Application for the Incidental Harassment Authorization for the Taking of Non-listed Whales and Seals in Conjunction with the Buccaneer Energy Drilling Activities in Upper Cook Inlet, 2014

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Prepared for

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1.0 DETAILED DESCRIPTION OF SPECIFIC ACTIVITIES EXPECTED TO RESULT IN THE INCIDENTAL TAKING OF MARINE MAMMALS

Buccaneer Alaska Operations, LLC (Buccaneer) is an Alaskan limited liability company with offices in Anchorage and Kenai, Alaska. It is wholly owned by Buccaneer Energy, Ltd based in Sydney, Australia and operates on behalf of Buccaneer Alaska, LLC based in Houston, Texas.

Buccaneer plans to conduct a multi-well, multi-year offshore exploratory drilling program in upper Cook Inlet at its proposed locations on the following State of Alaska oil and gas leases: Alaska Division of Land (ADL) 17595-2/Southern Cross Unit #1 (SC #1), ADL 391108/Southern Cross Unit #2 (SC #2), ADL 391270/Northwest Cook Inlet Unit #1 (NWCI #1), ADL 391611/Northwest Cook Inlet Unit #2 (NWCI #2), ADL 17589/Tyonek Deep #1, and ADL 37831/Tyonek Deep #2. Drilling would occur from the *Endeavour – Spirit of Independence* jack-up rig (previously called the *Adriatic XI*) at the wells during the April 15 to October 31 upper Cook Inlet summer drilling season over a three-year period (2013-2015). Buccaneer currently plans to drill Southern Cross #1 during the fall of 2013, NWCI #1 and Tyonek Deep #1 in 2014, and the remaining wells in 2015. However the order in which the identified wells are drilled may change depending on operational considerations. During the winter months the rig will be stationed in lower Cook Inlet where it will either be dry-docked for maintenance or operating under a separate exploratory drilling program.

There are five proposed phases of the upper Cook Inlet exploratory drilling program of most relevance to Cook Inlet marine mammals:

1. Mobilization of the drill rig from lower Cook Inlet to the well locations.
2. Driving of the conductor pipe.
3. Exploratory drilling.
4. Vertical Seismic Profiling (VSP).
5. Mobilization of the drill rig upon completion of seasonal drilling back to lower Cook Inlet.

In addition, the rig will remain active with generators, pumps, and other standard equipment operating during and outside the above phases.

While the operations would extend three open-water periods, this Incidental Harassment Authorization (IHA) request addresses only the 2014 summer operations (the 2015 drilling operations will be addressed in a subsequent IHA application), which will likely include drilling at NWCI #1 and Tyonek Deep #1. However, as mentioned above, many factors can result in a schedule change under which one or both of these wells may be replaced by another of the six wells identified in this IHA. Thus, it is assumed that any of the six wells above could be drilled in 2014. Also, this application only addresses non-listed cetaceans and pinnipeds. Listed marine mammals have been addressed under a separate ESA consultation governed by a Letter of Concurrence (LOC) from James Balsiger dated July 8, 2013.

Because this operation could acoustically harass local marine mammals, a form of take as defined under the Marine Mammal Protection Act (MMPA), it is subject to governance under MMPA. Incidental and unintentional harassment takes are permitted with the issuance of an IHA from the National Marine Fisheries Service (NMFS). NMFS guidance identifies 14 specific items that must be addressed when

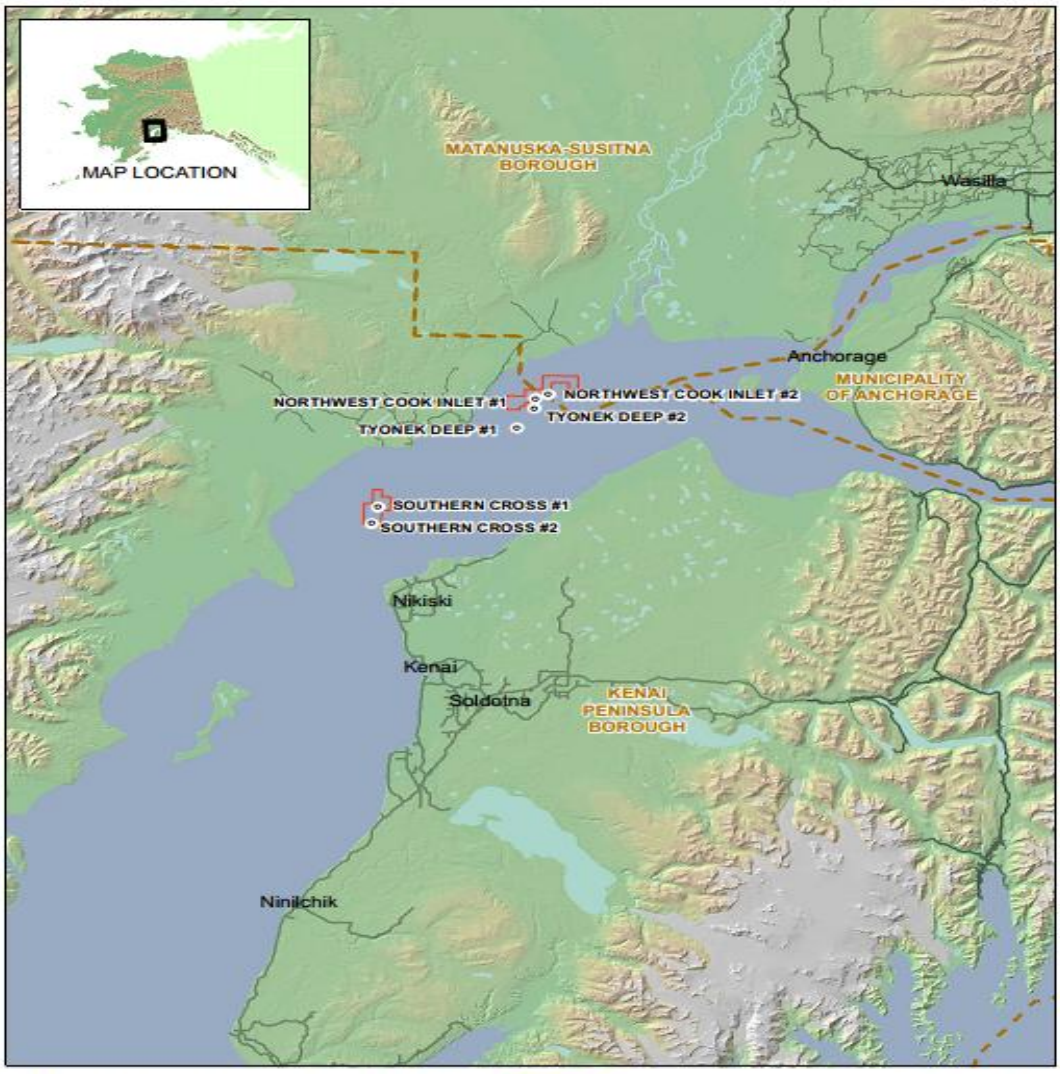
applying for an IHA, which allows NMFS to fully evaluate whether the proposed actions remain incidental and unintentional. The 14 items are addressed below in this application, which addresses Buccaneer's 2014 drilling program in upper Cook Inlet.

1.1 Overview of Activity

As mentioned above, Buccaneer plans to drill two wells in upper Cook Inlet during the summer and early fall of 2014. While the current schedule includes drilling NWCI #1 and Tyonek Deep #1 in 2014, operational considerations could result any of six wells being drilled in 2014. Specific locations of the six well sites are shown in Figure 1 and described below:

- SC #1 is located 18.8 miles southwest of the Tyonek Village airstrip, 9.4 miles north-northwest of the Nikiski OSK dock, and 52.2 miles southwest of the Ted Stevens Anchorage International Airport (TSAIA). Average water depth is 18 feet.
- SC #2 is located 15.8 miles southwest of the Tyonek Village airstrip, 11.1 miles north of the Nikiski OSK dock, and 51 miles southwest of TSAIA. Average water depth is 30 feet.
- NWCI #1 is located 7.9 miles northeast of the Tyonek Village airstrip, 29 miles northeast of the Nikiski OSK dock, and 29.7 miles west of TSAIA. Average water depth is 72 feet.
- NWCI #2 is located 5.6 miles northeast of the Tyonek Village airstrip, 27.1 miles northeast of the Nikiski OSK dock, and 31.8 miles west of the TSAIA. Average water depth is 69 feet.
- Tyonek Deep #1 is located 5.4 miles east of the Tyonek Village airstrip, 29.8 miles northeast of the Nikiski OSK dock, and 32.4 miles west of the TSAIA. Average water depth is 92 feet.
- Tyonek Deep #2 is located 7.4 miles northeast of the Tyonek Village airstrip, 33.3 miles northeast of the Nikiski OSK dock, and 30.0 miles west of the TSAIA. Average water depth is 90 feet.

Buccaneer will use existing infrastructure and resources found on the Kenai Peninsula and south-central Alaska area whenever possible during the project. These resources include barge landings, private staging areas, airstrips, landfills, water supplies, heavy equipment, and personnel. The phases of the operation and specifications of the equipment to be used are addressed individually below.



1.2 Project Details

Drilling Operations

Buccaneer proposes to conduct exploratory drilling operations at multiple wells in upper Cook Inlet during the 2014 summer and fall open water season. Before and after the summer and fall drilling season, the rig will be stationed in lower Cook Inlet, likely Port Graham, where it will undergo maintenance and winterizing.

Drilling Rig

Buccaneer proposes to conduct its exploratory drilling using the *Endeavour - Spirit of Independence* (a modified and improved *Adriatic XI*; Figure 1-2). Specifications, plans and drawings of the rig are presented in Appendix A. The *Endeavour* is an independent leg, cantilevered jack-up drill rig of the *Marathon LeTourneau* Class 116-C and is capable of drilling to 25,000 feet in water depths from 15 to 300 feet.

Figure 1-2. *Endeavour* arriving at Port of Homer.

To maintain safety and work efficiency, the jack-up rig will be equipped with the following:

- Either a 5,000, 10,000, or 15,000 pounds per square inch (psi) blow out preventer (BOP) stack, for drilling in higher pressure formations found at greater depths in Cook Inlet;
- Sufficient variable deck load to accommodate the increased drilling loads and tubular for deeper drilling;
- Reduced draft characteristics to enable the rig to easily access shallow water locations;
- Riser tensioning system to adequately deal with the extreme tides/currents in up to 300 feet water depth;
- Steel hull designed to withstand -10 degrees Celsius (°C) to eliminate the risk of steel failure during operations in Cook Inlet (*i.e.*, built for North Sea arctic conditions); and
- Ability to cantilever over existing platforms for working on development wells or during plug and abandonment (P&A).

Rig Mobilization

The rig will be towed between drilling locations and winter moorage by ocean-going tugs that are licensed to operate in Cook Inlet by the Southwest Pilots Association. All tow vessels will be United States Coast Guard (USCG) certified. Move plans will receive close scrutiny from the rig owner's tow master as well as the owner's insurers, and will be conducted in accordance with state and federal regulations. Rig moves will be conducted in a manner to minimize any potential risk regarding safety as well as cultural or environmental impact.

While under tow, the rig operations will be monitored by Buccaneer and the drilling contractor management, both aboard the rig and onshore. Very High Frequency (VHF) radio, satellite, and cellular phone communication systems will be used while the rig is under tow. Helicopter transport will also be available. A description of helicopter operations is presented below. A certified marine surveyor will also be onboard during all rig moves to ensure cadastral documentation of the rig and well locations and the final rig position at set-down.

Logistics Support and Oil Field Support Services

Buccaneer operations will be directed from the North America office in Houston, Texas; field offices in Anchorage and Kenai, Alaska; and an onsite field office on the rig. Contractor and vendor facilities are located at Nikiski, Kenai, Homer, and Anchorage.

Oil Field Support Services

Table 1-1 presents a list of services, activities, equipment, and supplies that will be mobilized to the exploration drill site during drilling operations. The rig will be stocked with most of the drilling supplies required to complete a full summer program. Deliveries of remaining items will be performed by support vessels and helicopters. The majority of the oilfield support services contractors have offices, shops, and additional equipment located in Kenai and Nikiski that will support their remote field operations. The tugs used to mobilize the rig will be staged nearby at the OSK Dock in Kenai or at the Homer Dock in Homer for additional rig support and anchor-handling.

Table 1-1: Identified Exploration Project Support Services, Service Activities, Equipment, and Supplies

Drill Site Management Drilling Engineering / Technical Support Well Testing / Drill Stem Testing Well Drilling Casing Plugging & Abandonment Drill Rig Crew Rig Mobilization Marine Surveyor Heavy Lift Vessel Oceangoing Tug Boats Waste Management Dumpsters Landfill Recycling Wastewater Treatment	Drill Cuttings & Drill Fluids Disposal Rig Camp Operations Catering Housekeeping Drilling & Completion Operations Cementing Services, Directional / MWD / LWD Mud Logging, Service Packers Completion Equipment, Casing Accessories Tubing and Perforating Wireline and Slickline Liner Hanging Drill Pipe Rental, Drilling Jars Fishing Services and Tubular Inspections	Well Control BOP Medical Onsite EMT 1st Aid & General Medical Equipment & Supplies Advanced Cardiac Life Support / Trauma Life Support Equipment & Supplies Marine Mammal Monitoring Certified Biologist / Marine Mammal Observers Oil Spill Response Action Contractors (ODPCP) Spill Technicians and Spill Prevention Fuel-Fluid Transfers

Helicopter Support

Helicopter logistics for project operations will include transportation for personnel, groceries, and supplies. Helicopter support will consist of a twin turbine Bell 212 (or equivalent) helicopter certified for instrument flight rules land and over water operations. Helicopter crews and support personnel will be housed in existing Kenai area facilities. The helicopter will be based at the Kenai Airport to support rig crew changes and cargo handling. Fueling will take place at these facilities. No helicopter refueling will take place on the rig.

Helicopter flights to and from the rig are expected to average two per day. Flight routes will follow a direct route to and from the rig location, and flight heights will be maintained 1,000 to 1,500 feet above ground level to avoid acoustical harassment of marine mammals (Richardson et al. 1995). The aircraft will be dedicated to the drilling operation and will be available for service 24 hours per day. A replacement aircraft will be available when major maintenance items are scheduled.

Rig crews, operator personnel, and third party personnel not already on the rig or in the Cook Inlet area will be flown to the Kenai Airport from Anchorage by scheduled commercial or chartered aircraft. Personnel will then be transported by helicopter to the rig. Personnel will be housed in an appropriate facility in the Homer or Kenai area in the event of inclement weather.

Alternate landing zones will be identified and available for diverted flights if weather prevents a helicopter landing at the Kenai Airport, such as the Nikiski OSK facility, Homer Airport, or the Hanson drill site helipad. Sufficient fuel will be carried on all flights under inclement weather conditions to return to the rig as an additional alternate destination. The rig will be provided with adequate instrumentation, communications, a helipad, and navigational aids to ensure all flight operations are conducted safely at all times.

Supply Vessel Support

Major supplies will be staged on-shore at the Kenai OSK Dock. Required supplies and equipment will be moved from the staging area by contracted supply vessels and loaded aboard the rig when the rig is established on a drilling location. Major supplies will include fuel, drilling water, mud materials, cement, casing, and well service equipment. Supply vessels also will be outfitted with fire-fighting systems as part of fire prevention and control as required by Cook Inlet Spill Prevention and Response, Inc. (CISPRI).

The specific supply vessels have not been identified; however, typical offshore drilling support work vessels are of steel construction with strengthened hulls to give the capability of working in extreme conditions.

Fuel

Rig equipment will use diesel fuel or electricity. Personnel associated with fuel delivery, transfer, and handling will be knowledgeable of Industry Best Management Practices related to fuel transfer and handing, drum labeling, secondary containment guidelines, and the use of liners/drip trays.

The jack-up rig will take on a maximum fuel load prior to operations to reduce fuel transfers during drilling. Commercial tank farms in the Nikiski or Kenai area will supply fuel transported by barge as needed. The rig barge master will be in charge of re-fueling and fluid transfers between the rig and fuel barge, and subsequent transfers between tanks on the rig.

Drilling Program and Well Operations

The drilling program for the wells have been described in detail in the Plan of Operations filed with the Alaska Division of Oil and Gas. The APD presents information on the drilling mud program; casing design, formation evaluation program; cementing programs; and other engineering information.

Buccaneer proposes to drill at each well site using the jack-up rig. After rig up/rig acceptance by Buccaneer, each well will be spudded and drilled to the bottom-hole depths of 7,000 to 16,000 feet. Drilling will take approximately 30 to 75 days per well. Well testing will take another 7 to 15 days per well.

Blowout Prevention Program and Equipment

All operating procedures on the rig, whether automated or controlled by company or contractor personnel, are specifically designed to prevent a loss of well control. The primary method of well control utilizes the hydrostatic pressure exerted by a column of drilling mud of sufficient density to prevent an undesired flow of formation fluid into the well bore. In the unlikely event that primary control is lost, surface blowout prevention (BOP) equipment would be used for secondary control. Buccaneer will use a 5,000 pounds of pressure per square inch (psi) BOP stack for shallow wells, and a 10,000 or 15,000 psi BOP stack for drilling deeper wells in higher pressure formations known to exist in Cook Inlet.

Well Plugging and Abandonment (P&A)

When planned and permitted operations are completed, the wells will be suspended or P&A'd according to AOGCC regulations. Each well string is sealed and cemented with mechanical plugging devices to prevent the movement of any reservoir fluids between various strata. P&A includes cutting the casing below the sea floor and retrieving the stub. A P&A procedure will be presented to the AOGCC for approval prior to beginning the operation.

Waste Management Program

The onsite Health, Safety, and Environmental (HSE) Advisor will supervise drilling waste, solid waste, and wastewater, and will be responsible for authorized discharge and proper manifesting for transport and off-site disposal.

Drilling Fluids and Cuttings

Drilling wastes include drilling fluids, known as mud, rock cuttings, and formation waters. Drilling wastes (non-hydrocarbon) will be discharged to the Cook Inlet under the approved Alaska Pollution Discharge Elimination System (APDES) general permit. Drilling wastes (hydrocarbon) will be delivered to an onshore permitted location for disposal. During drilling, the onsite tool pusher/driller and qualified mud engineers will direct and maintain desired mud properties, and maintain the quantities of basic mud materials on site as dictated by good oilfield practice. Buccaneer will follow best management practices to ensure that a sufficient inventory of barite and lost circulation materials are maintained on the drilling vessel to minimize the possibility of a well upset and the likelihood of a release of pollutants to Cook Inlet waters. These materials can be re-supplied, if required, using the supply vessel. Because adverse weather could prevent immediate re-supply, sufficient materials will be available on board to completely rebuild the total circulating volume. Buccaneer will conduct an Environmental Monitoring Study of relevant hydrographic, sediment hydrocarbon, and heavy metal data from surveys conducted before and during drilling mud disposal and up to a least one year after drilling operations cease in accordance with the APDES general permit for discharges of drilling muds and cuttings.

Non-drilling wastewater includes deck drainage, sanitary waste, domestic waste, blowout preventer fluid, boiler blowdown, fire control test water, bilge water, non-contact cooling water, and uncontaminated ballast water. Non-drilling wastewater will be discharged into Cook Inlet under the approved APDES general permit or delivered to an onshore permitted location for disposal.

Solid waste (*e.g.*, packaging, domestic trash) will be classified, segregated, and labeled as general, universal, and Resource Conservation and Recovery Act exempt or non-exempt waste. It will be stored in containers at designated accumulation areas. Then, it will be packaged and palletized for transport to an approved on-shore disposal facility. No hazardous wastes should be generated as a result of this project. However, if any hazardous wastes were generated, it would be temporarily stored in an onboard satellite accumulation area and then transported offsite for disposal at an approved facility.

1.3 Project Components of Relevance to Acoustical Harassment of Marine Mammals

The project components with a potential for harassment of marine mammals include:

1) towing of the jack-up drill rig between unrelated well sites in lower Cook Inlet and the Southern Cross, Northwest Cook Inlet, or Tyonek Deep well sites in upper Cook Inlet,

2) driving the conductor pipe at each well prior to drilling,

3) active exploratory drilling at each of the well sites with associated generator and pump noise, and

4) VSP operations that would occur at the completion of each well drilling.

For these activities the primary impact of concern is the effect the noise generated by these operations could have on local marine mammals. Helicopters will be used to transport personnel on and off the drill rig, but any noise related impacts to marine mammals will be avoided by maintaining 1,000 to 1,500-foot flight altitudes. Towing, drilling, generators, and submersible pumps generate continuous noises; therefore, continuous noise criteria developed by NMFS apply (*i.e.*, Level B disturbance harassment with exposure to sound levels >120 dB re 1 µPa-m (rms)). Potential impacts from these noise sources are addressed relative to exceeding the 120 dB noise "take" threshold. The conductor pipe driving and VSP are impulsive noise activities. Here the Level B disturbance exposure to sound levels >160 dB re 1 µPa-m (rms) applies, and "take" is addressed relative to noise levels exceeding 160 dB.

Rig Tow

The jack-up rig would be towed three times during the summer and fall seasons of 2014. It is estimated that the longer tows will take two days to complete, while the shorter tows between the upper Cook Inlet wells will take but a few hours (distance between the two wells is less than 5 miles).

The rig will be wet-towed by two or three ocean-going tugs licensed to operate in the Cook Inlet. Tugs generate their loudest sounds while towing due to propeller cavitation. While these continuous sounds have been measured at up to 171 dB re 1 µPa-m (rms) at 1-meter source (broadband), they are

generally emitted at dominant frequencies of less than 5 kHz (Miles et al. 1987, Richardson et al. 1995, Simmonds et al. 2004). The distance to the 120-dB isopleth (the Level B disturbance criteria for continuous noise sources) assuming a 171 dB source is 1,715 feet (523 meters) using Collins et al.'s (2007) 171 - 18.4 Log(R) – 0.00188 R spreading model developed from Cook Inlet.

For the most part, the dominant noise frequencies from propeller cavitation are significantly less than the dominant hearing frequencies for pinnipeds (10 to 30 kHz) and toothed whales (12 to >100 kHz) (Wartzok and Ketten 1999). Still, because it is currently unknown which tugs will be used to tow the rig on each tow, and there are few sound signatures for tugs in general, it is assumed that noise exceeding 120 dB extends 1,715 feet (523 meters) from the operating tugs.

Conductor Pipe Driving

A conductor pipe is a relatively short, large-diameter pipe driven into the sediment prior to the drilling of oil wells. This section of tubing serves to support the initial sedimentary part of the well, preventing the looser surface layer from collapsing and obstructing the wellbore. The pipe also facilitates the return of cuttings from the drill head. Conductor pipes are usually installed using drilling, pile driving, or a combination of these techniques. In offshore wells, the conductor pipe is also used as a foundation for the wellhead. Buccaneer proposes to drive approximately 300 feet (90 meters) of 30-inch conductor pipe at each of the upper Cook Inlet wells prior to drilling using a Delmar D62-22 impact hammer. This hammer has impact weight of 13,640 pounds (6,200 kg) and reaches a maximum impact energy of 165,215 foot-pounds (224 kilonewton-meters) at a drop height of 12 feet (3.6 meters).

Blackwell (2005) measured the noise produced by a Delmar D62-22 driving 36-inch steel pipe in upper Cook Inlet and found sound pressure levels to exceed 190 dB re 1µPa-m (rms) at about 200 feet (60 meters), 180 dB re 1µPa-m (rms) at about 820 feet (250 meters), and 160 dB re 1µPa-m (rms) at just less than 1.2 miles (1.9 kilometers). Each conductor pipe driving event is expected to last one to three days, although actual noise generation (pounding) would occur only intermittently during this period.

Exploratory Drilling and Standard Operation

Buccaneer proposes to use the jack-up drilling rig *Endeavour* for the Cook Inlet program. Because the drilling platform and other noise-generating equipment is located above the sea's surface, and there is very little surface contact with the water compared to drill ships and semi-submersible drill rigs, lattice-legged jack-up drill rigs are relatively quiet (Richardson et al. 1995, Spence et al. 2007).

The *Spartan 151*, the only other jack-up drilling rig operating in the Cook Inlet, was hydro acoustically measured by Marine Acoustics, Inc. (2011) while operating in 2011. The survey results showed that continuous noise levels exceeding 120 dB re 1µPa extended out only 164 feet (50 meters), and that this noise was largely associated with the diesel engines used as hotel power generators.

The *Endeavour* was hydro acoustically tested during drilling activities by Illingworth and Rodkin (2013a) in May 2013 while the rig was operating at a lower Cook Inlet well site (Cosmopolitan #1). The results from the sound source verification indicated that noise generated from drilling or generators were below ambient. The generators used on the *Endeavour* are mounted on pedestals specifically to reduce noise transfer through the infrastructure, and they are enclosed in an insulated engine room, which may

further have reduced underwater noise transmission to levels below those generated by the *Spartan 151.* Also, as mentioned above, the lattice legs limit transfer of noise generated from the drilling table to the water.

However, the sound source verification revealed that the submersed deep-well pumps that charges the fire-suppression system and cools the generators (in a closed water system) does generate noise levels exceeding 120 dB re 1µPa out a distance of approximately 984 feet (300 meters). It was not clear at the time of measurements whether the noise was direct result of the pumps or was from the systems discharge water falling approximately 40 feet (12 meters) from the deck. Thus, after the falling water was enclosed in pipe extending below the water surface in an effort to reduce the noise levels, the pump noise levels were re-measured in June 2013 (I&R 2013b) with results indicating that piping the falling water had a modicum of effect on reducing underwater noise levels; nevertheless, the 120-dB radius still extended out to 260 meters in certain directions.

Thus, neither drilling operations nor running generators on the *Endeavour* drill rig generates underwater noise levels exceeding 120 dB re 1µPa. However, the *Endeavour*'s submersed deep-well pumps generate continuous noise exceeding 120 dB re 1µPa to a maximum distance of 260 meters.

Vertical Seismic Profiling

Data on geological strata depth collected during initial seismic surveys at the surface can only be inferred. However, once a well is drilled, accurate follow-up seismic data can be collected by placing a receiver at known depths in the borehole and shooting a seismic airgun at the surface near the borehole. This gathered data provides not only high resolution images of the geological layers penetrated by the borehole, but can be used to accurately correlate (or correct) the original surface seismic data. The procedure is known as vertical seismic profiling, or VSP.

Buccaneer intends to conduct VSP operations at the end of drilling each well using an array of airguns with total volumes of between 600 and 880 cubic inches. Each VSP operation is expected to last less than one or two days. Assuming a 1-meter source level of 227 dB re 1µPa (based on manufacturer's specifications) for an 880 cubic inch array and using Collins et al.'s (2007) transmission loss model for the Cook Inlet (227 – 18.4 Log(R) - 0.00188), the 190 dB radius (Level A take threshold for pinnipeds) from source was estimated at 330 feet (100 meters), the 180 dB radius (Level A take threshold for cetaceans) at 1,090 feet (332 meters), and the 160 dB radius (Level B disturbance take threshold for all marine mammals) at 1.529 miles (2.46 kilometers). These were the initial injury and safety zones established for monitoring during a VSP operation conducted by Buccaneer at Cosmopolitan #1 during July 2013.

Illingworth and Rodkin (2013c) did measure the underwater noise levels associated with the July 2013 VSP operation using a 720 cubic inch array and found the noise exceeding 160 dB re 1 µPa (rms) extended out 1.535 miles (2.47 kilometers) or virtually identical to the modeled distance. The measured radius to the 190 dB level was 246 feet (75 meters) and to the 180 dB level was 787 feet (240 meters). The best fit model for the empirical data was 227 – 19.75 log(R) – 0.0 (I&R 2013c).

1.4 Maintaining Safe Radii

Acoustical injury to marine mammals can occur if received noise levels exceed 180 dB re 1 µPa (rms) for whales or 190 dB re 1 µPa (rms) for pinnipeds. Termed Level A injury take, these takes are not authorized by IHAs, and measures must be taken to avoid them. However, the drilling and rig towing procedures to be used during Buccaneer's operation do not have the potential to acoustically injure marine mammals (see Section 6). Therefore, no shutdown safety zones will be established for these activities (but see Section 13 regarding monitoring of harassment zones). The conductor pipe driving and VSP operations do generate impulsive noises exceeding 180 dB re 1 µPa (rms). Based on the estimated distances to the 180 dB isopleth addressed above, an 820-foot (250-meter) shutdown safety zone will be established and monitored during conductor pipe driving (at least until the noise levels are empirically verified), while a 787-foot (240-meter) shutdown safety zone will be monitored during VSP operations.

2.0 DATES AND DURATION OF PROPOSED ACTIVITY AND SPECIFIC GEOGRAPHICAL REGION

This request for incidental harassment authorization is for Buccaneer's exploratory drilling operations in upper Cook Inlet (Figure 1-1) during the 2014 open water season (April 15 to October 31). All activities associated with drilling would occur inclusive of the above dates. Mobilization of the rig to and from upper Cook Inlet may occur just prior or just after the above dates. The proposed dates and duration of each activity (timeline) is detailed in Figure 2-1.

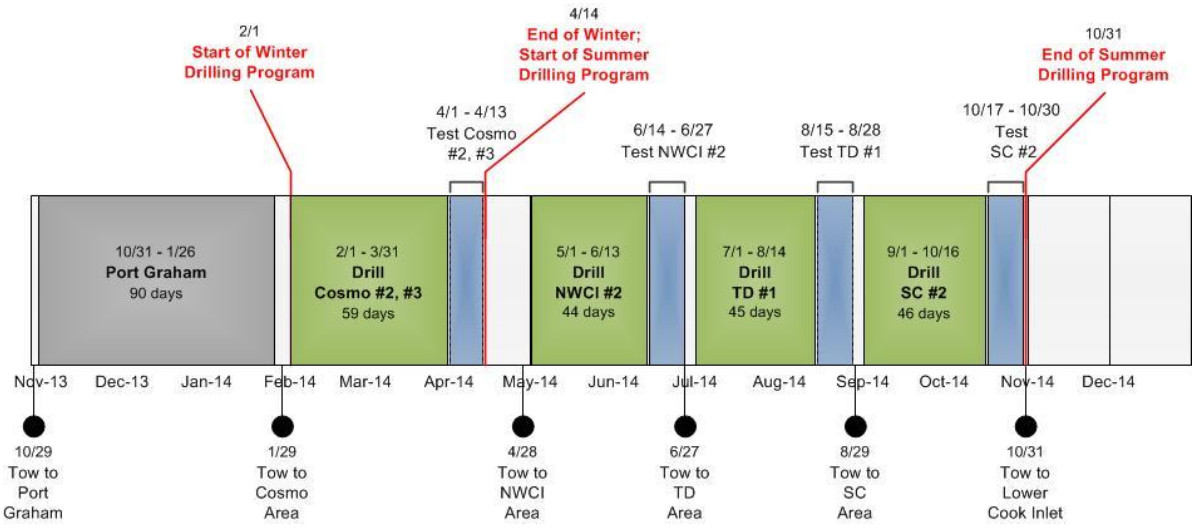


Figure 2-1. Project Timeline.

3.0 THE SPECIES AND NUMBERS OF MARINE MAMMALS LIKELY TO BE FOUND WITHIN THE ACTIVITY AREA

The species of marine mammals that are most likely to be found in the upper Cook Inlet activity area, at least seasonally, are beluga whales, harbor porpoises, and harbor seals. Humpback whales, gray whales, minke whales, killer whales, Dall's porpoise, Steller sea lions, and sea otters are found in lower Cook Inlet, including near Homer or Port Graham (Rugh et al. 2005) where winter rig maintenance might occur. However, beluga whales, humpback whales, and Steller sea lions are listed under ESA and addressed in a separate consultation with NMFS, while sea otters are administered by the U.S. Fish and Wildlife Service and are addressed in a separate IHA application.

The stock populations for non-listed marine mammals found in Cook Inlet are shown in Table 3-1. Minke whales have considered migratory in Alaska (Allen and Angliss 2012) but have recently been observed off Cape Starichkof and Anchor Point year-round and could be encountered during towing operations in and out of lower Cook Inlet. Killer whales could also be encountered during towing operations, but the expectation would be very low given the sporadic and infrequent use of upper Cook Inlet by these whales. Gray whales and Dall's porpoise are found only in lower Cook Inlet, and might be encountered during towing operations through lower Cook Inlet. The remaining species – harbor porpoise and harbor seal – are found in upper Cook Inlet during the summer months (Angliss and Allen 2012, Boveng et al. 2012), and could potentially occur in the vicinity of active drilling operations, although the chances of encounter are not high based on local population densities.

Table 3-1. Non-listed Marine Mammals Inhabiting Upper Cook Inlet.

Species	Stock Estimate	Comment
Minke Whale (*Balaenoptera acutorostra*)	~2,000	Alaska Stock
Gray Whale (*Eschrichtius robustus*)	18,017	Eastern North Pacific Stock
Harbor Porpoise (*Phocoena phocoena*)	31,046	Gulf of Alaska Stock
Killer Whale (*Orcinus orca*)	2,084	Alaska Resident Stock
Killer Whale (*Orcinus orca*)	552	Alaska Transient Stock
Dall's Porpoise (*Phocoenoides dalli*)	83,400	Alaska Stock
Harbor Seal (*Phoca vitulina*)	22,900	Cook Inlet/Shelikof Stock

Source: Allen and Angliss (2012, 2013)

4.0 A DESCRIPTION OF THE STATUS, DISTRIBUTION, AND SEASONAL DISTRIBUTION (WHEN APPLICABLE) OF THE AFFECTED SPECIES OR STOCKS OF MARINE MAMMALS LIKELY TO BE AFFECTED BY SUCH ACTIVITIES

4.1 Minke Whale (*Balaenoptera acutorostra*)

Minke whales are the smallest of the rorqual group of baleen whales reaching lengths of up to 35 feet. They are also the most common of the baleen whales with estimates exceeding one million animals in the Southern Hemisphere alone. There are no population estimates for the North Pacific, although

estimates have been made for some portions of Alaska. Zerbini et al. (2006) estimated the coastal population between Kenai Fjords and the Aleutian Islands at 1,233 animals.

During Cook Inlet-wide aerial surveys conducted from 1993 to 2004, minke whales were encountered only twice (1998, 1999), both times off Anchor Point 16 miles northwest of Homer. A minke whale was also reported off Cape Starichkof in 2011 (A. Holmes, pers. comm.) and 2013 (E. Fernandez and C. Hesselbach, pers. comm.), suggesting this location is regularly used by minke whales, including during the winter. There are no records north of Cape Starichkof, and this species is unlikely to be seen in upper Cook Inlet. There is a chance of encountering this whale during towing operations through lower Cook Inlet.

4.2 Gray Whale (*Eschrichtius robustus*)

Each spring, the Eastern North Pacific stock of gray whale migrates 5,000 miles (8,000 kilometers) northward from breeding lagoons in Baja California to feeding grounds in the Bering and Chukchi seas, reversing their travel again in the fall (Rice and Wolman 1971). Their migration route is for the most part coastal until they reach the feeding grounds. A small portion of whales do not annually complete the full circuit, as small numbers can be found summer feeding along the Oregon, Washington, British Columbia, and Alaskan coasts (Rice et al. 1984, Moore et al. 2007).

Human exploitation reduced this stock down to an estimated “few thousand” animals (Jones and Schwartz 2002). However, by the late 1980s the stock was appearing to reach carrying capacity and estimated to be at 26,600 animals (Jones and Schwartz 2002). By 2002 that stock had been reduced to about 16,000 animals, especially following unusually high mortality events in 1999 and 2000 (Allen and Angliss 2012). The stock has continued to grow since then and is currently estimated at 19,126 animals with a minimum estimate of 18,017 (Allen and Angliss 2012).

Most gray whales migrate past the mouth of Cook Inlet to and from northern feeding grounds. However, small numbers of summering gray whales have been noted by fisherman near Kachemak Bay and north of Anchor Point. Further, summer gray whales were seen offshore of Cape Starichkof by marine mammal observers monitoring Buccaneer’s Cosmopolitan drilling program in 2013. Regardless, gray whales are not expected to be encountered in upper Cook Inlet, where there are no records, but might be encountered during towing activities that might begin or end near Cape Starichkof.

4.3 Harbor Porpoise (*Phocoena phocoena*)

Harbor porpoise are small (1.5 meters length), relatively inconspicuous toothed whales. The Gulf of Alaska Stock is distributed from Cape Suckling to Unimak Pass and was most recently estimated at 31,046 animals (Allen and Angliss 2012). They are found primarily in coastal waters less than 328 feet (100 meters) deep (Hobbs and Waite 2010) where they feed on herring and other schooling fish/cephalopods.

Although they have been frequently observed during aerial surveys in Cook Inlet, most sightings are of single animals, and many of the sightings are concentrated at Chinitna and Tuxedni bays on the west side of lower Cook Inlet (Rugh et al. 2005). Dahlheim et al. (2000) estimated the 1991 Cook Inlet-wide

population at only 136 animals. However, they are one of the three marine mammals (besides belugas and harbor seals) regularly seen in upper Cook Inlet (Nemeth et al. 2007), especially during spring eulachon and summer salmon runs. Because harbor porpoise have been observed throughout Cook Inlet during the summer months, including mid-inlet waters, they represent one species that could be observed during Buccaneer's proposed drilling operations in upper Cook Inlet.

4.4 Dall's Porpoise (*Phocoenoides dalli*)

Dall's porpoise are widely distributed throughout the North Pacific Ocean including Alaska, although they are not found in upper Cook Inlet and the shallower waters of the Bering, Chukchi, and Beaufort Seas (Allen and Angliss 2013). Compared to harbor porpoise, Dall's porpoise prefer the deep offshore and shelf slope waters. The Alaskan population has been estimated at 83,400 animals (Allen and Angliss 2013), making it one of the more common cetaceans in the state. Dall's porpoise have been observed in lower Cook Inlet, including Kachemak Bay and near Anchor Point (Glenn Johnson, pers. comm.), but sightings there are rare. There is only the remote chance that Dall's porpoise might be observed during Buccaneer towing operations through lower Cook Inlet.

4.5 Killer Whale (*Orcinus orca*)

Two different stocks of killer whales inhabit the Cook Inlet region of Alaska: the Alaska Resident Stock and the Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock (Allen and Angliss 2012). The resident stock is estimated at 2,084 animals and occurs from Southeast Alaska to the Bering Sea (Allen and Angliss 2012). Resident whales feed exclusively on fish and are genetically distinct from transient whales (Saulitis et al. 2000). The transient whales feed primarily on marine mammals (Saulitis et al. 2000). The transient population inhabiting the Gulf of Alaska shares mitochondrial DNA haplotypes with whales found along the Aleutian Islands and the Bering Sea suggesting a common stock, although there appears to be some subpopulation genetic structuring occurring to suggest the gene flow between groups is limited (see Allen and Angliss 2012). For the three regions combined, the population has been estimated at 552 animals (Allen and Angliss 2012).

Killer whales are occasionally observed in lower Cook Inlet, especially near Homer and Port Graham (Shelden et al. 2003, Rugh et al. 2005). A concentration of sightings near Homer and inside Kachemak Bay may represent high use, or high observer-effort given most records are from a whale-watching venture based in Homer. The few whales that have been photographically identified in lower Cook Inlet belong to resident groups more commonly found in nearby Kenai Fjords and Prince William Sound (Shelden et al. 2003). Prior to the 1980s, killer whale sightings in upper Cook Inlet were very rare. During aerial surveys conducted between 1993 and 2004, killer whales were observed on only three flights, all in the Kachemak and English Bay area (Rugh et al. 2005). However, anecdotal reports of killer whales feeding on belugas in upper Cook Inlet began increasing in the 1990s, possibly in response to declines in sea lion and harbor seal prey elsewhere (Sheldon et al. 2003). These sporadic ventures of transient whales into beluga summering grounds have been implicated as a possible contributor to decline of Cook Inlet belugas in the 1990s, although the number of confirmed mortalities from killer whales is small (Sheldon et al. 2003). If killer whales were to venture into upper Cook Inlet in 2013, they might pass by Buccaneer's active drilling program.

4.6 Harbor Seal (*Phoca vitulina*)

At over 150,000 animals state-wide (Allen and Angliss 2012), harbor seals are one of the more common marine mammal species in Alaskan waters. They are most commonly seen hauled out at tidal flats and rocky areas. Harbor seals feed largely on schooling fish such a walleye pollock, Pacific cod, salmon, Pacific herring, eulachon , and squid. Although harbor seals may make seasonal movements in response to prey, they are resident to Alaska and do not migrate.

The Cook Inlet/Shelikof Stock, ranging from approximately Anchorage down along the south side of the Alaska Peninsula to Unimak Pass, has been recently estimated at a stable 22,900. Large numbers concentrate at the river mouths and embayments of lower Cook Inlet, including the Fox River mouth in Kachemak Bay (Rugh et al. 2005). Montgomery et al. (2007) recorded over 200 haulout sites in lower Cook Inlet alone. However, only a few dozens to a couple hundred seals seasonally occur in upper Cook Inlet (Rugh et al. 2005), mostly at the mouth of the Susitna River where their numbers vary in concert with the spring eulachon and summer salmon runs (Nemeth et al. 2007, Boveng et al. 2012). Montgomery et al. (2007) also found seals elsewhere in Cook Inlet to move in response to local steelhead and salmon runs. Harbor seals may be encountered during rig tows to and from Cape Starichkof, and possibly during drilling in upper Cook Inlet.

5.0 TYPE OF INCIDENTAL TAKING AUTHORIZATION BEING REQUESTED AND METHOD OF INCIDENTAL TAKING

The incidental taking authorization requested is for Level B continuous noise disturbance (received noise levels exceeding 120 dB re 1 µPa (rms)) associated with exploratory drilling, rig operations (generators and pumps), and towing of the drill rig. No Level A injury takes (noise exceeding 180 dB re 1 µPa (rms)) are expected from these activities. Authorization is also requested for impulsive noise harassment (exceeding 160 dB re 1 µPa (rms)) associated with the conductor pipe driving and the VSP operations. The actual Level B take will depend upon number of marine mammals occurring within the 120 dB Zone of Influence (ZOI) at the time of drilling, rig operations, or towing activity or within the 160 dB ZOI during conductor pipe driving or the VSP operations.

6.0 BY AGE, SEX, AND REPRODUCTIVE CONDITION (IF POSSIBLE) THE NUMBER OF MARINE MAMMALS (BY SPECIES) THAT MAY BE TAKEN

6.1 Basis for Estimating Numbers of Marine Mammals That Might Be "Taken by Harassment"

Exposure to continuous sound levels greater than 120 dB re 1 µPa (rms) and impulsive sounds greater than 160 dB re 1 µPa (rms) can elicit behavioral changes in marine mammals that might be detrimental to health and long-term survival where it disrupts normal behavioral routines, and is the Level B harassment criteria for acoustical disturbance under MMPA (NMFS 2005). Exposure to sound levels greater than 180 dB re 1 µPa (rms) for cetaceans and 190 dB re 1 µPa (rms) for pinnipeds can lead to acoustical injury including temporary loss in hearing sensitivity and permanent hearing damage. These

values are the MMPA Level A injury criterion. However, only the impulsive noise sources (pipe driving and VSP) are likely to exceed 180 dB (see below). Shutdown safety zones will be established to avoid Level A injury take.

The estimate of the numbers of each species of marine mammals that could be "taken" by exposure to exploratory drilling and drill rig towing noise levels is determined by multiplying the maximum seasonal density of each species by the area that will be ensonified by greater than 120 dB re 1 µPa (rms) for towing and drilling and greater than 160 dB re 1 µPa (rms) for pipe driving and VSP operations.

Ensonified Area - Rig Tow

The jack-up rig will be towed three times during 2014. It is estimated that the longer tows will take two days to complete. The rig will be wet-towed by at least two ocean-going tugs licensed to operate in Cook Inlet. Tugs generate their loudest sounds while towing due to propeller cavitation. While these continuous sounds have been measured at up to 171 dB re 1 µPa-m (rms) at source (broadband), they are generally emitted at dominant frequencies of less than 5 kHz (Miles et al. 1987, Richardson et al. 1995, Simmonds et al. 2004).

For the most part, the dominant noise frequencies from propeller cavitation are significantly less than the dominant hearing frequencies for pinnipeds (10 to 30 kHz) and toothed whales (12 to >100 kHz) (Wartzok and Ketten 1999). Still, because it is currently unknown which tug or tugs will be used to tow the rig, and there are few sound signatures for tugs in general, the potential area that could be ensonified by disturbance-level noise is calculated based on an assumed 171 dB re 1 µPa-m source. Using Collins et al.'s (2007) 171 - 18.4 Log(R) – 0.00188 spreading model determine from hydroacoustic surveys in Cook Inlet, the distance to the 120 dB isopleth would be at 1,715 feet (523 meters). The associated ZOI (area ensonified by noise greater than 120 dB) is, therefore, 212 acres (0.86 square kilometers).

Ensonified Area – Conductor Pipe Driving

The Delmar D62-22 diesel impact hammer proposed to be used by Buccaneer to drive the 30-inch conductor pipe was previously acoustically measured by Blackwell (2005) in upper Cook Inlet. She found that sound exceeding Level A noise limits for pinnipeds to extend to about 200 feet (60 meters), and Level A impacts to cetaceans to about 820 feet (250 meters). Level B disturbance levels extended to just less than 1.2 miles (1.9 kilometers). The associated ZOI (area ensonified by noise greater than 160 dB) is 4.4 square miles (11.3 square kilometers).

Ensonified Area – Deep-well Pumps

Buccaneer proposes to use the jack-up drilling rig *Endeavour* for the Cook Inlet program. Because the drilling platform and other noise-generating equipment on a jack-up rig are located above the sea's surface, and there is very little surface contact with the water compared to drill ships and semi-submersible drill rigs, lattice-legged jack-up drill rigs are relatively quiet (Richardson et al. 1995, Spence et al. 2007).

The *Spartan 151*, the only other jack-up drill rig currently operating in the Cook Inlet, was hydroacoustically measured by Marine Acoustics, Inc. (2011) in 2011. The survey results showed that

continuous noise levels exceeding 120 dB re 1 µPa extended out only 50 meters (164 feet), and that this noise was largely associated with the diesel engines used as hotel power generators, rather than the drilling table. Similar, or lesser, noise levels were expected to be generated by the *Endeavour* because generators are mounted on pedestals specifically to reduce noise transfer through the infrastructure, and enclosed in an insulated engine room, with the intent of reducing underwater noise transmission to levels even lower than the *Spartan 151.* This was confirmed during a sound source verification test on the *Endeavour* by Illingworth and Rodkin (2013a) in May 2013 where it was determined that the noise levels associated with drilling and operating generators are below ambient.

However the sound source verification identified another sound source, the submersed deep-well pumps, which were emitting underwater noise exceeding 120 dB. In the initial testing (I&R 2013a), the noise from the pump and the associated falling (from deck level) water discharge was found to exceed 120 dB re 1 µPa out a distance just beyond 984 feet (300 meters). After the falling water was piped as a mitigation measure to reduce noise levels, the pump noise was retested (I&R 2013b) with the results indicating that the primary deep-well pump, operating inside the bow leg, still exceeded 120 dB re 1 µPa at a maximum of 853 feet (260 meters). For calculating potential incidental harassment take, the 853-foot (260-meter) distance to the 120 dB isopleth will be used giving a ZOI of 52.5 acres (0.21 square kilometers).

Vertical Seismic Profiling

Illingworth and Rodkin (2013c) measured noise levels during VSP operations associated with Buccaneer post-drilling operations at the Cosmopolitan #1 site in lower Cook Inlet during July 2013. The results indicated that the 720 cubic inch airgun array used during the operation produced noise levels exceeding 160 dB re 1 µPa out to a distance of approximately 8,100 feet (2,470 meters). Based on these results, the associated ZOI would be 7.4 square miles (19.2 square kilometers).

Marine Mammal Densities

Density estimates were derived for harbor porpoises and harbor seals as described below and shown in Table 6-1. Because of their low numbers, there are no available Cook Inlet density estimates for the other marine mammals that occasionally inhabit Cook Inlet north of Anchor Point.

Table 6-1. Estimated Summer Marine Mammal Densities (number per square kilometer) in Cook Inlet.

Species	Summer Density
Harbor Porpoise	0.013
Harbor Seal	0.278

Harbor Porpoise

Hobbs and Waite (2010) calculated a Cook Inlet harbor porpoise density estimate of 0.013 per square kilometer based on sightings recorded during a 1998 aerial survey targeting beluga whales. They derived the value by dividing estimated number of harbor porpoise inhabiting Cook Inlet (249) by the area of the entire inlet (18,948 km^2).

Harbor Seal

Boveng et al. (2003) estimated the harbor seal population that inhabits Cook Inlet at 5,268 seals. Dividing that value by the area of the inlet (18,948 km^2) provides a Cook Inlet-wide density of 0.278 seals per square kilometer. Given that the majority of seal use in Cook Inlet is found in the lower inlet, this density value is very conservative relative to Buccaneer's proposed activities in upper Cook Inlet.

6.2 Exposure Calculations

The estimated potential harassment take of local marine mammals by Buccaneer's proposed drilling and rig towing activities was determined by multiplying the animal densities in Table 6-1 with the area ensonified by continuous noise greater than 120 dB re 1 µPa (rms) (0.86 square kilometers for rig towing and 0.21 square kilometers for the deep-well pumps), and by impulsive noise greater than 160 dB re 1 µPa (rms) (11.3 square kilometers for driving conductor pipe and 19.2 square kilometers for the VSP). The resulting exposure calculations are found in Table 6-2.

Table 6-2. Number of Marine Mammals Potentially Exposed to Received Sound Levels >120 dB

Species	Rig Tow	Deep-well Pump	Pipe Driving	VSP	Total
Harbor Porpoise	0.01	0.02	0.15	0.25	**0.43**
Harbor Seal	0.24	0.06	3.14	5.34	**8.78**

Based on the density estimates of the most common marine mammals potentially inhabiting the activity area and the area expected to ensonified by continuous noise levels exceeding 120 dB re 1 µPa (rms), neither of Buccaneer's proposed continuous noise activities (rig towing or deep-well pumps) is expected to result in the take of a single animal. The impulsive noise sources (conductor pipe driving and VSP) do generate louder noises, and could collectively harass eight harbor seals (but well less than one harbor porpoise). Doubling these estimates to account for the two separate drilling operations (Southern Cross #1 and Northwest Cook Inlet #1) results in an estimated take of one harbor porpoise and 18 harbor seals (with the full recognition that this take estimate is based on very conservative density estimates). These estimates are the basis for the requested take authorizations in Table 6-3. The requested take for harbor seals is 50 percent higher than the estimated take to account for variability, while the requested take for harbor porpoise was increased to five in the event a group of porpoise are encountered.

For the less common marine mammals such as gray whales, minke whales, killer whales, and Dall's porpoise population estimates within central and upper Cook Inlet are too small to calculate density estimates. Still, at even very low densities, it is possible to encounter these marine mammals during Buccaneer operations, especially during towing operations through lower Cook Inlet. Marine mammals may approach the drilling rig out of curiosity, and animals may approach in a group. Thus, requested take authorizations (Table 6-3) are based on density estimates where available, with the added combination of group size and the potential for attraction.

Table 6-3. The Estimated and Requested Take of Marine Mammals.

Species	Estimated Take	Take Authorization Request
Gray Whale	<1	2
Minke Whale	<1	2
Killer Whale	<1	5
Harbor Porpoise	1	5
Dall's Porpoise	<1	5
Harbor Seal	18	27

7.0 ANTICIPATED IMPACT OF THE ACTIVITY ON THE SPECIES OR STOCK

7.1 Introduction

The primary potential impact of the proposed Buccaneer drilling operations to local marine mammals is acoustical harassment from the short-term conductor pipe driving and VSP operations, both impulsive noise sources. The operating drill rig (drilling table, generators, etc.) and the rig tow (propeller cavitation from towing tug boats) are expected to have much less impact potential because the activities are short in duration and (insert other applicable reasoning). Noise generated from these continuous noise sources could disrupt normal behaviors of marine mammals where received levels exceed 120 dB re 1 µPa (rms). A summary of what is known about behavioral responses to noise stimuli by the marine mammals that inhabit the Cook Inlet project area follows. The estimated incidental harassment take as a percentage of the marine mammal stock is negligible (less than 0.01 percent of the stock) in all cases except for harbor seals, where the estimate take (18) represents less than 0.08 percent of the stock. Thus, the population level impacts of Buccaneer's proposed upper Cook Inlet activities on non-listed marine mammals is extremely small to discountable.

Acoustical injury is possible where received sound levels exceed 180 dB re 1 µPa (cetaceans) or 190 dB re 1 µPa (pinnipeds), but this potential impact will not occur given that the continuous noise sources do not exceed these values, and shutdown safety zones will be established during impulsive noise activities.

Other direct impacts to species could occur from an oil spill or pollution discharge event. The consequences and likelihood of these impacts are also addressed in the following subsections.

Table 7-1. Estimate of Take as Percentage of Stock

Species	Stock Estimate	Estimated Take	Percent of Population
Minke Whale	~2,000	<0.1	Negligible
Gray Whale	18,017	<0.1	Negligible
Harbor Porpoise	31,046	1	0.003
Killer Whale (Res.)	2,084	<0.1	Negligible
Killer Whale (Trans.)	552	<0.1	Negligible
Dall's Porpoise	83,400	<0.1	Negligible
Harbor Seal	22,900	18	0.056

Source: Allen and Angliss (2012, 2013)

7.2 Behavioral Response

Gray Whales - Gray whales, and other large baleen whales such as humpback and bowhead whales, have shown strong overt reactions to impulsive noises, such as seismic operations, at received levels between 160 and 173 dB re 1 µPa (rms) (Richardson et al. 1986, 1999; Ljungblad et al. 1988; Miller et al. 1999, 2005; McCauley et al. 2000). Baleen whales also seem to be sensitive to continuous noise (Richardson and Malme 1993), often detouring around drilling activity when received levels are as low as 119 dB re 1 µPa (rms) (Malme et al. 1983, Richardson et al. 1985, 1990). Based on the previously cited studies, NMFS developed the 120 dB re 1 µPa (rms) harassment criteria for continuous noise sources.

Ship strike is not an issue. Most strikes of marine mammals occur when vessels are traveling at speeds of between 13 and 24 knots (http://www.nmfs.noaa.gov/pr/pdfs/shipstrike/ss_speed.pdf), well above the 1 to 4 knot drill rig tow speed expected. However, ship cavitation noise, or mere presence, can result in behavioral changes by baleen whales. Humpback whales in particular have been studied relative to reactions to cruise ships and tankers with results showing a general avoidance reaction at distances from 2 to 4 kilometers (Baker et al. 1982, 1983), and no reaction at distances to 800 meters when the whales were feeding (Watkins et al. 1981, Krieger and Wing 1986). Also, humpback whales have been especially responsive to fast moving vessels (Richardson et al. 1995), and often react by with aerial behaviors such as breaching or tail/flipper slapping (Jurasz and Jurasz 1979). However, temporarily disturbed whales often remain in the area despite the presence of vessels (Baker et al. 1988, 1992). Between 1999 and 2003, the California stranding network reported only four serious injuries or mortalities of gray whales caused by ship strikes, and only one reported in Alaska (Allen and Angliss 2012). The estimated annual mortality to gray whales in the U.S. from ship strikes is 1.5 (Allen and Angliss 2012)

Minke Whales – Other than observations that minke whales are often seen at visual ranges from drilling vessels off Greenland (Kapel 1979), there is little information for this species specific to drilling and drilling related activities. Information on minke reactions to boats is varied. These whales have been observed to avoid boats when approached and approach boats when the boats are stationary (see Richardson et al. 1995). Relative to bigger ships, information is lacking.

Harbor Porpoise – Harbor porpoise are naturally shy and tend to move away from boats and ships. Reaction to boats can be strong when within 400 meters (Polachek and Thorpe 1990) out to 1.5 kilometers (Barlow 1988, Palka 1993). There is little information on harbor porpoise reaction to drilling activities, but they probably show tolerance to noise levels similar to other odontocetes given their effective hearing is above frequencies characterizing drilling sounds. However, Lucke et al. (2009) recently exposed harbor porpoise and found that a TTS was induced at sound pressure levels of about 200 dB re 1 µPa (peak-peak) and harbor porpoises showed behavioral aversion to impulsive sounds as low as 174 dB re 1 µPa (peak-peak), indicating a greater sensitivity to impulsive noise than beluga whales. Acoustical harassment devices with full spectrum impulsive source levels of 180 dB re 1 µPa effectively deterred harbor porpoise from salmon pens (Johnston 2002).

Killer Whale – There is very little information on killer whale reactions to drilling activity or ships other than studies on tour boat impacts to inland stocks of Washington and British Columbia. Presumably, the frequencies of noise generated by drilling and rig tow are largely below the effective hearing range of this odontocete. Killer whales are sensitive to impulsive noises as evidenced by the effective use of acoustical harassment devices to protect salmon pen fisheries (Morton and Symonds 2002).

Harbor Seal – Pinnipeds in general appear somewhat tolerant of underwater industrial noises, partially because they can escape underwater pressure levels by exposing their head above the water surface, and they are less sensitive to lower frequency noises. In her review of the known effects of noise on marine mammals, Weilgart (2007) largely confined her discussion on cetaceans and only once mentioned a possible negative effect on pinnipeds. What few studies have been conducted have shown that seals and sea lions do not avoid drilling ships and platforms (*e.g.*, Gales 1982, McCarty 1982, Brueggeman et al. 1991). Richardson et al. (1990, 1991) found ringed and bearded seals to approach within at least 164 feet (50 meters) of played back drilling rig sounds.

Most information on the reaction of seals and sea lions to boats relate to disturbance of hauled out animals. There is little information on the reaction of these pinnipeds to ships while in the water other than some anecdotal information that sea lions are often attracted to boats (Richardson et al. 1995).

7.3 Temporary Threshold Shift and Permanent Threshold Shift

Noise has the potential to induce temporary (temporary threshold shift [TTS]) or permanent (permanent threshold shift [PTS]) hearing loss (Weilgart 2007). The level of loss is dependent on sound frequency, intensity, and duration. Similar to masking, hearing loss reduces the ability for marine mammals to forage efficiently, maintain social cohesion, and avoid predators (Weilgart 2007). For example, Todd et al. (1996) found an unusual increase in fatal fishing gear entanglement of humpback whales to coincide with blasting activities, suggesting hearing damage from the blasting may have compromised the ability of the whales to use sound to passively detect the nets. Experiments with captive bottlenose dolphins and beluga whales found that short duration impulsive sounds can cause TTS (Finneran et al. 2002). The impulsive noises associated with conductor pipe driving and VSP operations could cause TTS if the animals were close enough to the activity. However, the monitoring of shutdown safety zones by qualified marine mammal observers is designed to ensure operations cease at the approach of a marine mammal to noise levels of TTS concern.

PTS occurs when continuous noise exposure causes hairs within the inner ear system to die. This can occur due to moderate durations of very loud noise levels, or long-term continuous exposure of moderate noise levels. However, PTS is not an issue with Buccaneer's drilling and towing operations. Deep-well pump noise levels are far below intensities of concern, and local marine mammals can easily move away from the drilling rig. Cavitation noise from the tugs during the wet tow is louder, but exposure would be of short duration as the tugs are continually moving.

7.4 Masking

Masking occurs when louder noises interfere with marine mammal vocalizations or ability to hear natural sounds in their environment (Richardson et al. 1995), which limit their ability to communicate or avoid predation or other natural hazards. Masking is of special concern for mysticetes that vocalize at low frequencies over long distances, as their communication frequencies overlap with anthropomorphic noises such as shipping traffic. Some baleen whales have adjusted their communication frequencies, intensity, and call rate to limit masking effects. For example, McDonald et al. (2009) found that California blue whales have shifted their call frequencies downward by 31% since the 1960s, possibly in an attempt to communicate at frequencies below masking shipping noise frequencies. Melcon et al. (2012) found blue whales to increase their call rates in the presence of shipping noise, but to significantly decrease call rates when exposed to mid-frequency sonar. Also, Di Iorio and Clark (2010) found blue whales to communicate more often in the presence of seismic surveys, which they attributed to compensating for an increase in ambient noise levels. Fin whales have reduced their calling rate in response to boat noise (Watkins 1986), and were thought to stop singing altogether for weeks in response to seismic surveys (IWC 2007).

Low frequency noise associated with underwater pumps and rig towing is unlikely to create masking issues for odontocetes and pinnipeds as these animals effectively hear and communicate at much higher frequencies. The impulsive noises associated with conductor pipe driving and VSP are both sporadic and short-term, limiting masking effects to a few hours at a time at most. Masking from low frequency noise sources is more a concern for baleen whales. However, both species of baleen whales of concern – gray whale and minke whale – are not found in upper Cook Inlet and are generally not found in lower Cook Inlet during the spring and fall when towing would occur, and the continuously moving towing activity would be of short duration in the presence of local marine mammals.

7.5 Oil Spills and Pollution Discharges

Oil spills are an inherent risk in oil drilling operations. To limit this risk and to mitigate any impacts in the unlikely event of a spill, Buccaneer has prepared an Oil Discharge Prevention and Contingency Plan (ODPCP) that was approved by Alaska's Department of Environmental Conservation (ADEC) on August 29, 2012, which covers operations in the upper Cook Inlet from April 15 to October 31. NMFS reviewed ODPCP during the ESA consultation process for Buccaneer's upper Cook Inlet leases and resolved that with the implementation of the plan, the potential impacts to beluga whales, and by extension other marine mammals, were discountable. Relevant detail from the plan modified from the Biological Assessment (BA) prepared for this project is found in Appendix B. Copies of both the ODPCP and BA have been provided to NMFS for review in association with this application.

The drill rig *Endeavour* is operating under the Alaska Pollutant Discharge Elimination System (APDES) general permit AKG-31-5021 for wastewater discharges (ADEC 2012). This permit authorizes discharges from oil and gas extraction facilities engaged in exploration under the Offshore and Coastal Subcategories of the Oil and Gas Extraction Point Source Category (40 CFR Part 435). Twelve effluents are authorized for discharge into Cook Inlet once ADEC discharge limits have been met. The authorized discharges include: drilling fluids and drill cuttings, deck drainage, sanitary waste, domestic waste,

blowout preventer fluid, boiler blow down, fire control system test water, uncontaminated ballast water, bilge water, excess cement slurry, mud cuttings cement at sea floor, and completion fluids. Areas prohibited from discharge in the Cook Inlet are 10-meter (33-foot) isobaths, 5-meter (16-foot) isobaths, and other geographic area restrictions (AKG-31-5021.I.C.).

NMFS reviewed the Revised Biological Evaluation, prepared by the Environmental Protection Agency (EPA), for the Cook Inlet National Pollutant Discharge Elimination System (NPDES). In a letter dated October 13, 2006, NMFS concurred with EPA's determination that the reissuance of the NPDES permit is not likely to adversely affect Steller sea lions. NMFS did not agree or disagree with the same determination for Cook Inlet beluga whales, but requested future analysis on potential bioaccumulation effects. However, NMFS' concerns were directed towards waters in critical habitat area 1 north of the Buccaneer wells. During the ESA consultation process for the Buccaneer leases, NMFS concluded that significant adverse effects from discharge are unlikely and that any harm, injury, or harassment to beluga whales, and by extension other marine mammals, is unlikely to occur, and is therefore, discountable (Appendix B).

8.0 ANTICIPATED IMPACT OF ACTIVITY ON AVAILABILITY OF SPECIES OR STOCKS OF MARINE MAMMALS FOR SUBSISTENCE USES

The proposed drilling activities will occur near the marine subsistence area used by the villages of Tyonek, Salamotof, and Kenai. The only non-listed marine mammal available for subsistence harvest in Cook Inlet is the harbor seal (ADFG 2009). There are no harvest quotas for other non-listed marine mammals found there. The Alaska Department of Fish and Game (ADFG 2009) has regularly conducted surveys of harbor seal subsistence harvest in Alaska. Since 1992, Alaskan natives from Cook Inlet villages (Homer, Kenai, Tyonek, Anchorage) have annually taken (harvested plus struck and lost) between four and 111 harbor seals since 1992. Most of these seals were harvested by Alaskan natives living in Anchorage, followed by Tyonek villagers. It is unclear where Anchorage-based hunters actually harvest animals (some may be taken in lower Cook Inlet), but Tyonek hunters are likely to harvest near the village.

Buccaneer's planned exploratory drilling activities will not impact the availability of harbor seals for subsistence harvest in Cook Inlet. It is unlikely that harbor seal subsistence harvest would occur in mid-channel waters of Cook Inlet where drilling associated activities would occur, and rig towing is unlikely to affect any harbor seal sufficient to render it unavailable for subsistence harvest in the future.

Oil spill trajectory scenarios developed in preparation of the ODPCP indicate that potential spills would travel south through the central channel of the inlet away from shoreline subsistence harvest areas. Further information can be found in the approved ODPCP provided to NMFS.

9.0 THE ANTICIPATED IMPACT OF THE ACTIVITY UPON THE HABITAT OF THE MAMMAL POPULATIONS AND THE LIKELIHOOD OF RESTORATION OF THE AFFECTED HABITAT

The Buccaneer exploratory drilling activity will occur at four locations in upper Cook Inlet. The physical habitat is characterized as a shallow water (18-92 feet deep) flat with a mostly pebbly or gravelly bottom substrate characteristic of most of upper Cook Inlet. Strong tidal currents, coarse bottom sediments, and turbid glacial waters limit the biological productivity in upper Cook Inlet.

Upper Cook Inlet marine mammals – beluga whales and harbor seals – feed primarily on migrating Susitna River eulachon during the spring and salmon during the summer months (but diversify into other, more resident prey items [e.g., cod, shrimp] in the lower reaches of Cook Inlet during the winter). Invertebrate prey includes polychaetes, amphipods, shrimp, and crabs (Quakenbush and Bryan 2010). Benthic feeding on invertebrate prey is probably more important during the winter than summer.

Summering harbor seals in Cook Inlet probably feed largely on eulachon and salmon, similar to beluga whales, and similar to harbor seals elsewhere in Alaska. Harbor seal numbers at the river mouths of upper Cook Inlet seasonally fluctuate coincident with the spring runs of eulachon and fall runs of salmon (Nemeth et al. 2007).

The potential direct habitat impact by the Buccaneer drilling operation is limited to the actual drill-rig footprint defined as the area occupied and enclosed by the drill-rig legs. This area was calculated as 0.54 acres during the land use permitting process. The collective 2-acre footprint of the wells represents a very small fraction of the 7,300 square mile Cook Inlet surface area. Potential damage to the Cook Inlet benthic community will be limited, however, to the actual surface area of the three spud cans (1,585 square feet each or 4,755 square feet total) that form the “foot” of each leg. Given the high tidal energy at the well site locations, drilling footprints are not expected to support benthic communities equivalent to shallow lower energy sites found in nearshore waters where harbor seals mostly feed.

The lease areas do not support major populations of cod, pollock, and sole, although all four salmon species and smelt migrate through the area to spawning rivers in upper Cook Inlet (Shields and Dupuis 2012). Residency time for the migrating finfish in the vicinity of an operating platform would be very short, limiting fish exposure to noise or toxins associated with drilling. Based on this information, NMFS concluded in the ESA consultation for this project that for beluga whales, at least, impacts from normal drilling operations to potential marine mammal prey are insignificant (see Appendix B). That conclusion should extend to harbor seals as well.

10.0 THE ANTICIPATED IMPACT OF THE LOSS OR MODIFICATION OF THE HABITAT ON THE MARINE MAMMAL POPULATIONS INVOLVED

Based on the conclusions of Section 9 above, there would be virtually no direct loss of any habitat important to Cook Inlet marine mammals. There will be no impact on prey resources most important to harbor seals when summering in upper Cook Inlet (eulachon and salmon), and any impacts to benthic prey resources is considered negligible. However, potential damage to local benthic resources from the

drill rig legs and anchors will be assessed with side-scan sonar (post-drilling well site survey) after the drill rig leaves the well site to confirm the extent, if any, of the damage.

Oil spill risks are reduced and mitigated with the implementation of the Oil Discharge Prevention and Contingency Plan (ODPCP) that will be used in the unlikely event of a spill. Alaska's Department of Environmental Conservation (ADEC) approved Buccaneer's ODPCP on August 29, 2012. Based on their review during ESA consultation process, NMFS concluded that oil spill risks to local marine mammals were negligible (see Appendix B).

With oil and gas platforms presently operating in Cook Inlet, there is concern for continuous exposure to potentially toxic heavy metals and metalloids (*i.e.*, mercury, lead, cadmium, copper, zinc, and arsenic) that are associated with oil and gas development and production. These elements occur naturally in the earth's crust and the oceans, but many also have anthropogenic origins from local sources of pollution or from contamination from atmospheric distribution. Beluga whales, for example, were analyzed for heavy metals and other elements. Cadmium, mercury, selenium, vanadium, and silver were generally lower in the livers of Cook Inlet animals than in the other beluga whale stocks, while copper was higher (Becker et al. 2001). Hepatic methyl mercury levels were similar to those reported for other beluga whales (Becker et al. 2001). Similar work on heavy metals has not been done for Cook Inlet harbor seals, but because discharge by Buccaneer of drilling muds, cuttings, or sanitary wastes from their rig will meet the conditions of the Cook Inlet pollution discharge permit, no impacts to water quality are expected, and any effects to harbor seal habitat are therefore insignificant (see Appendix B). Studies have been conducted on persistent organochlorines concentrations in Alaskan harbor seals (Papa and Becker 1998), which showed that Prince William Sound harbor seals had much lower loads of PCBs, DDT/DDE, and chlordane compared to seals inhabiting the Oregon and Washington coasts, reflective of differences in human development between the areas.

11.0 AVAILABILITY AND FEASIBILITY OF EQUIPMENT, METHODS, AND MANNER OF CONDUCTING ACTIVITY OR OTHER MEANS OF EFFECTING THE LEAST PRACTICABLE ADVERSE IMPACT UPON THE AFFECTED SPECIES OR STOCKS, THEIR HABITAT, AND ON AVAILABILITY FOR SUBSISTENCE USES, PAYING PARTICULAR ATTENTION TO ROOKERIES, MATING GROUNDS, AND AREAS OF SIMILAR SIGNIFICANCE

Compared to other drill rigs or platforms used in Cook Inlet, the use of the jack-up drilling rig *Endeavour* will mitigate potential noise impacts. With their lattice leg structure, jack-up rigs have less surface contact with the water and, therefore, convey less noise from the drilling table and generators into the underwater environment. Sound source verifications conducted by Illingsworth and Rodkin (2013a) confirmed that underwater drilling and generator noises produced by the *Endeavour* are below ambient.

The initial sound source verification (I&R 2013a) did identify noise levels exceeding 120 dB re 1 µPa (rms) produced by the submersed deep-well pumps and associated falling water. This was partially

mitigated by piping the falling water, resulting in a reduction of noise and a smaller radius to the 120 dB isopleth (I&R 2013b).

Reducing and mitigating potential acoustical impacts to local marine mammals while on site is further addressed in the Marine Mammal Monitoring and Mitigation Plan found in Appendix C.

In the unlikely event of an oil spill, Buccaneer will be working with Cook Inlet Spill Prevention and Response, Inc. (CISPRI), which is certified as a U.S. Coast Guard oil spill removal organization and State of Alaska Primary Response Action Contractor serving the Cook Inlet region of Alaska. Buccaneer will follow the procedures as outlined in CISPRI's Technical Manual, Wildlife Tactics. Most procedures discussed in the CISPRI Technical Manual are associated with responses for either waterfowl or marine mammals. CISPRI will dedicate personnel and equipment as appropriate in support of wildlife during a spill. The Planning Chief will work to implement a Wildlife Plan addressing those species anticipated to be at risk and needing protection. The protocols are described in further detail in the ODPCP.

12.0 LOCATION OF PROPOSED ACTIVITY – IN OR NEAR A TRADITIONAL ARCTIC SUBSISTENCE HUNTING AREA AND IMPACT ON AVAILABILITY OF SPECIES OR STOCK OF MARINE MAMMALS FOR ARCTIC SUBSISTENCE USES

The proposed activity does not occur in or near a traditional Arctic subsistence hunting area. Potential impacts to local Cook Inlet subsistence harvest of harbor seals are addressed in Section 8.0.

13.0 SUGGESTED MEANS OF ACCOMPLISHING THE NECESSARY MONITORING AND REPORTING THAT WILL RESULT IN INCREASED KNOWLEDGE OF THE SPECIES, THE LEVEL OF TAKING OR IMPACTS ON POPULATIONS OF MARINE MAMMALS THAT ARE EXPECTED TO BE PRESENT WHILE CONDUCTING ACTIVITIES AND SUGGESTED MEANS OF MINIMIZING BURDENS BY COORDINATING SUCH REPORTING REQUIREMENTS WITH OTHER SCHEMES ALREADY APPLICABLE TO PERSONS CONDUCTING SUCH ACTIVITY.

A detail Marine Mammal Monitoring and Mitigation Plan has been developed for Buccaneer's Cook Inlet projects and is attached as Appendix C. The plan will be modified as need or appropriate as required in the IHA.

14.0 LEARNING, ENCOURAGING, AND COORDINATING RESEARCH OPPORTUNITIES, PLANS, AND ACTIVITIES RELATING TO REDUCE AND EVALUATE INCIDENTAL "TAKE"

To ensure that there will be no adverse effects resulting from the planned exploratory drilling, rig operation, and towing, Buccaneer is coordinating with NMFS, USFWS, Bureau of Safety and

Environmental Enforcement (BSEE), the Army Corps of Engineers, the State of Alaska, and other state and federal agencies in the assessment of measures that can be taken to eliminate or minimize any impacts from planned activities. Buccaneer has also reached out and coordinated to numerous communities including the cities and villages of Homer, Kenai, Tyonek, Seldovia, Soldotna, Port Graham, and Ninilchik, as well as Kenai Peninsula Borough, Cook Inlet Region, Inc., Cook Inlet Keeper, United Cook Inlet Drift Association, Port Graham Native Association, and the Chugach Alaska Services.

Any observed marine mammal interactions with the Buccaneer operations deemed potentially harmful will be immediately reported to the Anchorage Office of NMFS (Mr. Brad Smith). Given the very low likelihood of observing marine mammals during the upper Cook Inlet operations, developing a research program would be impractical.

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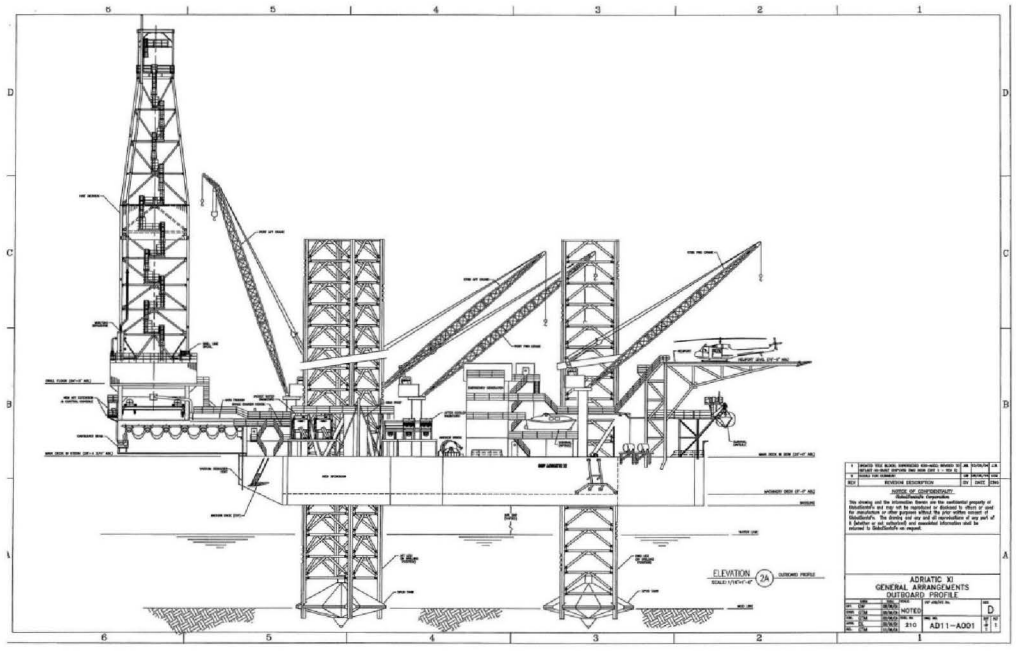
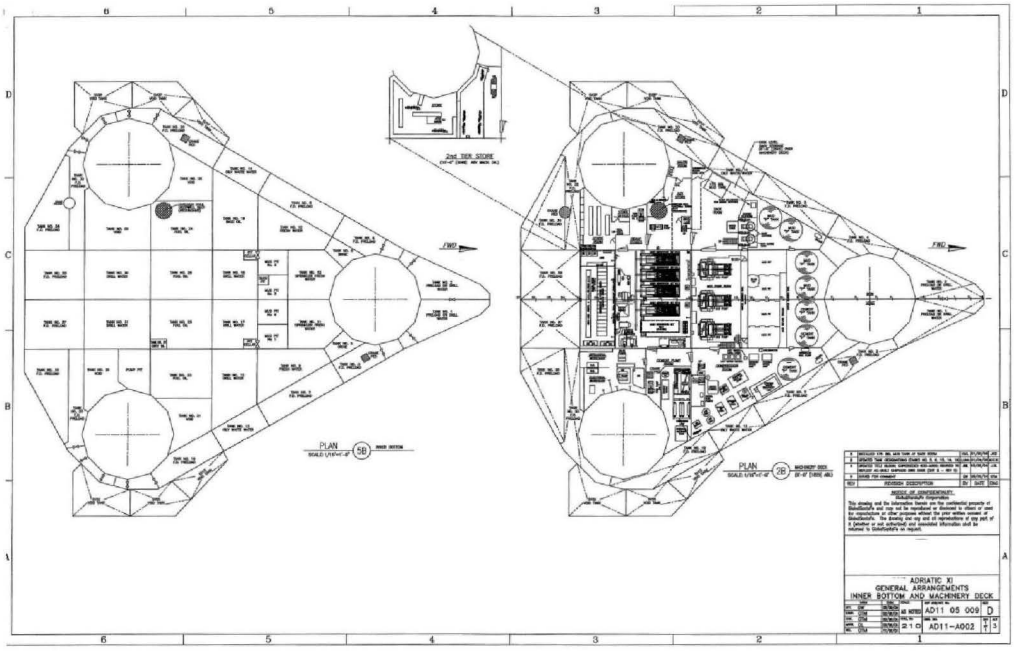
Appendix A

Drill Rig Specifications

Rig Profile View



Adriatic **– General Arrangements Inner Bottom and Machinery Deck**



General Arrangements Main Deck and Accommodation

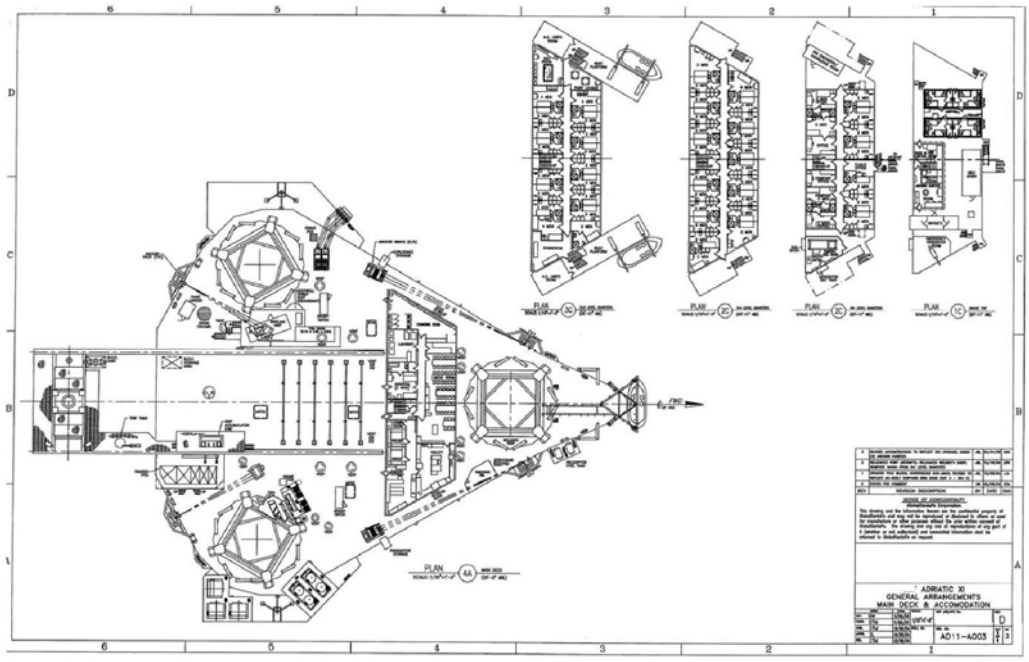
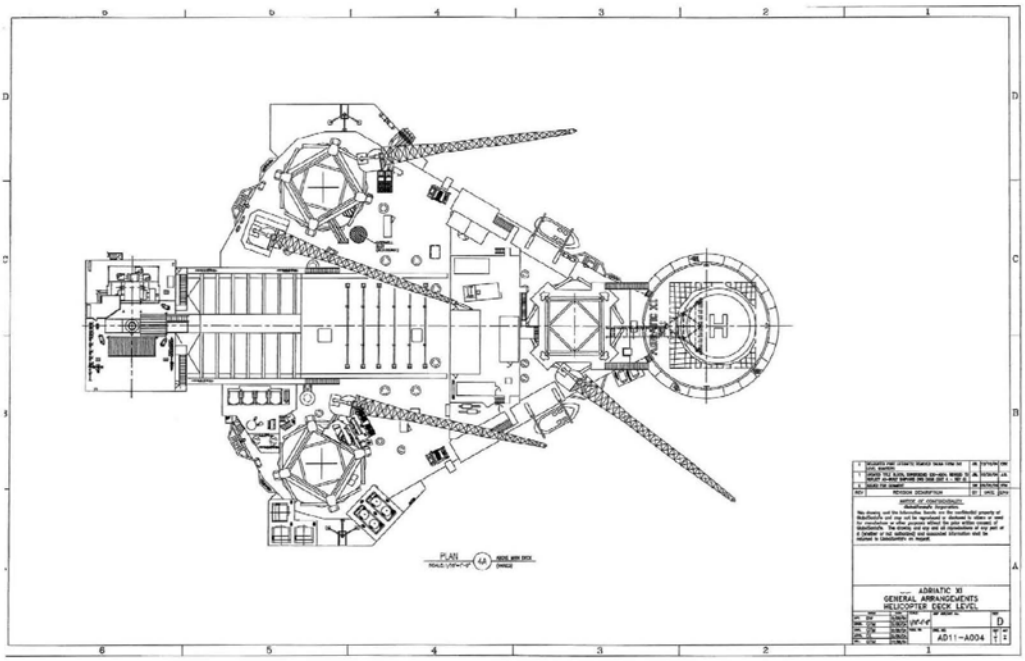


Figure 1.8-4 ***Adriatic*** **– General Arrangements Helicopter Deck Level**


ADRIATIC XI
GENERAL ARRANGEMENTS
HELICOPTER DECK LEVEL
AD11-A004

Appendix B

Oil Spill and Pollution Discharge Prevention and Mitigation Measures

[Modified from the Biological Assessment prepared as part of Buccaneer's ESA consultation.]

Oil Spills

A potential effect of the proposed natural gas exploration activities is an oil spill. As with any oil and gas operation, effects from any large oil spill (more than 1,000 bbl. [42,000 gallons]) represents a major concern. Although the likelihood of a spill is remote, if it were to occur, a spill could have the potential to create long term, if not permanent, damage to the environmental resources in Cook Inlet. Buccaneer has prepared an Oil Discharge Prevention and Contingency Plan (ODPCP) that will be used in the unlikely event of a spill. Alaska's Department of Environmental Conservation (ADEC) approved Buccaneer's ODPCP on August 29, 2012, which covers operations in the upper Cook Inlet from April 15 to October 31.

If a spill were to occur, it could adversely affect harbor porpoise and harbor seals, both directly and indirectly. Drilling will be conducted during the summer, and potentially fall, which are the seasons with the mildest temperature, weather, and sea condition (open water season when open pack ice conditions are less than 10 percent concentration) for this region. Buccaneer considered these environmental conditions when selecting the jack-up rig, equipment placement, and operations, to minimize the possibility of oil discharge.

Buccaneer conducted extensive modeling in its ODPCP to determine oil spill migration if a spill occurred. The trajectory of oil would be dependent on wind speed, direction, and ocean currents at the time of and directly after the spill. Tidal fluctuations in the main body of Cook Inlet regularly reach 7.6 m (25 ft.) and exhibit currents in excess of 5 knots (6 mph) at full tidal flow (NOAA 2008). If a spill were to occur, real time data would be required to assess the trajectory of the released oil.

The ODPCP identifies measures to be taken in the event of an oil spill. Wildlife protection strategies may entail, in order of priority:

- Containment and control to limit the spread and area influenced by the spill;
- Hazing of birds and mammals to prevent them from entering the spill area; and
- Capture and relocation of wildlife at direct threat.

Buccaneer will be working with Cook Inlet Spill Prevention and Response, Inc. (CISPRI), which is certified as a U.S. Coast Guard oil spill removal organization and State of Alaska Primary Response Action Contractor serving the Cook Inlet region of Alaska. Buccaneer will follow the procedures as outlined in CISPRI's Technical Manual, Wildlife Tactics. Most procedures discussed in the CISPRI Technical Manual are associated with responses for either waterfowl or marine mammals. CISPRI will dedicate personnel and equipment as appropriate in support of wildlife during a spill. The Planning Section Chief will work to implement a Wildlife Plan addressing those species anticipated to be at risk and needing protection.

Harbor Porpoise

The effects of oil spills on cetaceans such as harbor porpoises are generally unknown; however, some generalizations can be made regarding impacts from oil on individual whales based on present knowledge and from data collected on spills in similar regions, such as the *Exxon Valdez* oil spill in Prince William Sound, Alaska. Although cetaceans are capable of detecting oil, they do not seem to avoid the oil (Geraci 1990). Harbor porpoises swimming through an oil spill could be affected in several ways: skin contact with the oil; ingestion of oil; respiratory distress from hydrocarbon vapors; contaminated food sources; and displacement from feeding areas. Actual impacts would depend on the extent of duration of contact, and the characteristics (type and age) of the oil. Harbor porpoises could be affected by residual oil from a spill even if they were not present during the oil spill. However, the greatest potential threat to harbor porpoises from an oil spill is the inhalation of toxic vapors that concentrate above oil slicks as they surface to breath, and in extreme cases could result in sudden death (Geraci 1990). Geraci (1990) reviewed a number of studies pertaining to the physiologic and toxic impacts from oil on whales and concluded there was no definitive evidence that oil contamination had been responsible for the death of a cetacean. Cetaceans observed during the *Exxon Valdez* event made no effort to alter their behavior in the presence of oil (Harvey and Dahlheim 1994; Loughlin 1994). Dahlheim and Matkin (1994) concluded that because the highest recorded mortality rate of North Pacific killer whales occurred in 1989 and 1990, which coincided with the Exxon Valdez oil spill, there was a correlation between the loss of killer whales and the spill, but they could not identify a clear cause and effect relationship.

Any diminishment of feeding habitat during the summer months due to an oil spill could adversely affect the energy balance for harbor porpoises. The impacts from oil exposure to Cook Inlet harbor porpoises would also depend upon how many animals came into contact with oil. If oil found its way into nearshore feeding areas during summer months (*e.g.*, river mouths with eulachon runs), a significant proportion of the upper Cook Inlet population of harbor porpoise might be exposed. However, such a trajectory further north into upper Cook Inlet summering feeding areas is very unlikely from the Southern Cross, Northwest Cook Inlet, and Tyonek Deep wells.

Harbor Seal

Pinnipeds in general do not readily avoid oil (St. Aubin 1990), and mortality can occur, as evidenced by the estimated loss of 300 harbor seals from the *Exxon Valdez* spill. Pups seem to be the most vulnerable, either from the physical effects of heavy coatings of crude oil, or from the masking of identification odors preventing mothers from recognizing them. However, St. Aubin (1990), in his extensive investigation on oil effects on pinnipeds, stated “Pinnipeds show little behavioral or physiologic reactions to the noxious characteristics of oil”. Large scale pinniped mortality from oil has not been observed, and the thermal regulation impacts from oil fouling appear to be limited to fur seals (St. Aubin 1990). In controlled experiments, Kooyman et al. (1976) found oil to have little effect on the insulative value of sea lion pelts. Inhaling oil toxins can cause death, but not likely at the vapor concentrations found in a cold water oil spill (St. Aubin 1990).

Spill Prevention and Risk Analysis

Spill prevention is a primary goal for Buccaneer. Buccaneer has planned formal routine rig maintenance and surveillance checks as well as normal inspection and equipment checks to be conducted on the jack-up rig daily. The following steps will be in place to prevent oil from entering the water:

- Required inspections will follow standard operating procedures.
- Personnel working on the rig will be directed to report any unusual conditions appropriate personnel.
- Oily equipment will be regularly wiped down with oil absorbent pads to collect free oil. Drips and small spillage from equipment will be controlled through use of drip pans and oil absorbent drop clothes.
- Oil absorbent materials used to contain oil spills or seeps will be collected and disposed of in sealed plastic bags or metal drums and closed containers.
- The platform surfaces will be kept clean of waste materials and loose debris on a daily basis.
- Remedial actions will be taken when visual inspections indicate deterioration of equipment (tanks) and/or their control systems.
- Following remedial work, and as appropriate, tests will be conducted to determine that the systems function correctly.

Drilling and completion fluids provide primary well control during drilling, work over, or completion operations. These fluids are designed to exert hydrostatic pressure on the wellbore that exceeds the pore pressures within the subsurface formations. This prevents undesired fluid flow into the wellbore. Surface mounted blowout preventer (BOP) equipment provides secondary well control. In the event that primary well control is lost, this surface equipment is used to contain the influx of formation fluid and then safely circulate it out of the wellbore.

The BOP is a large, specialized valve used to seal, control, and monitor oil and gas wells. BOPs come in variety of styles, sizes, and pressure ratings. For Cook Inlet, the BOP equipment used by Buccaneer will consist of:

- Three BOPs pressure safety levels of: 1) 5,000 pounds per square inch (psi) 2) 10,000 psi, and 3) 15,000 psi;
- A minimum of three 35 cm (13 5/8 in), 10,000 psi WP ram type preventers;
- One 35 cm (13 5/8 in) annular preventer;
- Choke and kill lines that provide circulating paths from/to the choke manifold;
- A two choke manifold that allows for safe circulation of well influxes out of the well bore; and
- A hydraulic control system with accumulator backup closing.

The wellhead, associated valves, and control systems provide blowout prevention during well production. These systems provide several layers of redundancy to ensure pressure containment is maintained. Well control planning is performed in accordance with Alaska Oil and Gas Conservation Commission (AOGCC) and Bureau of Safety and Environment Enforcement (BSEE) regulations. The operator's policies and recommended practices are, at a minimum, equivalent to BSEE regulations. BOP

test drills are performed on a frequent basis to ensure the well will be shut in quickly and properly. BOP testing procedures will meet American Petroleum Institute Recommended Practice No. 53 and AOGCC specifications. The BOP tests will be conducted with a nonfreezing fluid when the ambient temperature around the BOP stack is below 0° C (32° F). Tests will be conducted at least weekly and before drilling out the shoe of each casing string. The AOGCC will be contacted before each test is conducted, and will be onsite during BOP tests unless an inspection waiver is approved.

In addition to the above water BOP system for the Southern Cross and Northwest Cook Inlet exploration wells, a comparison of the Deep Water Horizon Gulf of Mexico incident to the Cook Inlet exploration indicates the following risk reductions for the Buccaneer exploration:

Deep Water Horizon

- Gulf of Mexico
- Water depth greater than 5,000 feet
- Geological formation pressures unknown
- 50 miles offshore
- Floating drill rig

Buccaneer Exploration Wells

- Cook Inlet
- Water depth less than 100 feet
- Geological formation pressures established and well known
- Less than 10 miles offshore
- Stationary drill rig anchored to the seabed

Significant drilling on the Outer Continental Shelf in Alaska, including parts of Cook Inlet, has not occurred since the early 1990s. During exploration in Alaska Outer Continental Shelf waters from 1982 to 1991, 52 exploratory wells were drilled with five spills greater than one oil barrel (bbl.; 42 gallons); the total spillage from these events was 45 bbl. (1,890 gallons) (MMS 1996). From these data, Minerals Management Service determined a spill rate of 11 spills per 100 wells with an average spill size of nine bbl. (378 gallons).

Major spills could be caused by failure of a storage tank or mud tank. These tanks are routinely tested for structural integrity, so the most likely cause of failure would be due to significant impact from onsite equipment. A spill of this type is not known to have occurred at an exploration site in Alaska and, with monitoring, is expected to have a very low probability of occurrence.

Oil spill risk in Cook Inlet is lessened to some degree with the advancement of drilling technologies and safety assurances; and because formation pressures are generally known and understood in this area with previous oil development. Offshore oil spill records in Cook Inlet during 1994-2011 show only three spills during oil exploration: two oil spills at the UNOCAL Dillon 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) (ADNR 2011). During the same time, 71 spills occurred offshore in Cook Inlet during oil production. Most spills ranged between 0.0011 and 1 gallon (42 spills); with three spills larger than 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 (UNOCAL Dillon Platform). All 71 crude oil spills from the offshore platforms, both exploration and production, totaled less than 2,140 gallons. Based on historical data, most oil spills have been small.

During the 62 years of oil and gas exploration and development in Cook Inlet, there has not been a single oil well blowout, although there have been two incidents at gas wells, which makes it difficult to assign a precise risk factor to the possibility to such an event for Cook Inlet; but is thought to be an extremely low probability. There have been four natural gas blowouts in Cook Inlet since 1962

Beluga whales are not expected to be near the exploration drilling rig, as they are distributed well north of these drill sites during the summer; and harbor porpoise and harbor seals are not regularly observed in this area. Therefore, in light of the small probability of a spill occurring; if a spill were to occur, the small probability for it to persist during the time when local marine mammals are expected to be in the area of the spilled oil; and the spill response measures required for this project, it is unlikely that these marine mammals would be contacted by oil. Significant adverse effects would only be expected if several of these low probability events occurred at the same time. As such, an oil spill presenting harm, injury, or harassment to Cook Inlet beluga whales, harbor porpoises, and harbor seals is extremely unlikely to occur, and is therefore, discountable.

Pollution Discharge

The drill rig *Endeavour* is operating under the Alaska Pollutant Discharge Elimination System (APDES) general permit AKG-31-5021 for wastewater discharges (ADEC 2012). This permit authorizes discharges from oil and gas extraction facilities engaged in exploration under the Offshore and Coastal Subcategories of the Oil and Gas Extraction Point Source Category (40 CFR Part 435).

Twelve effluents are authorized for discharge into Cook Inlet once ADEC discharge limits have been met. The authorized discharges include: drilling fluids and drill cuttings, deck drainage, sanitary waste, domestic waste, blowout preventer fluid, boiler blow down, fire control system test water, uncontaminated ballast water, bilge water, excess cement slurry, mud cuttings cement at sea floor, and completion fluids. Areas prohibited from discharge in the Cook Inlet are 10-meter (33-foot) isobaths, 5-meter (16-foot) isobaths, and other geographic area restrictions (AKG-31-5021.I.C.).

The *Endeavour* is also authorized under EPA's Vessel General Permit (VGP) for deck wash down and runoff, gray water, and gray water mixed with sewage discharges. The effluent limits and related requirements for these discharges in the VGP are to minimize or eliminate to the extent achievable using control measures (best management practices) (EPA 2011). The control measures must be technologically available and economically practicable and achievable in the light of best marine practices.

NMFS reviewed the Revised Biological Evaluation, prepared by the Environmental Protection Agency (EPA), for the Cook Inlet National Pollutant Discharge Elimination System (NPDES). In their letter dated October 13, 2006, NMFS concurred with EPA's determination that the reissuance of the NPDES permit is not likely to adversely affect Steller sea lions. NMFS did not agree or disagree with the same

determination for Cook Inlet beluga whales, but requested future analysis on potential bioaccumulation effects. However, NMFS' concerns were directed towards waters in beluga critical habitat area 1 north of the Buccaneer wells. It is not clear how NMFS might view the determination relative to upper Cook Inlet populations of harbor seals and harbor porpoise.

During the summer harbor porpoises and harbor seals are concentrated near river mouth feeding areas and haul outs (Boveng et al. 2012). Therefore, it is unlikely that harbor porpoises or harbor seals would be contacted by discharge effluent, especially given the authorized discharge limitations. Significant adverse effects from discharge are unlikely, any harm, injury, or harassment to local marine mammals is unlikely to occur, and is therefore, discountable.

Appendix C

Marine Mammal Monitoring and Mitigation Plan

Marine Mammal Monitoring and Mitigation Plan

BUCCANEER ALASKA OPERATIONS, LLC
Cook Inlet Exploratory Drilling Program

August 2013

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Prepared by

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CONTENTS

1. Introduction

Buccaneer plans to conduct a multi-well, multi-year offshore exploratory drilling program in upper Cook Inlet at its proposed locations on the following State of Alaska oil and gas leases: Alaska Division of Land (ADL) 17595-2/Southern Cross Unit #1 (SC #1), ADL 391108/Southern Cross Unit #2 (SC #2), ADL 391270/Northwest Cook Inlet Unit #1 (NWCI #1), ADL 391611/Northwest Cook Inlet Unit #2 (NWCI #2), ADL 17589/Tyonek Deep #1 (TD #1), and ADL 37831/Tyonek Deep #2 (TD #2). The well locations are shown in Figure 1. Drilling would occur from the *Endeavour – Spirit of Independence* jack-up rig (previously called the *Adriatic XI*) at the wells during the April 15 to October 31 upper Cook Inlet summer drilling season over a three-year period (2013-2015). Buccaneer currently plans to drill Southern Cross #1 during the fall of 2013, NWCI #1 and Tyonek Deep #1 in 2014, and the remaining wells in 2015. However the order in which the identified wells are drilled may change depending on operational considerations. During the winter months the rig will be stationed in lower Cook Inlet where it will either be dry-docked for maintenance or operating under a separate exploratory drilling program. This marine mammal monitoring and mitigation plan (4MP) addresses the drilling and associated activities proposed during both years.

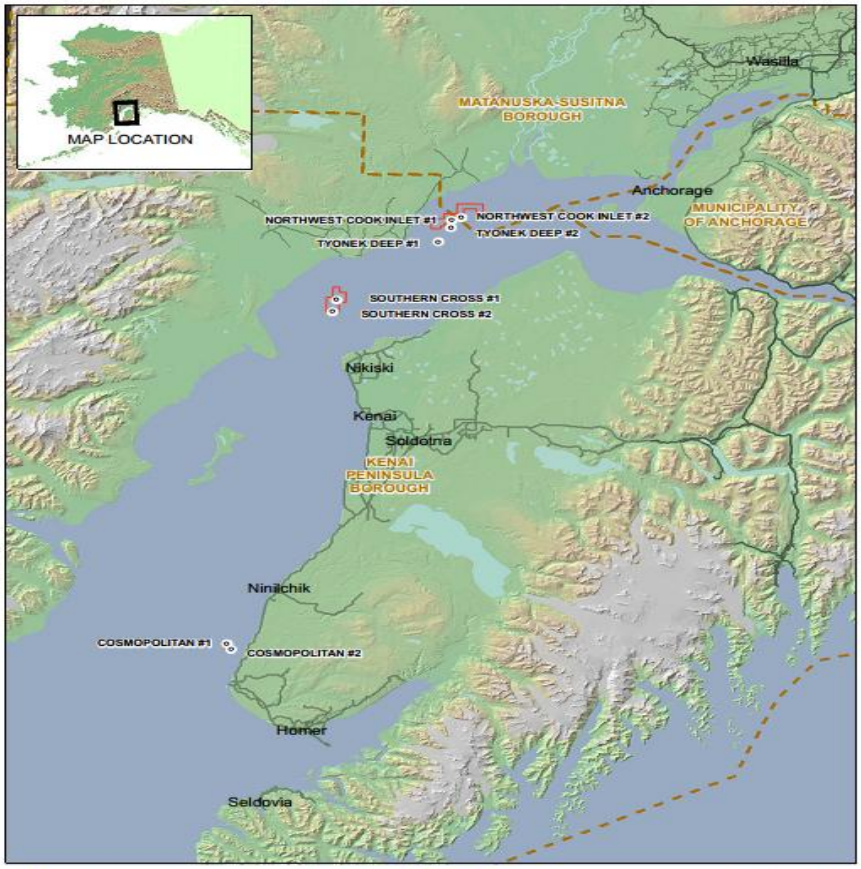

FIGURE 1
Vicinity Map
Revised August 26, 2013

Several species of marine mammals inhabit Cook Inlet, any of which could be acoustically harassed by the proposed exploratory drilling activities. Of particular concern is the Cook Inlet beluga whale (*Delphinapterus leucas*), a listed species, which has been recorded in the vicinity of the upper Cook Inlet well sites. The SC and TD wells, and NWCI #2, fall within the Critical Habitat Area 2 (fall and winter feeding habitat) for this species, while NWCI #1 occurs approximately 150 m (500 feet) inside the southern boundary of Critical Habitat Area 1 (FR 74 [230] 63080-63095). Neither of the two Cosmopolitan units fall within Cook Inlet beluga whale critical habitat, thus belugas are less of a concern there.

Two other marine mammals—harbor seals (*Phoca vitulina*) and harbor porpoises (*Phocoena phocoena*)—may be found in the vicinity of the Southern Cross, Northwestern Cook Inlet, and Tyonek Deep units as they move to and from seasonal foraging areas at the head of the inlet (e.g., the Susitna River delta). Marine mammals that have been found in the vicinity of the Cosmopolitan unit include the harbor seal, Steller sea lion (*Eumetopias jubatus*), harbor porpoise, humpback whale (*Megaptera novaeangliae*), minke whale (*Balaenoptera acutorostrata*), gray whale (*Eschrichtius robustus*), and sea otter (*Enhydra lutris*). Killer whales (*Orcinus orca*) may occasionally venture into either in upper or lower Cook Inlet in search of marine mammal prey.

This 4MP is designed to monitor and mitigate for all marine mammals regardless of status or which federal agency has jurisdiction. The primary concern is the harassing levels of underwater noise produced by the drilling program operations. For impulsive noise sources such as seismic profiling or impact hammering, the Level B harassment take threshold is 160 dB re 1µPa-m (rms) while for continuous noise sources such as propeller cavitation of drilling the threshold is 120 dB re 1µPa-m (rms). Because of the high noise levels generated by tidal bores in Cook Inlet, the ambient underwater noise levels may already exceed 120 dB re 1µPa-m (rms).

For all noise sources the Level A injury take thresholds are 190 dB re 1µPa-m (rms) for cetaceans and 180 dB re 1µPa-m (rms) for pinnipeds, although continuous noise sources rarely exceed 180 dB re 1µPa-m (rms).

Noise sources from the proposed drilling operations vary greatly with frequency, and not all local marine mammals can effectively hear all noise sources. Pinnipeds (harbor seals and sea lions) and odontocetes (toothed whales such as belugas, harbor porpoise, and killer whales) are high frequency marine mammals with dominant hearing ranges of 10 to 30 kHz for pinnipeds and 12 to 100 kHz for odontocetes (Wartzok and Ketten 1999). Mysticetes (baleen whales such as humpback and minke whales) are low frequency cetaceans with effective hearing between 0.5 and 5 kHz. Thus, odontocetes and pinnipeds would not effectively hear low frequency drilling and cavitation noise, while mysticetes would. None are likely to effectively hear the very high frequency (>200 kHz sonar and echo sounders. Seasonal distribution of each species also dictates noise exposure potential.

1.1. Exploration Program and Drilling Operations

Specific locations of the eight well sites are shown in Figure 1 and described below:

- **Southern Cross #1** (SC #1) is 18.8 miles southwest of Tyonek Village and 9.4 miles north-northwest of Nikiski.
- **Southern Cross #2** (SC #2) is 15.8 miles southwest of Tyonek Village and 11.1 miles north of Nikiski.
- **Northwest Cook Inlet #1** (NWCI #1) is 7.9 miles northeast of Tyonek Village and 29 miles northeast of Nikiski.
- **Northwest Cook Inlet #2** (NWCI #2) is 5.6 miles northeast of Tyonek Village and 27.1 miles northeast of the Nikiski.
- **Tyonek Deep #1** (TD #1)is located 5.4 miles east of the Tyonek Village and 29.8 miles northeast of Nikiski.
- **Tyonek Deep #2** (TD #2) is located 7.4 miles northeast of the Tyonek Village and 33.3 miles northeast of the Nikiski.
- **Cosmopolitan #1** (Cosmo #1) is located 3.1 miles off Cape Starichkof and 8.0 miles north of Anchor Point.
- **Cosmopolitan #2** (Cosmo #2) is located 2.5 miles off Cape Starichkof 6.8 miles north of Anchor Point.

Drilling in upper Cook Inlet (Southern Cross, Northwest Cook Inlet, and Tyonek Deep) would occur only during the open water season that runs from April 15 to October 31 (although rig movement may occur in November). Drilling in lower Cook Inlet (Cosmopolitan) could occur during the summer or winter. If seasonal maintenance is necessary, or drilling at Cosmopolitan is complete and upper Cook Inlet remains iced in, the drill rig may be moved to a suitable port (e.g., Homer, Port Graham, or Seward) for winter moorage to await the open water period.

There are six activities proposed for each well site of relative importance to acoustical harassment of marine mammals:

1. Pre-drilling well site survey.
2. Wet-tow mobilization of the rig to and from lower Cook Inlet and between well locations.
3. Driving of conductor pipe.
4. Exploratory drilling.
5. Vertical seismic profiling (VSP).
6. Post-drilling well site survey.

In addition, the rig will remain active with generators, pumps, and other standard equipment operating during and outside the above phases.

During previous Endangered Species Act (ESA) consultations (the latest a Letter of Concurrence [LOC] from James Balsiger dated July 8, 2013) with the National Marine Fisheries Service (NMFS) it was determined that the while all of the above have the potential to disturb Cook Inlet marine mammals, the boomer seismic profiler (well site survey), the conductor pipe driving, and the VSP operations, all

impulsive noises, have the greater potential to disturb Cook Inlet marine mammals. All of these operations emit 1-meter source noise levels exceeding 200 dB re 1 µPa-m (root mean square). Based on available literature, the continuous noise from cavitating tug propellers during the rig tows and the actual drilling occur at frequencies below the effective hearing range of toothed cetaceans (such as belugas) and pinnipeds, and at relatively low energy levels relative to the impulsive noise sources. Hydroacoustical tests conducted by Illingworth and Rodkin (2013a) in May 2013 revealed that underwater noise levels from drilling and rig generators are below ambient, of little concern regarding harassment of marine mammals. However, the same tests determined that the submersed deep-well pumps that charges the fire-suppression system and cools the generators (in a closed water system) does generate noise levels exceeding 120 dB re 1µPa (at levels requiring marine mammal monitoring). Other well site survey noise sources, such as side-scan sonar, occur at relatively high energy levels, but their frequencies are well beyond the hearing range of marine mammals.

In upper Cook Inlet, five of the six well sites do not fall within habitat (Critical Habitat Area 1) used by belugas during the summer, while the fourth site falls only about 500 feet (150 meters) inside the southern boundary of Critical Habitat Area 1. Because all upper Cook Inlet activities will be confined to the mid-channel of Cook Inlet (rarely used by belugas), and would occur between April and October (except short-term rig movement, which may occur in November), activity overlap with beluga winter use of Critical Habitat Area 2 is unexpected. Potential impacts are more likely limited to the Steller sea lions, harbor seals, minke whales, harbor porpoise, and sea otters found in the vicinity of the Cosmopolitan lease area (lower Cook Inlet).

The mitigation and monitoring measures that are planned to be implemented in association with Buccaneer's planned drilling and associated activities in Cook Inlet are described in the subsequent sections that follow. The focus of the plan is to deploy marine mammal observers in association with any activity that generates noise that could potentially harass marine mammals, and to shut down noise-generating operations at the approach of any marine mammal to the associated Level B take threshold. Observers would not be used during any activity that doesn't generate harassment level noise. The plan also includes conducting hydroacoustic surveys (sound source verifications [SSVs]) of the major noise sources to confirm the actual level of noise produced, and to empirically adjust the extent of the estimated shutdown safety zones.

1.2. Generated Noise Levels

1.2.1. Pre- and Post-Drilling Well Site Surveys

The well site surveys would include the use of the following equipment:

- Multibeam or Side-scan sonar for seafloor imagery. A multibeam or side-scan sonar system is the only sound generating equipment that will be used in both a pre-drilling and post-drilling survey.
- High frequency echo sounder for gathering bathymetric data.

- Three high resolution seismic profilers – sub-bottom profiler, boomer, and air gun – to search for shallow to deep natural gas formations.

The latter two systems (echo sounder and seismic profilers) will only be used for the pre-drilling well site survey.

Multibeam or Side-scan Sonar

The multibeam emits a swath of sonar downward to the seafloor. The reflection of the sonar signal provides for the production of seafloor images. The multibeam system to be used during the well site survey is the Reson 7125. This system emits acoustic energy at frequencies between 200 and 400 kHz, with a peak energy level of 220 dB re 1 µPa-m at source. The associated noise frequency levels are beyond the hearing range (maximum 100 kHz) of pinnipeds and odontocetes (Wartzok and Ketten 1999). Further, most sound energy is emitted directly downward, not laterally.

The side-scan sonar also emits a cone-shaped pulse downward to the seafloor. Acoustic reflections provide a two-dimensional image of the seafloor and other features. The sonar system to be used during the well site survey is the GeoAcoustics Sidescan Sonar. This system emits energy at frequencies between 100 and 500 kHz, with a peak energy level of 223 dB re 1 µPa-m at source. Although the system emits sound levels at frequencies that are detectable by the pinnipeds and odontocetes, these frequencies are greater than 100 kHz, or beyond the dominant hearing range (10 to ~100 kHz) of these animals (Wartzok and Ketten 1999).

Echo Sounder

The echo sounder calculates water depth by measuring the time it takes for emitted sound to reflect off of the seafloor bottom and return to the transducer. These sounders emit pulses at frequencies in excess of 200 kHz, and source levels between 200 and 215 dB re 1 µPa-m (peak). Again, these energy frequencies are largely beyond the dominant hearing range of Cook Inlet marine mammals.

High Resolution Seismic Profiling Systems

Shallow Penetrating Seismic

A sub-bottom profiler is used to penetrate the sediments near the water bottom with a resolution of one millisecond (ms). Sub-bottom profilers are precisely controlled “chirp” systems that emit high energy sounds. The system proposed for the Cook Inlet well site surveys—the GeoAcoustics Chirp Subbottom profiler—emits sound levels as high as 214 dB re 1 µPa-m (peak) at source frequencies between 1.5 and 13 kHz, within the effective hearing of most marine mammals.

Intermediate Penetrating Seismic

A system of a source (sparker or boomer plate) and a digital streamer is used to acquire acoustic reflection data with an intermediate penetration depth of up to 600 ms with a resolution of 2 to 10 ms. The system proposed for the Cook Inlet well site surveys is the AA 200 boomer. The source of this system emits acoustic peak levels of 215 dB re 1 µPa-m at source frequencies between 0.3 and 10 kHz. These frequencies are just below the dominant hearing range of pinnipeds and odontocetes, but are detectable by all marine mammals.

Deep Penetrating Seismic

A system of a source (air gun) and a digital streamer is used to acquire acoustic reflection data with a deeper penetration depth of up to 1.5 ms with a vertical resolution of at least 10 ms. The seismic air gun proposed for collecting 2D and 3D seismic data is the Sercel G. Gun II. This multi-channel system deploys a single 60-cubic-inch airgun fired by a 3000 psi air compressor. The gun operates at a frequency range between 1 and 1,500 Hz with a peak source level of less than 200 dB re 1 µPa-m (with a presumable root means square sound pressure level of 190 dB). These low frequencies are well below the dominant hearing range of pinnipeds and odontocetes, but within the effective hearing range of mysticetes (Wartzok and Ketten 1999). This system is not proposed to be used, but is included as an option if needed. It should also not be confused with the similar VSP operation (that uses a 600-cubic-inch airgun) discussed below.

1.2.2. Drill Rig Tow

The rig will be wet-towed by two or three ocean-going tugs licensed to operate in the Cook Inlet. Tugs generate their loudest sounds while towing due to the propeller cavitations. While these continuous sounds have been measured at up to 171 dB re 1 µPa-m (rms) at 1-meter source, they are generally emitted at dominant frequencies of less than 5 kHz (Miles et al. 1987, Richardson et al. 1995, Simmonds et al. 2004). Thus, the dominant noise frequencies from propeller cavitation are significantly less than the dominant hearing frequencies for pinnipeds and odontocetes. Still, because it is currently unknown which tugs will be used to tow the rig on each tow, and there are few sound signatures for tugs in general, it is assumed that noise exceeding 120 dB extends 2,000 feet (600 meters) from the operating tugs.

1.2.3. Conductor Pipe Driving

A conductor pipe is a relatively short, large-diameter pipe driven into the sediment prior to the drilling of oil wells. This section of tubing serves to support the initial sedimentary part of the well, preventing the looser surface layer from collapsing and obstructing the wellbore. The pipe also facilitates the return of cuttings from the drill head. Conductor pipes are usually installed using drilling, pile driving, or a combination of these techniques. In offshore wells, the conductor pipe is also be used as a foundation for the wellhead. Buccaneer proposes to drive 311 feet of 30-inch conductor pipe at each of the Cosmopolitan wells prior to drilling using a Delmag D62-22 impact hammer. This hammer has impact weight of 13,640 pounds and reaches a maximum impact energy of 165,215 foot-pounds at a drop height of 12 feet.

The above size hammer can produce source noise levels exceeding 200 dB re 1µPa-m (rms) when at full power. Blackwell (2005) measured the noise produced by a Delmag D62-22 driving 36-inch steel pipe in upper Cook Inlet and found sound pressure levels to exceed 190 dB re 1µPa-m (rms) at about 200 feet (60 meters), 180 dB re 1µPa-m (rms) at about 820 feet (250 meters), and 160 dB re 1µPa-m (rms) at just less than 1.2 miles (1.9 kilometers). Each conductor pipe driving event is expected to last two to three days.

1.2.4. Exploratory Drilling

Buccaneer proposes to use the jack-up drilling rig *Endeavour* for the Cook Inlet program. Because the drilling platform and other noise-generating equipment is located above the sea's surface, and there is very little surface contact with the water compared to drill ships and semi-submersible drill rigs, lattice-legged jack-up drill rigs are relatively quiet (Richardson et al. 1995, Spence et al. 2007).

The *Spartan 151*, the only other jack-up drilling rig operating in the Cook Inlet, was hydroacoustically measured by Marine Acoustics, Inc. (2011) while operating in 2011. The survey results showed that continuous noise levels exceeding 120 dB re 1µPa extended out only 164 feet (50 meters), and that this noise was largely associated with the diesel engines used as hotel power generators.

The *Endeavour* was hydroacoustically tested during drilling activities by Illingworth and Rodkin (2013a) in May 2013 while the rig was operating at a lower Cook Inlet well site (Cosmopolitan #1). The results from the sound source verification indicated that noise generated from drilling or generators were below ambient. The generators used on the *Endeavour* are mounted on pedestals specifically to reduce noise transfer through the infrastructure, and they are enclosed in an insulated engine room, which may further have reduced underwater noise transmission to levels below those generated by the *Spartan 151.* Also, as mentioned above, the lattice legs limit transfer of noise generated from the drilling table to the water.

However, the sound source verification revealed that the submersed deep-well pumps that charges the fire-suppression system and cools the generators (in a closed water system) does generate noise levels exceeding 120 dB re 1µPa out a distance of approximately 984 feet (300 meters). It was not clear at the time of measurements whether the noise was direct result of the pumps or was from the systems discharge water falling approximately 40 feet (12 meters) from the deck. Thus, after the falling water was enclosed in pipe extending below the water surface in an effort to reduce the noise levels, the pump noise levels were re-measured in June 2013 (I&R 2013b) with results indicating that piping the falling water had a modicum of effect on reducing underwater noise levels; nevertheless, the 120-dB radius still extended out to 260 meters in certain directions.

Thus, neither drilling operations nor running generators on the *Endeavour* drill rig generates underwater noise levels exceeding 120 dB re 1µPa. However, the *Endeavour*'s submersed deep-well pumps generate continuous noise exceeding 120 dB re 1µPa to a maximum distance of 260 meters.

1.2.5. Vertical Seismic Profiling

Data on geological strata depth collected during initial seismic surveys at the surface can only be inferred. However, once a well is drilled, accurate follow-up seismic data can be collected by placing a receiver at known depths in the borehole and shooting a seismic airgun at the surface near the borehole. This gathered data provides not only high resolution images of the geological layers penetrated by the borehole, but can be used to accurately correlate (or correct) the original surface seismic data. The procedure is known as vertical seismic profiling, or VSP.

Buccaneer intends to conduct VSP operations at the end of drilling each well using an array of airguns with total volumes of between 600 and 880 cubic inches. Each VSP operation is expected to last less than one or two days. Assuming a 1-meter source level of 227 dB re 1µPa (based on manufacturer's specifications) for an 880 cubic inch array and using Collins et al.'s (2007) transmission loss model for the Cook Inlet (227 – 18.4 Log(R) - 0.00188), the 190 dB radius (Level A take threshold for pinnipeds) from source was estimated at 330 feet (100 meters), the 180 dB radius (Level A take threshold for cetaceans) at 1,090 feet (332 meters), and the 160 dB radius (Level B disturbance take threshold for all marine mammals) at 1.529 miles (2.46 kilometers). These were the initial injury and safety zones established for monitoring during a VSP operation conducted by Buccaneer at Cosmopolitan #1 during July 2013.

Illingworth and Rodkin (2013c) did measure the underwater noise levels associated with the July 2013 VSP operation using a 720 cubic inch array and found the noise exceeding 160 dB re 1 µPa (rms) extended out 1.535 miles (2.47 kilometers) or virtually identical to the modeled distance. The measured radius to the 190 dB level was 246 feet (75 meters) and to the 180 dB level was 787 feet (240 meters). The best fit model for the empirical data was 227 – 19.75 log(R) – 0.0 (I&R 2013c).

2. Mitigation Measures

2.1. Pre- and Post-drilling Well Site Surveys

Pre-drilling hazard surveys for all for six of the well sites (Southern Cross, Northwest Cook Inlet, and Cosmopolitan were conducted in 2011 and 2012 following an earlier version of this 4MP developed for the initial ESA consultation with NMFS. Because the sub-bottom profilers and boomer plates were used, marine mammal observers were deployed to monitor a 1-kilometer shutdown safety zone. The zone radius is based on applying Collins et al.'s (2007) 18.4 Log r spreading model to an estimated 205 dB re 1µPa (rms) source for the loudest equipment (boomer) producing an estimate distance of 920 feet (280 meters) to the 160 dB isopleth (Level B take threshold). This distance was established as the shutdown safety zone.

In addition, a ramp up was used in powering the equipment. A ramp up involves "soft starting" seismic profiling equipment at low power and sound levels then slowly increasing the volume to until full volume is achieved. The purpose of a ramp up is to alert marine mammals of the noise generating activities allowing them to vacate the area before potential disturbance or injury sound levels are generated. The well site surveyors ramped up at the start of each survey session, with specific ramping procedure dependent on the equipment being used. The area within 1,000 feet of the survey vessel was thoroughly surveyed (and cleared) for marine mammals before ramp up began. The same procedures will be followed if pre-drilling well site surveys are necessary before drilling the Tyonek Deep wells.

Marine mammal monitoring will not occur during the post-drilling well site surveys unless the seismic profilers are employed (which is not expected; but see the VSP operations below).

2.2. Drill Rig Tow

The initial wet-towing of the drill rig occurred in April 2013 with the rig moved from the Port of Homer to Cosmo #1. Given the drilling activities commence as planned, Buccaneer will move the rig to SC #1 in August, then to lower Cook Inlet where it will undergo winter maintenance (likely Port Graham) or be used at Cosmo #2.

The expected source levels from tugs during wet-tow operations are expected to be well less than 180 dB, thus there are no Level A injury concerns relative to noise. The estimated distance to the 120-dB isopleth (the Level B harassment threshold), assuming a 171 dB re 1µPa source and using Collins et al.'s (2007) 18.4 Log r spreading model determined from Cook Inlet, is 2,000 feet (600 meters).

Because the ocean tugs will be under tow while they are generating noises of concern they will be traveling at very slow speeds (1 to 5 knots) providing sufficient time for marine mammals to move from the vicinity and avoid any possible injury take due to collision or noises exceeding injury thresholds. Altering courses or speeds to avoid harassment takes will be conducted when feasible, but completely shutting engines down would represent a major (and perhaps illegal) safety concern given the inherent hazards of towing at sea, thus, while marine mammals will be monitored, no safety shutdowns will occur, however, marine mammal monitoring will occur during all tow events.

2.3. Conductor Pipe Driving

Soon after the drill rig positioned on the well head, the conductor pipe will be driven as the first stage of the drilling operation. At least two marine mammal observers will be stationed aboard the rig during this two to three day operation monitoring a 1.24-mile (2-kilometer) shutdown safety zone (see Appendix A for safety zone angles). The impact hammer operator will be notified to shutdown hammering operations at the approach of a marine mammal to the safety zone. Also, a ramp up of the hammering will begin at the start of each hammering session. The ramp-up procedure, detailed in Appendix B, involves initially starting with three soft strikes, 30 seconds apart. This delayed-strike start alerts marine mammals of the pending hammering activity and provides them time to vacate the area. Monitoring will occur during all hammering sessions.

2.4. Submersed Deep-well Pumps

Hydroacoustic tests conducted by Illingworth and Rodkin (2013a, b) in May 2013 while the rig was operating at a lower Cook Inlet well site (Cosmo #1) showed that the submersed deep-well pumps that charge the fire-suppression system and cool the generators (in a closed water system) generate noise levels exceeding 120 dB re 1µPa out a maximum distance of approximately 853 feet (260 meters). Because the distance to the 120 dB radius exceeds the 25-meter limit written in the LOC, marine mammal monitoring is required from the *Endeavour* at all times the pumps are operating (or essentially at all times the rig is operating). Two marine mammal observers, working in shifts, will continue to monitor from the rig during all periods of rig operation. Temporary shutdown of the pump system will occur at the approach of a marine mammal to the 853-foot (260-meter) shutdown zone.

2.5. VSP Operations

As with the conductor pipe driving, marine mammal observers will be redeployed during the VSP operations to monitor a shutdown safety zone. Initially, the zone was estimated at 1.24-miles (2-kilometers), based on use of a 600 cubic inch airgun array. However, Illingworth and Rodkin (2013c) measured noise levels during VSP operations associated with Buccaneer post-drilling operations at the Cosmopolitan #1 site in lower Cook Inlet during July 2013. The results indicated that for the 720 cubic inch airgun array used during the operation produced noise levels exceeding 160 dB re 1 µPa out to a distance of approximately 8,100 feet (2,470 meters). All future VSP monitoring will involve a 2.5 kilometer shutdown zone. The airgun operator will be notified to shut down firing of the guns at the approach of a marine mammal to the safety zone. Also, a "soft start" ramp up of the guns will begin at the start of each airgun session.

2.6. Summary of Safety Zones

- Pre-drilling Well Site Surveys – 920 feet (280 meters).
- Wet-tow – 2,000 feet (600 meters), no shutdown, only avoidance.
- Driving of conductor pipe – 1.24 miles (2 kilometers).
- Deep-well pump operation – 853 feet (260 meters).
- Vertical seismic profiling (VSP) – 1.55 miles (2.5 kilometers).
- Post-drilling well site survey – none, no monitoring needed.

3. Marine Mammal Observers

3.1. Number of Observers

3.1.1. Pre- and Post-drilling Well Site Surveys

The pre-drilling well site surveys for Southern Cross, Northwest Cook Inlet, and Cosmopolitan well sites were effectively completed in 2012 using a single observer. No observers will be employed during the post-drilling surveys unless seismic profilers are used (which is not expected). If pre-drilling well site survey of the Tyonek Deep wells is necessary, a marine mammal observer will be deployed at that time.

3.1.2. Drill Rig Tow

The initial rig tow from the Port of Homer to Cosmo#1 is expected to last less than 12 hours. A single observer will monitor for marine mammals from the helicopter platform (bow) of the drill rig positioned about 100 feet above the waterline. Two observers will be used for any subsequent rig tow expected to last more than 12 hours, or when two observers are already stationed aboard the rig for other purposes (e.g., monitoring deep-well pumps).

3.1.3. Conductor Pipe Driving

Conductor pipe driving is expected to take two to three days to complete. Two marine mammal observers will be stationed aboard the drill rig during all conductor driving activities at the eight wells. The observers will operate from a station as close to the well head as safely possible.

3.1.4. Deep-well Pump

Two marine mammal observers will work aboard the drill rig during all periods that the deep-well pump is operating. The observers will operate from multiple stations on the rig, recognizing that the shutdown radius begins from the submersed pump housed inside the forward jack up leg.

3.1.5. VSP Operations

As with the conductor driving, two observers will monitor all VSP activities at all well sites. Monitoring during zero-offset VSP will be conducted by two marine mammal observers operating from the drill rig. During walk-away VSP operations, an additional two marine mammal observers will monitor from the seismic source vessel.

3.2. Observer Qualifications

Only trained marine mammal observers will be used during this project. All observers will either have previous experience monitoring for marine mammals, or will go through a rigorous marine mammal monitoring training course. Observers will also be provided with field guides, instructional handbooks, and a contacts list to assist in assuring data are collected effectively and accurately.

4. Monitoring Methodology

4.1. Monitoring at Night and in Poor Visibility

Pre- and post-drilling well site hazard surveys will not occur during periods of poor weather or poor visibility, including during hours of darkness. Thus, there are no marine mammal observation concerns for these conditions. Most of the rig wet-tows will occur during the summer when Alaska days are long. However, because there are no injury-take concerns with the wet-tows, and only a very low potential for acoustical harassment, no special considerations will be made to monitor during poor visibility conditions. Exploratory drilling will occur around the clock regardless of weather or light conditions, but because any potential Level B harassment zone is expected to be very close to the drill rig (a few tens to hundreds of meters at most), few marine mammals would escape detection (especially since summer nights are short in Cook Inlet). Also there are no injury take concerns for either wet-towing or exploratory drilling. Monitoring during hours of darkness will occur for the conductor driving and VSP operations using night scopes if necessary.

4.2. Field Equipment

Standard marine mammal observing field equipment will be used including reticule binoculars (10x42), big-eye binoculars (30x), inclinometers, and range-finders. As there are no injury-take concerns associated with the rig tows or exploratory drilling, no special equipment (e.g., night-scopes, FLIRs) will be used to monitor those activities during low light conditions. Night scopes may be used to monitor at least the Level A injury zones during the conductor pipe driving and VSP activities.

4.3. Field Data Recording

All location, weather, and marine mammal observation data will be recorded onto a standard field form. Field forms will be printed on Rite-in-the-Rain® paper, and attached to the daily report forms. Global positioning system (GPS) and weather data will be collected at the beginning and end of a marine mammal monitoring period and at every half-hour in between. Position data will also be recorded at the change of an observer or the sighting of a marine mammal. Enough position data will be collected to eventually map an accurate charting of any vessel travel. Recorded marine mammal data will also include species, group size, behavior, and any apparent reactions to the project activities. Any behavior that could be construed as a take will also be recorded in the notes. (Because observers will be constantly moving about the rig observing from various unprotected vantage points without power sources, data will not be collected electronically.)

4.4. Field Reports

Daily field reports will be prepared that include daily activities, marine mammal monitoring efforts, and a record of the marine mammals, and their behaviors and reactions, recorded that day. The daily reports will be used to develop an annual 90-day report.

5. Reporting

The lead marine mammal observer will generate daily reports providing information on each of the previous day's marine mammal observations and on any shutdowns that might have occurred. At the completion of each well, a 90-day report will be prepared that will include a compendium of the marine mammals observed during the monitoring activity, and the location of each animal relative to the rig or to mapped vessel track lines (wet-tow and walk-away VSP). Specific reported information will include distances animals were observed from the vessels or rig, and the reaction classification of each.

6. Sound Source Verification

A sound source verification of the underwater sound pressures emanating from the active drilling rig will be conducted by an acoustical engineer. The measurements would be made in a boat that is drifting near the rig in the current. Measuring while drifting will minimize the noise contamination caused by strumming of the hydrophone lines and flow noise. Measurements will be made with a two-channel system that will provide measurements at two specified depths up to 100 feet. The underwater sound levels would be measured using hydrophones, sound level meters, and recording devices.

Measurements would be made by hydrophones that have a flat frequency response and are omni-directional over a frequency range of 10 to 20,000 Hz. The signals shall be fed into an appropriate date-logging device, such as an integrating sound level meter (SLM). The systems will have the capability to make quality recordings using a digital audio recorder (either solid state or tape). The accuracy of the measurement system shall be 1 dB from 10 to 10,000 Hz referenced to 1 micro Pascal (µPa). The measurement system shall be able to measure the unweighted or C-weighted root-mean-square (rms) sound pressure levels in dB referenced to 1 µPa. The measurement systems will have the capability to provide a real time readout display of underwater sound levels. The real-time display shall provide the unweighted peak sound pressure and the sound pressure level. During drilling, measurements were made out to beyond the 120 dB isopleth. During any other activity (e.g., conductor driving and VSP operations), measurements were or will be made to at least one kilometer from the rig. To date, SSVs have been conducted for drilling operations, generators, submersed pumps, and VSP operations (I&R 2013a, b, c). SSV of the conductor pipe driving activity is planned to occur at SC #1.

Recordings of sounds will be conducted so that subsequent analysis could be provided and certain sounds could be identified or at least described. The subsequent analysis would include providing frequency spectra for different sounds or distances from the rig. The spectra data would be provided in 1/3rd octave bands for sounds in the 10 to 10,000 Hz range.

In addition to the underwater sound measurements, measurements of sea temperature, wind speed, and sea state will be (or were) taken as well.

Results of the monitoring would be reported in a brief report or letter. The report describes the source of the sound, the environment, and the measurements. The methodology employed to make the measurements is also described. Results would be presented as overall sound pressure levels and displays of 1/3rd octave band sound levels. Specific sounds would be identified. Findings relative to the 120 dB and 160 dB isopleths will be provided within one week of survey completion.

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Appendix A – Inclinometer Angles

Inclinometer Angle to Distance Relative to Eye Height Above the Water.

Height Above Water	Distance (meters) 100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500
10	5.7	2.9	1.9	1.4	1.1	1.0	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2
15	8.5	4.3	2.9	2.1	1.7	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.3
20	11.3	5.7	3.8	2.9	2.3	1.9	1.6	1.4	1.3	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5
25	14.0	7.1	4.8	3.6	2.9	2.4	2.0	1.8	1.6	1.4	1.3	1.2	1.1	1.0	1.0	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.6
30	16.7	8.5	5.7	4.3	3.4	2.9	2.5	2.1	1.9	1.7	1.6	1.4	1.3	1.2	1.1	1.1	1.0	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.7
35	19.3	9.9	6.7	5.0	4.0	3.3	2.9	2.5	2.2	2.0	1.8	1.7	1.5	1.4	1.3	1.3	1.2	1.1	1.1	1.0	1.0	0.9	0.9	0.8	0.8
40	21.8	11.3	7.6	5.7	4.6	3.8	3.3	2.9	2.5	2.3	2.1	1.9	1.8	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.1	1.0	1.0	1.0	0.9
45	24.2	12.7	8.5	6.4	5.1	4.3	3.7	3.2	2.9	2.6	2.3	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.4	1.3	1.2	1.2	1.1	1.1	1.0
50	26.6	14.0	9.5	7.1	5.7	4.8	4.1	3.6	3.2	2.9	2.6	2.4	2.2	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.4	1.3	1.2	1.2	1.1
55	28.8	15.4	10.4	7.8	6.3	5.2	4.5	3.9	3.5	3.1	2.9	2.6	2.4	2.2	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.4	1.3	1.3
60	31.0	16.7	11.3	8.5	6.8	5.7	4.9	4.3	3.8	3.4	3.1	2.9	2.6	2.5	2.3	2.1	2.0	1.9	1.8	1.7	1.6	1.6	1.5	1.4	1.4
65	33.0	18.0	12.2	9.2	7.4	6.2	5.3	4.6	4.1	3.7	3.4	3.1	2.9	2.7	2.5	2.3	2.2	2.1	2.0	1.9	1.8	1.7	1.6	1.6	1.5
70	35.0	19.3	13.1	9.9	8.0	6.7	5.7	5.0	4.4	4.0	3.6	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.9	1.8	1.7	1.7	1.6
75	36.9	20.6	14.0	10.6	8.5	7.1	6.1	5.4	4.8	4.3	3.9	3.6	3.3	3.1	2.9	2.7	2.5	2.4	2.3	2.1	2.0	2.0	1.9	1.8	1.7
80	38.7	21.8	14.9	11.3	9.1	7.6	6.5	5.7	5.1	4.6	4.2	3.8	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.3	2.2	2.1	2.0	1.9	1.8
85	40.4	23.0	15.8	12.0	9.6	8.1	6.9	6.1	5.4	4.9	4.4	4.1	3.7	3.5	3.2	3.0	2.9	2.7	2.6	2.4	2.3	2.2	2.1	2.0	1.9
90	42.0	24.2	16.7	12.7	10.2	8.5	7.3	6.4	5.7	5.1	4.7	4.3	4.0	3.7	3.4	3.2	3.0	2.9	2.7	2.6	2.5	2.3	2.2	2.1	2.1
95	43.5	25.4	17.6	13.4	10.8	9.0	7.7	6.8	6.0	5.4	4.9	4.5	4.2	3.9	3.6	3.4	3.2	3.0	2.9	2.7	2.6	2.5	2.4	2.3	2.2
100	45.0	26.6	18.4	14.0	11.3	9.5	8.1	7.1	6.3	5.7	5.2	4.8	4.4	4.1	3.8	3.6	3.4	3.2	3.0	2.9	2.7	2.6	2.5	2.4	2.3
105	46.4	27.7	19.3	14.7	11.9	9.9	8.5	7.5	6.7	6.0	5.5	5.0	4.6	4.3	4.0	3.8	3.5	3.3	3.2	3.0	2.9	2.7	2.6	2.5	2.4
110	47.7	28.8	20.1	15.4	12.4	10.4	8.9	7.8	7.0	6.3	5.7	5.2	4.8	4.5	4.2	3.9	3.7	3.5	3.3	3.1	3.0	2.9	2.7	2.6	2.5
115	49.0	29.9	21.0	16.0	13.0	10.9	9.3	8.2	7.3	6.6	6.0	5.5	5.1	4.7	4.4	4.1	3.9	3.7	3.5	3.3	3.1	3.0	2.9	2.7	2.6
120	50.2	31.0	21.8	16.7	13.5	11.3	9.7	8.5	7.6	6.8	6.2	5.7	5.3	4.9	4.6	4.3	4.0	3.8	3.6	3.4	3.3	3.1	3.0	2.9	2.7
125	51.3	32.0	22.6	17.4	14.0	11.8	10.1	8.9	7.9	7.1	6.5	5.9	5.5	5.1	4.8	4.5	4.2	4.0	3.8	3.6	3.4	3.3	3.1	3.0	2.9

Appendix B – Ramp-up Procedures

The intent of ramp-up is to warn marine mammals pending seismic or hammering operations and to allow sufficient time for those animals to leave the immediate vicinity. Under normal conditions, animals sensitive to these activities are expected to move out of the area. For all seismic surveys and pipe/pile driving using an impact hammer, use the ramp-up procedures described below to allow marine mammals to depart the safety and harassment zones before operations begin.

Measures to conduct ramp-up procedures are as follows:

1. Visually monitor the safety zone and adjacent waters for the presence of marine mammals for at least 30 minutes before initiating ramp-up procedures. If none are detected, you may initiate ramp-up procedures.

2. For seismic, initiate ramp-up procedures by firing a single airgun. The preferred airgun to begin with should be the smallest airgun, in terms of energy output (dB) and volume (in3).

3. Continue ramp-up by gradually activating additional airguns over a period of at least 30 minutes, but no longer than 40 minutes, until the desired operating level of the airgun array is obtained.

4. For impact hammering, "soft-start" technique shall be used at the beginning of each day's pipe/pile driving activities or if pipe/pile driving has ceased for more than one hour to allow any marine mammal that may be in the immediate area to leave before pile driving reaches full energy.

5. Begin impact hammering soft-start with an initial set of three strikes from the impact hammer at 40 percent energy, followed by a one minute waiting period, then two subsequent 3-strike sets.

6. Immediately shut down all airguns and hammers at any time a marine mammal is detected entering or within the safety zone. You may recommence seismic and hammering operations only when the exclusion zone has been visually inspected for at least 30 minutes to ensure the absence of marine mammals.

Initial seismic and hammering starts should not begin during periods of poor visibility (e.g., night, fog, wind). Any shut-down due to a marine mammals sighting within the safety zone must be followed by a 30-minute all-clear period and then a standard, full ramp-up. Any shut-down for other reasons resulting in the cessation of the sound source for a period greater than 30 minutes, must also be followed by full ramp-up procedures. In recognition of occasional, short periods of the cessation of airgun firing or hammering for a variety of reasons, periods of airgun silence not exceeding 30 minutes in duration will not require ramp-up for the resumption of seismic or hammering operations if: (1) visual surveys are continued diligently throughout the silent period (requiring daylight and reasonable sighting conditions), and (2) no marine mammals are observed in the safety zone.