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DFO – IR 05b Effects of Project Activities on Walrus in Steensby Inlet

During the IR process and again during the meeting in Winnipeg on 6 July 2011, DFO noted that walruses use Steensby Inlet and they indicated that this contradicts BIM's conclusion of "no significant impacts". DFO requested a "thorough effects assessment".

Response

The DEIS acknowledged that walruses do occur in and near Steensby Inlet. The presence of walruses in the area and hence, potential interactions between individuals and Project activities does not equate to a significant impact. The DEIS provided a thorough effects assessment for this indicator species by using baseline data collected during aerial surveys, acoustic modelling results, and a review of the literature and IQ regarding walrus response to shipping and other disturbance sources. Since submission of the DEIS, DFO (S. Frame, Fishery Management Coordinator, DFO, 20 July 2011) has provided an additional draft map based on IQ showing locations of known walrus haulout sites, areas of occurrence, and common/known birthing areas. IQ data support the observations made during baseline aerial surveys conducted for the Project. No major haul-out sites were identified in Steensby Inlet and the closest known haulout sites were identified at Jens Munk Island and Bushnan Rock. The Steensby Inlet port site is at its closest point 73 km from Jens Munk Island. Bushnan Rock is over 100 km from the Steensby Inlet port site and Koch Island serves as a geographic barrier between this walrus haul-out site and the port site. Project activities at the Steensby Inlet port during both the Construction and Operation Phase are not expected to affect walruses hauled out at these sites (see Section 5.7.2.2 of the DEIS). Also, given the distance between these haulout sites (Jens Munk Island = 59 km and Bushnan Rock = 44.7 km) and the nominal shipping route, the DEIS predicted that vessel traffic would not affect walruses hauled out at these sites.

Although no major haul-out sites have been identified in Steensby Inlet, walruses were observed there during aerial surveys conducted during 2006-2008. Of note, only one walrus was observed hauled out in Steensby Inlet in 2006, the remaining walruses were observed in the water (W. Bernhardt, Biologist, North-South Consultants, July 2011). Estimates of the number of walruses affected by Project activities provided in the DEIS were based on data collected during the 2007-2008 aerial surveys. Data from 2006 were not directly used in calculating the estimated number of walruses affected by Project activities because of differing survey techniques, reduced survey coverage in terms of overall area surveyed, and limited temporal scope. However, survey results for 2006 were presented in Appendix 8A-2 of the DEIS—see Tables 4.10; and used qualitatively in the DEIS. During 23-24 September 2006, there were 22 walrus sightings consisting of 66 individuals in Steensby Inlet. This resulted in a corrected density estimate of 4.3 individuals/100 km^2. Corresponding density estimates for walrus in Steensby Inlet in September 2007 and 2008 were 0.5 and 0.7 individuals/100 km^2, respectively. Of note, the highest walrus density estimates were observed south of Steensby Inlet in northwest Foxe Basin during September (15.3 individuals/100 km^2) and October (19.3 individuals/100 km^2) 2008.

An analysis of the aerial survey results for Steensby Inlet for September 2006 relative to predicted sound levels from Project activities at the port site (e.g., dredging and vessel traffic) results in the same prediction as the analysis based on the 2007-2008 aerial survey results used in the DEIS: "Walruses in the vicinity of dredging operations and the associated construction activity (vessel traffic, dock construction) may exhibit localized avoidance of the area, but the numbers of affected animals will be few." The number of walruses that occur near the Steensby Inlet port site will no doubt vary from year to year. During the September 2006 aerial surveys when walrus density was the highest in Steensby Inlet relative to 2007 and 2008, five walruses (6.1% of the 66 walruses recorded during the entire survey) were observed within 5 km of the Steensby Inlet port site.

The DEIS does note (see Section 5.7.5) that "There is some uncertainty about how many walruses use Steensby Inlet during the open-water period and how walruses that may occur there will respond to daily overflights of Boeing 737s during the Construction Phase. Thus, monitoring will be undertaken at the Steensby Inlet Port site during the Construction Phase to document walrus occurrence and their potential responses to site activity, including overflights." Monitoring of walruses near the Steensby Inlet port will be undertaken during the Construction Phase to address the uncertainty associated with effects of the Project on walrus. Walrus response to aircraft overflights is further discussed in response to DFO IR 05e.

DFO – IR 05e Effects of Aircraft Overflights on Walrus in Steensby Inlet

DFO's initial IR asked for justification of why "low altitudes of the Boeing 737s would not pose a significant risk to walruses in Steensby Inlet at times when walrus haul out in significant numbers, as was the case in September 2006". At the meeting in Winnipeg on 6 July 2011, it was agreed that BIM would map the approach/departure paths of the Boeing 737s at the Steensby Inlet airstrip and estimate airborne noise levels.

Response

Airborne noise levels from a Boeing 737 landing and taking off from the proposed Steensby airstrip were modeled. It was assumed that flights were to and from Iqaluit. The modeling approach, methods, and resulting assessment of the effects of the aircraft overflights on hauled out walruses are provided below.

Approach

We estimated the sound levels likely produced by the Boeing 737 aircraft during takeoff, climb and descent, landing along the flight paths between the proposed airstrip at Steensby Inlet and the Iqaluit airport. These estimates were then compared with the known in-air hearing ability of walrus. To estimate sound levels the following was needed: estimates of the source level of noise produced by the aircraft, a sound propagation model for in-air noise that accounts for attenuation due to various sources, and an estimate of the flight profile (range and altitude) of the aircraft as it approaches and departs the airstrip at Steensby Inlet. The airstrip is designed so that the aircraft can land or takeoff in both the westerly and easterly direction although the vast majority of the takeoffs and landings will be into the prevailing west winds.

Aircraft Source Levels

Three sources for Boeing 737 1/3 octave band aircraft source noise levels were examined (Richardson and Malme 1993; Richardson et al. 1995; Blackwell and Greene 2002). We determined that Richardson et al. (1995) had the best estimates of the aircraft source levels. We also registered with the Aircraft Noise and Performance Database website (ANPD 2011) to allow us access to other aircraft noise data but the moderators of that website did not approve our registration in time for this analysis. We contacted several airport noise abatement departments to enquire if they had 1/3 octave band noise level information for Boeing 737s that use their airport and they usually directed us to Boeing Corporation who in turn directed us to documents available on their website; these documents did not provide the information we needed.

Aircraft Flight Profiles

The departure flight profile was based the generalized profile presented in a Boeing Corporation document available on their website (Boeing 2011). The arrival profile was based on that same document. For this analysis we assumed that the Boeing 737 aircraft could maintain its normal rate of climb and flight profile in a wide banking turn.

We assumed a takeoff speed of 147 kts and an initial climb rate of 3000 ft/min (which gives a takeoff slope of about 10.5 degrees). The aircraft accelerates to 162 kts within approximately 30 seconds and climbs to an altitude of 1500 ft. At this point the aircraft would pitch down to a climb rate of 1500 ft/min and accelerate to 250 kts. At this airspeed, the aircraft pitches up to a climb rate of 3000 ft/min and climbs to 12,000 ft. At 12,000 ft altitude the aircraft pitches down to a climb rate of 1500 ft/min and then accelerates to 300 kts. At this speed, it again pitches up to a climb rate of 1800 ft/min and continues this rate of climb and airspeed to reach a cruising altitude of 30,000 feet.

The aircraft flight profile for arrivals at Steensby Inlet was based on a simpler set of rules which use angle of approach. The aircraft decelerates upon approach at various points but we assume that the angle of approach does not change. At approximately 70 mi from the airstrip the aircraft begins its descent from the cruise altitude of 30,000 feet at a 3 degree glide slope until it reaches about 10,000 ft altitude (12 miles from the airport), below this altitude the aircraft descends at a 2.5 degree glide. The aircraft must have completed any turns by the time it is at the 1500 feet altitude, after this point the aircraft has a straight line descent to the airstrip.

We calculated a conservative banking turn for the Boeing 737 aircraft using an online tool (CSGNetwork 2011). With a conservative 250 kts speed over ground the tool gives a large turn radius of 3.4 nmi while banked at 15 degrees, and even more conservative turn would be at the same turn radius but a banking angle of 6.45 degrees and the slower speed of 162 kts.

Departure flight profiles were estimated for the aircraft taking off to the east and west and then flying to Iqaluit. Arrival flight profiles were estimated for the aircraft departing from Iqaluit and landing at the airstrip from the east and from the west.

The flight paths were digitized in MapInfo Pro with the turn radius defined above. An additional tool (Routeware Toolbox 2011) was used in MapInfo to add nodes along the flight path polyline every 100 m starting at the ends of the Steensby Inlet airstrip. The ends of the airstrip are 50 m above sea level. The nodes are saved as individual points in the GIS. Mapinfo is used to update the nodes attribute table with the UTM coordinates, the table is then exported to comma delimited files that were manipulated in Excel.

The exported flight path points were manipulated in Microsoft Excel by interpolating flight altitudes at each node based on the flight profiles defined above. The horizontal distance along the flight path and the altitude for each node is used as the basis to estimate the range from that point to dB levels at 5 dB increments beginning at 40 dB and ending at 100 dB.

Calculated Received Sound Levels at Water Surface along B737-200 Flight Paths

The source level of the Boeing 737 aircraft (at 1 m) was back-calculated based on the sound level (at 300 m from the aircraft) presented in Richardson et al. (1995). We then calculated noise levels for the various 1/3 octave bands at systematic distances from the aircraft using the formula described in Plotkin et al. (2000). This formula subtracts loss from the source noise levels caused by distance from the sound source, loss due to absorption by atmosphere, and the loss due to lateral attenuation (as per SAE 1751 protocol in Plotkin et al., 2000). The formula from Plotkin et al. (2000) is:

noise level (range) = source level - 20*log(range) - (absorption coefficient * range) + lateral attenuation/amplification (at range)

The 1/3 octave band with the consistently highest noise level across all range values was used to estimate the noise levels at a variety of increasing aircraft altitudes (50 m altitude interval), and increasing lateral range (100 m interval) from the aircraft flight path.

We used these results as input required to interpolate the range where specific dB noise levels from the aircraft would occur at 5 dB intervals between 40 and 100 dB re 20 μPa for each aircraft altitude (0-9100 m at 50 m intervals). Based on the altitude at each node along each of the four flight paths, we interpolated the range of each 5 dB noise level between 40 and 100 dB.

Each flight path's nodes were imported into MapInfo and buffered by the range for each 5 dB level to create a contour map of estimated sound levels at the water surface. We overlaid the contour maps with the known walrus haulout locations, and the estimated noise levels with the in-air hearing ability of walrus (Kastelein et al. 1996).

Results

Figure 1 and Figure 2 present the nominal flight paths of Boeing 737 aircraft landing from the east and west, respectively at the proposed airstrip at Steensby Inlet. Figure 3 and Figure 4 present the nominal flight paths of Boeing 737 aircraft taking off to the east and to the west, respectively from the proposed Steensby Inlet airstrip. Each map shows the predicted received airborne noise levels at sea-level ranging from 40 dB to 100 dB re 20 μPa. It was conservatively assumed that the ambient in-air noise levels would be approximately 55 dB (Blackwell and Greene 2002), therefore walruses would not detect noise levels less than 55 dB. In addition, Kastelein et al. (1996) has shown that the minimum in-air sound levels that can be perceived by walruses are approximately 55 dB or greater. None of the known walrus haulout locations are located within estimated noise level contours greater than 40 dB. Therefore, it is unlikely that walruses hauled out at the known haulout sites would hear an overhead Boeing 737. Given the geographic separation of the known haulout sites and the aircraft flight paths and the estimated altitude of the aircraft, it is very unlikely that hauled out walruses on Jens Munk Island and Bushnan Rock (two closest known haulout sites) would visually detect Boeing 737s.

Therefore, as predicted in the DEIS and confirmed with this further analysis, Boeing 737 overflights are not expected to significantly affect hauled out walruses. If walruses haul out adjacent to the shoreline near the proposed Steensby airstrip during the Construction Phase, they may respond to aircraft overflights. Walruses are not known to haul out in large numbers around the proposed port site and it is likely that marine construction activities would deter walruses from at least the immediate area.

The DEIS does note (see Section 5.7.5) that "There is some uncertainty about how many walruses use Steensby Inlet during the open-water period and how walruses that may occur there will respond to daily overflights of Boeing 737s during the Construction Phase. Thus, monitoring will be undertaken at the Steensby Inlet Port site during the Construction Phase to document walrus occurrence and the potential response to site activity, including overflights." Further to this, as noted in previous response to DFO IR 05e, noise levels produced by aircraft will be monitored at the port site and at select haulout sites during the Construction Phase. In addition, if walrus haulout sites are found to occur in Steensby Inlet, walrus behaviour in response to aircraft overflights will be monitored. Details will be provided in the updated mitigation and monitoring plan.

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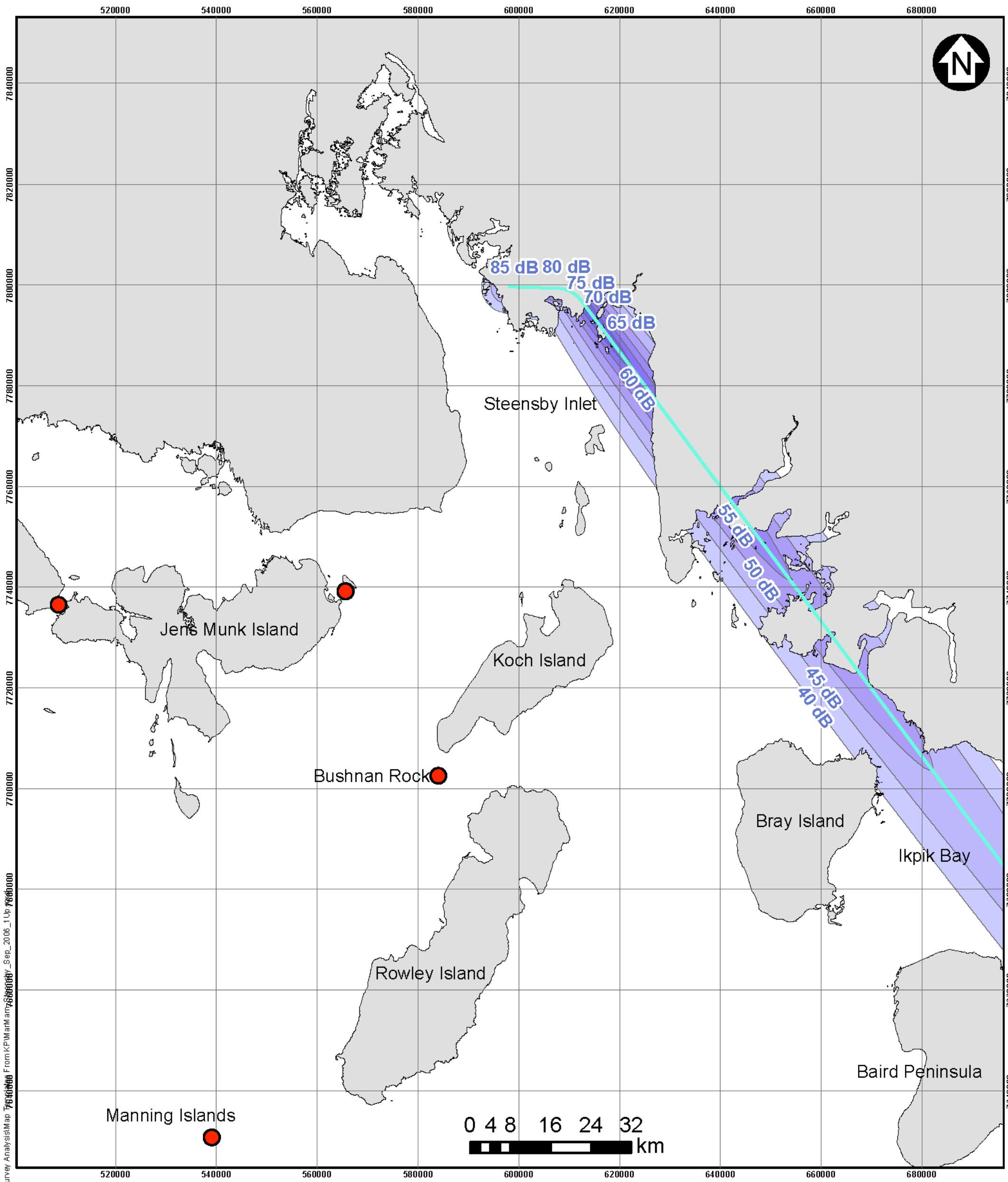

LEGEND:

PREDICTED NOISE LEVEL (DB RE 20 µPA) AT WATER SURFACE

- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- > 85
- FLIGHT PATH
- KNOWN WALRUS HAULOUT SITES
- LAND

NOTES:

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3. CONTOUR INTERVAL IS METRES.

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BAFFINLAND IRON MINES CORP.

MARY RIVER PROJECT

MARINE MAMMAL SURVEY
Walrus Haulout Sites and Predicted In-air Noise from Boeing 737 Landing At Steensby Inlet From East

LGL LIMITED

P/A NO. NB000-000/00

REF NO. -

FIGURE 1

REV -

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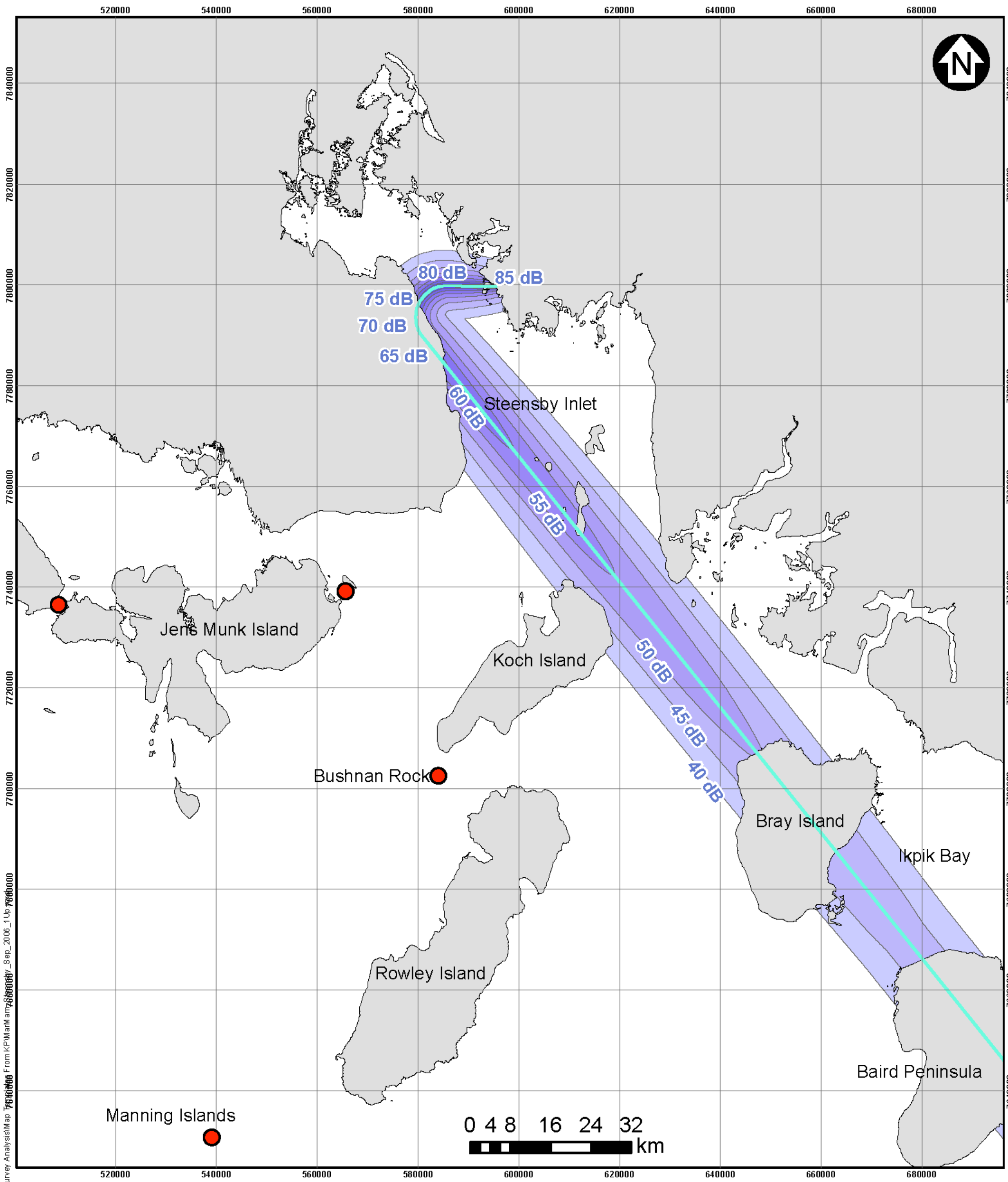

LEGEND:

PREDICTED NOISE LEVEL (DB RE 20 µPA) AT WATER SURFACE

40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
65 - 70
70 -75
75 - 80
80 - 85
> 85

FLIGHT PATH

KNOWN WALRUS HAULOUT SITES

LAND

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MARY RIVER PROJECT

MARINE MAMMAL SURVEY

Walrus Haulout Sites and Predicted In-air Noise from Boeing 737 Landing At Steensby Inlet From West

P/A NO. NB000-000/00

REF NO. -

FIGURE 2

REV -

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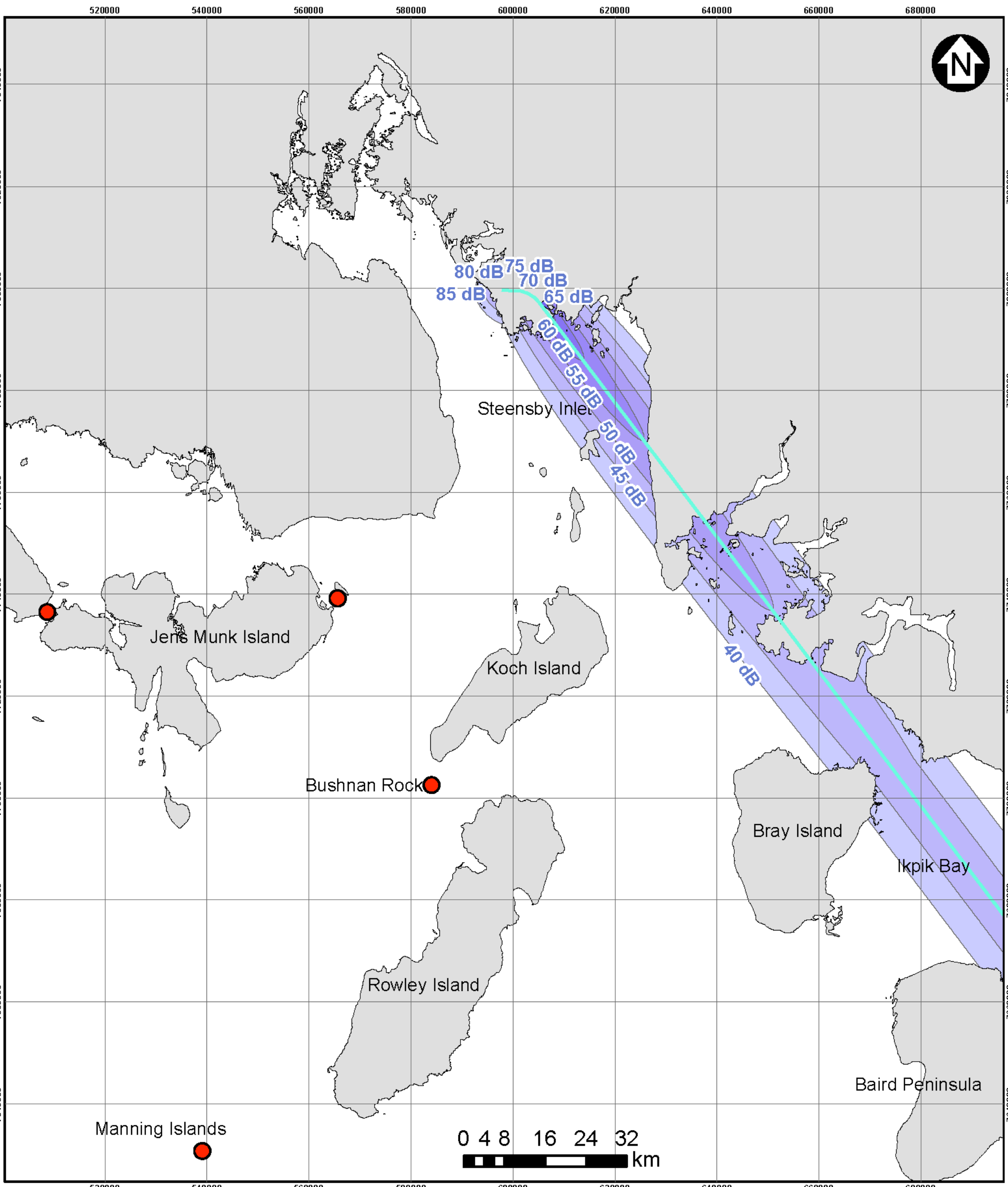

LEGEND:

PREDICTED NOISE LEVEL (DB RE 20 μPA) AT WATER SURFACE

40 - 45	65 - 70
45 - 50	70 - 75
50 - 55	75 - 80
55 - 60	80 - 85
60 - 65	> 85

FLIGHT PATH

KNOWN WALRUS HAULOUT SITES

LAND

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MARY RIVER PROJECT

MARINE MAMMAL SURVEY
Walrus Haulout Sites and Predicted In-air Noise from Boeing 737 Take-off To East From Steensby Inlet

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FIGURE 3

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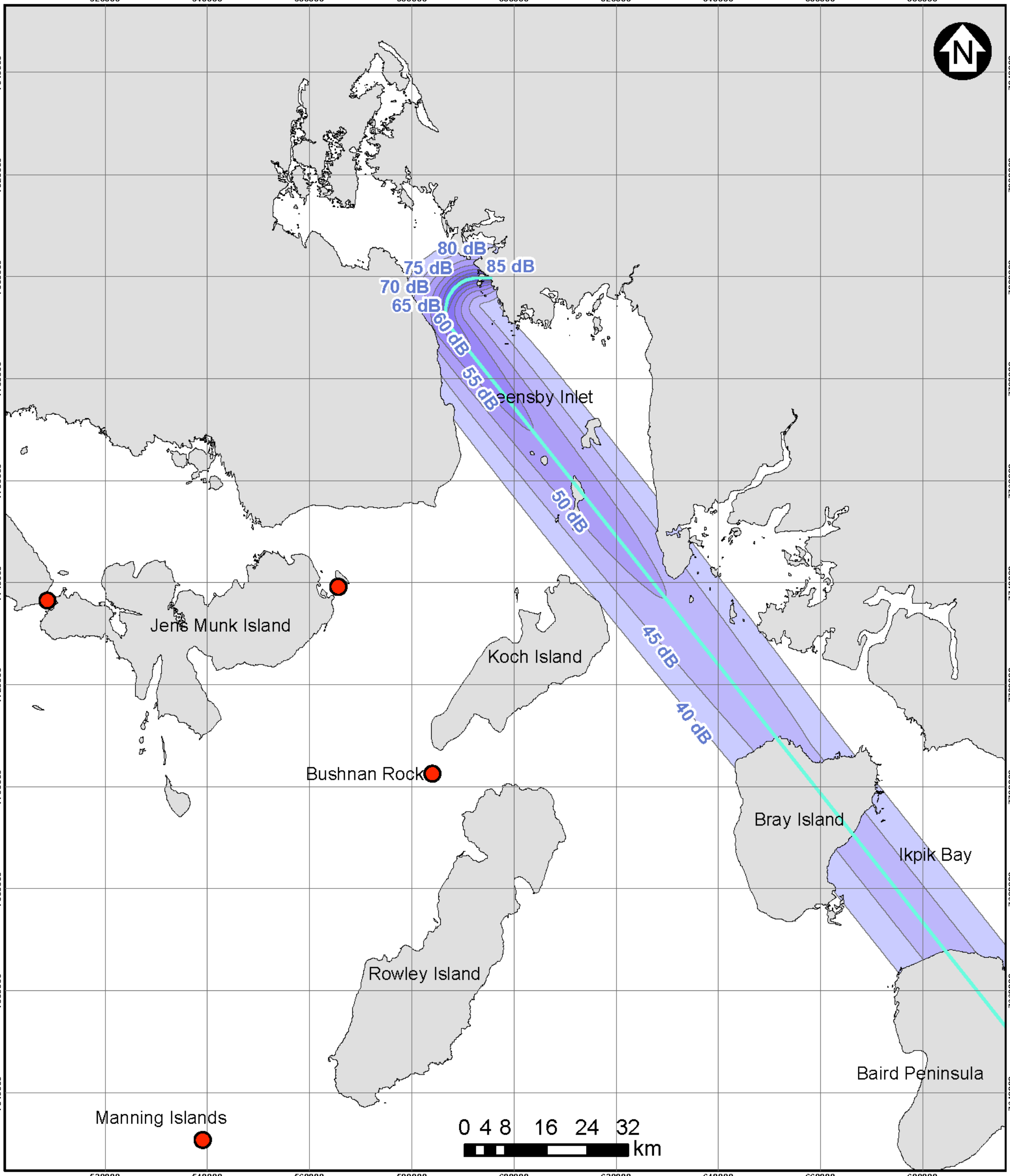

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LEGEND:

PREDICTED NOISE LEVEL (DB RE 20 μPA) AT WATER SURFACE

- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- > 85

FLIGHT PATH

KNOWN WALRUS HAULOUT SITES

LAND

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MARY RIVER PROJECT

MARINE MAMMAL SURVEY

Walrus Haulout Sites and Predicted In-air Noise from Boeing 737 Taking-off to West From Steensby Inlet

LGL LIMITED

P/A NO. NB000-000/00

REF NO. -

FIGURE 4

REV -

DFO – IR 05f Mitigation for Aircraft Overflights Effects on Hauled Out Walruses

DFO requested additional information on mitigation measures that would be used for commercial jets and for clarity on how long monitoring at walrus haul-out sites relative to aircraft overflights would occur.

Response

Based on analyses in the DEIS and consideration of predicted airborne noise levels from a Boeing 737 (see response to DFO IR 05e), walruses at known haulout sites are not expected to respond to commercial jets landing and taking off from the Steensby airstrip. As noted in the DEIS, terrestrial haulout sites where walruses congregate in relatively high numbers will be mapped and project aircraft will be prohibited from flying directly over these sites. Received aircraft sound levels will be measured near Steensby Port and at selected walrus haulout sites to confirm the modelled results. These measurements will be made as soon as possible after the Steensby airstrip is able to receive Boeing 737s. Surveys will be undertaken to further document walrus use of Steensby Inlet prior to the construction period, during construction (including periods with Boeing 737 overflights), and after construction. In addition, walrus behaviour relative to aircraft overflights will be monitored at haulout site(s). Details will be provided in the updated mitigation and monitoring plan.

DFO – IR 05h – Additional Information

Repeated Disturbance of Walrus

DFO requested an assessment of potential effects on walruses from repeated disturbances over the life of the Project. BIM's initial response commented only on effects of aircraft overflights and DFO indicated that the response should not be limited to that Project activity.

Response

See response to DFO IR 05i.

DFO IR-05l – Ship Disturbance of Walrus Haulouts

This IR requests clarification on how published information was used to reach the conclusion in the DEIS that the ore carriers would not affect walruses on distant terrestrial haulout sites. It further asks for a comparison of noise produced by icebreakers referred to in the literature cited in the DEIS with expected noise levels of the ore carriers. The original IR asked for *"published information and expert opinion that support claims that walruses will not likely leave terrestrial haulout sites in response to passing ore carriers at distances of 4.6-8 km."*

Response

Walruses on a terrestrial haulout sites are not exposed to the underwater noise from the ore carriers. There are no specific in-air measurements or modelling of the in-air noise levels emanating from the ore-carriers. In general, in-air noise from large vessels is not very high. This is demonstrated on many large vessels where humans on board the travelling vessels do not require ear-protection (e.g. very large crude carriers, large cruise vessels, aircraft carriers, etc.). The in-air noise from icebreakers travelling in open water will be similar to or less than the larger vessels. At distances of 4.6 to 8 km, the received in-air noise levels from the passing ore-carriers will not be high at the haulout location. At the longer distances, it is probable that walrus will not even hear the ore-carriers. Similarly, walruses on a haulout are not much higher than the adjacent water making it difficult to see vessels at long horizontal distances. In addition, the ore-carriers will be travelling on a steady course that parallels the shore where the walruses are hauled out. The vessels will not approach the haulout and in no way will be seen to pose a direct threat to the animals. In such situations, animals rapidly habituate to the presence of distant, non-threatening stimuli that appear at regular intervals. There are no published records of walruses responding by abandoning a haulout with similar types of stimuli. [See also our response to DFO IR#5i. and the discussion in Section 5.7.2.2 in Volume 8 of the DEIS.]