cook Inlet from point and non-point sources through NPDES/APDES permits. As a result, permittees will be required to renew their permits, verify they meet permit standards and potentially upgrade facilities. APDES discharge waivers granted to permittees could result in adverse impacts to listed marine mammals, particularly Cook Inlet beluga whales.

There have been several past State oil and gas lease sales in Cook Inlet. Future sales are anticipated, including much of the submerged lands of Cook Inlet. While lease sales on State lands do not have an apparent Federal Nexus, they will require an ESA section 10 permit if they are expected to result in take, and the granting of such a permit typically requires development of a habitat conservation plan. Most other actions beyond the issuance of leases of state land are likely to have some Federal nexus. Location of drilling structures would require authorization from the Corps. Discharges such as muds and cuttings or produced waters require permitting through the EPA or ADEC. Oil and hazardous substance spills would be one example of an unauthorized activity.

7.5 Tourism/Whale Watching

There are no existing boat-based commercial whale-watching activities in upper Cook Inlet. The popularity of whale watching and the close proximity of beluga whales to Anchorage make it a theoretical possibility that such operations may exist in the future. However, it is unlikely this industry will reach the levels of intensity seen elsewhere because of upper Cook Inlet's climate and navigation hazards (e.g., shallow waters, extreme tides and currents, and associated human safety risks).

Vessel-based whale-watching may cause stress to the beluga whales through increased noise and intrusion into beluga habitat not ordinarily disturbed by boats. Avoidance reactions have often been observed in beluga whales when approached by watercraft, particularly small, fast-moving craft that are able to maneuver quickly and unpredictably; larger vessels which do not alter course or motor speed around these whales seem to cause little, if any, reaction (NMFS 2008a). The small size and low profile of beluga whales, and the poor visibility within Cook Inlet waters, may result in closer-than-intended approaches to beluga whales, closer than usually permitted for marine mammals. General marine mammal viewing guidelines would be adopted, and possibly enhanced, for any commercial beluga whale watching tours. Humpback whales and Steller sea lions are extremely unlikely to be a focal point for any such tours because they are so uncommon in Cook Inlet, and so common elsewhere in less hazardous and more picturesque waters.

7.6 Subsistence Hunting

Alaska Natives do not currently harvest Cook Inlet beluga whales. They do harvest harbor seals, however. These are typically boat-based hunts which could temporarily increase noise in the environment and increase the potential for accidental ship strikes of Cook Inlet belugas. The impact of harbor seal hunts on Cook Inlet beluga whales has not been assessed. Future hunts targeting Cook Inlet belugas will likely require federal authorization and are therefore not considered to be a cumulative impact.

8. INTEGRATION AND SYNTHESIS

Pursuant to Section 7(a)(2) of the ESA, federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed endangered and threatened species or result in the destruction or adverse modification of designated critical habitat. "Jeopardize the continued existence of" is defined in regulations as "to engage any action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both

the survival and recovery of listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02).

In this section, we assess the effects from the seismic program on Cook Inlet beluga whales, western DPS Steller sea lions, and humpback whales, and integrate those effects with the environmental baseline and cumulative effects. Finally, we consider the implication of those effects on the continued existence of these three listed species.

In particular, we examine the scientific data available to determine if an individual beluga whale, western DPS Steller sea lion, or humpback whale's probable responses to the action's effects are likely to have consequences for the individual's growth, survival, annual reproductive success, and lifetime reproductive success (i.e., fitness). When individual animals exposed to an action's effects are expected to experience reductions in fitness, we would expect reductions in the abundance, reproduction rates, and/or growth rates (or increase in the variance in these measures among affected animals) of the population those individuals represent. On the other hand, when animals are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the population's viability.

In determining whether individual Cook Inlet beluga whales, Steller sea lions, or humpback whales would be affected, it is necessary to analyze when, where, and how an animal would be exposed to activities associated with the seismic program. During our analysis, some assumptions were made about their habitats, hearing abilities, and behaviors to reach the conclusions. The ESA does not require scientific certainty. In this Biological Opinion, AKR has utilized the best available scientific data to evaluate the consequences from the seismic program.

In considering uncertainty, we are cautious to not speculate or make unsupported assumptions. We remain unable to relate take by harassment to changes in survival, productivity, fitness or population trends for listed species affected by this action. However, a reasonable impact assessment can still be conducted by considering the status of the population, population trends, each species reactions to harassment, the consequence of that reaction to individuals, the impact of those individual reactions to the species, and the degree of uncertainty in the relationship between harassments and changes in the species probability of survival and recovery.

Uncertainty is also considered as we manage risk. We know the continued survival of the Cook Inlet beluga is precarious, with a 26 percent probability of extinction within 100 years. The consequence of uncertainty in our ability to promote the survival and recovery of these whales is great. To avoid Type II errors, (i.e., concluding that the animal was not affected when in fact it was) in situations with many unknowns or uncertainties, a precautionary approach is warranted, whereby we assume an effect that may occur actually will occur. The acceptability of risk is a function of the status of the species/habitat in question; and for the Cook Inlet beluga whale, the threshold for acceptable levels of risk is quite low.

8.1 Synthesis

Humpback Whale

The action area is within the range of two humpback whale stocks that number over 8,000 and are increasing (minimum population estimates and trends: Central North Pacific population = 7,500 with a 7 percent growth rate; Western North Pacific population = 732, with a 6.5 percent

growth rate). Presence of humpbacks in the action area is rare, but has been documented. Most of these sightings were made by NMFS observers along the southern extent of the proposed action area. Lomac-MacNair et al. (2014) indicate that two humpback whales were subjected to Level A take in 2014 by Apache seismic surveys.

The proposed Cook Inlet Seismic Program is likely to adversely affect individual humpback whales in small numbers through acoustic harassment or harm. Proposed mitigation measures will help to reduce adverse effects to this species. Adverse effects could be further reduced through effective efforts to detect this species within the zone of harassment during seismic operations conducted between local sunset and sunrise. We have determined that passive acoustic monitoring is the most effective method available for monitoring during non-daylight hours, and are therefore requiring such monitoring under the Terms and Conditions in the Incidental Stake Statement.

This project is unlikely to affect the Central North Pacific or Western North Pacific stocks at the population level because humpback the proportion of humpback whales in the action area is small. For humpback whales affected by this action, the resulting harm would likely be temporary (e.g., TTS, behavior change), and would not affect any individual's fitness (ability to survive and reproduce). Therefore, the take of humpbacks due to this activity would not rise to the level that would measurably slow the recovery of this species. This project is expected to affect only very small numbers of humpback whales (harassment of up to 2 animals over the 5-year life of the project). Therefore, with the implementation of mitigation measures and non-discretionary terms and conditions issued in the Incidental Take Statement associated with this Biological Opinion, we expect no population level effects to this species resulting from the proposed seismic program.

Steller Sea Lion

The baseline condition of western DPS Steller sea lions in the central Gulf of Alaska region is one of low numbers and stable trend (population growth near zero) (Allen and Angliss 2014). Currently, the western DPS Steller sea lion population as a whole is estimated to be increasing at about 1.67 percent per year from 2000-2012. The presence of western DPS Steller sea lions in the action area is rare. Since 2004, NMFS systematic aerial surveys of Cook Inlet have documented one Steller sea lion observation within the action area; a group of 20 animals observed on June 10, 2006 (NMFS unpubl. data). Aerial surveys associated with past Apache efforts recorded 4 Steller sea lions in 2012. Other reported sightings of Steller sea lions in the action area of which NMFS is aware include only a few sightings of individuals or pairs, averaging 0.5 Steller sea lions observed per year.

The proposed seismic survey is likely to adversely affect Steller sea lions. Proposed mitigation measures will help to reduce adverse effects to this species. Adverse effects could be further reduced through effective efforts to detect this species within the zone of harassment during seismic operations conducted between local sunset and sunrise. We have determined that passive acoustic monitoring is the most effective method available for monitoring during non-daylight hours.

This action is unlikely to affect the western DPS Steller sea lions at the population level because: 1) western DPS Steller sea lions are rarely observed within the action area, 2) the proposed

project is located outside of Steller sea lion critical habitat, 3) there are no haul-outs or rookeries in the action area, and 4) mitigation measures will be implemented to reduce the impacts of seismic exploration activity on western DPS Steller sea lions. In the event that western DPS Steller sea lions are within the disturbance zone of the seismic vessels, noise from the airguns may adversely affect those individuals, but the resulting take would be temporary in nature (e.g., TTS, behavior change), would likely be limited to a single exposure, and thus would not affect any individual's fitness. As such, we do not expect that this action will affect the survival or recovery of this species. This project is expected to affect only very low numbers of western DPS Steller sea lions (harassment of 20 or fewer animals per year). Therefore, with the implementation of mitigation measures and non-discretionary terms and conditions issued in the Incidental Take Statement associated with this Biological Opinion, we expect no population level effects to this species resulting from the proposed seismic program, and the remaining discussion is specific to Cook Inlet beluga whales.

Cook Inlet Beluga Whale

The baseline condition of Cook Inlet beluga whales is characterized by its very low abundance, and unexpected lack of recovery despite discontinuation of the subsistence hunting that is believed to have resulted in its precipitous population decline. This species has a high (26 percent) probability of extinction within the next 100 years (Hobbs and Shelden 2008). Any additional mortality above those predicted in the population viability model would accelerate this extinction timeframe, even the removal of a single individual from the breeding population. At the same time, this species faces continuing, and perhaps increasing, natural and anthropogenic threats. Threats discussed in this Biological Opinion are summarized in Table 4.

The Cook Inlet beluga whale population can be considered to have collapsed and now lies within the "small population dynamics" phase of a population (Figure 17). In this phase, stochastic (random) events can have disproportionally large impacts on the population. Management of such populations warrants a precautionary approach to minimize the likelihood of causing such a stochastic event or making the population even more vulnerable to extinction as a result of stochastic events.

Beluga whales have a low productivity rate, have undergone range contraction within Cook Inlet, and occupy the most populated and developed region in the state. They experience many anthropogenic stressors, including habitat development, pollution, and harassment. These whales often occur in dense aggregations within small near shore areas, where they are predisposed to adverse effects such as oil spills, noise, directed take, pollution, ship strikes, and disease outbreaks. Live strandings are not uncommon for Cook Inlet beluga whales, and have resulted in deaths due to prolonged exposure. Killer whale forays into Upper Cook Inlet to feed on beluga whales is an example of the disproportionate impact associated with the "small population dynamics" phase. Should a killer whale pod take ten whales annually, a population with 1,000 or more animals and a positive population growth rate could likely sustain that level of removal. The current Cook Inlet beluga population, with its recent population trend, could not recover if, all else equal, killer whales increased their level of take by one or more individuals per year.

The longer a population exists within the "small dynamics" zone, the higher the extinction risk. Unfortunately, the Cook Inlet beluga may exist at this zone for some time because of its: 1) low abundance, 2) low growth potential, and 3) lack of observed recovery.

Table 4 lists and rates the severity of threats to Cook Inlet beluga whales, and is excerpted from the draft Cook Inlet Beluga Whale recovery plan. The only high significance threat on this list that is likely to result from this project is seismic exploration noise, although it is conceivable that this action could also influence two other high significance threats; live stranding rates and predation rates. The probability of seismic surveys affecting stranding rates and predation rates is unknown, but we have concluded that it is very low.

This proposed project is likely to adversely affect Cook Inlet beluga whales, primarily through acoustic harassment. Although we have no conclusive evidence of past acoustic-related injuries or deaths of Cook Inlet beluga whales, other marine mammals have been harmed and killed by underwater noise. Proposed mitigation measures will help to reduce the risk and degree of adverse effects to this species, including the immediate shut-down of survey operations in the event of a marine mammal stranding within 20 miles of a seismic sound source. Adverse effects due to loud underwater sound could be further reduced through effective efforts to detect this species within the zones of harassment and injury during seismic operations conducted between local sunset and sunrise. We have determined that passive acoustic monitoring is the most effective method available for monitoring during non-daylight hours, and are therefore requiring such monitoring under the Terms and Conditions in the Incidental Stake Statement.

In recent years, no lethal takes of Cook Inlet beluga whales have been authorized. A limited number of directed research projects have received low levels of authorized direct (non-lethal) take, but the remaining take authorizations have been for incidental take in the form of harassment only. Given AKR's extensive reviews of proposed activities' in Cook Inlet, and the effects of these activities upon CI belugas, the issuance of incidental take authorizations issued to date has not been a threat to the survival or recovery of Cook Inlet beluga whales.

Unauthorized harassment is likely occurring as a result of small vessels operations, aircraft overflights, and other actions by humans, but there is little data available to allow us to quantify the extent of, or effects of this harassment. We assume that the effects of such actions at the population level are small. We are unaware of any on-going lethal or injurious takes, although unobserved, unreported, and illegal harvests are possible, and observed scarring from vessel propellers suggests some interaction between Cook Inlet beluga whales and vessels. A low rate of entanglement with marine debris also occurs, with unknown effects.

This Biological Opinion has analyzed the effects of seismic survey noise, along with proposed mitigation measures and non-discretionary terms and conditions. AKR has determined that, with the implementation of proposed mitigation measures and implementation of the Reasonable and Prudent Measures and associated Terms and Conditions contained in this Biological Opinion, sufficient steps will be taken to ensure that this action will not have population-level effects on Cook Inlet beluga whales, and will not affect survival or recovery of the species. That is, we do not expect this action to affect productivity of individuals or cause any beluga mortalities. Effects to individual whales, if they occur, will be temporary in nature (behavioral changes, and possibly temporary threshold shifts in hearing). This is a particularly important conclusion given that recent population models for this species indicate that the loss of one additional whale above the environmental baseline could measurably affect the recovery rate of this species.

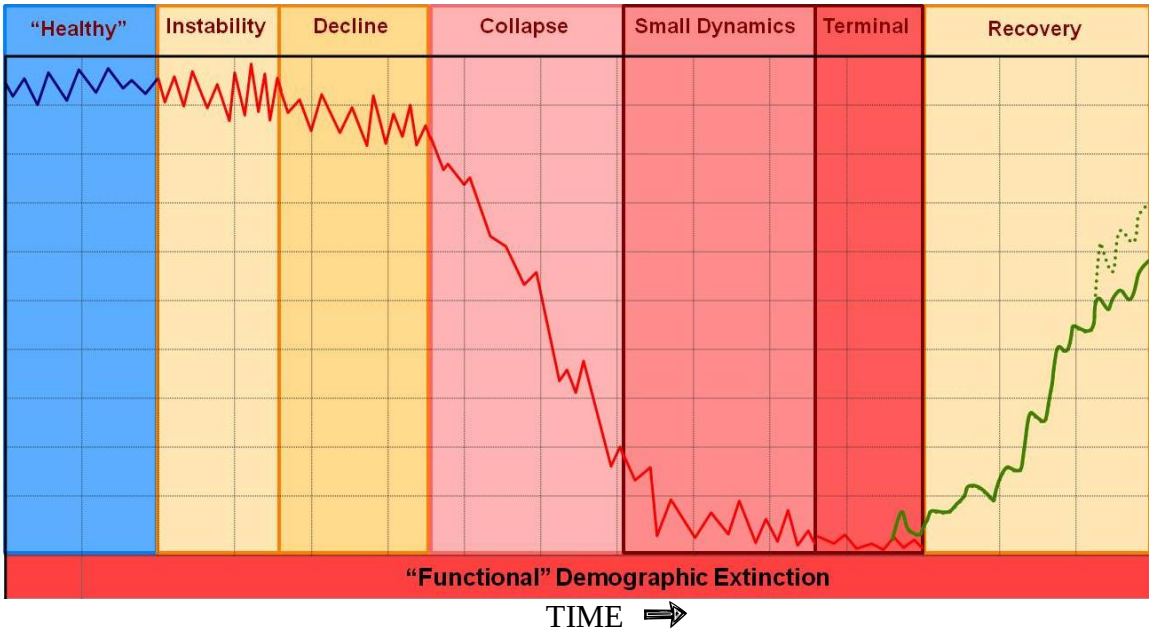

Figure 17. Population trajectory phases representing phases of the extinction process[14]

8.2 Integration

Beluga whales are likely being taken by factors considered in the environmental baseline, and may be taken in the future by actions with cumulative effects. The effects of the environmental baseline are already reflected in current population trends and are therefore indirectly included in our population viability analyses. We have insufficient information to project the effects of future non-Federal actions (cumulative effects) on beluga population dynamics.

Upon integrating the effects from the proposed seismic program on beluga whales and their critical habitat with the environmental baseline and cumulative effects, we expect that individual or small groups of whales are likely to be harassed by the proposed action, but we do not expect this project will have population-level impacts. Beluga whales are unlikely to be killed or injured by this project, and harassment is expected to be limited to MMPA Level B harassment that is localized and temporary. Whales will experience higher than ambient noise levels, and could be harassed if they experience sound that exceeds 160 dB. The most pronounced increase in noise levels will occur from the use of the 2,400 in^3 airgun array. The use of this array will be intermittent, averaging 8-12 hours per day, but usually discontinuously, for a maximum of about 6 continuous hours centered around a slack tide. We have insufficient information to enable us to translate the effects of acoustic harassment into modeled extinction risk probabilities for this species. However, we conclude that take in the form of harassment by activities associated with this proposed action, in combination with effects represented in the environmental baseline and cumulative effects analyses, and with the implementation of mitigation measures, Reasonable and Prudent Measures, and Terms and Conditions associated with this Biological Opinion, will not measurably affect the survival and recovery of Cook Inlet beluga whales.

We expect up to 30 Cook Inlet beluga whales will be exposed to sounds $\geq$160 dB as a result of the seismic survey each year, for five years. But it is difficult to quantify the impact of such

[14] C. Johnson, NMFS, unpublished figure.

exposure to these exposed whales as the observed responses are a function of many factors (including group size and composition, sound characteristics, time of year, activity in which the whales are engaged, previous exposure to similar sounds and individual variability). However, as set forth above, and summarized in Table 4, the factors that may affect recovery include: 1) noise that affects the ability to communicate, echolocate, and avoid predators; 2) prey availability; 3) access to breeding and foraging areas; 4) contaminants/pollution; 5) direct mortality (ship strikes, hunting); 6) live strandings, and 7) killer whale predation. It is unlikely that the proposed seismic surveys will affect these factors in a way that measurably increases the risk of extinction, reduces the projected time to extinction, or increases the time to recovery.

We expect that nearly nine percent of Cook Inlet beluga whales may experience Level B take in the form of harassment due to this action (30 whales out of a population of 340). The expected forms of take represent a temporary affect upon taken whales (e.g. TTS, temporary behavior changes), and no other form of take is expected. Therefore, we find that no individual beluga whale's growth, survival, or reproductive success will be adversely affected by this proposed action. In the absence of a reduction to individual fitness, we do not anticipate reductions in the abundance, reproduction rates, or growth rates to the population as a whole, and thus do not expect this action to affect the survival or recovery of this species.

Similarly, in integrating the effects of this proposed action on western DPS Steller sea lions with their environmental baseline and cumulative effects, we expect that very small numbers of western DPS Steller sea lions may be subjected to take by this proposed action in the form of MMPA level B harassment; take that is localized in extent and temporary in duration. At most 0.02 percent (20 animals out of a population of 79,300) of western DPS Steller sea lions are expected to be taken by this action. We therefore expect no population-level effects upon this DPS resulting from this action. There is no evidence that a single exposure, or multiple exposures over a five year period, would have a negative consequence to the fitness of any western DPS Steller sea lion. Expected effects would be due to acoustic harassment, and would be limited to TTS and temporary behavioral changes. As such, it is unlikely that any individual sea lion's growth, survival, or reproductive success will be adversely affected by this proposed action. In the absence of a reduction to individual fitness, we do not anticipate reductions in the abundance, reproduction rates, or growth rates to the population as a whole. Thus, it is unlikely that the proposed seismic program would result in population-level consequences to survival or recovery of western DPS Steller sea lions.

While there is evidence that humpback whale take due to seismic exploration activities in Cook Inlet has already occurred, humpback whale aerial survey data indicates that the likelihood of such an event re-occurring is unlikely. In a worst-case scenario, in which taken humpbacks were from the Western North Pacific population, the smallest population (n=732) with a range that includes Cook Inlet, we expect only 0.2 percent of the population would be taken over the course of the action (2 out of 732).

In integrating the effects of this proposed action on humpback whales with their environmental baseline and cumulative effects, we expect that very small numbers of this species may be subjected to take by this proposed action in the form of MMPA level B harassment; take that is localized in extent and temporary in duration. We expect no population-level effects upon humpback whales resulting from this proposed action. There is no evidence that a single

exposure, or multiple exposures of seismic operation noise to an insignificant proportion of the humpback whale populations using Cook Inlet over a five year period, would have a negative consequence to the fitness of either the Central North Pacific or Western North Pacific stock of humpback whale. As such, we do not anticipate reductions in the abundance, reproduction rates, or growth rates to the listed species. Thus, AKR has determined that the proposed seismic program would not affect the survival or recovery of the humpback whale.

Discretionary Conservation Recommendations are included in this Biological Opinion. These measures, MMPA permit conditions, and the mitigation measures described as part of the proposed action will all further reduce the probability of occurrence, and significance of, impacts to listed species and designated critical habitat.

We conclude that there is a low risk of adverse effects upon Cook Inlet beluga whales, western DPS Steller sea lions, or humpback whales as a result of this action because of: 1) the limited geographic extent of Cook Inlet being ensonified as a result of the proposed action at any given time; 2) the spatial and temporal restrictions included in the mitigation measures designed to protect concentrations of Cook Inlet beluga whales using essential habitats during vital portions of their annual cycle; 3) the monitoring program designed to detect listed marine mammals that are within or approaching the defined disturbance and exclusion zones, 4) mitigation measures built into the action that are intended to reduce harassment to marine mammals; 5) the setbacks from specific anadromous streams and river mouths designed to protect valuable foraging habitat for Cook Inlet beluga whales; and 6) the extremely low density of western DPS Steller sea lions and humpback whales in the action area.

9. CONCLUSIONS

After reviewing the project description and mitigation measures, status of these species, environmental baseline for the action area, the effects of the action, and cumulative effects, it is AKR's Biological Opinion that NMFS PR1's issuance of five-year incidental take regulations and subsequent Letters of Authorization for Apache's seismic exploration activities in Cook Inlet from 2016-2021 is not likely to jeopardize the continued existence of Cook Inlet beluga whales, western DPS Steller sea lions, or humpback whales. AKR concurs that the above actions are not likely to adversely affect the critical habitat for Steller sea lions or Cook Inlet beluga whales. AKR further concurs that the above actions are likely to adversely affect western DPS Steller sea lions, Cook Inlet beluga whales and humpback whales. Adverse effects are expected to be in the form of acoustic harassment.

However, AKR has concluded that the mitigation measures proposed during non-daylight periods of time (between local sunset and local sunrise) are inadequate to ensure proper monitoring and minimization of take of listed marine mammals at night. Furthermore, AKR has concluded that the previous Susitna Delta area restriction, and the area restriction proposed by ASRC (2014) around the Susitna Delta, was inadequate to provide sufficient protection to whale using this essential breeding, nursing and feeding habitat. AKR has also determined that all entities receiving any form of MMPA or ESA take authorizations must avoid concurrent harassment-level ensonification of any waters, and must provide for sufficient passage between waters ensonified to a degree where harassment may occur. We address these factors in our Reasonable and Prudent Measures and associated Terms and Conditions.

10. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species without special exemption. For certain species listed as threatened, NMFS has promulgated regulations pursuant to section 4(d) of the ESA applying those same section 9 take prohibitions to the threatened species. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. The MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment] (16 U.S.C. §1362(18)(A)(i) and (ii)).

Harm is further defined in regulations to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), any taking that would otherwise be prohibited by the ESA but is incidental to and not intended as part of the agency action and is in compliance with the terms and conditions of this Incidental Take Statement will be considered to not be a prohibited taking of the species.

Section 7(b)(4)(C) of the ESA provides that the operator needs to obtain authorization under section 101(a)(5) of the MMPA before this Incidental Take Statement can become effective. Accordingly, the terms of this statement and the exemption from Section 9 of the ESA that the statement affords are conditional upon the issuance of MMPA authorization to take the marine mammals identified here. Similarly, this Biological Opinion and Incidental Take Statement cover the entire scope of the proposed activities, *i.e.*, survey operations in Cook Inlet from 2016-2021. The operator will need MMPA authorization each year for this take statement to become effective. Take that is noted in this Incidental Take Statement is authorized only if MMPA authorization is also obtained.

10.1 Amount or Extent of Take Authorized by this Biological Opinion

Available information indicates that incidental acoustic harassment of small numbers of Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions may occur during Apache's Cook Inlet Seismic Program. AKR does not expect whales or sea lions to be injured or killed by the Apache seismic surveys and such injurious takings are not authorized. It is possible that the hearing systems of marine mammals very close to seismic survey noise sources would be at risk of temporary or permanent threshold shifts or hearing impairment. However, planned monitoring and mitigation measures are designed to: avoid sudden onsets of seismic pulses at full power, detect marine mammals occurring near the array during conditions of good visibility, and avoid exposing marine mammals to sound pulses that may cause hearing impairment.

AKR anticipates and authorizes the non-lethal, incidental take of no more than 30 Cook Inlet beluga whales per calendar year for the years 2016 through 2021, no more than 20 western DPS Steller sea lions per calendar year for the years 2016 through 2021, and no more than 2 humpback whales total from 2016 through 2021 as a result of this proposed

action. Authorized take for any calendar year cannot carry over or be applied to operations that occur during subsequent years. Authorized take cannot be transferred to any other entity unless they are operating as a contractor to Apache America Corporation.

10.2 Definition of Take

The ESA prohibits the unauthorized take of threatened or endangered species, and defines the term "take" to include harassment. The ESA, however, does not define harassment. The U.S. Fish & Wildlife Service has promulgated a regulation which defines it as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (50 C.F.R. § 17.3). Under the Marine Mammal Protection Act, there is a definition of what is referred to as Level B harassment: "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." (16 U.S.C. §1362(18)(A)(ii)).

Here, AKR assumes a "take" occurs when a listed species is exposed to sounds greater than or equal to the current NMFS acoustic thresholds; 180 dB re 1 μPa_{rms} for cetaceans and 190 dB re 1 μPa_{rms} for pinnipeds (Level A injurious take, the isopleth of which defines the exclusion zone), and 160 dB re 1 μPa_{rms} (Level B harassment take, the isopleth of which defines the disturbance zone for impulsive noises).

10.3 Determining Whether Take has Occurred

An animal will be considered taken if it is observed within the area ensonified to $\geq$160 dB re 1 μPa_{rms} (also referred to as the disturbance zone) during seismic exploration. The 160 dB re 1 μPa_{rms} disturbance zone distance thresholds for the pinger, mitigation gun and the two anticipated airgun arrays appears in Table 8.

If a cetacean enters the area ensonified to $\geq$180 dB re 1 μPa_{rms}, or a pinniped enters the area ensonified to $\geq$190 dB re 1 μPa_{rms} (Table ITS1), (also referred to as the exclusion zone) then unauthorized Level A take has occurred even if there are subsequent modifications to seismic survey activity (e.g. power-down, shut-down). Similarly, if any marine mammal enters the area ensonified to $\geq$160 dB re 1 μPa_{rms} (disturbance zone), then Level B take has occurred, even if there are subsequent modifications to seismic survey activity (e.g. power down, shut-down) (Table 8).

10.4 Amount of Take

All authorized takes are for MMPA Level B harassment only; these takes are expected to result primarily from exposure to noise generated by airgun arrays; no Level A takes (exposure to sound levels above 180dB for cetaceans or 190 dB for pinnipeds) are expected, and none are authorized. In 2012, Apache reported zero observed takes via acoustic harassment for both Cook Inlet beluga whales and western DPS Steller sea lions. In 2014, Apache reported information that indicated 12 Level B takes of Cook Inlet beluga whales, 2 Level A takes of humpback whales and 0 takes of Steller sea lions.

Instances of take of listed species resulting from this proposed action are expected to be few because the density of marine mammals in the action area is low, especially that of western DPS Steller sea lions and humpback whales, and because the mitigation measures described in this Biological Opinion will reduce the probability of animals encountering the 160 dB level B harassment zone or the 180 dB cetacean Level A exclusion zone / 190 dB pinniped Level A exclusion zone.

Table 8. Radii for level A and level B takes indicated by maximum threshold distances for the pinger, 10 in^3 mitigation airgun, 440 in^3 airgun array and 2400 in^3 airgun array. Distances are maximized over direction and environment and are based on the 90th percentile fits. The 90^{th} percentile distances correspond to exclusion and disturbance zone radii for marine mammals, as indicated. Pinger exclusion zones assume a spherical spreading loss of 20 log R (where R is radius) with a source level of 188 dB.

SPL_{rms90} Threshold (dB re 1 μPa)	90th Percentile Distance (m)			
	Pinger	10 in^3	440 in^3	2400 in^3
190 (level A pinniped exclusion zone)[1]	1	10	100	380
180 (level A cetacean exclusion zone)[2]	3	10	310	1400
160 (level B marine mammal disturbance zone)[3]	25	280	2500	9500

[1]Each listed pinniped observed at less than the indicated distance during operational volumes of the indicated sound source must be considered to have been subjected to level A take under the MMPA and must count as one take each time the individual enters the area so ensonified.
[2]Each listed cetacean observed at less than the indicated distance during operational volumes of the indicated sound source must be considered to have been subjected to level A take under the MMPA and must count as one take each time the individual enters the area so ensonified.
[3]Each listed marine mammal observed at less than the indicated distance during operational volumes of the indicated sound source must be considered to have been subjected to level B take under the MMPA and must count as one take each time the individual enters the area so ensonified.

Cook Inlet Beluga Whale Take

Estimates for take of Cook Inlet beluga whales were adopted from NMFS PR1's proposed rule for this project. Apache intends to operate in a manner that ensures limited temporal overlap of its operations with Cook Inlet beluga whales, and thus NMFS PR1 expects Apache to take no more than 30 Cook Inlet beluga whales per year. We note that this method of calculating take is conservative insofar as it does not factor in take reduction deriving from implementation of mitigation measures included in the description of the action.

We adopt NMFS PR1's estimate of MMPA take for Cook Inlet belugas (30 per year) as a reasonable estimate for the number of animals projected to be exposed to NMFS's sound thresholds and taken per the Endangered Species Act definition of take.

Western DPS Steller Sea Lion Take

Our estimate for take of western DPS Steller Sea lions does not incorporate the speculation that 75 unidentified pinnipeds observed hauled out on the banks of the Beluga River (north of the operational area) in June 2012 were Steller sea lions, as recent reports of such a large group of Steller sea lions in that portion of Cook Inlet are otherwise unprecedented; sea lion sightings in Upper Cook Inlet are rare, and have been previously been reported only as singles or pairs. As previously described, one group of 20 Steller sea lions was reported in lower Cook Inlet by NMFS aerial observers.

Our estimation of take of western DPS Steller sea lions assumes annual take equal to the maximum number of western DPS Steller sea lions observed in the action area in a year, as reflected by the maximum number of animals reported by NMFS aerial observers surveying the action area for beluga whales between 2004 and 2014 (4 Steller sea lions were observed by Apache in 2012, and one observation of 20 Steller sea lions was made on June 10, 2006 at the southern extreme of the action area on NMFS aerial surveys of Cook Inlet from 2004-2014). AKR's estimate of Steller sea lion take includes the anomalous sighting of 20 animals along the southern edge of the action area, far from any known haulouts or rookeries (such a large congregation of Steller sea lions far from haulouts or rookeries is unusual). However, our estimate of take does not include animals or density estimates derived from animals observed outside of the action area. AKR is typically made aware of one or two Steller sea lions within the action area per year. Two individuals were observed by Apache PSOs in 2014 and three groups totaling about four animals were observed in 2012. We have dismissed the observation of unknown hauled-out marine mammals in the far northern section of Cook Inlet as being Steller sea lions, and do not take that sighting into account in our density estimates or take calculation. Nevertheless, we conclude that our Western DPS Steller sea lion take estimate is neither excessively conservative nor liberal. Our take adequately accounts for what one may expect seismic vessels implementing mitigation measures to encounter in a year, but allows for the possibility that the survey may encounter an anomalously large group such as was observed by NMFS aerial observers near the southern portion of the action area in 2006 (Shelden et al. 2013).

While ASRC reports an average density of 0.008281 Steller sea lions per km^2 in the action area, NMFS aerial survey data indicate a maximum density of 0.003518 Steller sea lions per km^2 in the action area (20 animals /5684 km^2). Therefore, we have determined that authorizing take of 20 Steller sea lions per year (the same number that was authorized in 2012 and 2014) is most appropriate and reflects appropriate use of the best available scientific data.

Humpback Whale Take

AKR has determined that a take estimate of two humpback whales over the entire duration of this project is appropriate because Apache data indicates that this level of take has already occurred, but existing observation data indicates that such an occurrence is highly unlikely to be repeated. No more than two humpback whales have been recorded by NMFS observers or Apache PSOs in the action area in any given year, and the probability of project vessels encountering and taking all individuals in the action area is low. AKR has determined that the humpback take event of 2014 was a highly unusual event that is unlikely to be repeated during this survey due to both the rarity of this species in the action area and the effectiveness of project mitigation measures.

10.5 Effect of Take

Studies of marine mammals and responses to seismic transmissions have shown that marine mammals are likely to respond behaviorally upon hearing seismic transmissions. The only takes authorized during the proposed action are takes by acoustic harassment. No serious injury or mortalities are anticipated or authorized as part of this proposed action. Although the biological significance of those behavioral responses remains unknown, this consultation has assumed that exposure to major noise sources might disrupt one or more behavioral patterns that are essential

to an individual animal's life history. However, any behavioral responses of these whales and pinnipeds to major noise sources and any associated disruptions are not expected to affect the reproduction, survival, or recovery of these species.

In Section 9, NMFS determined that the level of anticipated take, coupled with other effects of the proposed action, and considering the environmental baseline and cumulative effects, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat

10.6 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02).

The RPMs included below, along with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. NMFS concludes that the following RPMs are necessary and appropriate to minimize or to monitor the incidental take of Cook Inlet beluga whales, western DPS Steller sea lions and humpback whales resulting from the proposed action.

1. All seismic-related activity must comply with all applicable regulations, permit conditions, and requirements.

2. The taking of Cook Inlet beluga whales, western DPS Steller sea lions, and humpback whales must be by incidental acoustic harassment only (MMPA Level B take). Term and Condition 2.1 sets forth the conditions for determining whether take has occurred. The taking by serious injury or death (MMPA Level A take; see Term and Condition 2.1), or the taking by harassment of a greater numbers of animals than is authorized in this Incidental Take Statement, is prohibited and may result in the modification, suspension, or revocation of the Incidental Take Statement. Level A take must be reported within 24 hours of occurrence to the NMFS contacts listed under Term and Condition 6.11. Apache's determination of the occurrence of take must be consistent with the guidelines for determining occurrence of take set forth in this Biological Opinion and the associated ITS.

3. A comprehensive mitigation, monitoring and reporting program must be implemented to ensure that listed marine mammals are not taken in numbers or in a manner not anticipated by the Biological Opinion.

4. Waters within the action area that are known to be perennially used by Cook Inlet beluga whales for feeding, breeding or nursing (see Term and Condition 4.1) must not be ensonified to levels $\geq$160 dB when Cook Inlet beluga whales are present.

5. Aerial surveys must be flown in a way that further reduces the risk of take of marine mammals by this action.

6. Records, including metadata, of all marine mammal observations made by aerial, ship-based and shore-based observers associated with this project, regardless of the observed marine

mammal(s) distance from the source vessel, must be made available to NMFS and the public in machine-readable format[15].

10.7 Terms and Conditions

"Terms and conditions" implement the reasonable and prudent measures (50 CFR 402.14). These must be carried out for the exemption in section 7(o)(2) to apply.

In order to be exempt from the prohibitions of section 9 of the ESA, the National Marine Fisheries Service PR1 must comply with the following terms and conditions, which implement the RPMs described above and the mitigation measures set forth in [*Section 2.3.4*] of this opinion. The National Marine Fisheries Service PR1 and Apache have a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this Incidental Take Statement (50 CFR 402.14).

Full compliance with these terms and conditions is required in order to receive the ESA section 9 take exemption afforded by this incidental take statement. Partial compliance with these terms and conditions will invalidate this take exemption. These terms and conditions constitute no more than a minor change to the proposed action because they are consistent with the basic design of the proposed action.

1. **Terms and conditions associated with Reasonable and Prudent Measure 1**: *All seismic-related activity must comply with all applicable regulations, permit conditions, and requirements.*

    1.1. All seismic-related activity must comply with all applicable regulations, permit conditions, and requirements listed in each valid, current Incidental Harassment Authorization (IHA), or incidental take authorization, issued to the operator for this project under the authority of MMPA section 101(a)(5) and 50 CFR 216.107.

2. **Terms and Conditions associated with Reasonable and Prudent Measure 2**: *The taking of Cook Inlet beluga whales, western DPS Steller sea lions, and humpback whales must be by incidental acoustic harassment only (MMPA Level B take) where Term and Condition 2.1 sets forth the conditions for determining whether take has occurred. The taking by serious injury or death (MMPA Level A take; see Term and Condition 2.1), or the taking by harassment of a greater numbers of animals than is authorized in this Incidental Take Statement (ITS), is prohibited and may result in the modification, suspension, or revocation of the ITS. Level A take must be reported within 24 hours of occurrence to the NMFS contacts listed under Term and Condition 6.11. Apache's determination of the occurrence of take must be consistent with the guidelines for determining occurrence of take set forth in this Biological Opinion and the associated ITS.*

    2.1. Determination and reporting of take of listed[16] marine mammals must be as follows: If a listed cetacean enters the area ensonified to ≥180 dB re 1 μPa_{rms}, or a listed pinniped

[15] See (un-numbered) Executive Order of May 9, 2013 -- Making Open and Machine Readable the New Default for Government Information

enters the area ensonified to ≥190 dB re 1 μPa_{rms} as indicated in Table 8, then Level A take has occurred even if there are subsequent modifications to seismic survey activity (e.g. power-down, shut-down as described in sections 2.3.4.4 and 2.3.4.5). Level A take is not authorized. Should Level A take occur, the equipment that produced the sound that resulted in Level A take must be immediately shut-down and remain so until the listed marine mammal has left the Level A exclusion and Level B disturbance zones described in Table 8. Level A take must be reported within 24 hours of occurrence to the contacts listed at Term and Condition 6.11, and must also be recorded in weekly and final reports to NMFS. See Terms and Conditions associated with reasonable and prudent measure 6 for reporting parameters.

2.2. If any listed marine mammal enters the area ensonified to ≥160 dB re 1 μPa_{rms}, then Level B take has occurred, even if there are subsequent modifications to seismic survey activity (e.g. power down, shut-down). Having already exposed an animal to Level B take does not negate the obligation to immediately implement mitigation measures; the sound sources that caused level B take must be powered down or shut down immediately upon observing listed marine mammals within the 160 dB re 1 μPa_{rms} disturbance zone as described in Table 8. Power-downs must be sufficient to cause the cessation of level B take. Level B take must be recorded and reported in weekly and final reports to NMFS. See Terms and Conditions associated with reasonable and prudent measure 6 for reporting parameters.

2.3. In determining the number of Level A and level B takes that have occurred, each individual animal must be considered a discrete take if it approaches any sound source more closely than the designated threshold distance for that sound source (as listed in Table 8).

3. **Terms and Conditions associated with Reasonable and Prudent Measure 3**: *A comprehensive mitigation, monitoring and reporting program must be implemented to ensure that listed marine mammals are not taken in numbers or in a manner not anticipated by the Biological Opinion.*

3.1. All mitigation measures described in section 2.3.4 (2.3.4.1 through 2.3.4.7) of this Biological Opinion must be implemented, and these mitigation measures must be implemented for humpback whales as they are for beluga whales. Vessel crews must assist in implementing these mitigation measures. Implementation of these measures for western DPS Steller sea lions must be as indicated in sections 2.3.4.1 through 2.3.4.7, except as indicated in these terms and conditions.

3.2. After each power-down and shut-down, the entire 160 dB disturbance zone must be visible for 15 minutes (for pinniped-induced mitigation actions) or 30 minutes (for cetacean-induced mitigation actions) before ramp-up procedures may begin. Further, during this pre-ramp-up period, PSO's must constantly scan the entire 160 dB disturbance zone to ensure that it remains void of listed marine mammals. If the disturbance zone remains void of listed marine mammals for the entire pre-ramp-up

[16] A listed marine mammal is one that is designated as threatened or endangered under the Endangered Species Act.

scan, ramp-up operations may be implemented. If a listed marine mammal is observed within the 160 dB disturbance zone during the pre-ramp-up scan, then the pre-ramp-up scan must start over following the most recent sighting of the listed marine mammal within the 160 dB disturbance zone..

3.3. The operator must possess on board each seismic sound source vessel:
  3.3.1. a copy of this ITS issued under the authority of section 7 of the Endangered Species Act
  3.3.2. a current and valid Incidental Harassment Authorization or Letter of Authorization issued by NMFS PR1 to Apache under the authority of the MMPA. Any take must be authorized by: 1) one or more valid IHAs or LOAs issued by NMFS to Apache and 2) a valid ITS. Take of listed species must occur in compliance with all terms, conditions, and requirements included in such authorizations.

3.4. Copies of all reports required by all MMPA authorizations must be submitted within the indicated timeframes to the NMFS contacts listed in Term and Condition 6.7.

3.5. Shore-based observers must position themselves such that they can see marine mammals at least as far away as the edge of the 160 dB disturbance zone; if necessary, the PSO would be outfitted with big-eye or reticulated binoculars as appropriate, and a theodolite or GPS, compass and rangefinder and/or other instruments to determine and report the geographic coordinates of observed listed marine mammals and their position within the disturbance or exclusion zone at the time of first detection.

3.6. Following a power-down or shut-down due to the proximity of listed marine mammals, daylight ramp up must not be initiated until the listed marine mammal has cleared the 160 dB disturbance zone. The zone will be considered to be void of listed marine mammals if:
  3.6.1. The animals that were observed within the zone have all been observed to have left the zone: or
  3.6.2. no listed pinnipeds have been observed within the zone for 15 minutes or
  3.6.3. no listed cetaceans have been observed within the zone for 30 minutes.
3.7. Following a power-down or shut-down due to the proximity of listed marine mammals, night (between local sunset and sunrise) ramp-up operations must not be initiated unless:
  3.7.1. The area has been monitored by a PSO using a fully functional PAM system as described in 3.9 below, and no listed marine mammals have been detected;

3.8. During daylight ramp-up operations for each airgun array, the 160 dB disturbance zone for that array must be monitored for listed marine mammals, and a power-down or shut-down must be implemented if listed marine mammals appear likely to enter the zone prior to or during operational seismic survey work using that array.

3.9. In order to minimize take of listed marine mammals during non-daylight hours (between local sunset and local sunrise), a Passive Acoustic Monitoring system (PAM) must be used to monitor for the presence of marine mammals in waters within 2.0 km of MLLW that are ensonified to $\geq$160 dB (distances as indicated in Table 8). This measure is

required only in instances when ice comprises less than 1% of the surface area of Cook Inlet to avoid ice damage to acoustic equipment.

PAM is considered here to be a necessary substitute for PSO visual monitoring during non-daylight hours while generating seismic sound sources (airgun arrays, shallow shot charges and pingers) in Cook Inlet waters north of 60° 43'N at any time of year, and south of 60° 43' from October 15 through April 15.

Vessels that begin a seismic transect prior to sunset may complete that transect line without the use of PAM provided there are no interruptions in completing that transect line. Transect lines that ensonify waters within 2.0 km of MLLW to ≥160 dB may not be initiated after local sunset without the use of PAM as described in this Incidental Take Statement.

PAM systems are silent buoy platforms designed for passive acoustic monitoring. In this instance, they must be comprised of autonomous wireless communication buoys that allow real-time transmission of detected vocalization and echolocation signals from endangered Cook Inlet beluga whales. Real time transmission indicates that signal processing will be onboard, or raw hydrophone signals will be transmitted to the base station located on land or on a vessel, where the signals will be processed, and with the incoming signal monitored at all times by an experienced and well-qualified PAM operator. Because the PAM systems contemplated here are considered to be only minimally effective in detecting beluga whales beyond 2000 meters, and the area ensonified by airguns to greater than or equal to 160 dB re 1 µPa extends well beyond 2000 m, all airgun operations must be shut down immediately upon acoustic detection of one or more beluga whales or other threatened or endangered marine mammals. All PSOs must have the authority to order this shutdown.

Following a shutdown or prior to ramp-up between local sunset and sunrise, a properly trained PSO, using an appropriate and fully functional PAM, must indicate zero detections of listed marine mammal species for 30 minutes prior to ramp-up. The PSO must continue to monitor the PAM throughout seismic operations that occur between local sunset and sunrise.

PAM buoys may be instrumented with one single hydrophone because localization function is not required. Additional hydrophones to help determine signal azimuth (using 2 hydrophones) or signal localization (when using more than two hydrophones) are optional. To prevent loss and to detect drifting away from the targeted exploration patch, PAM buoys should be equipped with GPS transmitters to allow the PAM operator(s) to know the near real-time location of all buoys. Buoy wireless communication system to a base station must be via direct radio, 3G cell phone network if coverage is confirmed for all patch areas, or satellite, whichever allows full spatial coverage for each patch. If signal processing occurs at the buoy, both detection alarms and waveform clips of the detection must be transmitted to the base station to allow detection validation by the PAM operator. If signal processing occurs at the base, the selected wireless communication mode (e.g. radio modem) must provide enough bandwidth for full signal transmission from buoys to base. Buoy to buoy (mesh network)

communications should ensure that only one base station is needed to receive signals from all PAM buoys, provided the base station is within receiving range of at least one PAM buoy at all times.

Frequency response for the PAM system (i.e. hydrophone, preamplifiers, A/D converter, wireless communication system) should be at least 250 Hz to 140 kHz. Sampling rate should be set to 285 kHz or higher. Frequencies less than 250 Hz should be avoided (high-pass filtered) to reduce flow and strumming noise. However, if self-noise is found to be low, high-pass frequency can be reduced to 100 Hz to maximize humpback whale detection in the lower Cook Inlet. Hydrophone sensitivity should be at least -175 dBV re 1 µPa with dynamic range of 90 dB to allow appropriate detection and identification of both faint and loud marine mammal signals. Humpback whale calls and beluga calls and echolocation should be automatically processed in real-time with signal detectors based on energy sum, matched filtering, spectrogram correlation, or other advanced algorithms to minimize the chances of missing marine mammal signals. Selected detectors must have been proved to be effective at detecting Cook Inlet target species. The processing software should allow the PAM operator to save and validate the automatic detections by visualizing and listening the spectrogram and waveform of the potential marine mammal signals without interrupting the real-time monitoring. The processing software must include a function to mute airgun noise (i.e. seismic veto function). PAM operator shifts shall last no longer than 4 hours at a time with at least a one-hour break between shifts, and no more than three shifts per 24-hour period.

Technical specifications detailed above will ensure detection of nearby humpback whale calls and beluga calls and clicks, but will also allow for detection of the more common harbor porpoise. Receiving acoustic signals from harbor porpoises indicates their presence, but does not allow for their accurate enumeration. However, detection of these more common marine mammal vocalizations will help provide assurance that the PAM system remains operational.

Placement of PAM buoys must comport as closely as practicable to the design described below:

As used here, the term “night survey patch” refers to the area of marine water that can be covered by seismic exploration vessel(s) between local sunset and local sunrise. For each night survey patch that will result in ensonification of waters within 2.0 km of MLLW to sounds greater than or equal to 160 dB re 1 µPa, four passive acoustic monitoring buoys must be deployed. For patches with seismic transects running within 45 degrees of perpendicular to shore, deployment of these buoys will adhere as closely as possible to the following conditions:

- 2 buoys deployed 100-500 m distal from the two outer seismic transects bounding the edge of the expected night survey patch, with one buoy on each side of the patch deployed approximately 2 km seaward of MLLW and another buoy on each side of the patch deployed about 5 km seaward of MLLW.
- Buoys should be moored with an anchor of sufficient mass to maintain the position of the buoy throughout local tidal exchanges and resulting currents (NMFS estimates that anchors should not be of mass less than 90 kg in air).

For seismic transects running roughly perpendicular to shore, buoy placement will resemble the schematic shown in Figure 18. For seismic transects that are not within 45 degrees of perpendicular to the shore, the shoreward-most PAM buoys should be placed so that they provide passive acoustic monitoring of the beginning and end of the most shoreward and most seaward seismic transects with two buoys set about 2 km seaward of MLLW and two buoys set about 5 km seaward of MLLW. Because this increases the lateral distance between the pairs of buoys, a shore-based receiving station may be required to relays signals from some the buoys to the PAM base station.

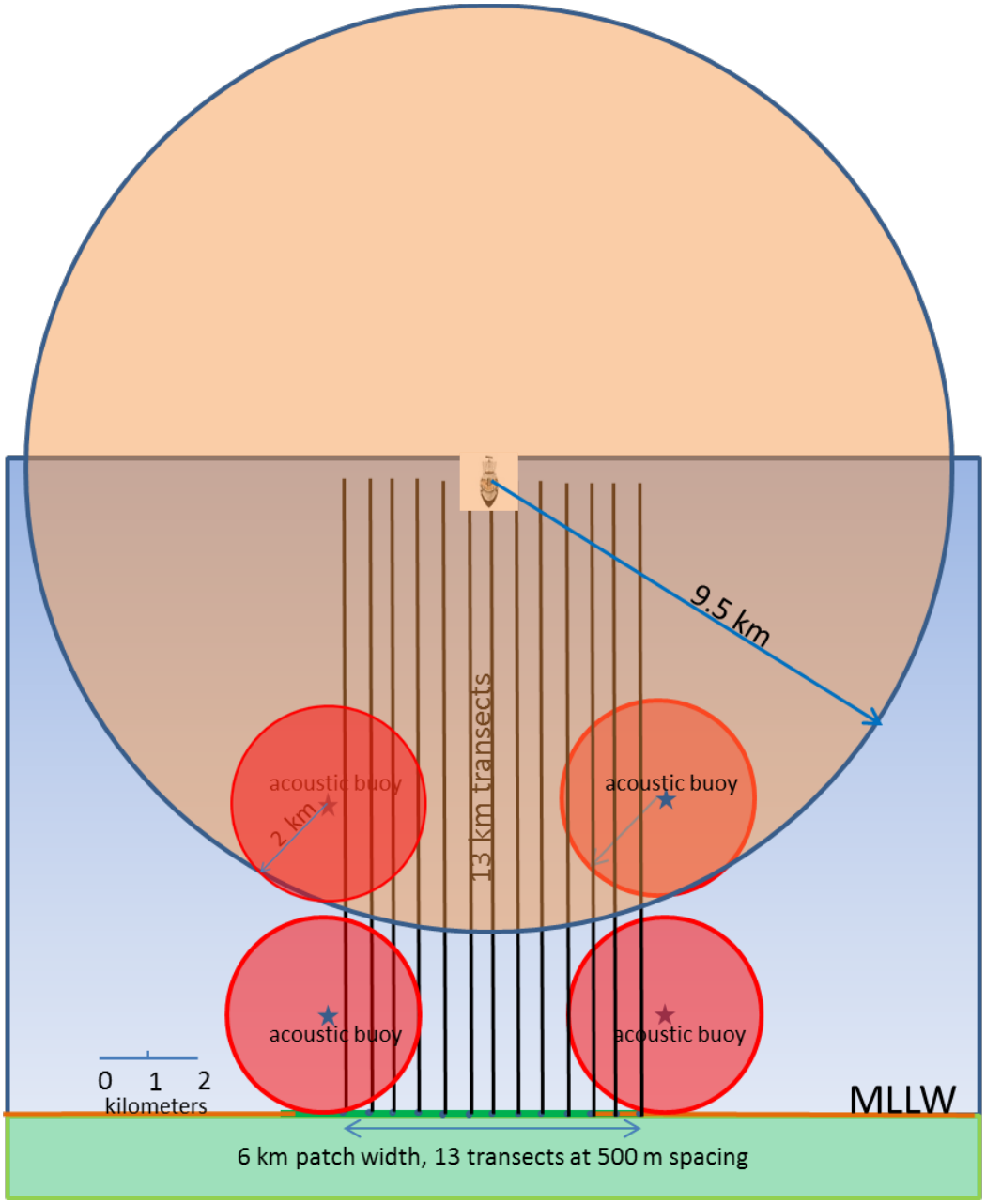

Figure 18. Schematic diagram of PAM buoy placement relative to shore, transect beginning and end points. For purposes of illustration, the shaded brown area represents the area ensonified to >160 dB when the source vessel is at the seaward terminus of a central transect within a patch.

PAM buoy signal transmission must be tested and verified as operational prior to the initiation of seismic exploration in each night survey patch. The PAM system must be monitored until post-sunrise conditions allow PSOs to conduct effective visual monitoring of all waters ensonified to greater than or equal to 160 dB re 1 µPa. If necessary, PAM buoys will be serviced during the process of relocation between night survey patches (e.g. batteries replaced or recharged) such that successful signal detection and transmission is ensured for operations throughout data acquisition of the next night survey patch.

The receiving base station can be located anywhere that receives a sufficient signal from all buoy transmitters for each night survey patch, or from at least one buoy if the buoys are part of a mesh network that allows any buoy in the mesh network to transmit signals from all networked buoys to the base station. The PAM operator must monitor the base station at all times during seismic operations between sunset and sunrise, and must be able to communicate with the seismic source vessel at all times, with the authority to order seismic operation shutdowns if one or more ESA listed marine mammals are detected or if the PAM network becomes inoperable.

3.10. Marine mammal monitoring during the intertidal shallow-shot operations will have at least three Protected Species Observers (PSOs) monitoring for marine mammals prior to and during intertidal or transition zone detonations (one in a vessel, one on land and an aerial observer). At the 10 m (35 ft) depth detonations, PSOs will monitor 3.5 km (2.2 mi) radius for marine mammals. The 3.5 km (2.2 mi) distance will be measured from the waterline closest to the seaward-most shot. PSOs will observe from vantage points which allow good visibility, and monitor for 30 minutes prior to any intertidal detonations. No detonation will occur until this zone has been clear of ESA-listed marine mammals for at least 30 minutes. PSOs will communicate to the shot operator any sightings of a listed marine mammal approaching or within the monitoring area, and have the authority to delay and stop operations. Detonations will not begin or resume until the 3.5 km (2.2 mi) monitoring zone is void of listed marine mammals, or until PSO observers confirm that the zone has been clear of any listed marine mammals for 30 minutes. All shot hole detonations will occur only during daytime operations.

In the event that the planned charge depth of 10 m (35 ft) is unattainable due to loose sediments collapsing the bore hole, Apache may detonate “shallow” shots at 0.3 m (1 ft) depth, below the high tide line in the area between Grey Cliffs and Moose Point. Each of these “shallow” shots will consist of four charges arranged in a 0.91 m (3.0 ft) diameter circle and buried 0.3 m (1 ft) below the surface of the mudflats. Each of the four charges will be no greater than 0.45 kg (1.0 lb). During these detonations, Apache will monitor for listed marine mammals, as described above.

If a Sound Source Verification study (SSV) is conducted for intertidal shallow-shot charges (charges detonated within the intertidal zone at buried depths less than 10 m) indicating that acoustic energy from intertidal shallow-shot charges exceeds 160 dB at a distance of 3.5 km (2.2 mi.), then use of intertidal shallow-shot charges must cease immediately, the SSV data must be made available to NMFS, and formal section 7 consultation with AKR must be reinitiated.

3.11. If a live marine mammal stranding is reported within 20 miles of seismic operations (roughly 2x the radius of the largest Level B disturbance zone), seismic operations must cease and must not be initiated until AKR has determined that the stranding is not likely to have been caused by seismic operations, or until all marine mammals involved in the live stranding event are no longer stranded and are clear of the 160 dB Level B disturbance zone with no stranding- or seismic exploration-induced mortalities reported.

3.12. Airgun arrays must be used for purposes of exploration and seismic data acquisition only. The use of any airgun array must not continue for more than 30 minutes after it has discontinued gathering survey data from a node-equipped patch consistent with methods described in the Biological Assessment. That is, airgun arrays must not continue to fire for the purpose of avoiding ramp-up procedures following a power-down or shut-down. Likewise, airgun arrays cannot be fired for 30 minutes after discontinuation of gathering seismic survey data, powered off for 10 or fewer minutes, and restarted at full volume unless the vessel is once again actively gathering seismic data.

4. **Terms and Conditions associated with Reasonable and Prudent Measure 4**: *Waters within the action area that are known to be perennially used by Cook Inlet beluga whales for feeding, breeding or nursing (see term and condition 4.1) must not be ensonified to levels ≥160 dB when Cook Inlet beluga whales are present.*

4.1. No seismic exploration activity associated with this proposed action may occur within the Susitna Delta Exclusion Zone from 15 April through 15 October of each year. The Susitna Delta Exclusion Zone is defined as the union of the areas defined by a 10 mi (16 km) buffer of the Beluga River thalweg[17] seaward of the MLLW line, a 10 mi (16 km) buffer of the Little Susitna River thalweg seaward of the MLLW line, and a 10 mi (16 km) seaward buffer of the MLLW line between the Beluga River and Little Susitna River. The buffer extends landward along these thalwegs to include intertidal areas up to MHHW (Figure 19). The seaward boundary has been simplified so that it is defined by lines connecting readily discernable landmarks. In consultation with AKR, Apache may obtain authorization to conduct daytime-only (between local sunrise and local sunset) seismic surveys within the Susitna Delta Exclusion Zone between 15 April and 15 October if aerial surveys covering 100% of the zone conducted under ice-free conditions and during Beaufort Sea State 2 or less indicate an absence of beluga whales from the Susitna Delta Exclusion Zone for at least three consecutive days.

[17] A thalweg is the line that defines the deepest channel along the length of a streambed.

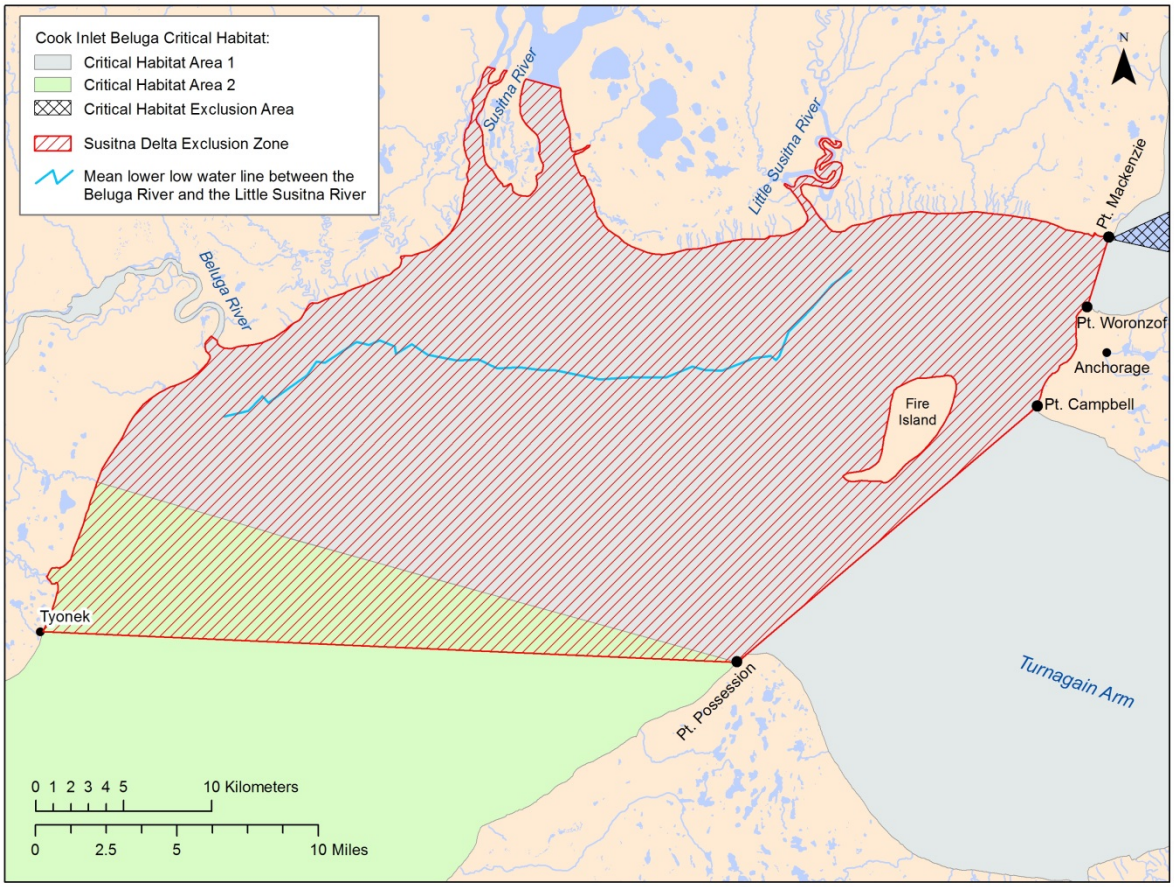

Figure 19. Depiction of the Susitna Delta Exclusion Zone (red hashed area).

4.2. Fluvial outlets (i.e. mouths of rivers, streams, and creeks) that are being used by listed marine mammals must remain outside of the 160 dB disturbance zone until listed marine mammals are no longer using those waters.

5. **Terms and Conditions associated with Reasonable and Prudent Measure 5:** *Aerial surveys must be flown in a way that further reduces the risk of take of marine mammals by this action.*

5.1 Aerial surveys to monitor for and document the presence of listed marine mammals must be flown as follows:

5.1.1) Apache must conduct daily aerial surveys of waters to be ensonified to ≥160 dB in the course of seismic surveys conducted that day.

5.1.2) As logistically feasible, the waters that are expected to be ensonified to ≥160 dB in the course of seismic surveys within 24 hours must be surveyed from aircraft flying linear transects that provide 100 percent survey coverage of those ensonified waters.

5.1.3) On a weekly basis, aerial surveys must also occur along and parallel to the coast throughout the action area as follows:

5.1.3)1. When seismic surveys are being conducted north of 60°43’ N latitude, aerial surveys must include all coastline within the action

area that is north of 60°43' N latitude (approximately north of the Forelands).

5.1.3)2. When seismic surveys are being conducted south of 60°43' N latitude, aerial surveys must include all coastline within the action area that is south of 60°43' N latitude (approximately south of the Forelands).

5.1.4) Aircraft engaged in aerial surveys associated with this project must fly surveys at an altitude of approximately 305 m (1,000 ft) above sea level, weather permitting.

5.1.5) Upon observing listed marine mammals, aircraft must attempt to maintain a radial distance of at least 457 m (1,500 ft) from the nearest marine mammal.

5.1.6) Aircraft must avoid approaching listed marine mammals from head-on, flying over or passing the shadow of the aircraft over the mammals.

5.1.7) Aircraft must provide an unobstructed view of waters on each side of the craft.

5.1.8) Daily aerial surveys must include all of the waters of the Susitna Delta Exclusion Zone on those days when seismic operations occur in waters north of 61° 03' N latitude.

Terms and Conditions associated with Reasonable and Prudent Measure 6: *Records, including metadata, of all marine mammal observations made by aerial, ship-based and shore-based observers associated with this project, regardless of the observed marine mammal(s) distance from the source vessel, must be made available to NMFS and the public in machine-readable format.*

6.1 The period of reporting for weekly reports will be for the week ending Tuesday prior to the Thursday reporting deadline (e.g., the weekly report for the period June 30-July 7, 2016 will be submitted to NMFS PR1 and NMFS AKR by close of business, Alaska time, July 9th, 2016).

6.2 The reporting period for each monthly report will be the entire calendar month, and will be submitted by close of business of the 5th day of the month following the end of the reporting period (e.g., The monthly report covering July 1-31, 2016, will be submitted to NMFS PR1 and NMFS AKR by close of business on August 5th, 2016).

6.3 A final technical report will be submitted to NMFS PR1 and NMFS AKR within 90 days after the final seismic shot has been fired for the season, or at least 60 days before the request for another Incidental Take Authorization for the next open water season, which would enable NMFS PR1 to incorporate observation data into the next IHA and Biological Opinion. The report will summarize all seismic activities and marine mammal monitoring results (i.e., vessel and shore-based visual monitoring) conducted during in-water seismic surveys. The Final Technical Report will include information required by terms and conditions 6.6.1-6.7.8. as well as:

6.3.1 Summaries that include monitoring effort, including vessel and PAM-specific total hours spent monitoring, total transect lengths monitored, areal extent of aerial surveys, and observed marine mammal distribution through the study

period on a daily basis, with associated metadata sufficient to indicate marine mammal observation conditions.

6.3.2 Analyses on the effects from various factors that influences detectability of marine mammals (e.g., sea state, number of observers, fog, glare, etc.)

6.3.3 Species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and local percentage of ice cover.

6.3.4 Analyses on the effects of seismic survey operations on listed marine mammals

6.3.5 Number of marine mammals observed (by species) during periods with and without seismic survey activities (and other variables that could affect detectability), such as:

6.3.5.1 Initial sighting distances between listed marine mammals and sound source versus survey activity state

6.3.5.2 Closest point of approach between listed marine mammals and sound source versus survey activity state

6.3.5.3 Observed behaviors and movement types of listed marine mammals versus survey activity state

6.3.5.4 Numbers of sightings/individuals seen versus survey activity state

6.3.5.5 Distribution of listed marine mammals around the source vessels versus survey activity state.

6.4 In an effort to maximize use of marine mammal observation data to minimize future take of listed marine mammals, Apache must, within 90 days of the final seismic transect surveyed by them in Cook Inlet in each year, provide AKR with both a raw and a quality controlled digital database.

6.5 A standardized data recording format is under development. Upon delivery of this data recording format from AKR to Apache, that format must be adopted by all PSOs for the reporting of listed marine mammal observations and interactions by Apache and its contractors. Prior to that time, the parameters set forth in Term and Condition 6.3 must be recorded by all PSOs and reported using an industry-standard machine-readable spreadsheet or relational database format. Upon request, AKR will work with the applicant to provide a suitable data-recording template (e.g., the Mysticetus System at http://www.mysticetus.com/).

6.6 Marine mammal observation data must include the following data for each listed marine mammal observation (or “sighting event” if repeated sightings are made of the same animal or animals):

6.6.1 species, date and time of each sighting event;

6.6.2 number of animals per sighting event and number of adults/juveniles/calves per sighting event;

6.6.3 primary, and, if observed, secondary behaviors of the marine mammals in each sighting event;

6.6.4 geographic coordinates of both the observed animals and most proximal actively operating seismic vessel, with the position recorded using the most

precise coordinates practicable (coordinates must be in recorded in decimal degrees or similar standard and defined coordinate system);

6.6.5 time of most recent seismic shot (of the most proximal actively operating seismic vessel) prior to marine mammal observation;

6.6.6 environmental conditions as they existed during each sighting event, including Beaufort sea state, weather conditions, miles of visibility, lighting conditions, and percentage of ice cover.

6.7 If a listed marine mammal enters the 160 dB disturbance zone or 180/190 dB exclusion zone (Table 8), it must be reported in the weekly reports, as well as included in the comprehensive observation database. The period of reporting for weekly reports will be for the week ending Tuesday prior to the Thursday reporting deadline (e.g., the weekly report for the period June 30-July 7, 2016 will be submitted to NMFS PR1 and NMFS AKR by close of business, Alaska time, July 9th, 2016). Recall that Term and Condition 2.1 requires reporting of Level A take of listed species within 24 hours, where level A take is exposure of pinnipeds to ≥190 dB and exposure of cetaceans to ≥180 dB. Observation records of listed marine mammals that enter the 160 dB disturbance zone or 180/190 dB exclusion zone must include:

6.7.1 all of the information required under Term and Condition 6.3 and 6.6 above

6.7.2 number of animals subjected to MMPA Level A take (≥180 dB for humpback whales and beluga whales and ≥190 dB for Steller sea lions)

6.7.3 number of animals subjected to MMPA Level B take (≥160 dB)

6.7.4 the date and time of each take;

6.7.5 the sound-producing device that resulted in take having occurred;

6.7.6 the time the animals entered the 160 dB disturbance zone or 180/190 dB exclusion zone, and the time that they exited the zone (whether due to animal movement, ship movement or mitigation measures);

6.7.7 mitigation measures implemented prior to and after the animal entered the 160 dB disturbance zone and the mitigation measures implemented prior to and after the animal entered the 180/190 dB exclusion zone.

6.8 Although Level A take is not authorized, any Level A take, as defined in Term and Condition 2.1 must be reported within 24 hours of occurrence to all NMFS contacts listed in Term and Condition 6.11.

6.9 In instances where Level A or Level B take is detected through passive acoustic monitoring, recordings of the detected signals, along with coordinates of the PAM buoy that detects each marine mammal signal, must be submitted to NMFS within 90 days of the completion of seismic exploration each year (i.e., if the final day of seismic operation in Cook Inlet during 2016 occurs on October 31st, the saved acoustic signatures, and accompanying buoy coordinates, must be submitted by January 29, 2017).

6.10 These reporting requirements are in addition to those required by the MMPA authorization. AKR will incorporate the Cook Inlet beluga whale sightings data into the Cook Inlet Beluga Whale Scientific Sightings Data Portal. Observations of other species will be archived for future use.

6.11 **NMFS Contacts:** In the event that the specified activity causes the take of a marine mammal in a manner other than that authorized by this ITS, Apache must immediately cease the specified activities pending reinitiation of formal consultation with NMFS, and must report the incident to:

AKR Protected Resources Division at: 907-271-5006,
NMFS stranding hotline at: 877-925-7773

and by email to:
Greg.Balogh@noaa.gov
and
Mandy.Migura@noaa.gov
and
Barbara.Mahoney@noaa.gov.

11. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

These discretionary measures are designed to minimize adverse effects to Cook Inlet beluga whales and other listed species from in-water noise generated by the airguns used in the seismic program.

1. Evaluate and consider using new research and techniques (e.g., by the Joint Industry Program) for reducing the horizontal spread of noise associated with the airguns.

2. Extend the ramp-up procedure from 30 minutes to 45 minutes to provide any undetected whales additional time to swim beyond the 9.5 km harassment radius.

3. Conduct a sound source verification (SSV) study for both shallow and 10 m deep intertidal seismic charges.

4. NMFS remains concerned about multiple contemporaneous noise-producing anthropogenic activities in Cook Inlet impeding unrestricted passage of Cook Inlet beluga whales within or between portions of their critical habitat (PCE 4). To minimize the risk of hindering this unrestricted passage, Apache should maintain a minimum buffer of 10 miles (16.1 km) between the perimeter of their 160dB disturbance zone and the perimeter

of the disturbance zone for other entities who have obtained MMPA or ESA take authorization[18].

In order for AKR to be kept informed of actions minimizing or avoiding adverse effects or benefiting the endangered Cook Inlet beluga whales, we request notification of the implementation of any conservation recommendations.

12. REINITIATION OF CONSULTATION

This concludes formal consultation on this action. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded in any operational year; 2) new information reveals effects from this action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this Biological Opinion; 3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this Biological Opinion; or 4) a new species is listed or critical habitat designated that may be affected by the identified action.

13. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (Data Quality Act (DQA)) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

13.1 Utility

This document records the results of an interagency consultation. The information presented in this document is useful to *NMFS* and the general public. These consultations help to fulfill multiple legal obligations of the named agencies. The information is also useful and of interest to the general public as it describes the manner in which public trust resources are being managed and conserved. The information presented in these documents and used in the underlying consultations represents the best available scientific and commercial information and has been improved through interaction with the consulting agency.

This consultation will be posted on the NMFS Alaska Region website, and may be accessed from https://alaskafisheries.noaa.gov/pr/esa-consultations).

13.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the

[18] The size of the disturbance zone for other authorized entities will depend upon factors such as sound source level, use of sound attenuation devices, application of appropriate sound source verification measurements, and whether the sound is impulsive or non-impulsive.

Computer Security Act; and the Government Information Security Reform Act.

13.3 Objectivity

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01 et seq.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the literature cited section. The analyses in this opinion contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA implementation, and reviewed in accordance with Alaska Region ESA quality control and assurance processes.

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