

APPENDIX E

SUMMARY OF SELECTED VALUED ECOSYSTEM COMPONENTS

Table E-1 Summary of Selected Valued Ecosystem Components for the Project

Environment	VEC	VEC Sub-components	Reason for Inclusion
Physical	Sediment Quality	-	Accidental events such as hydrocarbon spills may have indirect impacts on biological VEC via direct impacts on sediment quality
	Water Quality	-	Vessel discharges and accidental events such as fuel spills may have indirect impacts on biological VEC via direct impacts on water quality
	Air Quality	-	Air emissions from Project vessels may have indirect impacts on the human receptors via direct impacts on air quality
Biological	Marine Fish	Polar cod	Primary food source for marine mammals and seabirds; potentially occur in License Block area; commercially important species in West Greenland
		Arctic Cod	
		Greenland Halibut	
	Seabirds	Arctic tern	Greenland Red List – Near Threatened
		Atlantic puffin	Greenland Red List – Near Threatened
		Black-legged kittiwake	Greenland Red List – Vulnerable
		Common eider	Greenland Red List – Vulnerable
		Great cormorant	~ 10% of Greenland population occurs in Baffin Bay
		Ivory gull	Greenland Red List – Vulnerable; IUCN listed – Near Threatened (2010)
		King eider	Large flocks assemble in coastal areas and are flightless for a three-week moulting period
		Little auk	> 80% of global population breeds in Greenland with majority of Greenland population in Baffin Bay
		Long-tailed duck	Breed on islets in West Greenland fjords; gather in small flocks in summer for a flightless moulting period; IUCN listed – Least Concern (2010)
		Thick-billed murre	Greenland Red List – Vulnerable; West Greenland population declining; most commonly hunted species in Project area
	Marine Mammals	Bearded seal	Greenland Red List – Data Deficient; year-round resident; possible encounter during survey
		Ringed seal	Locally harvested species; year-round resident
		Polar bear	Greenland Red List – Vulnerable; locally harvested species; potential for occurrence in License Block during survey
Walrus		Greenland Red List – Endangered; locally harvested species; potential for occurrence in License Block during survey	
Bowhead		Greenland Red List – Near Threatened	
Narwhal		Greenland Red List – Critically Endangered; locally harvested species; potential for occurrence in License Block during survey;	
Beluga		Greenland Red List – Critically Endangered; locally harvested species; potential for occurrence in License Block during survey	
Land Use / Sea Use	Subsistence Hunting / Fishing	-	Cultural and economic importance
	Tourism and Recreation	-	Cultural and economic importance

Note: “-“ indicates no sub-components exist

APPENDIX F

PROJECT-ENVIRONMENT INTERACTION MATRIX

Table F-1 Project-Environment Interaction Matrix

Type of Project Activity	Planned Activities						Unplanned Activities	
	Underwater Sound	Vessel Traffic	Vessel Lighting	Ballast Water Exchange	Vessel Discharge	Airborne Emissions	Minor Spills	Major Spills
VEC								
sediment quality	-	-	-	-	-	-	✓	✓
water quality	-	-	-	-	✓	-	✓	✓
air quality	-	-	-	-	-	✓	-	-
marine invertebrates	✓	-	-	-	-	-	-	-
marine fish	✓	-	-	✓	✓	-	✓	✓
seabirds	✓	-	✓	✓	✓	-	✓	✓
marine mammals	✓	✓	-	✓	✓	-	✓	✓
species of concern/ protected areas	✓	✓	✓	✓	✓	-	✓	✓
subsistence fishing and hunting	✓	✓	-	✓	-	-	✓	✓
tourism and recreation	-	✓	-	-	-	-	✓	✓

Note: "-" indicates the VEC will not be assessed against the particular project activity

Note: "✓" indicates the VEC will be assessed against the particular project activity

APPENDIX G

IMPACT ASSESSMENT TERMINOLOGY

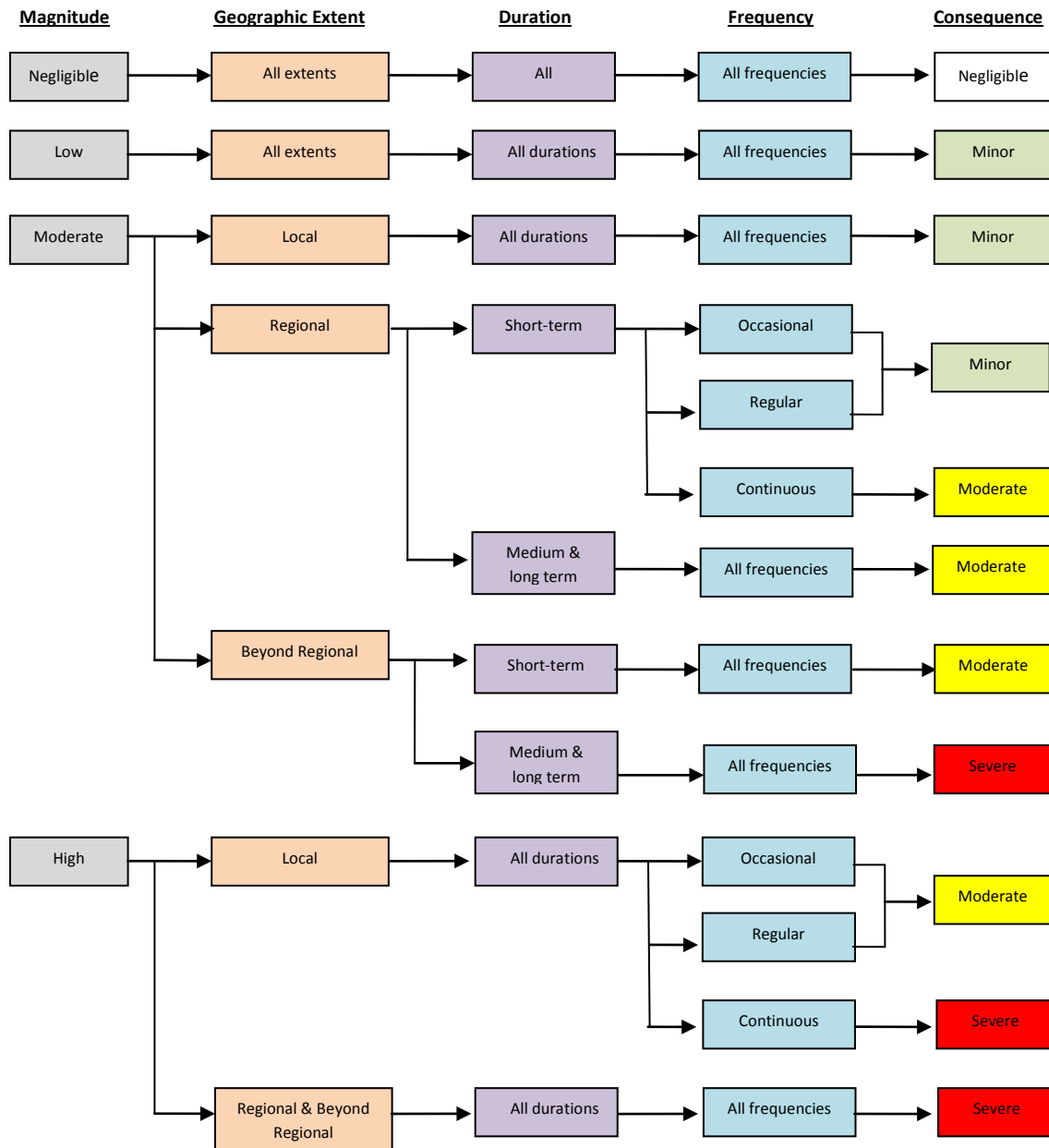
Table G-1 Impact Assessment Terminology

Criteria	Physical	Biological	Land and Sea Use
Magnitude			
Negligible	No changes or small adverse changes unlikely to be measurable against background levels		
Low	Adverse changes that can be monitored and measured above background conditions, but are within the scope of the natural variability, do not exceed established criteria or scientific threshold levels, and do not meet any of the 'moderate' or 'high' magnitude definitions		
Moderate	<p>Likely to result in one or more of the following:</p> <ol style="list-style-type: none"> 1) localized, occasional violations of air, water, or sediment quality standards or guidelines; or 2) localized contamination of marine environment with hydrocarbons, toxic metals, or other toxic substances 	<p>Likely to result in one or more of the following:</p> <ol style="list-style-type: none"> 1) detectable changes above background conditions, exceed established criteria or scientific threshold levels but effects not expected at population level; 2) ≥1 death or injury of a VEC species; or, 3) occasional or temporary disruption of critical activities (e.g., breeding, nursing); and/or localized damage to sensitive habitats 	<p>Likely to result in one or more of the following:</p> <ol style="list-style-type: none"> 1) localized, temporary displacement from preferred fishing sites and/or other negative interactions with fisheries (e.g., nets or traps damaged); or, 2) localized, short-term decline in fishery harvest
High	<p>Likely to result in one or more of the following:</p> <ol style="list-style-type: none"> 1) continuous violation of air or water quality standards or guidelines; or, 2) widespread contamination of marine environment with hydrocarbons, toxic metals, or other toxic substances 	<p>Likely to result in one or more of the following:</p> <ol style="list-style-type: none"> 1) detectable changes above background conditions, exceed established criteria or scientific threshold levels with effects potentially occurring at population level; 2) ≥1 death or injury of a Greenland red-listed species; or, 3) extensive disruption of critical activities or damage to sensitive habitats 	<p>Likely to result in one or more of the following:</p> <ol style="list-style-type: none"> 1) extensive, permanent displacement from preferred fishing sites and/or continuous negative interactions with fisheries; 2) extensive, persistent decline in fishery; or, 3) substantial public controversy or social unrest
Geographic extent			
Local	Effect is limited to the Licence Block plus 10 km buffer zone (LSA)		
Regional	Effect extends beyond LSA and limited to Greenlandic territorial waters of Baffin Bay (RSA)		
Beyond Regional	Effect extends beyond the regional study area (RSA)		
Duration			
Short-term	Effects only occur during the active seismic program plus two (2) months post-survey		
Medium-term	Effects occur up to one (1) year following completion of survey		
Long-term	Effects occur greater than one (1) year following completion of survey		
Frequency			
Occasional	Conditions causing the effect occur sporadically throughout the Project		
Regular	Conditions causing the effect occur at regular intervals throughout the Project		
Continuous	Conditions causing the effect occur continuously throughout the Project		

APPENDIX H

DECISION TREE FOR ASSESSMENT OF IMPACT CONSEQUENCE

Figure H-1 Decision Tree for Assessment of Impact Consequence



APPENDIX I

SUMMARY OF PROJECT MITIGATION AND ENVIRONMENTAL PROTECTION PLANS

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
Physical Presence			
	(1) Consultation and communication with relevant authorities, consultees, and local stakeholders and a dedicated local Greenland phone number will be provided to local stakeholders for any concerns or complaints. (2) Notification of survey details to BMP and appropriate shipping and harbour authorities prior to the start of the survey. (3) Obtaining all appropriate environmental permits and associated conditions prior to the start of the program.	Conoco Phillips Conoco Phillips Conoco Phillips	BMP Guidelines BMP Guidelines Industry Best Practice
Environmental Sensitivities			
	(1) All associated subcontractors will be made aware of environmental sensitivities and procedures/mitigation measures to be used; and include any relevant finds and mitigation measure presented in the EIA are incorporated into the operational management of the project. (2) All associated subcontractors will be provided with details of conditions attached to the environmental authorization and any commitments to the Greenland Government. (3) Information on all aspects of the environment that may affect the conduct of survey operations (e.g. Navigation hazards, shipping routes, marine life, etc.) will be provided to the operator of the vessel. (4) Copies of the NERI and BMP Seismic Guidelines as well as copies of the manual for seabird and marine mammal survey on seismic vessels in Greenland will be provided to contractors to ensure that they understand the role of the MMSO and the measures they will be required to follow in accordance with the guidelines.	Conoco Phillips Conoco Phillips Conoco Phillips Conoco Phillips	BMP Guidelines BMP Guidelines BMP Guidelines BMP Guidelines
Operational Phase Measures			
	(1) The vessel operators will maintain contact with the relevant authorities to update on survey progress and vessel position. (2) The vessel operators will operate in accordance with all applicable laws, standards and conditions while in Greenland waters including: -MARPOL 73/78; SOLAS 1974; any requirement attached to the authorization or any associated conditions required by authorities; E&P Forum Health, Safety and Environmental Schedules for Marine Geophysical Operations (Report No. 6.34/206); IAGC Marine Geophysical Operations Safety Manual (published by the International Association of Geophysical Contractors); IAGC Environmental Guidelines for Worldwide Geophysical Operations; NERI Guidelines to Environmental Impact Assessment of Seismic Activities in Greenland Waters; and OGP Guideline: Managing HSE in a Geophysical Contract (Report No. 432). (3) A log will be maintained of all sightings and contacts with other vessels. (4) A log will be kept of any fishing equipment removed from the sea for the purpose of clearing a path for the survey vessel including location, date, type of equipment and any identifying marks.	Vessel Operator Vessel Operator Vessel Operator Vessel Operator	BMP Guidelines Industry Best Practice and BMP Guidelines BMP Guidelines BMP Guidelines

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
Emissions and Discharges			
Airborne Emissions			
<p>Primary Sources: exhaust gases from diesel engines on vessels (note: other onboard ancillary equipment i.e., generators not assessed as emissions anticipated to be intermittent and of smaller magnitude).</p>	<p>(1) Estimates of fuel consumption for all Project vessels calculated based on assumption that all vessels will operate on Marine Heavy Fuel Oil. (2) Estimates of total air emissions for the proposed Project provided based on the following parameters: PM; SOx; NOx; VOC; CO. (3) Estimates of total greenhouse gas emissions for the proposed Project provided. (4) Project vessels will comply with local and international pollution prevention requirements including, but not limited to: Act on the Protection of the Marine Environment (1993); International Convention for the Prevention of Pollutions from Ships (1973) as modified by the Protocol of 1978, MARPOL 73/78 (Annex VI); and the BMP Guidelines for Application, Execution and Reporting of Offshore Hydrocarbon Exploration Activities (Excluding Drilling) in Greenland Waters (2011). (5) Diesel engines, incinerators and equipment will be maintained and operated efficiently. All equipment will be checked on regular basis and maintained in accordance with the manufacturer's guidelines in order to maximise efficiency and minimize discharges to the environment. (6) Ozone depleting substances will not be used except in refrigeration equipment where closed recovery systems are used. (7) Project vessels and equipment will use fuel with a sulphur content <1.5% (weight) - fuel with higher sulphur content will not used.</p>	<p>Golder A/S Vessel Operator and Conoco Phillips</p>	<p>Effects of Airborne Emissions from Project Vessels</p>
Effluent Discharge			
<p>Primary Sources: liquid wastes including grey water (domestic wastewater), black water (sewage), drainage and bilge water, and solid wastes including kitchen waste, medical waster, potentially hazardous wastes, and other miscellaneous garbage.</p>	<p>(1) Estimates of grey and black produced and discharged from Project vessels will be provided. (2) Grey water will be discharged directly to sea as treatment of grey water is not required prior to discharge to sea under MARPOL 73/78. (3) All vessels will follow the Project specific Waste Management Plan. (4) Solid wastes will be sorted by type, compacted where practicable, and stored or incinerated onboard until they can be disposed of at a certified waste handling or recycling facility (proposed that disposal occur at the home port of the vessel upon completion of Project). (5) Food waste will be macerated and disposed at sea at least 12 nautical miles from the nearest point of land in accordance with the Act on the Protection of the Marine Environment (Part 7, 22-1, 1993) and under Annex V of MARPOL 73/78. (6) Sewage and kitchen waste will be treated onboard prior to discharge and will meet International Maritime Operation Standards, Annex IV of MARPOL 73/78. (7) Discharge of bilge and drainage water is not planned for the duration of the Project. In the event that discharge is unavoidable, bilge and drainage water will be routed through and oil/water separator and assessed for oil concentration prior to discharge and, where possible, meet the best practices of Annex I of MARPOL. (8) Records will be maintained of all discharges, including estimates of grey and blackwater discharge, dirty oil, bilge and ballast water discharges or quantities held in tanks for onshore disposal.</p>	<p>Golder A/S Vessel Operator and Conoco Phillips Vessel Operator</p>	<p>Effects of Discharges from Project Vessels</p>

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
<p>Seismic Surveys may result in indirect effects on commercial fisheries in Baffin Bay by potentially displacing or harming fish, and thus affecting catch rates. The probability of seismic sound impacting commercial fisheries is considered unlikely with mitigation (ramp-up) in place, effects are anticipated to be limited to displacement of commercial fish species in the immediate vicinity of the seismic operations and subsequent reductions in catch rates which are predicted to return to pre-shooting levels with a short time period.</p> <p>it is not expected that Project activities will result in adverse effects on subsistence fishing and hunting activities, as the Qamut Block and surrounding area does not overlap with traditional fishing and hunting grounds.</p>	<p>For all fish VECs in the Qamut Block and surrounding area, the magnitude of the effect of seismic noise was considered to be moderate because sound levels will likely exceed established thresholds for the onset of injury and behavioural changes. However, effects are not anticipated at the population level, as fish and ichthyoplankton are generally widely distributed, and recovery, in terms of both diversity and abundance, occurs rapidly in response to localized impacts. Seismic noise will be restricted to the LSA and will occur over the short-term (survey period) at a continuous frequency (assuming 24-hour shooting).</p> <p>(9) Presence of the seismic vessel itself will likely result in avoidance behaviour and therefore minimize the potential risk to seabirds. Furthermore, the sensory cells of the inner ear in marine birds can regenerate following incidents of acoustic trauma, even after intense exposure.</p> <p>(10) The proposed survey is not expected to cause any measurable effects on marine birds in the proposed survey area, therefore no mitigation is proposed.</p> <p>(11) Unnecessary shooting will be avoided wherever possible.</p> <p>(12) A Project specific 50 m safety zone will be established for the hydrographic survey program based on acoustic impact criteria established by NMFS. As the hydrographic survey vessel only involves the use of a single airgun, no ramp-up procedure is proposed.</p> <p>(13) A MMSO program will also be conducted onboard the hydrographic survey vessel whereby a minimum of two qualified MMSOs will be onboard the vessel, with one MMSO providing continuous monitoring for marine mammals during all periods of daylight, and good visibility.</p> <p>(14) Shutdown procedures related to the hydrographic survey vessel will only occur if a marine mammal is observed within the 50 m safety zone, in which case the source will be shut down and activities will resume no sooner than 20 minutes after the marine mammal has left the safety zone. If the source has stopped and not restarted for at least 10 minutes, then a pre-shooting search and ramp-up procedure will be carried out. If the break is less than 10 minutes, the MMSO will visually scan for marine mammals within the 50 m safety zone, and if a marine mammal is detected, a 20 minute delay will be applied prior to resuming operations. When line are changes occur, the source will be terminated at the end of each survey line and a pre-shooting search will be undertaken before starting the next survey line, provided the line change time is >20 minutes. Shooting will be delayed if marine mammals are observed within the 50 m safety zone during the search. When the line change time is ≤ 20 minutes, the airgun will continue shooting during the line change.</p>		<p>Effects of Underwater Sound from Project Activities</p>

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
<p>Effects of Accidental Events and Spills</p> <p>Primary Source: accidental events and spills have the potential to occur during Project activities. Minor events during routine operations (such as positioning and transiting) have the potential to release small amounts of liquid hydrocarbon, liquid or chemicals, and solid or liquid wastes. Major events could include large hydrocarbon spills due to the vessel sinking, running aground, collisions with icebergs or other vessels, fires and explosions.</p> <p>Effects: environmental conditions during a hydrocarbon spill significantly influences the duration and extent. Currents and tides also play an important role in determine duration and extent. An oil spill in a coastal environment may result in high mortality of adult and juvenile plant and fauna species. Loss of food sources may occur by causing direct mortality or physical injury. Offshore and land feeding areas as well as breeding and moulting habitats can be temporarily or permanently disrupted. Physical injury or death may result from ingestion of contaminated food sources or smothering due to fouling.</p>	<p>(1) The Project strategy to mitigate the potential effects from accidental oil and chemicals spills includes two main components: prevention and response.</p> <p>(2) All operations that involve use, shipping, handling, storage and transfer of fuel, grease and lubricants, and other chemical materials will follow specific procedures and requirements that comply with international safety standards, industry best management practices, and international and local regulations including the following:</p> <ul style="list-style-type: none"> • Engineering design: fuel tanks, lubricant, and chemical storage containers and components will meet relevant safety standards for preventing uncontrolled release of stored materials during normal operation and during exposure to natural hazards and to prevent fires and explosions; • Personnel training and competence: all activities will be conducted by properly trained personnel; • Documented procedures: all activities will be conducted according to pre-established formal procedures to prevent accidental releases and fire and explosion hazards; all materials will be managed with the use of Material Safety Data Sheets (MSDS) that provide the information necessary to understand the product and to take precautions in case of an accident; • Inspection and maintenance: fuel tanks, lubricant and chemicals storage containers and fuel and lubricant transfer systems and components will be regularly inspected and maintained in proper order to prevent uncontrolled release of substances; and, • Record keeping: fuel, lubricants, and other chemicals transfers, and inspection and maintenance activities will be recorded and records will be kept according to the Project records-keeping procedures. <p>(3) To minimize the potential for vessel accidents, Project vessels will comply with the navigation and safety acts, regulations, and guidelines. The include, but are not limited to: SOLAS 1974, and Acts, Orders, and Regulations established by the Danish Maritime Authority.</p> <p>(4) An Ice Management Plan will be implemented to avoid potential collisions and chase vessels may be used for</p>	<p>Vessel Operators and Conoco Phillips</p>	<p>Unplanned Events and Accidental Spills</p>

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
<p>Commercial and substances fisheries may be impacted by oil spills by temporary closures due to concerns due to toxicity levels. Tourism may also suffer from deterioration of the aesthetic value of the affected areas.</p>	<p>spotting and managing glacial ice providing for safe operations. (5) All Project vessels will have an appropriate ice-class rating and be equipped with fixed ice-searchlights. (6) Qualified navigators will be used for navigation through Greenlandic waters. (7) Project vessels will use the Greenland VMS (Vessel Monitoring System) and LRIT (Long Range Identification and Tracking System). Prior to installation of the VMS in Greenland, vessels may use GREENPOS reporting system while navigating to the Greenland EEZ. (8) Each ship will have emergency notification and response equipment, including alarm systems, fire-fighting equipment and spill response kits. (9) All vessels will employ the use of a Shipboard Oil Pollution Emergency Plan as set out in the best practices under MARPOL 73/78, and will be certified to meet the standards of the convention. (10) Regular drills and spill response exercises will be conducted. (11) All accidents, spills, and near-misses will be reported and recorded. A formal investigation will be conducted, if necessary, to determine root cause.</p>		
Effects of Vessel Traffic			
<p>Primary Source: vessel traffic by means of ship strikes - direct mortality and physical injury. Effects: direct mortality and physical injury with baleen whales more probable due to large size and slower travelling and manoeuvring speeds and lower avoidance capabilities.</p>	<p>(1) Speed restrictions will be imposed on all Project vessels and speeds will not exceed 14 knots which will reduce the likelihood of vessels strikes on marine mammals by providing ample time for avoidance. (2) Marine mammal monitoring will be conducted onboard seismic and hydrographic vessels by trained MMSOs. The MMSO will notify the Survey Party Chief if there is a concern of the vessel striking a marine mammal so that an assessment can be made if action is required to avoid collision. (3) Ramping up of the airguns will also be used to deter marine mammals from the area. (4) When in proximity to marine mammals, the following mitigation will be applied where possible: • Vessels will not approach or be positioned closer than 100 meters to any marine mammal; • If marine mammals approach within 100 meters of a Project vessel, the vessel will reduce speed and cautiously move away; • If it is not possible for support vessels to detour around a stationary marine mammal or group of marine mammals, the support vessel will reduce speed and wait until the animals have departed the area and are at least 100 m from the vessel prior to resuming operational speeds; • As possible, Project vessels will avoid marine protected areas and areas identified as important to marine mammals, specifically, the Melville Bay Reserve and Narwhal Protection Zone (NPZ) IV (summer habitat near Qaanaaq); Project vessels will limit time spent in NPZ - I: (summer habitat area in Melville Bay) and NPZ- II (autumn migratory corridor in Eastern Baffin Bay).</p>	<p>Vessel Operators and Conoco Phillips</p>	<p>Effect of Vessel Traffic</p>

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
<p>Effects: Project vessel traffic may overlap with other marine traffic in the Qamut Block. No commercial fisheries for Greenland halibut, snow crab, or other species presently exist within the Qamut Block. However, there may be potential for Project vessels to interfere with vessels or fishing gear . Project vessels may also have an effect on tourism by temporally displacing sightseeing vessels or cruise ships.</p>	<p>(5) It is not anticipated that Project survey vessels will interact with subsistence fishing and hunting, as the survey area does not overlap any traditional fishing and hunting grounds.</p> <p>(6) If deemed necessary by BMP (2011), one or more BMP-approved Fisheries Liaison Officers (FLO) will be onboard the survey and/or support vessels. The FLO will serve as an advisory observer and will facilitate communications for matters related to fisheries.</p> <p>(7) The relevant Greenland authorities (i.e., Island Command Greenland/MRCC Grønnedal) will be notified prior to commencement of operations. This will allow Island Command Greenland, through regular marine radio broadcasts, to alert commercial fishing vessels and other operators to avoid the survey areas where possible.</p> <p>(8) During the seismic operations, a 'notice to mariners' will be regularly broadcast (e.g. every four hours) over local marine radio channel(s) to provide commercial fishing vessels and other marine traffic in the area with details on the proposed survey activities and locations. Where possible, specific notices regarding Project operations and schedule will be provided directly to known operators in the Qamut Block and surrounding area prior to the start of the Project.</p> <p>(9) Conoco Phillips is proposing to include early entry into the block (early July). This would allow completion of part of the program prior to entry from other operators, effectively reducing the amount of time all operators are in the area concurrently. All three operators have agreed to develop simultaneous operations planning in an attempt to reduce the extent of potential cumulative effects on marine mammals and fish.</p>		

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
<p>Effects to Marine Mammals and Fish</p> <p>Primary Source: man-made underwater sound, particularly for marine mammals that may be sensitive to certain sound levels or frequencies;</p> <p>Effects: potential physical (such as: damage to body tissue, temporary or permanent hearing loss due to auditory trauma) and/or behaviour impacts from introduced noise sources (varying nature and degree of impact based on animal's distance from the source); avoidance, masking of biologically relevant sounds. Note: potential effects of underwater sound depend on the marine mammal involved and the level and type of ambient noise.</p> <p>Based on modelling results, sound exposure levels should dissipate to levels below injury thresholds within several hundred meters of seismic sound sources. However, sound exposure levels capable of resulting in behavioural changes could extend as far as several tens of kilometres from each seismic source, depending on topography, water depth, and proximity to adjacent seismic programs.</p>	<p>(1) Underwater noise models were used to predict the underwater acoustic field surrounding the seismic array under various Project scenarios. Two complementary acoustic models were used to predict the underwater acoustic field surrounding the seismic airgun array: airgun array pressure signatures and directional source levels were predicted using JASCO's Airgun Array Source Model (AASM) and acoustic fields were modelled using JASCO's Marine Operations Noise Model (MONM).</p> <p>(2) The survey will follow mitigation measures outline in the Project specific Marine Mammal Management Plan which combines a vessel-based marine mammal and seabird observer (MMSO) program and a Passive Acoustic Monitoring Program (PAM) with vessel-specific operational procedures to mitigate, minimize, prevent and/or manage effects of noise related to the seismic survey. A brief summary of the proposed mitigation measure is provided below:</p> <p>Mitigation through Survey Design</p> <ul style="list-style-type: none"> • Control at the source: airguns will be operated at lowest practicable power levels; • The source/receiver ratio has been increased to reduce the number of source shots transmitted per survey line, as well as the total number of seismic lines required (provides for a reduction in the duration and extent of potential noise effects); • Where possible, the smallest airgun in terms of energy output (dB) and volume will remain shooting when otherwise the entire array is shut-down (maintaining the mitigation gun in active mode at all times to acoustically discourage the approach of marine mammals); <p>Mitigation through Operational Procedures</p> <ul style="list-style-type: none"> • The MMSO program that will adhere to industry standard survey protocols and NERI standards will be carried out on the seismic vessel during the full duration of the proposed program providing a minimum of one qualified MMSO continuously monitoring for marine mammals during all periods of daylight, good visibility and sea states; • MMSOs will be responsible for advising the seismic operator to shutdown the airgun operations if marine mammal(s) are observed within the designated safe zone; 		<p>Effects of Underwater Sound from Project Activities</p>

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
	<ul style="list-style-type: none"> • Based on acoustical modelling completed by JASCO the project specific marine mammal safety radii was determined to be 800 m to avoid the potential for injury to marine mammals; • Implementation of "ramp-up" (soft start) procedures allowing power to be built up slowly from a low energy start-up beginning with the smallest airgun in the array providing a constant increase in output that slowly increases over a minimum ramp-up period of 20 minutes, thus providing adequate time for marine mammals to leave the area prior to the airguns operating a full power (where possible, ramp-ups will be planned so that they commence during daylight hours); • Implementation of pre-shooting searches to determine that no marine mammals are present with the 800 m safety zone (completed by MMSO or an acoustic scan of the areas by the PAM operator); • Implementation of shutdown procedures - if marine mammals are observed within the 800 m safety zone during the ramp-up procedure, the airguns will be reduced to a single mitigation gun (smallest airgun in array in terms of energy output and volume), and a new revamp-up procedure will be initiated no earlier than 20 minutes after the marine mammals have left the safety zone. Once airguns have achieved full operational power, shut-down procedures will only occur if marine mammals are observed with 200 m of the seismic array, in which case the airguns will be reduced to a single mitigation gun until the marine mammals are outside the 200 m protection zone. A new ramp-up procedure will be initiated no earlier than 20 minutes after the marine mammal is beyond the 800 m safety zone; • If shooting of the airguns has stopped and not restarted for at least 10 minutes, then a pre-shooting search and 20 minute ramp-up will be completed. If the break is less than 10 minutes the MMSO will visually scan within the 800 m safety zone; • Firing of airguns will be terminated at the end of each survey line and a full 20 minute soft-start will be undertaken prior to starting the next survey line, providing that the line chance time is less than 20 minutes. If this is not the case, the smallest airgun will remain shooting; 		

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
	<ul style="list-style-type: none"> • A PAM program will be carried out in conjunction with the MMSO program. A certified PAM operator will acoustically monitor for marine mammals during all periods of darkness, limited visibility, and sea states; • Airguns will be operated at the lowest practicable power levels to achieve the geophysical objectives of the proposed seismic survey; • Seismic activities will be avoided in the Melville Bay Reserve and the designated narwhal protection zones (NPZ-IV - summer habitat near Qaanaaq and NPZ- I and II) during the designated protection periods where practical. If avoidance is not possible, then seismic lines occurring in the protection zones will be limited to more widely spaced lines (>10 km). Note: the proposed survey will terminate prior to the start of the NPZ-II protection period. • If limited seismic surveys are planned within a narwhal protection zone, a detailed shooting program will be provided and subject to approval by BMP. • Support will be provided for a acoustic monitoring field program to be conducted during the during active seismic operations involving in-field verification of sound levels emitted, as well as seismic operations in adjacent License Blocks. In-situ sound levels will be compared to acoustically modeled sound levels and the safety radii may be revised in the field accordingly. Acoustic monitoring will be conducted in critical habitat areas (e.g. NPZ-II) on sufficient temporal and spatial scales to adequately capture pre- and post-seismic events. • Support will be provided for the implementation of a narwhal behavioural study to be conducted during the 2012 open-water season. Behavioural responses of narwhal to active seismic operations will be investigated, using aerial surveys conducted in the Qamut Block and adjacent areas. The study will aid understanding of behavioural reactions of narwhals to seismic noise. Aerial-based visual monitoring of critical habitats will be performed to evaluate potential displacement of narwhal from critical habitat areas and/or disruption of important narwhal behaviours in critical habitat areas as a result of seismic activity. • Support will be provided for a study on the effects of seismic noise on local subsistence harvest activities. Interviews will be conducted with Greenlandic hunters to determine potential effects of the 2012 seismic program on marine mammal catch rates; and 		

Issue / Impact Measure	Mitigation	Responsibility	EIA Reference
	<ul style="list-style-type: none"> • Observation will include all marine wildlife including: cetaceans, pinnipeds, polar bears and avian species. A log will be maintain to record daily sightings, observation locations and data, and a record of operations using the forms associated with the guidelines and all marine mammal observations will be in accordance with the NERI and BMP Seismic Guidelines for seabird and marine mammal surveys in Greenland waters; (3) In order to minimize the potential effects of vessel noise on marine mammals, the following mitigation will be applied: <ul style="list-style-type: none"> • Project vessels will regularly maintain propellers to minimize propeller cavitations; • Project vessels will be fitted with nozzles/cowlings around propeller blades as this practice significantly reduces propeller noise (especially for ice rated vessels); • Project vessels will avoid rapid acceleration, and will keep speeds as low as practical within specified Project guidelines (speed reduced to less than 14 knots when within 300 m and avoid abrupt course changes); • Project vessels will not approach or position themselves closer than 100 m to any whale and will reduce speed and cautiously move way from whales if they approach within 100 m; • Project vessels will avoid marine protected areas as defined in Section * of the EIA; 		
Unplanned Events			
	<p>(1) A log will be maintained of all health, safety and environmental accidents or incidents.</p> <p>(2) BMP will be notified immediately of any significant situation or event, including loss of life, missing person, serious injury to a person, fire onboard, oil spill or threat to the vessel or personnel.</p>	<p>Vessel Operator</p> <p>Conoco Phillips</p>	<p>BMP Guidelines</p>
Post Survey Phase			
	<p>(1) MOKN will ensure that any unresolved conditions of the survey authorization, such as reporting requirements or follow-up activities are completed.</p> <p>(2) A report will be provided summarizing all observations and the associated log forms will be provided as appendices.</p>	<p>Conoco Phillips</p> <p>Conoco Phillips</p>	<p>BMP Guidelines</p>

APPENDIX J

MARINE MAMMAL AND SEABIRD OBSERVATION AND PASSIVE ACOUSTIC MONITORING PLANS



15 March 2012

**CONOCOPHILLIPS GLOBAL NVE
GREENLAND LTD**

**Marine Mammal and Seabird
Observation (MMSO) and Passive
Acoustic Monitoring (PAM) for 2D-
Seismic Activity in Qamut Block**

Submitted to:

Golder Associates A/S - Copenhagen

Golder Associates Ltd. - Calgary

REPORT



Report Number: 1113340071





Table of Contents

1.0 INTRODUCTION..... 1

2.0 MARINE MAMMAL MITIGATION..... 1

 2.1 Survey Design 2

 2.1.1 Marine Mammal and Seabird Observer (MMSO) Program 2

3.0 ON-BOARD MITIGATION 7

 3.1 Seismic Survey (MV *Princess*) 8

 3.1.1 Safety Zones..... 8

 3.1.2 Ramp-ups / Soft-starts 8

 3.1.3 Pre-shooting Search 8

 3.1.4 Shut-downs 9

 3.1.5 Breaks in Seismic Activity 9

 3.1.6 Airgun Testing..... 9

 3.1.7 Line Changes..... 10

 3.1.8 Passive Acoustic Monitoring (PAM)..... 10

 3.2 Data Collection and Survey Equipment 11

 3.2.1 Data Entry and Back-up..... 11

 3.3 Vessel Traffic..... 12

4.0 REPORTING..... 12

5.0 LITERATURE CITED..... 13

TABLES

Table 1: Example 1 of MMSO Schedule for Seismic Operations in the Qamut Block 4

Table 2: Example 2 of MMSO Schedule for a Systematic Marine Mammal Survey in Support of Seismic Operations in the Qamut Block 5

ATTACHMENTS

- Attachment A 3-Day Activity Report Template
- Attachment B Weekly Activity Report Template
- Attachment C Completion Report Template



1.0 INTRODUCTION

ConocoPhillips Global NVE Greenland Ltd. (ConocoPhillips) plans to conduct a 2D seismic survey in the central and eastern parts of Block 2 (Qamut) in Eastern Baffin Bay during the 2012 open-water season (the Project). One seismic survey vessel (MV *Princess*) and two support vessels (MV Thor Supplier and MV Thor Beamer) will be used to complete the Project. A Marine Mammal and Seabird Observation (MMSO) Plan and Passive Acoustic Monitoring (PAM) program has been developed for the Project to meet the requirements outlined in the “BMP Guidelines for Application, Execution and Reporting of Offshore Hydrocarbon Exploration Activities (excluding drilling) in Greenland” (BMP 2011a) issued by the Government of Greenland’s Bureau of Minerals and petroleum (BMP) in December 2011; and “Guidelines to environmental impact assessment of seismic activities in Greenland waters” issued by the Danish Center for Environment and Energy (DCE) in December 2011 (DCE 2011).

The MMSO and PAM programs are Project-specific mitigation measures designed to minimize Project impacts on marine mammals. If marine mammals are observed within or about to enter Project-specific safety zones set around the proposed seismic survey activities, mitigation will be initiated by vessel-based MMSOs or PAM operators. In addition, speed limits for all project vessels will be applied to minimize the potential for collisions with marine mammals.

An 800 meter (m) ‘safety zone’ and 200 m ‘protection zone’ will be used by the MMSOs and PAM operators during the course of the Project on the seismic vessel. Safety zones were established using Project-specific acoustic modeling performed by JASCO Research. The methods and results of this modeling are discussed in detail in [Appendix X](#) of the Environmental Impact Assessment (EIA) completed for the Project (Golder 2012).

Data collected by the MMSOs and PAM operators during marine mammal and seabird observing program will also provide information to the Government of Greenland on the location, behaviour, abundance, and species observed during seismic investigations in the Qamut Block. Data will be collected opportunistically and during systematic marine mammal and seabird surveys conducted on-board. Dedicated systematic surveys will follow methodology described in BMP’s manual for seabird and marine mammal surveys on seismic vessels in Greenland (BMP 2011b).

2.0 MARINE MAMMAL MITIGATION

The objectives of the MMSO and PAM plans are to:

- Minimize and/or avoid potential impacts to marine mammals in the Qamut Block as a result of Project activities; and
- Collect data on marine mammals and seabirds in the Qamut Block during the proposed seismic survey. Where feasible, MMSOs will also record observations during daytime non-survey periods such that comparisons can be made with data collected during active seismic operations.

ConocoPhillips’s seismic program incorporates both design features and operational procedures for minimizing potential impacts on marine mammals.



2.1 Survey Design

Mitigation has been incorporated into the planning and design stage of the seismic program. Survey design features include:

- The airgun array will not be larger than needed for the specific survey;
- Airguns will be operated at the lowest practicable power levels to achieve the geophysical objectives of the Project;
- When possible, the smallest airgun in terms of energy output (decibel [dB]) and volume (in³) (the mitigation gun) will remain shooting when otherwise the entire array is shut-down; and
- The source/receiver ratio (i.e., number of hydrophone streamers per airgun array) has been increased to reduce the number of source shots and seismic lines required to complete the survey.

2.1.1 Marine Mammal and Seabird Observer (MMSO) Program

The MMSO program will be required to support the survey activities in the Qamut Block. Survey activities are expected to occur from early July to late September; however, the survey schedule may be altered depending on regulatory requirements, and weather, ice, and sea conditions.

The MMSO program will be carried out on the seismic vessel during the full duration of Project. The MMSO and PAM will be implemented by a team of experienced and certified MMSO and PAM operators trained in observation methodology and seismic mitigation and approved by BMP. During all seismic operations, a minimum of two qualified MMSOs will be onboard the seismic vessel, and a minimum of one qualified MMSO will continuously monitor for marine mammals during all periods of daylight, good visibility, and sea states below Beaufort 3. One of the on-board MMSOs will be an experienced Field Crew Lead responsible for overseeing the MMSO program and managing the MMSO and PAM team onboard the survey vessel. At least one qualified PAM / MMSO operator with training in PAM techniques, PAM software, and seismic mitigation will be present onboard the seismic vessel to acoustically monitor for marine mammals during all periods of darkness, poor visibility, and sea states above Beaufort 3.

MMSO observation platforms will be located at the highest elevation point available on each vessel with the maximum viewable range from the bow to 90 degrees port/starboard of the vessel. Daytime observations will be made using reticle binoculars, the naked eye, and big-eye binoculars. Data collection techniques are described in section 3.0 below.

The MMSO and PAM operator responsibilities include:

- Conducting marine mammal and seabird watches prior to start-up (pre-shooting searches) and during active seismic operations in order to mitigate around project-specific safety zones. The MMSO will be responsible for advising the airgun operator to shut-down operations if a marine mammal is observed within the designated safety or protection zones, as applicable (see sections 3.1.1 and 3.2.1); and
- Systematically collecting data on marine mammals and seabirds using industry-standard survey protocols.



These actions shall be carried out during the active seismic surveys, during turning of the seismic vessel from one line to another, as well as during mobilization to and from the survey area. The data collected will improve the knowledge on the temporal and spatial distribution of marine mammals and seabirds in the Baffin Bay area. Data collected will be submitted to DCE to be included in their regional database.

2.1.1.1 Number of Observers and Watch Schedule

Standard procedures call for MMSO and PAM operators to work no longer than one continuous 4-hour shift with a minimum of 2 hours between shifts to avoid observer fatigue. For summer surveys at high latitudes, this typically requires the deployment of at least three MMSO and one PAM operator on the seismic vessel.

A sufficient number of MMSOs and PAM operators will be required onboard the survey vessel to meet the following criteria:

- 100% visual monitoring coverage during all daylight periods when visibility conditions permit;
- A maximum of 4 consecutive hours on watch per MMSO and PAM operator; and
- A maximum of ~12 hours of watch time per day per MMSO and PAM operator.

Table 1 and Table 2 outline examples of on-board schedules for the MMSO and PAM Program in the Qamut Block during summer of 2012. Option 1 (Table 1) includes a team of 3 MMSO (including 1 Crew Lead MMSO and 2 MMSO with alternative PAM duties) and one dedicated PAM operator. Option 2 (Table 2) includes a team of 4 MMSO (including 1 Crew Lead MMSO) and two dedicated PAM operators. Option 2 would be needed to meet the statistical design requirements of a systematic marine mammal survey to acquire density estimates using distance sampling techniques.



CONOCOPHILLIPS MMSO AND PAM - QAMUT BLOCK

Table 1: Example 1 of MMSO Schedule for Seismic Operations in the Qamut Block

24 Hour Clock (MDT)	Marine Mammal and Seabird Observer				Notes
	MMSO1	MMSO2 w PAM	MMSO3 w PAM	PAM1 / on call	
0:00	Watch	Break	Break	On-call	One MMSO assigned as crew lead During darkness and low visibility periods, MMSO1's watch duties will be replaced with PAM1 duties, MMSO2 & MMSO3 are also certified PAM operators. During low visibility conditions apply, their duties will switch to PAM operations.
0:30					
1:00					
1:30					
2:00					
2:30					
3:00					
3:30	Break	Watch (on-call for PAM)	Break	Break	As above
4:00					
4:30					
5:00					
5:30					
6:00					
6:30					
7:00	Break	Break	Watch (on-call for PAM)	Break	As above
7:30					
8:00					
8:30					
9:00					
9:30					
10:00					
10:30	Watch	Break	Break	On-call	As above
11:00					
11:30					
12:00					
12:30					
13:00					
13:30					
14:00	Break	Watch (on-call for PAM)	Break	Break	As above
14:30					
15:00					
15:30					
16:00					
16:30					
17:00					
17:30	Break	Break	Watch (on-call for PAM)	Break	As above
18:00					
18:30					
19:00					
19:30					
20:00					
20:30					
21:00	Break	Break	Watch (on-call for PAM)	Break	As above
21:30					
22:00					
22:30					
23:00					
23:30					
23:30					



Table 2: Example 2 of MMSO Schedule for a Systematic Marine Mammal Survey in Support of Seismic Operations in the Qamut Block

24 Hour Clock (MDT)	Marine Mammal and Seabird Observer				PAM Operators	
	Team 1		Team 2		Team 1	Team 2
	MMO1	MMO2	MMO3	MMO4	PAM1	PAM2
0:00						
0:30						
1:00						
1:30						
2:00						
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Notes: grey shading = MMSO 'on watch'; brown shading = PAM operator 'on watch'.



2.1.1.2 Observer Qualifications and Training

MMSOs will have previous marine mammal observation experience, and the MMSO Crew Lead will have direct experience conducting vessel-based seismic monitoring programs. Resumes for those individuals will be provided to BMP for their review and acceptance of MMSO qualifications. A MMSO manual adapted for the specifics of the planned survey program will be prepared and distributed to all MMSOs prior to commencement of the program.

Where possible, observers will complete a two-day refresher session on marine mammal monitoring, to be conducted shortly before the anticipated start of the 2012 open-water season. The training session(s) will be conducted by qualified marine mammalogists with crew lead experience during previous vessel-based seismic monitoring programs.

Primary objectives of the training include:

- Review of the Project-specific MMSO manual;
- Review of marine mammal observation, identification, and distance estimation methods;
- Review of operation of specialized equipment (reticle binoculars, GPS system and iPAQ system described below); and
- Review of, and classroom practice with, data recording and data entry systems, including procedures for recording data on marine mammal sightings, monitoring operations, environmental conditions, data entry error control, and reporting requirements. These procedures will be implemented through use of a customized electronic database called Pendragon installed on laptop computers. Section 3.2 provides details on these systems.

2.1.1.3 MMSO Manual

Survey methodology described in BMP's manual for seabird and marine mammal surveys on seismic vessels in Greenland (BMP 2011b) will be implemented where practical into the MMSO manual. The manual will also include maps, illustrations, photographs, as well as Project-specific procedures for watch scheduling and reporting. The manual is intended to provide Project-specific guidance to trained MMSO and PAM operators. The following topics are examples of what may be covered in the MMSO manual for the ConocoPhillips 2D seismic program:

- Marine mammals of Baffin Bay (e.g., species identification, seasonal occurrence, behaviour);
- Role and responsibilities of MMSOs;
- Overview of the seismic program;
- Overview of mitigation measures;
- Health, Safety, and Environment;
- Equipment specifications, operation, and maintenance;
- Distances estimation techniques for various scenarios (reticle binoculars, no horizon);
- Observation techniques (scanning techniques, detection cues);
- Environmental variables; and
- Reporting templates and requirements.



2.1.1.4 Communication Plan

Proper and effective communication between the MMSOs, PAM operators, and seismic crew is essential for implementing a successful MMSO and PAM program. Prior to deployment, all MMSOs, PAM operators, and seismic survey crew will be made aware of the communication procedures in place for the Project.

A designated Crew Lead MMSO will be present and available on the seismic vessel at all times. The MMSO, PAM operator, and airgun operator (instrument room) will have a direct line of contact to the Crew Lead MMSO at all times, likely by way of portable VHF radios or phones present on the bridge and in the instrument room. In instances of uncertainty for an operational shut-down or delay, the Crew Lead MMSO will make the final decision. Where problems in communication are encountered, these will be communicated with company representatives on the survey vessel.

There will be many different circumstances when communication will be necessary between the MMSO, PAM operator, and seismic crew. The following section provided details on communication procedures in place for the MMSO program.

The airgun operator will contact the MMSO or PAM operator (as applicable) at least 20 minutes prior to the start of any airgun activity to allow for the pre-shooting search. When testing of airguns is required, the airgun operator will clarify what type of testing is to be conducted. The MMSO or PAM operator will contact the airgun operator to communicate the following events:

- After each 20 minute pre-shooting search has been completed to allow for the start of ramp-up;
- Following a 'marine mammal event' within the designated safety zone / protection zone to communicate the need for a shut-down or delay in ramp-up (as applicable);
- After a marine mammal has been observed leaving the prescribed safety zone (i.e., the start of a 20 minute delay); and
- After a 20 minute delay has ended and a ramp-up procedure can begin.

3.0 ON-BOARD MITIGATION

The MMSO program will provide real-time mitigation on the seismic vessel, and data collection for the occurrence, distribution, and activities of seabirds and marine mammals in the Qamut Block and surrounding area. All observations shall be undertaken from the seismic source vessel; the MV Princess. The MMSO shall be positioned on a high platform with a clear unobstructed view of the horizon and surrounding water. A detailed communication plan with the seismic crew (e.g., airgun operator) shall be established in a Project-specific MMSO manual to facilitate implementation of the proposed operational activities (shooting, testing, and line-changing) in conjunction with vessel-based mitigation actions.

On-board mitigation and best practices for the seismic program will include the following:

- Implementation of marine mammal safety zones;
- Implementation of ramp-up procedures;
- Implementation of pre-shooting searches;
- Implementation of shut-down procedures;
- Mitigation during breaks in shooting;
- Mitigation during line changes; and



- Implementation of a PAM program.

3.1 Seismic Survey (MV *Princess*)

In order to minimize potential impacts to marine mammals as a result of seismic survey sound, the following vessel-based mitigation measures and best practices have been developed for the seismic program.

3.1.1 Safety Zones

Safety zones are used to mitigate the potential effect of injury (permanent or temporary trauma) to marine mammals as a result of airgun sound. It is not feasible for safety zones to be based on behavioural responses as these can occur at distances of many kilometres from the source (beyond the detection limits of vessel-based MMSO) and are not necessarily predictable based on the received airgun sound level (e.g., depends on behaviour, background sound, auditory experience etc.).

A Project-specific marine mammal safety zone has been developed based on acoustic impact criteria established by the National Marine Fisheries Service (NMFS) for protecting marine mammals from anthropogenic sound. For impulsive sound sources, NMFS has adopted 190 dB re 1 uPa (rms) and 180 dB re 1 uPa (rms) as conservative thresholds for the onset of auditory injury for pinnipeds and cetaceans, respectively. Based on the proposed seismic program, JASCO Research conducted acoustic modeling (**Appendix X**) in the Qamut Block to predict Project-specific marine mammal safety radii, or the distance from the seismic array at which point seismic sound was predicted to exceed the applicable NMFS injury threshold for cetaceans (180 dB re 1 μ Pa rms). The range to this threshold was determined to be approximately 710 m ($R_{95\%}$) which exceeds the safety range recommended by the Joint Nature Conservation committee (JNCC) 2010 guidelines (JNCC 2010). Based on a pre-cautionary approach, an 800 m safety zone (as measured from the center of the source) was established for the Project. The occurrence of marine mammals within this designated safety zone will trigger specific on-board mitigation actions such to avoid potential for physical injury from the seismic source.

3.1.2 Ramp-ups / Soft-starts

A ramp-up (soft-start) procedure will occur prior to active shooting. Power will be built up slowly from a low energy start-up (starting with the smallest airgun in the array). Individual airguns will be started up sequentially in uniform stages to provide a constant increase in output that slowly increases over a minimum ramp-up period of 20 minutes (and no more than 40 minutes), thus providing adequate time for marine mammals to leave the area prior to the airguns operating at full power. The ramp-up period is defined as the time that airguns commence shooting until the time that full operational power is obtained. Where possible, ramp-ups will be planned so that they commence during daylight hours.

Ramp-ups will be applied every time the airguns are used; the only exceptions being for certain types of airgun testing or during short breaks in airgun activity (see sections below). Ramp-up procedures may occur while the survey vessel is in transit to the starting point of the transect line (i.e., during line-changes see section below).

3.1.3 Pre-shooting Search

A pre-shooting search will occur prior to the commencement of any airgun activity including ramp-up (some exceptions apply, see 'Breaks in Seismic Activity' section below) and will consist of a visual scan of the water by the MMSO or an acoustic scan of the areas by the PAM operator to determine that no marine mammals are present within the 800 m safety zone as measured from the center of the array. The duration of the pre-shooting search will be 30 minutes in waters <200 m depth and 60 minutes in waters >200 m depth. If marine mammals are spotted within the 800 m safety zone during the pre-shooting search, the ramp-up



procedure will be delayed 20 minutes from the time the marine mammal was observed leaving the safety zone, or 20 minutes from the time the marine mammal was last detected inside the safety zone.

To avoid unnecessary down time of seismic operations when surveying in deeper waters (when 60 minute pre-searches apply), pre-shooting searches for marine mammals will commence before the end of the survey line (whilst the airguns are still shooting). If marine mammals are spotted within the 800 m safety zone during a pre-shooting search conducted between survey lines (when no airguns are firing), the ramp-up procedure will be delayed 20 minutes from the time the marine mammal was observed leaving the safety zone, or 20 minutes from the time the marine mammal was last detected inside the safety zone.

3.1.4 Shut-downs

If marine mammals are observed within the 800 m safety zone during the ramp-up procedure, the airguns will be reduced to a single mitigation gun (smallest gun in the array in terms of energy output and volume), and a new ramp-up procedure will be initiated no sooner than 20 minutes after the marine mammals have left the safety zone. The theory behind maintaining the mitigation gun active during this procedure is to prevent further approach of the marine mammal to the array while reducing the potential injury to the animal.

Once airguns attain full operational power (post ramp-up), shut-down procedures will only occur if marine mammals are observed within 200 m of the seismic array (protection zone), in which case the airguns will be reduced to a single mitigation gun until the marine mammals are outside the 200 m protection zone. A new ramp-up procedure will be initiated no sooner than 20 minutes after the marine mammal has departed the 800 m safety zone. A shut-down procedure is not required if marine mammals are observed between the 200 m protection zone and the 800 m safety zone during full output power.

3.1.5 Breaks in Seismic Activity

If possible, the mitigation gun will remain shooting when otherwise the entire array is shut-down. In the event that a full break in shooting occurs (entire array and mitigation gun), then the following mitigation will be applied:

- For breaks less than 10 minutes:
 - The MMSO or PAM operator shall make a short visual or acoustic scan for marine mammals (not a pre-shooting search) within the 800 m safety zone.
 - If a marine mammal is detected in the safety zone at this time, a delay in commencement will occur (as per the pre-shooting search) followed by standard ramp-up procedures.
 - If a marine mammal is not detected in the safety zone at this time, the MMSO or PAM operator will advise commencement of airgun shooting at full output power.
- For breaks greater than 10 minutes:
 - A pre-shooting search and 20 minute ramp-up procedure shall be carried out.

3.1.6 Airgun Testing

Airgun testing may be required before the proposed seismic survey commences, or during the survey to test damaged or miss-firing guns. This may require the testing of individual airguns, or the whole array, or testing at various output energies. The following mitigation will be applied during any airgun testing:

- If full output power of the entire array is to be tested, then standard ramp-up procedures shall be applied.



- If a number of guns are to be tested (not the full array), the lowest powered airgun shall be fired first at its lowest power, with airgun power increasing gradually to the power of the required test. This modified ramp-up procedure will be carried out over a time period proportional to the number of guns being tested and ideally will not exceed 20 minutes in duration.
- MMSOs will maintain a watch as outlined in the pre-shooting search procedure before any instances of gun testing. If a single airgun on low power is to be tested then a ramp-up is not required.

3.1.7 Line Changes

Line changes are the activity of turning the seismic vessel at the end of one line prior to commencement of the next line. The duration of proposed line changes will be determined once the detailed seismic survey line plan has been finalized. The total airgun volume for the proposed seismic survey is 3,940 in³. DCE recommends the following mitigation measures for line changes involving airgun volumes ≥ 500 in³.

Firing of airguns will be terminated at the end of each survey line and a full 20 minute ramp-up will be undertaken before starting the next survey line, provided that the line change time is >20 minutes. A pre-shooting search will also be undertaken during the scheduled line change and the soft-start delayed if marine mammals are seen within the 800 m safety zone. When the line change time is ≤ 20 minutes, the smallest airgun in terms of energy output (dB) and volume (in³) (the mitigation gun) will remain shooting when otherwise the entire array is shut-down.

3.1.8 Passive Acoustic Monitoring (PAM)

A vessel-based PAM program will be carried out on the seismic vessel in conjunction with the MMSO program. A certified PAM operator will acoustically monitor for marine mammals (in lieu of visual monitoring) during all periods of darkness, limited visibility, and sea states greater than Beaufort 3. The designated PAM operator will follow the same mitigation approaches as described above (for MMSO), with respect to pre-shooting searches, ramp-ups, and shut-down procedures. Communication procedures will be established between the MMSO, PAM operator, and airgun operator for determining when and how the transfer of monitoring responsibilities will be implemented. This communication plan will be detailed in the Project-specific MMSO manual.

The PAM system chosen for detecting marine mammal vocalizations is provided by Seiche Measurements Ltd.[®] The system has been used extensively on offshore seismic programs and consists of four omnidirectional towed hydrophone elements with onboard acoustic visualizing software (Pamguard) and audio output for both visual and aural real time monitoring. The sensors will be towed near the surface (<30 m depth) at a range of 240 m behind the vessel, thus minimizing ship sound contribution in the data. The sensors have a large bandwidth of 20 herz (Hz) to 200 kilohertz (kHz), which allows for the detection of a variety of marine mammal species. Identification will occur through recognition and comparison of the structure and spectral content of the detected calls with the signature call types of the predominant species found in the study area. The Pamguard software includes automated click detection and can be configured to identify and localize sounds from particular species of interest using filters and detection algorithms from the Ishmael[®] software package. Of particular interest are narwhals, beluga whales, and seal species which primarily vocalize in the mid- to higher-frequency range, and are therefore less likely to be masked by short pulses of predominant lower-frequency airgun sound (<1 kHz; Richardson *et al.* 1994) and narrow-band ship sound. PAM will be given particular importance during start up at night or during periods of low visibility or when the sea state is above 3, but the equipment will be recording continuously. If the PAM operator considers that a marine mammal is present within 800 m of the source during a pre-shooting search, the soft-start will be delayed until 20 minutes has passed from the time of the last in-range detection. If the PAM operator considers that a marine mammal is located within the 200 m protection zone as measured from the



center of the array while it is firing at full power, the array will be reduced to the mitigation gun until the marine mammal exits the 200 m protection zone.

3.2 Data Collection and Survey Equipment

MMSOs will record data on all marine mammal sightings, airgun activities, and responsive actions where and when they are required (e.g., shut-downs, ramp-ups). Data will be recorded using handheld computers called iPAQs integrated with a Bluetooth GPS system.

An iPAQ is a type of small, handheld computer with an integrated software program for data collection called Pendragon. iPAQs are used in lieu of hard-copy data sheets to record marine mammal sightings to maintain consistency of data input and efficiency in data reporting. iPAQs maximize the amount of data that can be collected during a MMSO program. Each iPAQ communicates with its own dedicated Bluetooth GPS unit which tracks the vessel location at all times and automatically transmits vessel waypoints to the iPAQ data system when prompted (e.g., in the event of a marine mammals encounter). To facilitate data entry, iPAQs are programmed with Project-specific data forms (drop-down windows) that prompt the user to record data in a consistent manner. The iPAQ forms will be programmed to the specifications of the survey protocol outlined in BMP's manual for seabird and marine mammal surveys (BMP 2011b). Data will be transferable to Shipsurvey 1.0[®] software.

Five data forms will be completed as part of the MMSO program:

- Marine Mammal and Seabird Survey Information Form;
- Marine Mammal and Seabird Sightings Form;
- Record of Seismic Survey Activities;
- Record of Vessel Traffic; and
- Record of Environmental Variables.

MMSO forms will include:

- Information on watch/survey effort and vessel position and activity;
- Environmental variables (weather, sea state, etc.);
- Marine mammal and seabird observations; and
- Shut-downs / ramp-ups / line changes, and other important operational activities.

The electronic forms contain "drop-down" lists with pre-defined information (e.g., narwhal whale, belugas) which allows MMSOs to record data more rapidly, efficiently, and consistently than manual forms.

3.2.1 Data Entry and Back-up

At the end of each watch, data entered into the iPAQs will be transferred to a laptop computer and saved into excel spreadsheets, as well as backed-up in a Microsoft Access[®] database. A daily Quality Assurance / Quality Check (QA/QC) will be performed on the data by the MMSO or PAM operator responsible for collecting the data. The Crew Lead MMSO will also provide a QA/QC on all survey data prior to reporting. All raw survey data will be backed-up on an external hard drive or USB drive, and when possible, backed up off-vessel via the internet.



Easy step-by-step instructions on how to save data, make back-ups both on-board and off-vessel, as well as troubleshooting procedures, will be provided in the MMSO manual.

3.3 Vessel Traffic

All Project vessels will maintain a speed of <14 knots during all Project activities. This reduces the likelihood of collisions with marine mammals and allows sufficient time for vessel crews to detect and avoid marine mammals in the Project area. Vessel speed restrictions will apply to all vessel activities during seismic operations, support operations, and refuelling / resupply voyages between the License Block and the regional port facilities. Marine mammal monitoring will be conducted on the seismic vessel by trained MMSOs. The MMSO will notify the Survey Party Chief if there is a concern of the ship striking a marine mammal and if actions are required to avoid the risk of collision. This may include slowing the vessel down as practical until the animal has traveled clear of the ship's course.

In the event of a marine mammal encounter, the following mitigation will be applied:

- Vessels will not approach or be positioned closer than 100 m to any marine mammal;
- If marine mammals approach within 100 m of a Project vessel, the Project vessel will reduce its speed and will cautiously move away from marine mammals;
- If it is not possible for support vessels to detour around a stationary marine mammal or group of marine mammals, the support vessel will reduce its speed and wait until the animals depart the area and are at least 100 m from the vessel prior to resuming operational speed; and
- As possible, Project vessels will avoid marine protected areas and areas identified as important to marine mammals, as defined in Section 4.2.2 (Protected Areas) and presented on Figure 4.2-7. Vessels will avoid Melville Bay Reserve and Narwhal Protection Zone (NPZ) IV (summer habitat near Qaanaaq). Project vessels will limit time spent in NPZ-I: (summer habitat area in Melville Bay) and NPZ-II (autumn migratory corridor in Eastern Baffin Bay).

4.0 REPORTING

- Any significant environmental events will be immediately reported to BMP during the active seismic program;
- A 3-day activity report will be submitted to BMP three times a week throughout the active seismic program in accordance with the template provided (Attachment A – BMP 2011);
- A weekly report will be submitted each Monday throughout the active seismic program in accordance with the template provided (Attachment B – BMP 2011); and
- A completion report (cruise report) will be submitted immediately following completion of the seismic program in accordance with the template provided (Attachment C – BMP 2011).



5.0 LITERATURE CITED

- Bureau of Minerals and Petroleum (BMP). 2011a. BMP Guidelines for Application, Execution and Reporting of Offshore Hydrocarbon Exploration Activities (excluding drilling) in Greenland. December 2011. Greenland Government.
- BMP. 2011b. Manual for Seabird and Marine Mammal Surveys on Seismic Vessels in Greenland. May 2011. Government of Greenland and the National Environmental Research Institute (NERI), Aarhus University.
- Danish Center for Environment and Energy (DCE). 2011. L. A. Kyhn, Boertmann, D., Tougaard, J., Johansen, K., Mosbech, A. Guidelines to Environmental Impact Assessment of Seismic Activities in Greenland Waters. 3rd Revised Edition, Dec. 2011.
- Golder Associates Ltd. (Golder). 2012. Environmental Impact Assessment for 2D Seismic Survey in Block 2 (Qamut). March 08, 2012.
- JNCC (Joint Nature Conservation Committee). 2010. JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys. United Kingdom.



Report Signature Page

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ATTACHMENT A

3-Day Activity Report Template

Appendix A; Template for 3 Day Activity Report

Activity report shall be submitted to: bmp@nanog.gl 3 times a week for the entire duration of the activity/survey using the below outlined template. If possible the font and size of the below template shall be used, and the reports shall be submitted in an edible word or pdf format, to facilitate an easy compilation of the reports.

Deadlines:

Sundays by 12 midnight

Tuesdays by 12 midnight

Thursdays by 12 midnight

Survey	
Activity/survey name	
Operator	
Short description of Activity/Survey methodology	
Total activity/survey area	e.g. the licence block(s)
Total activity/survey period	
Contact info at sea	
Vessel	Name of vessel: contact info:
Supply vessel(s)	Name of vessel(s): contact info:
Fishery Liaison Officer (FLO)	Vessel where FLO is stationed on: Name and telephone number of FLO:
Activity Report	
Current position, speed and direction	
Current (updated) activity/survey plan for the next 3 days	Corner positions or end points of survey lines: (if possible refer to lines in the enclosed map)
<i>Maps to be enclosed showing the completed acquisition, the last 3 days acquisition, and planned acquisition for the coming 3 days</i>	Map must show: <ul style="list-style-type: none"> • clear markings of longitudes and latitudes • key map showing where the activity/survey area is situated in Greenland • an arrow showing the current position of the vessel • activity/survey lines planned to be acquired over the coming 3 days marked with fat red font • activity/survey lines acquired (shot) the last 3 days marked with fat green font • Box stating the name and year of the survey • Box stating the date and time of the daily update
Report made by:	
Date and time of this update:	



ATTACHMENT B

Weekly Activity Report Template

Appendix B: Template for Weekly Reports

Licensee:	
Operator of the licensee:	
Contractor (e.g. seismic contractor):	
Vessels:	
Survey name:	
Survey area (licence area and positions):	
Time span for this reporting:	
Date of survey commencement:	
Expected date of survey termination:	
Type of data collected (survey methodology):	
<i>Results:</i>	
This weeks total production:	
Production per day, and daily average production:	
Total production in Greenlandic waters:	
Planned/expected total production in Greenlandic waters:	
Short description of this weeks activities:	

Description of deviations from the planned operations programme:	
<i>Maps to be enclosed showing the completed acquisition and the planned acquisition.</i>	
Incidents, accidents or near-incidents:	
Particular observations regarding ice, oceanographic, meteorological features, wildlife, fishery-activities etc.	
Others:	
Planned production in the coming week; scope and location:	
When and why is the next port call expected?:	
Reporting made by:	
Date:	



ATTACHMENT C

Completion Report Template

Appendix C; Template for Final Acquisition Report, offshore exploration activities

Licensee:	
Operator of the licensee:	
Contractor (e.g. seismic contractor):	
Vessels:	
Survey name:	
Survey area (licence area and positions):	
Time span for the operation; date of mobilisation, survey commencement, survey completion, demobilisation:	
Type of data collected (survey methodology):	
<i>Results:</i>	
Total produktion:	
Daily average production:	
Weekly average production	
Description of deviations from the planned operation programme:	
<i>Maps to be enclosed showing the completed</i>	

<i>acquisition and the planned acquisition.</i>	
Summary of Incidents, accidents or near-incidents:	
Particular observations regarding ice, oceanographic, meteorological features, wildlife, fishery-activities etc	<i>Completed log books from fishery liaison officer, marine mammal and seabird observer and logs of meteorological-, oceanographic- and ice observations (if applicable) shall in addition to this also be submitted in accordance with the Guidelines.</i>
Others	
Reporting made by:	
Date	

Please note that submission of this final acquisition report does not replace the requirements for submittal of data and geological reports etc. in accordance with chapter 8 of the Guidelines, Appendix I and the permission letter.

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