Knight Piésold CONSULTING

MEMORANDUM

Date:	August 23, 2019	**File No.:**	NB102-00181/53-A.01
		Cont. No.:	VA19-01477
To:	Mr. Lou Kamermans		
Copy To:			
From:	Oscar Gustafson		
Re:	**Mary River Project - Phase 2 Proposal - Revised Addendum to Technical Supporting Document 27 - Cumulative Effects Assessment**		

1.0 INTRODUCTION

This memorandum provides supplementary information to the cumulative effects assessment (CEA) prepared for the Phase 2 Proposal (Baffinland, 2018), in response to technical review comments (TRCs) from the Government of Nunavut (GN, 2019), Parks Canada (2019), and Crown-Indigenous and Northern Affairs Canada (CIRNAC, 2019). This memo supersedes and builds on a similar memo by Knight Piésold Ltd. (KP) dated May 16, 2019 (KP, 2019a), and should be read in conjunction with the main CEA prepared for the Phase 2 Proposal (Baffinland, 2018).

This addendum includes the following information:

- Section 2 - TRCs and related feedback during technical meetings addressed in this addendum.
- Section 3 - Updated assessment of cumulative effects on caribou that addresses the GN's TRCs summarized in Section 2.1.
- Section 4 - Updated assessment of cumulative effects on marine mammals, based on a more detailed forecast of vessel traffic.
- Section 5 - Updated Project assessment and cumulative effects assessment of impacts on the visitor wilderness experience, in response to Parks Canada's TRC #03.
- Section 6 - Comments on the cumulative effects of alternatives, in response to CIRNAC's TRC #18.

KP developed this CEA supplement with technical input on caribou provided by Environmental Dynamics Inc. (EDI) and technical input to the marine mammal assessment provided by Golder Associates Ltd. (Golder).

During the June 2019 NIRB technical meeting, Baffinland acknowledged comments from the Qikiqtani Inuit Association (QIA) on the assessment of cumulative effects on Culture, Resources and Land Use (CRLU). Cumulative effects on CRLU are being reconsidered separately as part of an updated assessment of Project effects on CRLU.

2.0 TECHNICAL REVIEW COMMENTS

2.1 GOVERNMENT OF NUNAVUT REVIEW COMMENTS

The GN submitted three TRCs regarding the CEA, the recommendations of which are included below.

TRC#14: Caribou Habitat Loss

The GN offers the following recommendations to the Board to assist with the disposition of this issue:

1. *The Proponent should revise the effects assessment for loss of habitat on caribou winter range to a level III effect for magnitude. The Proponent should provide a revised significance determination;*
2. *The Proponent should provide an explanation with respect to how each of the residual effect evaluation criteria were applied to derive the significance determination for loss of caribou habitat. The Proponent should explain how the various criteria were weighted and a rationale for this weighting should be provided. The Proponent should use the revised significance determination requested in recommendation #1 in this technical review comment as an example;*
3. *The Proponent should address uncertainty regarding the Project's Zone-of-Influence (and resulting habitat loss) through effects monitoring, should the Project proceed. As recommended elsewhere in this submission (GN TRC #08), the Proponent should revise the Project's Terrestrial Environment Mitigation and Monitoring Plan (TEMMP. TSD 28, Appendix U) to support effective monitoring of caribou movements and estimation of ZOI; and*
4. *The Proponent should revise the Terrestrial Environment Mitigation and Monitoring Plan (TEMMP. TSD 28, Appendix U) to include a program to measure habitat loss (direct and indirect) relative to the thresholds applied in the effects assessment, as presented in table 7 (TSD 10). This will permit testing of FEIS Addendum predictions and facilitate on-going adaptive management.*

TRC#15: Caribou Habitat

5. *The Proponent should revise the CEA presented in the FEIS Addendum to provide quantitative estimates of cumulative caribou habitat loss for 'existing' and 'reasonably foreseeable' development scenarios. These estimates should be derived following the same methodology used in the FEIS Addendum for estimating direct and indirect loss of caribou habitat associated with the proposed project itself (TSD 10, Section 3.3.1).*
6. *The CEA should include direct and indirect losses of caribou habitat associated with all sites of exploration, mine development and operation within the regional study area and seasonal ranges for caribou. Helicopter flight corridors, and other transport corridors (i.e. rail or road) that might be necessary to access these sites, should be included. Other sites of human activity including communities should be included. Direct losses as well as indirect loss of habitat associated with changes in habitat quality and/or sensory disturbance should be accounted for in the analyses.*
7. *The Proponent should provide maps and tables showing the sites and activities included in the existing and future CEA scenarios including the zone-of-influence for each site and activity that is used in the CEA analyses.*
8. *The Proponent should provide estimates of cumulative caribou habitat loss in the same format as Table 8 (TSD 10).*

TRC#26: Cumulative Effects, Development

1. *The Proponent should update its CEA to include its plans for potential future development.*

GN provided additional comments on the CEA for caribou during the Nunavut Impact Review Board's (NIRB's) June 2019 Technical Meeting in Iqaluit:

- **Additional Projects and Activities to Consider -** Include Baffinland-related helicopter overflights <300 metres above ground level (magl) located outside of existing ZOIs as existing disturbances with reasonable habitat disturbance coefficients; consider exploration activities at Deposits No. 6 to 11 as part of the future development scenario in the CEA.
- **Disturbance Coefficients -** Adjust the disturbance coefficients (DCs) assigned to the ports (Milne and Steensby) and municipalities.
- **Sensitivity Analysis -** Include a sensitivity analysis of cumulative impacts by providing under- and over-estimates of potential disturbance associated with anthropogenic disturbances.

Regarding adjustments to DCs, the GN requested that:

- While the ZOI of 15 km for a community may be appropriate, the DCs applied should be greater than those for the Mine Site (which they acknowledge would do everything possible to protect caribou).
- Greater DCs be applied to the port sites than are currently being applied (in the Phase 2 assessment they were equivalent to the transportation corridor DCs).

In response, the Baffinland EIS team suggested that the extent of the ZOI along the transportation corridor should be reduced from 14 km to 4 km based on literature. The GN (S. Atkinson) preferred that the ZOI remain as is and the DCs be adjusted for the ports. They additionally asked that we apply a ZOI (S. Atkinson mentioned 1 or 2 km) and a DC (S. Atkinson mentioned "…certainly not a 95% reduction, but something") be applied to helicopter overflights as an existing disturbance.

The GN stated that there is little scientific support to justify specific habitat DCs, particularly for helicopter overflights and port activities. While they made no particular suggestions on DCs (except that they do not expect helicopter overflights to be a 95% reduction), they did suggest that the DC for a community should be greater than that of the Mine Site, and that the DC applied at the ports is likely greater than that of the transportation corridor.

The GN further suggested that the northern transportation corridor (a combination of road and rail) should be greater than the southern transportation corridor. However, since the southern transportation corridor also includes a combination service road and rail, the DCs associated with the transportation corridors will remain as is. The port DCs will be adjusted to reflect a site-specific level of near continual disturbance and human presence.

The GN's comments are addressed in Section 3.

2.2 PARKS CANADA REVIEW COMMENT

Parks Canada submitted one TRC relating to the CEA (Parks Canada, 2019).

TRC #03: Effects related to potential impacts on visitor experience and public safety

> *Please describe shipping related effects of the Phase 2 Proposal, both cumulative and project related, in relation to effects to public/visitor safety and visitor experience (e.g.: quietness and solitude, experiencing marine mammals in a pristine environment), using:*
>
> - *Accurate information concerning the number of vessels involved in Phase 2 shipping. Note that when considering project shipping cumulatively with other shipping, project shipping must include ice breaker, ore, freight, and fuel vessels*
> - *Information about the proposed increase in project shipping and the proposed increased in project flights*
> - *Information related to recreational vessels, in addition to military and government icebreaking exercises, and Baffinland and other project shipping.*

An updated assessment of cumulative effects on marine mammals based on the updated shipping information is provided in Section 4. Parks Canada's comments are addressed in Section 5.

2.3 CIRNAC REVIEW COMMENT

CIRNAC (2019) submitted one TRC related to the CEA for which Baffinland committed to a response.

TRC #18: Cumulative Effects Assessment in Alternatives Assessment

> *CIRNAC recommends that information be provided on potential cumulative effects for each of the project alternatives that are discussed (i.e., Shipping Season Alternatives, Northern Shipping Route Options, Trans-shipping, Transportation of Ore to Milne Port, Rail Alignment, Location of Second Ore Dock, and Renewable Energy Sources), specifically with respect to marine ecosystems and Inuit harvesting. Alternatively, if the cumulative effects assessment of alternatives is found elsewhere, direct the reader to that location.*
>
> *For those project alternatives that will not impact marine ecosystems, a simple statement regarding the inapplicability of cumulative effects assessment will suffice.*

Baffinland discussed this comment with CIRNAC prior to the April 2019 technical meetings. CIRNAC was satisfied with the response and requested that Baffinland integrate and elaborate on the discussion in this CEA Addendum.

2.4 ADDRESSING THE TECHNICAL REVIEW COMMENTS

These TRCs have been addressed by presenting updates to the terrestrial wildlife and marine mammal portions of the CEA in Sections 3 and 4, respectively. An assessment of the impacts of Phase 2 shipping on the visitor experience of tourists is provided in Section 5. A discussion on the assessment of the cumulative effects of project alternatives is provided in Section 6.

3.0 UPDATED CARIBOU ASSESSMENT

3.1 HELICOPTER OVERFLIGHTS

3.1.1 Baffinland's Regional Exploration Activities

Baffinland has been undertaking regional exploration activities within the mineral claim blocks seasonally (approximately May to September) since 2013. Exploration activities involved geological mapping, airborne and ground-based geophysical surveys and surface sampling but no drilling. These exploration programs involve the use of helicopter to move small exploration crews to undertake mapping and sampling. At present, Baffinland is the only company conducting helicopter-supported mineral exploration on northern Baffin Island. In addition to supporting regional exploration, Baffinland uses helicopters in environmental monitoring programs.

Regional exploration is supported by multiple helicopter overflights. Helicopter disturbance is a concern to wildlife and staging waterfowl, and requirements to minimize helicopter disturbance are outlined in the Project Conditions. The helicopter contractor provides monthly flight tracklog data and daily pilot timesheets. Data from helicopter flights logs are analyzed to assess compliance with conditions of Project Certificate No. 005, and the results are presented in Baffinland's annual reports to the NIRB. Flight height data points were designated "compliant" when elevation requirements of a minimum flight altitude of 610 m and a minimum flight altitude of 1,100 m over the Snow Goose Management Area for the months of July and August were achieved, or where pilot's discretionary rationale for deviating from flight heights was provided. Data points were designated "non-compliant" if they did not meet elevation requirements, and no explanation was given. Flights were compliant 98.7 % of the time and non-compliant 1.3% of the time during 2018 although most flights were below the minimum flight altitude (Baffinland, 2019).

The helicopter flight data show a large volume of flights between the Mine Site and Baffinland's Eqe Bay Exploration Program approximately 200 km to the south of the Mine Site. In 2018 and into 2019, Baffinland sought and received approval to establish an exploration camp and conduct exploration drilling at the Eqe Bay Prospect. The plan is to access the future exploration camp at Eqe Bay from Iqaluit or Hall Beach, as accessing the Eqe Bay Exploration Area from the Mine Site (a 200 km distance) is costly. Therefore, flights between Eqe Bay and the Mine Site are not expected to continue, and therefore have not been assessed for cumulative effects.

3.1.2 Disturbance Studies

Some studies have been conducted on the responses of caribou to aerial overflights. However, the significance of those responses (e.g., physiological impacts) on caribou is still not determined, and there is very little evidence to support a quantifiable measure of the impact of helicopter overflights.

Calef et al. (1976) observed barren-ground caribou in Yukon and Alaska and noted strong escape reactions in any group size when flights were less than 60 magl. No panic or strong escape responses were observed when aircraft were flying >150 magl during spring and fall migrations.

Surrendi and DeBock (1976) studied the response to helicopter overflights by caribou from the Porcupine herd (Alaska/Yukon). No escape response occurred when helicopters were >240 m elevation (presumed magl). Distance from caribou was mentioned as a factor when a change in behaviour took place, but no quantitative data were provided.

Miller and Gunn (1979) studied the response of Peary caribou and muskoxen to helicopter overflights on the Arctic Islands of Canada. The study focused on overflights (vertical distance) and did not provide information on the horizontal distance at which caribou first showed a response to approaching aircraft. The distance from approaching helicopters when caribou first responded was categorized, but the distances were not recorded explicitly in the paper. Caribou responses to aircraft landings and ascents were studied, with caribou responses being variable. Simulated work parties landing may not have elicited caribou response >200 m from aircraft. Some caribou approached the helicopter within 5–100 m after shutdown and crews were present on the ground for several minutes. *"Our observations suggest that some percentages of any helicopter overflights at <400 magl and greater percentages at <200 magl will cause harassment to both Peary caribou and muskoxen.* ***The short-term costs to individuals and the long-term impact on populations are not known."*** The only horizontal guideline to minimize disturbance to caribou was to land helicopters no less than 1,000 m (or further) away from animals. There was no quantification for the duration of caribou being visibly disturbed after the start of a disturbance event.

Gunn et al. (1985) reported on helicopter overflights >300 magl, and landings between 300 and 2,200 m from post-calving caribou from the Beverly herd (mainland Nunavut). Responses were observed with landings up to 2,200 m away (including caribou approaching the landing aircraft), but results are inconclusive due to the sample size and a need to revise the study design. Caribou groups were frequently spread over 200–300 m.

Harrington and Veitch (1991, 1992) studied woodland caribou in Labrador and low level (<30 magl) jet overflights. They made some suggestion of calving effects, but no data or statistical analysis was presented.

In summary, no information was found regarding caribou tolerance/avoidance of overflight frequency, the distance at which caribou first respond to horizontal distance, how long caribou were disturbed after a disturbance event, and ultimately whether the overflights had an adverse impact on individuals or populations.

3.1.3 Corridors

Sixteen distinct helicopter flight corridors were identified by visually analyzing flight line data from 2015-2018. The frequency of use varies by year for many of the corridors (Figure 1). To determine what a ZOI may be for helicopter overflights, the centreline of the corridors was buffered by 1 km on each side (i.e., a total 2 km wide ZOI) to represent the potential ZOI of the most frequently used travel routes by helicopters in the project area. The 1 km buffer ZOI was selected as an area within which caribou may become disturbed by helicopters flying < 300 magl based on Miller and Gunn's (1979) landing distance of 1,000 m or more to avoid disturbance to caribou. The helicopter ZOI applies to areas outside of existing ZOIs previously identified for project effects assessment.

3.1.4 Disturbance Coefficient

To characterize the potential disturbance associated with a helicopter corridor and define a DC to apply to the helicopter ZOI, a caribou's potential exposure to frequency and duration of helicopter disturbance was characterized.

The frequency of flights within each corridor was determined by intersecting the helicopter flight data for each year with the flight corridors. Although the 2015 flight data were used to identify flight corridors, upon further inspection, errors were found in those data and they were excluded from further analysis. Further data processing was done to determine the number of flights with flight elevations <300 magl (the elevation

at which caribou may be disturbed by overhead flights). This processing involved splitting the flight lines into segments based on the associated GPS point data for each flight. The GPS data were queried to select only points with flight elevations <300 magl. Those points were joined to the intersecting flight line segment to transfer the attributes of the GPS point to the flight line segment. These segments were then intersected with the flight corridors to calculate the number of flights <300 magl for each corridor, by year.

A caribou's potential exposure to helicopter overflights along the individual corridors varies considerably, from 0.01 (Corridor A) to 1.25 flights per day (Corridor M) depending on route and year (Table 1). No helicopters are present on the site during the winter, so no helicopter overflight disturbance occurs to winter habitat.

If a helicopter travels at an average speed of ~160 km/hr (calculated from existing data), a caribou would experience disturbance from a helicopter overflight within a 1 km radius for 45 seconds. Assuming all trips are round trips, caribou could experience, on average, a maximum total disturbance up to 1.5 minutes per day. Averaged over the season, if a caribou were to be immobile in the busiest flight corridor (Corridor M from Milne Port to Bruce Head), that caribou would experience overhead flight disturbance for 210 minutes over a 140-day period in 2018 (0.1% of the 140 days exposed to overhead flight disturbance).

As noted above, it is not clear what impact an overflight disturbance creates other than strong escape responses when flights were <60 magl as the most extreme behaviour (Calef et al., 1976), and that the effects on the individual or the population are not understood (Miller and Gunn, 1979). No evidence was found in the literature that suggests a quantifiable DC that could be applied to this assessment.

However, considering community concerns about disturbance to caribou from helicopter overflights and requests from the GN to include overflights in the CEA, a DC is applied nonetheless. Considering community concern balanced by: 1) the extremely low proportion of time that caribou are exposed to helicopter overflights, even in the busiest corridor, 2) the complete reversibility of the disturbance, and 3) the uncertainty of whether the behavioural responses actually have an impact on individuals or populations, a DC of **0.9** (i.e., a 10% habitat effect) was used for this assessment.

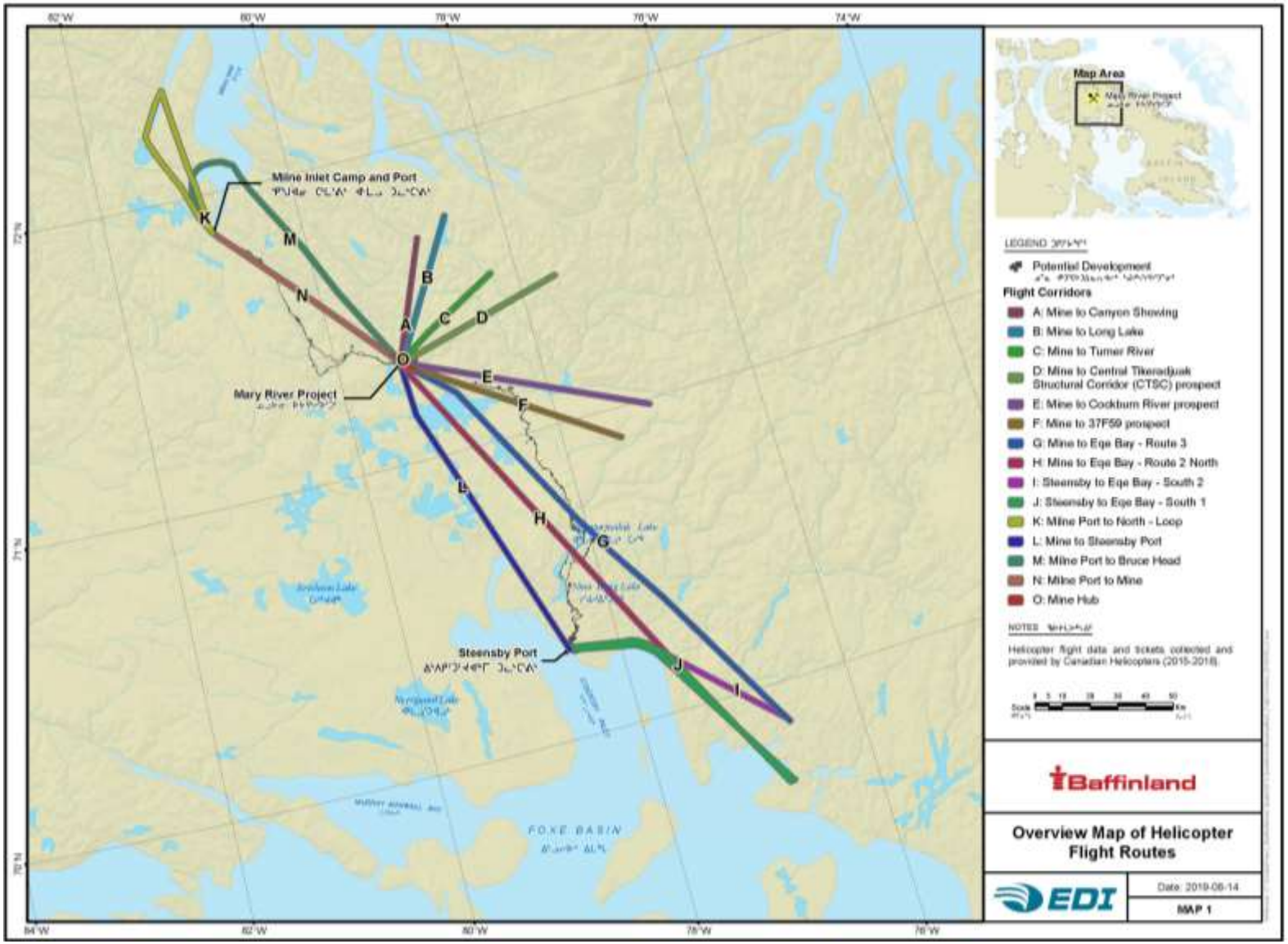

Figure 1 Overview Map of Helicopter Flight Routes

Table 1 Project Flight Corridors and Number of Flights <300 magl, 2016-2018

Corridor	Overhead Flights/Day <300 magl		
	2016	2017	2018
A: Mine to Canyon Showing	0.02	0.01	0.01
B: Mine to Long Lake	0.04	0.01	0.04
C: Mine to Turner River	0.25	0.02	0.04
D: Mine to Central Tikeradjuak Structural Corridor (CTSC) prospect	0.03	0.03	0.01
E: Mine to Cockburn River prospect	0.09	0.04	0.06
F: Mine to 37F59 prospect	0.11	0.19	0.01
G: Mine to Eqe Bay - Route 3	0.03	0.04	0.78
H: Mine to Eqe Bay - Route 2 North	0.08	0.19	0.30
I: Steensby to Eqe Bay - South 2	0.07	0.05	0.55
J: Steensby to Eqe Bay - South 1	0.42	0.54	0.94
K: Milne Port to North – Loop	0.08	0.71	0.50
L: Mine to Steensby Port	0.34	0.76	0.70
M: Milne Port to Bruce Head	0.62	1.25	0.27

3.2 FUTURE DEVELOPMENT SCENARIO

In the EIS Guidelines, NIRB (2015) instructed Baffinland to consider potential future development of the Mary River Project in its CEA. CEAs consider past, present or reasonably foreseeable projects and activities, and future Project development does not qualify as a reasonably foreseeable project or activity:

> ***Reasonably foreseeable future developments:*** *Projects or activities that are currently under regulatory review or that will be submitted for regulatory review in the near future, as determined by the existence of a proposed project description, letter of intent, or any regulatory application filed with an authorizing agency* (NIRB, 2015).

Nonetheless, Baffinland developed a future development scenario for consideration in the CEA.

Baffinland has identified 11 iron ore deposits to date (Figure 2). While surface exploration and in some cases limited drilling has identified several promising iron ore deposits, no other mineral resource estimates have been developed. Mineral resource estimates are required before engineering feasibility studies can be undertaken, and such feasibility studies would define the what, how and when in terms of a mine plan and transportation facilities. The EIS Guidelines clearly defines what a reasonably foreseeable project is, and Baffinland's additional iron ore deposits do not meet any of the criteria.

Deposits No. 2 and 3 are located within the Mary River watershed upstream of Deposit No. 1. Given the proximity of these deposits to mining infrastructure of Deposit No. 1, these deposits are the most likely to be mined next, based on current information. Limited additional infrastructure would be required to mine these deposits. The Mine Site Project Development Area (PDA) would expand to incorporate the footprint of the open pits and the associated waste rock stockpiles.

Limited additional infrastructure would be required if these deposits were mined subsequent to mining Deposit No. 1, beyond a new haul road and/or conveyor to move ore from these deposits to the crusher and stockpiling area within the current Mine Site. Other than the expanded PDA, limited modifications to existing facilities would be required.

These deposits could also be mined concurrent with Deposit No. 1 under an increased production rate scenario with modest additional infrastructure. Existing material handling and transportation infrastructure would need to be upsized to account for handling a larger quantity of ore. This would potentially include upsizing crushers, conveyors, stockpile areas, and increasing the number of rail cars transporting ore to one or both ports. Additional vessel traffic would be needed to ship the increased volume of ore to market. Ore shipment via both Milne Port and Steensby Port would continue.

Drilling at Deposits No. 4 and 5 commenced in 2010 but remains preliminary. Based upon their proximity to existing and Phase 2 Proposal infrastructure, it is reasonable to assume in the absence of a mineral reserve estimates that development of one or both deposits could occur. Ore from these deposits could be transported to Milne Port over the Milne Inlet Tote Road, which is close by, or with the North Railway in place, approximately 6 km and 3 km long railway spurs would be required to connect to the two deposits. Unlike Deposits No. 2 and 3, Deposits No. 4 and 5 would require dedicated ore stockpiling, crushing and rail loading facilities and would likely need to be supported by a separate camp. The development of these two deposits would extend the useful life of the infrastructure constructed for the exploitation of Deposit No. 1. Upsizing of material handling facilities would also be required at the railway (i.e., more rail cars) and at Milne Port.

Other deposits (Deposits No. 6 through 11) were discovered in 2010 and have been sampled at surface only (Figure 2). These deposits are located tens of kilometres (up to 50 km) from the Mine Site and either railway. While these deposits do represent potential development opportunities, more exploration work is required to prove these deposits, and more infrastructure would also be required to develop any of these deposits.

The GN requested Baffinland to consider incorporating exploration of Deposits No. 6 to 11 into the future development scenario in the CEA. The future development scenario adopted by Baffinland ambitiously considers the exploration and development of all of four additional deposits (Deposits No. 2 to 5) within the temporal boundaries of the assessment. If this future development scenario was actually realized, it is unlikely that any exploration would occur on any of the other deposits (Deposits No. 6 to 11) over the temporal scale of this CEA. Thus, exploration of these additional deposits has not been considered.

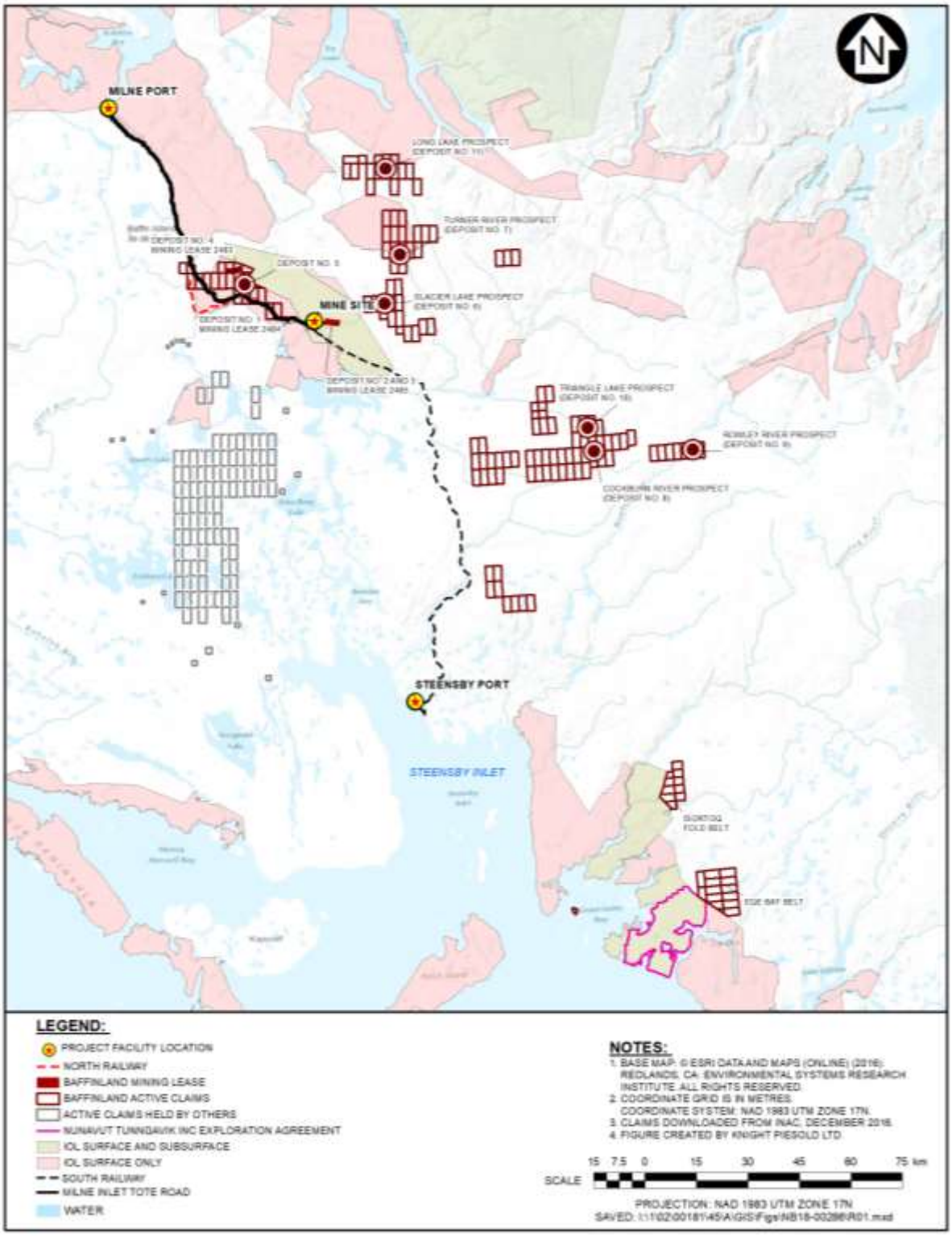

Figure 2 Mineral Leases and Claims in the Vicinity of the Project

The additional PDA that would result from this future development scenario is provided in Table 2 and shown on Figure 3.

Table 2 Increased Project Development Area from Future Development Scenario

Project Component	Phase 2 Proposal PDA (ha)	Doubling of Production PDA (ha)
Milne Port (land)	340	340
Milne Port (water)	36	36
Tote Road	865	865
North Railway	1,384	1,384
Mine Site	2,740	2,740
South Railway	2,722	2,722
Steensby Port	2,482	2,482
Deposits No. 2 and 3	n/a	1,960
Deposits No. 4 and 5	n/a	2,100
Total	**10,569**	**14,629**

Development of Deposits No. 2 and 3 would increase the total PDA area by roughly 18.5%, and development of Deposits No. 4 and 5 would increase the total PDA area by another roughly 20% over the PDA for the Phase 2 Proposal. Developing all these deposits (Deposits No. 2 through 5) would increase the PDA by approximately 38.5%. This provides a rough approximation of the potential vegetation and wildlife habitat losses that may be incurred from such future developments.

An increase in ore shipments to 24 Mtpa through Milne Port would require an extension of the shipping season along the Northern shipping route and associated icebreaking activities. Baffinland recognizes that extending the Milne Port shipping window through the winter months would require continued consultation with the North Baffin communities, as well as an amendment to the North Baffin Region Land Use Plan (NBRLUP; Nunavut Planning Commission 2000), but it must be assessed as part of the future development scenario.

This development scenario is entirely speculative and does not qualify as a reasonably foreseeable project. Consideration of this future development scenario, therefore, is entirely hypothetical.

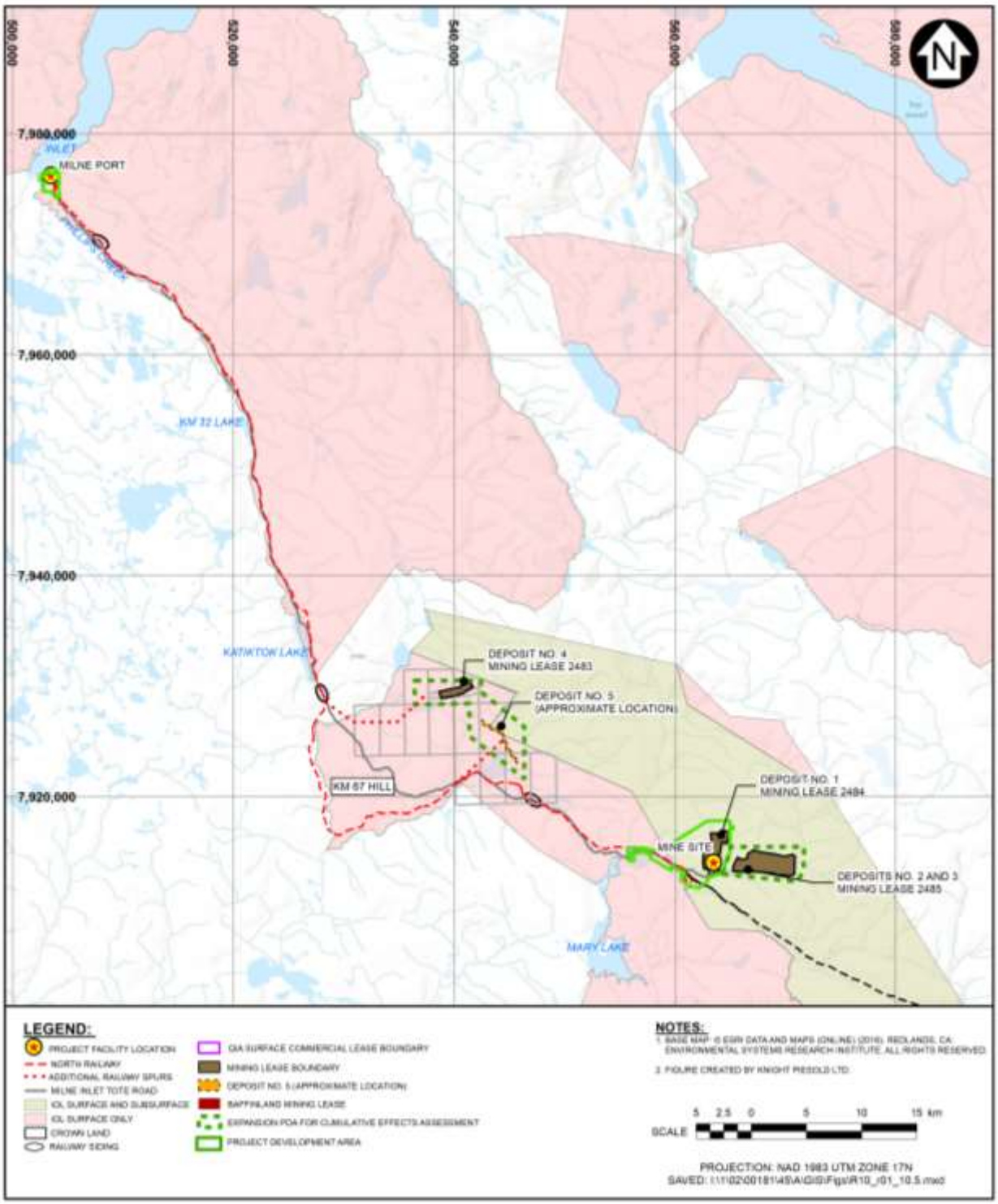

Figure 3 Future Development Scenario

3.3 CUMULATIVE EFFECTS TO TERRESTRIAL WILDLIFE AND HABITAT

The Projects and activities that have the potential to act cumulatively with the effects of the Phase 2 Proposal on terrestrial wildlife and habitat include:

- Mary River Project definition phase
- Regional exploration
- Regional air transport
- Communities and traditional or recreational land use
- Regional monitoring programs
- Climate change
- Potential future development scenario

With respect to incorporating helicopter flight corridors in the CEA, flights between the Mine Site and Eqe Bay are also not expected to continue with the establishment of an exploration camp at Eqe Bay. Most of the Mary River Project helicopter traffic is captured within the zone of influence (ZOI) of the Phase 2 Proposal and future development scenario. Helicopter traffic not captured by existing ZOIs is challenging to incorporate into an assessment, as the nature of helicopter disturbance outside of the Project ZOI is both transient and infrequent. For this reason, helicopter flights outside of the ZOI have not been accounted for in the cumulative habitat loss or disturbance footprint.

As described for vegetation, most of the above activities are minor contributors to habitat loss and/or sensory disturbance to terrestrial wildlife within the Terrestrial Regional Study Area (TRSA) or the range of North Baffin caribou. The exceptions include the harvesting of wildlife by communities, which though important to community food security and cultural well-being, results in mortalities that may have the potential to affect caribou at the population level. With respect to the harvesting of caribou, the GN implemented an interim moratorium on caribou harvest on January 1, 2015 followed by a total allowable harvest of 250 male caribou for Baffin Island (Government of Nunavut, 2014 and 2015) due to the very low population estimate derived from an island-wide aerial survey in 2014. This measure, while the caribou population remains low, will moderate harvesting impacts.

Climate change may have a disruptive effect for many wildlife species on northern Baffin Island. Effects on wildlife species population parameters such as survival, fecundity, abundance and distribution are likely, but difficult to predict as either positive or negative effects. Changes in environmental processes as a result of climate change will occur independently of the Phase 2 Proposal. Therefore, potential interactions of climate change with the Project and their effects on wildlife are likely not directly measurable within the life of the Project on Baffin Island (Government of Nunavut, 2014 and 2015).

Based on comments from the Government of Nunavut during the technical review of the Phase 2 Proposal (GN-TCR-18) (Government of Nunavut, 2019), the CEA for caribou habitat was revised to reflect existing and reasonably foreseeable development on seasonal habitat within the northern Baffin Caribou Range (NBCR). Future development was considered in the CEA at the request of NIRB, noting it does not meet NIRB's definition of reasonably foreseeable project.

3.3.1 Adjustments to Port and Municipality Disturbance Coefficients

No known studies or publications were found on caribou response to an Arctic port site. However, the terrestrial activities (e.g., continually moving truck traffic, active conveyors, future crushing) are similar to, yet likely less intense than, those observed at the Mine Site. Based on discussion with the GN's technical

advisor during the technical review of the Phase 2 Proposal, it was agreed that the DCs for the port should be different than those used for the transportation corridors (as was presented in TSD-10). Therefore, after consultation with the GN's technical advisor, there was agreement that DCs are likely less than those associated with the mine site, but more than those associated with the northern transportation corridor. Therefore, partially based on literature from measured disturbances from mine and road activities, revised DCs are identified in Table 3.

Table 3 Revised Reasonable DCs Used to Reduce RSPF Habitat Model Values

Project Area	Zone of Influence (ZOI)	Seasonal Habitat Disturbance Coefficient	Calving season Disturbance Coefficient	Subspecies or Herd	Source of Information
All	PDA	0.00	0.00	na	na
Milne Port, Steensby Port	>PDA–2.0 km	0.30	0.15	na	No source. DC estimate is a balance between disturbance coefficients at mine (which the GN does not disagree with) and disturbance coefficients from the transportation corridor.
	>2.0–4.0 km	0.60	0.30		
	>4.0–14.0 km	0.90	0.45		
Northern and Southern Transportation Corridor	>PDA–2.0 km	0.25	0.125	Central Arctic herd (Alaska), woodland (Alberta)	Cameron et al. 1992, Dyer et al. 2001
	>2.0–4.0 km	0.75	0.375	Woodland (Newfoundland), central Arctic herd, reindeer (Norway)	Weir et al. 2007; Cameron et al. 2005; Vistnes and Nellemann, 2008
	>4.0–14.0 km	0.90	0.45	Woodland (Ontario)	Vors et al. 2007; Mayor et al. 2007, 2009
Mine Site	>PDA–3.5 km	0.30	0.15	Bathurst herd	Boulanger et al. 2012
	>3.5–7.0 km	0.40	0.20	Bathurst herd	Boulanger et al. 2012
	>7.0–10.5 km	0.60	0.30	Bathurst herd	Boulanger et al. 2012
	>10.5–14 km	0.80	0.40	Bathurst herd	Boulanger et al. 2012
All	>14.0 km	1.00	1.00	na	Vors et al. 2007; Mayor et al. 2007, 2009; Boulanger et al. 2012

NOTES:

1. PDA = POTENTIAL DEVELOPMENT AREA.
2. RSPF = RESOURCE SELECTION PROBABILITY FUNCTION.
3. VALUES IN BLUE TEXT (PORT SITES) ARE REVISED FROM WHAT WAS PRESENTED IN THE FEIS, ERP, AND SUBMISSION 2 OF THE PHASE 2 PROJECT PROPOSAL TO ADDRESS SUGGESTIONS FROM THE GOVERNMENT OF NUNAVUT TO ADJUST VALUES FOR PORT SITE DISTURBANCE COEFFICIENTS TO REFLECT GREATER HABITAT DISTURBANCE THAN MAY BE OBSERVED FROM THE TRANSPORTATION CORRIDORS.
4. THIS TABLE (WITH REVISED DISTURBANCE COEFFICIENTS FOR THE PORT SITES) REPLACES TABLE 5 OF TSD-10.

As requested by the GN, to address any uncertainty around those values, a range of possible DCs for the ports (and other anthropogenic disturbances) are considered as discussed in the Habitat Impact Sensitivity Analysis section.

The DC associated with municipalities was increased in ZOI range 2 to reflect a greater disturbance to caribou habitat and is summarized in the Habitat Impact Sensitivity Analysis section.

3.3.2 Habitat Impact Sensitivity Analysis

The GN requested that Baffinland perform a "sensitivity" analysis of the selected DCs by presenting upper and lower limits to address uncertainty about the disturbance. The GN did not provide specific values but stated that the GN would like to see an example of a more extreme and less extreme value associated with DCs (other than the Mine Site, which they agreed appropriately quantified disturbance).

The bounds of the ZOI are the basis for the DCs described in Table 4 (updated to include a helicopter overflight ZOI). The DCs applied within the variable ZOIs are summarized in Table 5 to address the GN's requests to include them for helicopter overflights, increase the effect for port sites (relative to the transportation corridor), and to increase the effect of municipalities.

3.3.3 Reasonable, Underestimate and Overestimate Analysis

To address the GN's uncertainty about DCs used as a measure of disturbance to habitat effects, the GN's technical advisor requested that a range of DCs be considered as a form of a "sensitivity" analysis. Nunavut Tunngavik Inc.'s (NTI's) wildlife biologist in the Technical Meeting II also suggested that a sensitivity analysis would be informative. This analysis provides a range of possible habitat impacts, ranging from a potential underestimate to a likely overestimate of habitat loss and reduced habitat effectiveness.

The GN's technical advisor did not suggest specific values for the sensitivity analysis. Therefore, Baffinland suggests a Reasonable Scenario based on literature or precedents set in other Arctic mining projects that have been reviewed through the NIRB or Mackenzie Valley Environmental Impact Review Board (MVEIRB) processes (i.e., the DCs presented in Table 5), a possible underestimate that uses coefficients 25% less than the "Reasonable" scenario, and a possible overestimate that is 25% more than the "Reasonable" Scenario.

- **Possible Underestimate -** 25% less disturbance than the reasonable scenario. In absence of further direction from the requesting party (GN), this approximation is based on the GN's requested "sensitivity" analysis for the railway embankment where they required a -25% consideration of a 2-m embankment height as a potential barrier to caribou movement.
- **Reasonable -** Based on approximation from literature, ongoing monitoring of caribou response at similar projects, or precedents used for other mining project environmental assessments, e.g., AREVA Kiggavik, Agnico Eagle Meliadine and Whale Tail, Sabina Back River, TMAC Boston-Madrid, Baffinland FEIS and ERP, Dominion Diamond Ekati and Jay Pipe expansion).
- **Possible Overestimate -** 25% more disturbance than the reasonable scenario (based on the same reasoning used for the Possible Underestimate).

Table 4 Hypothetical ZOIs for Development Activities in the North Baffin Caribou Range

Disturbance Activity	ZOI (km)	Published Literature	Similar Environmental Assessments	Notes
Municipalities (Polygon)	15	Hypothetical **1,000 m** (Johnson et al. 2005), but no disturbance coefficients identified.	Meliadine FEIS (Agnico Eagle Mines and Golder Associates Ltd. 2014) and Gahcho Kué (De Beers Canada Inc. 2010) used a 15 km extent with variable disturbance coefficients from 0.05 to 0.75.	Presume community ZOI is extensive due to likely greater harvest pressure and other land uses (e.g., traffic, noise). Use ZOI like other likely high disturbance activities; extend to 15 km, precedent set for Meliadine FEIS.
All Season Roads (ASR), Winter Road (WR)	4 (ASR), 0.2 (WR)	4 km (Vistnes and Nellemann 2001, Nellemann et al. 2003, Weir et al. 2007; Hypothetical 95% (i.e., DC = 0.05) reduction with 1 km radius of operating mine road (Misery road, Johnson et al. 2005); Abundance of calving caribou less than expected within 4 km of a road Cameron et al. 2005).	Hypothetical: All weather construction: 4 km radius (Rescan 2013); All weather operations: 1.5 km (Rescan 2013); Winter Road: 200 m (Rescan 2013); ZOI extended to 5 km for the Meliadine Project (Agnico Eagle Mines and Golder Associates Ltd. 2014) and the Gahcho Kué Project (De Beers Canada Inc. 2010) with variable disturbance coefficients from 0.05 to 0.75.	
Exploration (Point or Polygon)	5	Mineral exploration sites affected a *hypothetical* 50% reduction [i.e., DC = 0.5] in the value of habitats found within a 10 km radius of the assumed development site, and a 25% reduction [i.e., DC = 0.75] within a 5 km zone around that buffered area [total 15 km] (Johnson et al. 2005, pg. 16).	For the Meliadine and Gahcho Kué Project assessments, exploration projects were assumed to have a 500 m radius footprint (De Beers Canada Inc. 2010, Agnico Eagle Mines and Golder Associates Ltd. 2014). Also, for both projects, a 5 km ZOI was applied to all active exploration permits for the entire five-year period, and over the entire year.	The cumulative effects assessment for the Back River Project did not include exploration projects as disturbance activities. An internal review conducted by Areva (unpublished data) showed that exploration footprints likely to represent a 7.4 ha area (~154 m radius).

Disturbance Activity	ZOI (km)	Published Literature	Similar Environmental Assessments	Notes
Mining (Polygon or Point)	14	Observed lower probability of occurrence of caribou within 6–14 km around combined mines and road in some, but not all years (some years no ZOI was observed; Boulanger et al., 2012). Hypothetical (not modelled) 15 km ZOI (Johnson et al. 2005). Caribou numbers decreased within 6 km of mine centre in late winter through calving seasons (Weir et al., 2007).	The Back River Project considered two ZOIs at 4 km and 14 km (Rescan, 2013). The Meliadine Project considered a three ZOI range with variable disturbance coefficients 0-1, 1 to 5, 5 to 14 based on Boulanger (2012) (Agnico Eagle Mines and Golder, 2014). The Gahcho Kué Project assumed a 15 km ZOI was applied to all active mine sites regardless of the size of the footprint or the level of activity for each mine (De Beers Canada Inc., 2010).	The only operating mine in the NBCR is the Approved Project.
Energy corridors Point (plant); line(transmission)	4	Transmission lines: 4 km ZOI Vistnes and Nellemann 2001, Nellemann et al. 2003).	Meliadine Agnico Eagle Mines and Golder Associates Ltd. 2014); Gahcho Kué (De Beers Canada Inc. 2010) used a 500 m radius footprint and a 1 km ZOI for power plants, and a 200 m footprint for transmission lines. A ZOI ranged from 0 to 5 km with variable disturbance coefficients from 0.05 to 0.75.	There are no energy corridors in the NBCR.
Helicopter overflights < 300 magl corridor	1	<300 m (Appendix I, North Baffin Regional Land Use Plan Nunavut Planning Commission 2000); Miller and Gunn's (1979) landing distance of 1,000 m or more to avoid disturbance to caribou as basis for 1 km buffer.	None known to have been used in impact assessment.	Helicopter overflights <300 magl considered potentially disturbing to barren ground caribou (GN, pers comm, June 2019, Department of Indian Affairs and Northern Development, 1978).
Tourism (e.g. guide and outfitting) Point	4	4 km ZOI (Vistnes and Nellemann 2001, Nellemann et al. 2003); 10% i.e., DC = 0.9) reduction in areas influenced by outfitters in a 500 m buffer (Johnson et al. 2005).	Not considered in cumulative effects for Meliadine or Back River CEAs. Gahcho Kué used a 200 m radius footprint and a 5 km radius ZOI with a DC of 0.1 (De Beers Canada Inc. 2010).	Accounts for seasonality and presumed quota (i.e., managed) harvest around outfitter camps. There are no known tourism facilities in the NBCR.

Disturbance Activity	ZOI (km)	Published Literature	Similar Environmental Assessments	Notes
Traditional Harvest and Land Use	na	Johnson et al. (2005) noted specifically that they did not consider responses to subsistence harvest.	Not considered in cumulative effects for Meliadine, Gahcho Kué or Back River CEAs.	Not a spatial reference, background conditions.

NOTES:

1. ADAPTED FROM EDI-AUTHORED REVIEW USED IN THE KIGGAVIK CUMULATIVE EFFECTS ASSESSMENT (AREVA RESOURCES CANADA, 2014; RUSSELL, 2014).
2. HELICOPTER OVERFLIGHTS ARE REVISED FROM WHAT WAS PRESENTED IN THE FEIS, ERP, AND SUBMISSION 2 OF THE PHASE 2 PROJECT PROPOSAL TO ADDRESS SUGGESTIONS FROM THE GOVERNMENT OF NUNAVUT TO INCLUDE A ZOI FOR HELICOPTER OVERFLIGHTS.

3.3.4 Habitat Impact Analysis

Based on the request for a re-analysis using a range of DCs to encompass uncertainty, the habitat impact assessment was completely revised to ensure clarity and eliminate the potential for cumulative error in analysis. The habitat impact re-analysis was refreshed and re-analyzed from the base data to address the requested scenarios.

3.3.5 Methods

- A ZOI layer was created in vector format based on the Project ZOI boundaries identified in Table 3 and for non-Project disturbances identified in Table 5 (Figure 4). Overlap in ZOIs was dealt with by the greatest DC superseding lower DCs (i.e., the greatest disturbance trumps the lower disturbance).
- The ZOIs were converted to a raster format using the ESRI ARcGIS category field. This conversion allowed for a DC to be applied to the raster Resource Selection Probability Function (RSPF) habitat models. This process was replicated nine times (three for each of calving, growing and winter season models) to address the uncertainty by providing a reasonable scenario (Table 3, Table 5), as well as underestimated (+25%), and overestimate (-25%) DCs for the ZOIs.
- The impacts on the RSPF model (e.g., sum of probabilities) output for calving, winter and growing were calculated with Raster Calculator using the reasonable, underestimate, and overestimate DCs within the derived ZOIs.
- Resulting statistics tables (12) were derived to obtain values by category for each disturbance level (e.g., reasonable, underestimate, overestimate), season model and baseline model.
- The revised sum of probabilities was calculated from each table. The difference between the base model and the revised sum of probabilities is a quantification of the potential magnitude of impact.
- The values calculated (including the baseline values) replace the habitat assessment in TSD-10.
- Due to the iterative process, it is not possible to present in TSD-10 Table 8 format as requested by the GN.

3.3.6 Results

Values presented in Tables 6 and 7 are different than those found in the FEIS and TSD-10 due both to the revised DCs and a revision to the GIS analysis approach. This revision includes a calculation to subtract the effect (baseline * ZOI) from the baseline RSPF model. Previous analyses did not include that process and only used the affected values (ZOI coefficients applied), without subtracting those values from the baseline model. As a result, previous reports on impacts focused on the application of the ZOI coefficients

only and did not calculate the impact or actual change in values. To properly portray project impact, the affected model value was subtracted from the baseline model once the ZOI coefficients had been applied. By including that step to the process, values changed from previously reported versions. Effects on the calving model have increased while effects on winter and growing models decreased.

- **Project Impacts -** The re-analysis of the Approved Project's potential impacts on habitat using the revised DCs resulted in not significant impacts to calving (-3.6%), growing (-1.6%) and winter (-1.8%) habitat in the North Baffin Caribou Range (NBCR, Table 6) for the reasonable scenario.
- **Cumulative Impacts -** Incorporating existing disturbances such as municipalities, roads and helicopter overflights in the NBCR slightly increases the potential impacts to calving (-4.1%), growing (-1.8%) and winter (-1.9%) habitat in the NBCR (Table 7) for the reasonable scenario.

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Table 5 Disturbance Coefficients Applied to Human-Related Land Disturbances (ZOIs) in the North Baffin Island Caribou Range

Disturbance Type	Feature type	Footprint		ZOI Range 1		ZOI Range 2		ZOI Range 3		Notes
		Extent	DC	Range (km)	DC	Range (km)	DC	Range (km)	DC	
Municipality	Polygon	Digitized from Google Earth	0	0–1	0.05	1–5	0.25	5–15	0.75	Updated from CEA update to address GN comments that DCs of a municipality should show more disturbance than the DCs of a mine site.
All Season Roads	Polygon	Digitized from Google Earth	0	0–1	0.05	1–4	0.75	n/a	n/a	All season roads are all contained within municipal boundaries.
Summer Trail	Polygon	Digitized from Google Earth	0	0–1	0.75	n/a	n/a	n/a	n/a	There are numerous trails, including older trails associated with Nanisivik area mine that are likely used only by infrequent all terrain vehicle access. The trails with greatest impact are likely encompassed within community ZOIs. Distant trails have minor negative influence on caribou habitat.
Quarry	Polygon	Digitized from Google Earth	0	0–3	0.75	n/a	n/a	n/a	n/a	
Miscellaneous	Polygon	Digitized from Google Earth	0	n/a	n/a	n/a	n/a	n/a	n/a	Likely reclaimed quarry sites/Nanisivik mine structure footprints.
Exploration	Polygon	Polygon derived from application	0	0–5	0.5	n/a	n/a	n/a	n/a	
Helicopter overflights <300 magl	Polygon	Derived from Mary River Project Helicopter Overflight monitoring (Terrestrial Environmental Annual Monitoring Reports - various EDI)	n/a – no physical footprint exists	0–1 (i.e., within corridor)	0.90	n/a	n/a	n/a	n/a	Only occasional disturbance (e.g., 1.5 minutes per day) with no footprint impact and entirely reversible.

NOTES:

1. HELICOPTER OVERFLIGHTS ARE REVISED FROM WHAT WAS PRESENTED IN THE FEIS, ERP, AND SUBMISSION 2 OF THE PHASE 2 PROJECT PROPOSAL TO ADDRESS SUGGESTIONS FROM THE GOVERNMENT OF NUNAVUT TO INCLUDE A DISTURBANCE COEFFICIENT FOR HELICOPTER OVERFLIGHTS.

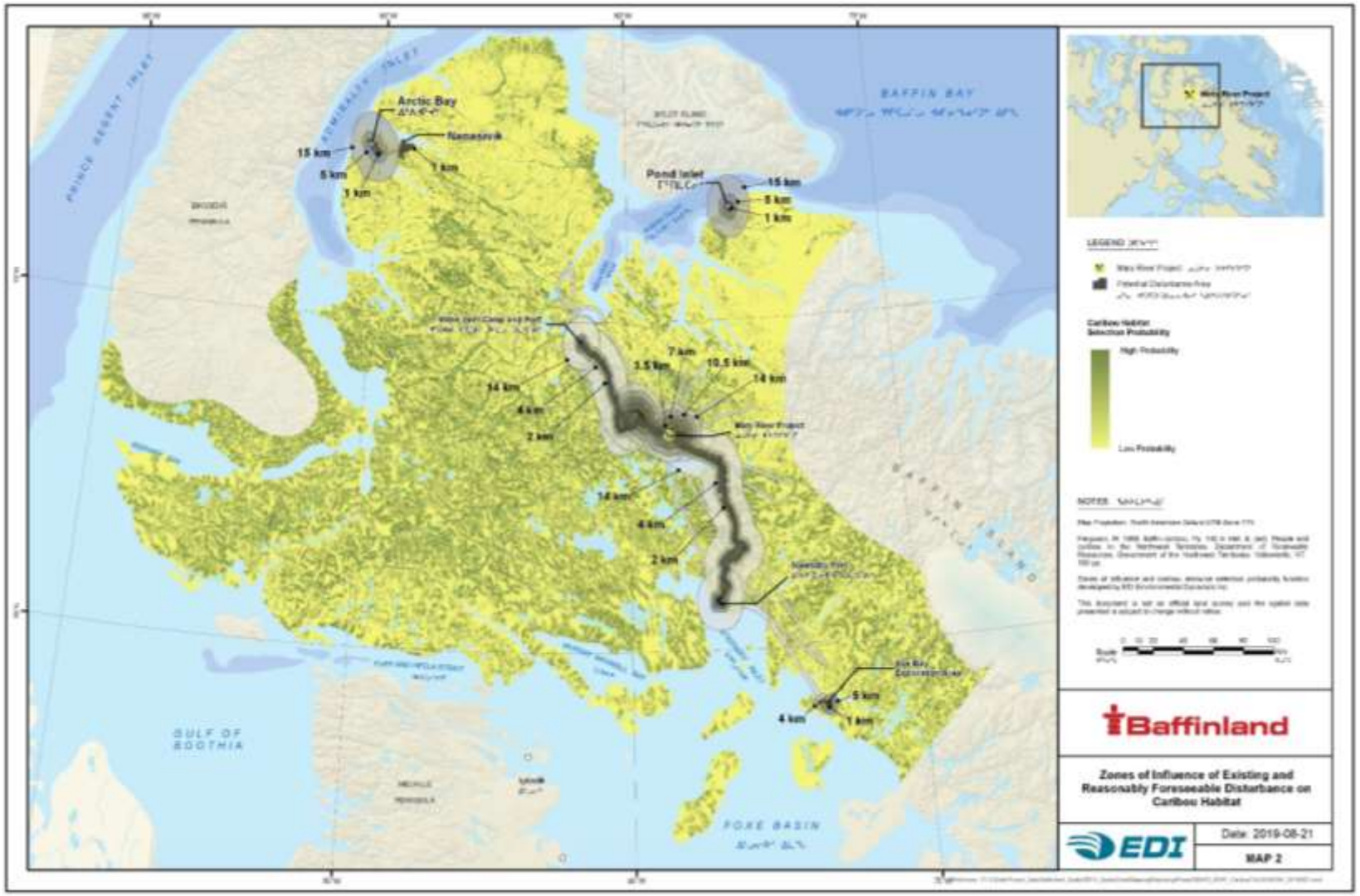

Figure 4 Zones of Influence of Existing and Reasonably Foreseeable Disturbance in Caribou Habitat

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Table 6 Re-Analysis of Project Habitat Impacts Using Suggested Revisions to the Zone of Influence DCs

Sensitivity		Calving Baseline SoP = 2,310,306						Growing Baseline SoP = 6,372,250						Winter Baseline SoP = 4,741,184					
		PDA	% NBCR	ZOI	% NBCR	PDA + ZOI	% NBCR	PDA	% NBCR	ZOI	% NBCR	PDA + ZOI	% NBCR	PDA	% NBCR	ZOI	% NBCR	PDA + ZOI	% NBCR
Underestimate	Approved Project	-2,049	-0.09	-64,758	-2.80	-66,807	-2.89	-5,249	-0.08	-58,880	-0.92	-64,129	-1.01	-4,611	-0.10	-48,033	-1.01	-52,644	-1.11
	Phase 2 Additions	-372	-0.02	-5,772	-0.25	-6,144	-0.27	-905	-0.01	-5,803	-0.09	-6,708	-0.11	-750	-0.02	-4,794	-0.10	-5,544	-0.12
	Total Phase 2	-2,421	-0.10	-70,530	-3.05	-72,951	**-3.16**	-6,154	-0.10	-64,683	-1.02	-70,837	**-1.11**	-5,361	-0.11	-52,827	-1.11	-58,188	**-1.23**
Reasonable	Approved Project	-2,049	-0.09	-74,161	-3.21	-76,210	-3.30	-5,249	-0.08	-88,248	-1.38	-93,497	-1.47	-4,611	-0.10	-70,827	-1.49	-75,438	-1.59
	Phase 2 Additions	-372	-0.02	-6,581	-0.28	-6,953	-0.30	-905	-0.01	-8,363	-0.13	-9,268	-0.15	-750	-0.02	-6,702	-0.14	-7,452	-0.16
	Total Phase 2	-2,421	-0.10	-80,742	-3.49	-83,163	**-3.60**	-6,154	-0.10	-96,611	-1.52	-102,765	**-1.61**	-5,361	-0.11	-77,529	-1.64	-82,890	**-1.75**
Overestimate	Approved Project	-2,049	-0.09	-83,425	-3.61	-85,474	-3.70	-5,249	-0.08	-139,940	-2.20	-145,189	-2.28	-4,611	-0.10	-110,554	-2.33	-115,165	-2.43
	Phase 2 Additions	-372	-0.02	-7,373	-0.32	-7,745	-0.34	-905	-0.01	-12,495	-0.20	-13,400	-0.21	-750	-0.02	-9,654	-0.20	-10,404	-0.22
	Total Phase 2	-2,421	-0.10	-90,798	-3.93	-93,219	**-4.03**	-6,154	-0.10	-152,435	-2.39	-158,589	**-2.49**	-5,361	-0.11	-120,208	-2.54	-125,569	**-2.65**

NOTES:

1. SOP = SUM OF PROBABILITIES (OF THE RASTER VALUES OF THE RESOURCE SELECTION PROBABILITY FUNCTION HABITAT MODELS.
2. PDA = POTENTIAL DEVELOPMENT AREA.
3. %NBCR = PERCENT OF THE NORTH BAFFIN CARIBOU RANGE.
4. ZOI = ZONE OF INFLUENCE.

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Table 7 Re-Analysis of Cumulative Habitat Impacts Using Suggested Revisions to the Zone of Influence DCs

Sensitivity	Disturbance	Feature	Calving Baseline SoP = 2,310,306						Growing Baseline SoP = 6,372,250						Winter Baseline SoP = 4,741,184					
			PDA	% NBCR	ZOI	% NBCR	PDA + ZOI	% NBCR	PDA	% NBCR	ZOI	% NBCR	PDA + ZOI	% NBCR	PDA	% NBCR	ZOI	% NBCR	PDA + ZOI	% NBCR
Underestimate	Past / Present	Municipalities	-312	-0.01	-9,796	-0.42	-10,108	-0.44	-801	-0.01	-8,879	-0.14	-9,680	-0.15	-613	-0.01	-7,881	-0.17	-8,494	-0.18
		Approved Project	-2,049	-0.09	-64,758	-2.80	-66,807	-2.89	-5,249	-0.08	-58,880	-0.92	-64,129	-1.01	-4,611	-0.10	-48,033	-1.03	-52,644	-1.11
		Helicopter Overflights	0	0.00	-5,734	-0.25	-5,734	-0.25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
		Existing Impact	-2,361	-0.10	-80,288	-3.48	-82,649	**-3.58**	-6,050	-0.09	-67,759	-1.06	-73,809	**-1.16**	-5,224	-0.11	-56,914	-1.20	-62,138	**-1.29**
	Reasonably Foreseeable	Helicopter Overflights	0	0.00	-4,011	-0.17	-4,011	-0.17	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
		Exploration	-26	0.00	-1,328	-0.06	-1,354	-0.06	-80	0.00	-2,316	-0.04	-2,396	-0.04	-62	0.00	-2,310	-0.05	-2,372	-0.05
		Phase 2 Project	-372	-0.02	-5,772	-0.25	-6,144	-0.27	-905	-0.01	-5,803	-0.09	-6,708	-0.11	-750	-0.02	-6,702	-0.14	-7,452	-0.16
		Mary River Deposits	-1,151	-0.05	-16,570	-0.72	-17,721	-0.77	-2,794	-0.04	-25,479	-0.40	-28,273	-0.44	-2,486	-0.05	-22,552	-0.48	-25,038	-0.53
		Deposit Roads	-22	0.00	-384	-0.02	-406	-0.02	-59	0.00	-860	-0.01	-919	-0.01	-50	0.00	-892	-0.02	-942	-0.02
	Cumulative Impact		-3,932	-0.17	-102,619	-4.44	-106,551	**-4.61**	-9,888	-0.16	-102,217	-1.60	-112,105	**-1.76**	-8,572	-0.18	-89,370	-1.88	-97,942	**-2.04**

Sensitivity	Disturbance	Feature	Calving Baseline SoP = 2,310,306						Growing Baseline SoP = 6,372,250						Winter Baseline SoP = 4,741,184					
			PDA	% NBCR	ZOI	% NBCR	PDA + ZOI	% NBCR	PDA	% NBCR	ZOI	% NBCR	PDA + ZOI	% NBCR	PDA	% NBCR	ZOI	% NBCR	PDA + ZOI	% NBCR
Reasonable	Past / Present	Municipalities	-312	-0.01	-11,203	-0.48	-11,515	-0.50	-801	-0.01	-16,467	-0.26	-17,268	-0.27	-613	-0.01	-15,058	-0.32	-15,671	-0.33
		Approved Project	-2,049	-0.09	-74,161	-3.21	-76,210	-3.30	-5,249	-0.08	-88,248	-1.38	-93,497	-1.47	-4,611	-0.10	-70,827	-1.49	-75,438	-1.59
		Helicopter Overflights	0	0.00	-7,167	-0.31	-7,167	-0.31	0	0.00	-3,404	-0.05	-3,404	-0.05	0	0.00	0	0.00	0	0.00
		Existing Impact	-2,361	-0.10	-92,531	-4.01	-94,892	**-4.11**	-6,050	-0.09	-108,119	-1.70	-114,169	**-1.79**	-5,224	-0.11	-85,885	-1.81	-91,109	**-1.92**
	Reasonably Foreseeable	Helicopter Overflights	0	0.00	5,013	0.22	5,013	0.22	0	0.00	-2,543	-0.04	-2,543	-0.04	0	0.00	0	0.00	0	0.00
		Exploration	-26	0.00	-1,436	-0.06	-1,462	-0.06	-80	0.00	-2,951	-0.05	-3,031	-0.05	-62	0.00	-2,310	-0.05	-2,372	-0.05
		Phase 2 Project	-372	-0.02	-6,581	-0.28	-6,953	-0.30	-905	-0.01	-8,363	-0.13	-9,268	-0.15	-750	-0.02	-6,702	-0.14	-7,452	-0.16
		Mary River Deposits	-1,151	-0.05	-16,570	-0.72	-17,721	-0.77	-2,794	-0.04	-25,479	-0.40	-28,273	-0.44	-2,486	-0.05	-22,552	-0.48	-25,038	-0.53
		Deposit Roads	-22	0.00	-398	-0.02	-420	-0.02	-59	0.00	-935	-0.01	-994	-0.02	-50	0.00	-892	-0.02	-942	-0.02
	Cumulative Impact		-3,932	-0.17	-105,336	-4.56	-109,268	**-4.73**	-9,888	-0.16	-144,986	-2.28	-154,874	**-2.43**	-8,572	-0.18	-118,341	-2.50	-111,242	**-2.35**

Sensitivity	Disturbance	Feature	Calving Baseline SoP = 2,310,306						Growing Baseline SoP = 6,372,250						Winter Baseline SoP = 4,741,184					
			PDA	% NBCR	ZOI	% NBCR	PDA + ZOI	% NBCR	PDA	% NBCR	ZOI	% NBCR	PDA + ZOI	% NBCR	PDA	% NBCR	ZOI	% NBCR	PDA + ZOI	% NBCR
Overestimate	Past / Present	Municipalities	-312	-0.01	-12,489	-0.54	-12,801	-0.55	-801	-0.01	-23,972	-0.38	-24,773	-0.39	-613	-0.01	-22,164	-0.47	-22,777	-0.48
		Approved Project	-2,049	-0.09	-83,425	-3.61	-85,474	-3.70	-5,249	-0.08	-139,940	-2.20	-145,189	-2.28	-4,611	-0.10	-110,554	-2.33	-115,165	-2.43
		Helicopter Overflights	0	0.00	-8,601	-0.37	-8,601	-0.37	0	0.00	-10,892	-0.17	-10,892	-0.17	0	0.00	0	0.00	0	0.00
		Existing Impact	-2,361	-0.10	-104,515	-4.52	-106,876	**-4.63**	-6,050	-0.09	-174,804	-2.74	-180,854	**-2.84**	-5,224	-0.11	-132,718	-2.80	-137,942	**-2.91**
	Reasonably Foreseeable	Helicopter Overflights	0	-0.01	-6,016	-0.26	-6,016	-0.26	0	0.00	-7,850	-0.12	-7,850	-0.12	0	0.00	0	0.00	0	0.00
		Exploration	-26	0.00	-1,538	-0.07	-1,564	-0.07	-80	0.00	-3,563	-0.06	-3,643	-0.06	-62	0.00	-2,793	-0.06	-2,855	-0.06
		Phase 2 Project	-372	-0.02	-7,373	-0.32	-7,745	-0.34	-905	-0.01	-12,495	-0.20	-13,400	-0.21	-750	-0.02	-9,654	-0.20	-10,404	-0.22
		Mary River Deposits	-1,151	-0.05	-16,570	-0.72	-17,721	-0.77	-2,794	-0.04	-25,479	-0.40	-28,273	-0.44	-2,486	-0.05	-22,552	-0.48	-25,038	-0.53
		Deposit Roads	-22	0.00	-411	-0.02	-433	-0.02	-59	0.00	-1,009	-0.02	-1,068	-0.02	-50	0.00	-963	-0.02	-1,013	-0.02
	Cumulative Impact		-3,932	-0.17	-127,822	-5.53	-131,754	**-5.70**	-9,888	-0.16	-214,308	-3.36	-224,196	**-3.52**	-8,572	-0.18	-168,680	-3.56	-177,252	**-3.74**

NOTES:

1. SOP = SUM OF PROBABILITIES (OF THE RASTER VALUES OF THE RESOURCE SELECTION PROBABILITY FUNCTION HABITAT MODELS.
2. PDA = POTENTIAL DEVELOPMENT AREA.
3. %NBCR = PERCENT OF THE NORTH BAFFIN CARIBOU RANGE.
4. ZOI = ZONE OF INFLUENCE.

- **Sensitivity Analysis -** The sensitivity analysis produced varying results when DCs were varied by ±25%. However, within all sensitivity scenarios, all impacts are a Level II, except for the overestimated foreseeable future scenario on calving habitat (-5.70%, Table 7).

Where the DCs were varied by 25%, the resulting impact did not change proportionally. Changes to the potential impacts ranged from ~2.5% to 59% of the reasonable scenario, depending on the seasonal model considered. The calving habitat analysis generally showed less variation from the reasonable scenario, with greater variability in the growing and winter habitats.

Table 8 summarizes the habitat effects for each season under all sensitivity scenarios, for the Approved Project, the incremental additional footprint associated with the Phase 2 Proposal, and for the cumulative scenario which includes past, present and reasonably foreseeable (the latter including the future development scenario).

Table 8 Summary of Habitat Impacts as a Percent of North Baffin Caribou Range

Sensitivity	Impact Category	Season		
		Calving	Growing	Winter
Underestimate	Approved Project	-2.89	-1.01	-1.11
	Phase 2 Proposal	-0.27	-0.11	-0.16
	Cumulative Total	**-4.61**	**-1.76**	**-2.04**
Reasonable	Approved Project	-3.30	-1.47	-1.59
	Phase 2 Proposal	-0.30	-0.15	-0.16
	Cumulative Total	**-4.73**	**-2.43**	**-2.35**
Overestimate	Approved Project	-3.70	-2.28	-2.43
	Phase 2 Proposal	-0.34	-0.21	-0.22
	Cumulative Total	**-5.7**	**-3.52**	**-3.74**

As noted in Section 3.2, the future development scenario is speculative and does not meet NIRB's definition of a reasonably foreseeable project.

The magnitude of habitat effects are Level I for underestimate, reasonable and overestimate scenarios of the winter and growing seasons, and Level II for all scenarios during the calving season. All impacts are still considered not significant even at the overestimated scenario magnitude of effects. Significance is discussed further in Section 3.4.

3.4 HABITAT IMPACTS AND SIGNIFICANCE

3.4.1 Magnitude as a Criteria of Significance

The magnitude of effect is one, but not the only, of several criteria considered for cumulative effect significance. The consideration of significance follows a conservative approach to predicting loss (i.e., over emphasizing the loss of habitat within a broadly-identify PDA for the Project, and likely over emphasizing impacts on caribou and habitat in the ZOIs), and takes into consideration literature suggesting that 5% is an extremely conservative consideration of habitat loss before a demographic effect occurs (e.g., Swift and

Hannon 2010, Environment Canada 2011, and discussed further below). Consequently, regardless of the magnitude of potential calving habitat cumulative loss being slightly greater than 5% in the overestimate scenario (a Level III effect), the cumulative habitat effect is not significant on North Baffin Island caribou. Regardless, Baffinland will continue to monitor caribou distribution, habitat loss, and collaborate on studies to determine the potential zone of influences on caribou as data are available and described in the Terrestrial Environment Mitigation and Monitoring Plan (TEMMP).

As a follow-up to the GN's concerns regarding literature citations for Baffinland's conservative use of 5% as a limit for a level III impact on habitat, the following clarifications and citations are provided.

The GN has suggested that the Swift and Hannon (2010) citation does not mention the proportion of habitat loss, and that Environment Canada (2011) habitat loss limits consider only habitat amounts suitable for stable, not increasing, populations. The clarification below provides further certainty on those values and shows that, within the scientific literature and scientific thought, a 5% magnitude of habitat effect is well within conservative estimates of tolerable habitat loss where wildlife population functions will continue to provide for stable or increasing populations.

A broader discussion and review of literature on the topic of the magnitude of habitat disturbance thresholds for wildlife (particularly barren-ground caribou) in the context of environmental assessment was part of the review of the Jay Pipe expansion project in the Northwest Territories (Dominion Diamond, 2014). That assessment provided a review of the scientific literature and showed that the literature does suggest wildlife population tolerance of a relatively high level of disturbance before a response to habitat effects. The citations below elaborate on some of those citations and provide relevant updated citations. The review is not biased and illustrates that, while there is some uncertainty, the weight of evidence suggests thresholds substantially higher than the conservative (i.e., overestimate effect) of 5% used in the Baffinland Project assessment (from the FEIS, ERP, and Phase 2 assessments).

Swift and Hannon (2010) provide a meta-analysis of simulation, and empirical small scale (e.g., fungus and some insect habitat) and large-scale (e.g., birds and some mammals) studies on habitat pattern and habitat loss factors that lead to potential population-level impacts.

- Simulation Studies - "The threshold levels range across nearly the entire continuum of habitat proportion, from about 1-99% (though most fall between 10-50%)" [habitat remaining].
- Empirical Small-Scale - 20–40%, range from 20–100% habitat remaining.
- Empirical Large-Scale - 20%, 10–30% habitat remaining (e.g., impacts seen at 70–90% habitat loss).

Environment Canada (2011) thresholds are within the bounds of increasing populations.

- Low risk of decline when disturbance is 10–35% with a 60–90% probability of a stable ($\lambda = 1$) or increasing ($\lambda > 1$) population.
- Very low risk when disturbance is <10%, >90% probability of a stable ($\lambda = 1$) or increasing ($\lambda > 1$) population.

The Draft Bathurst Caribou Range Plan (Government of Northwest Territories, 2018), of which the GN is noted as a participant of the workgroup that drafted the plan, identifies 8% as a low risk, and 16% as a high risk to caribou in the Nunavut portion (RAA1) of the range (the identified calving area, Table 3 in that report summarized above as proportion of the total area of RAA1.

Regardless of the discussion above, Baffinland will remain considering anything >5% across seasonal habitat as a Level III effect. which has been used as the criterion since the FEIS. However, a >5% magnitude effect alone does not suggest a “significant” impact (i.e., measurable impact on population), as illustrated in the discussion above. All impacts are still considered not significant even at the overestimated scenario magnitude of effects.

3.4.2 Inuit Qaujimajatuqangit and Impact Significance

All impacts are still considered not significant (Section 3.3.6), even at the overestimated scenario magnitude of effects (Section 3.4.1).

It is recognized that the term significance in the context of environmental impact likely means different things to different individuals, organizations and cultures. This was expressed by several parties during the last technical meeting hosted by the NIRB.

In attempts to balance input between science and Inuit Qaujimajatuqangit (IQ), Baffinland’s EIS team made early attempts to obtain feedback on what magnitude of habitat impact might be considered “significant” to Inuit (discussion at 2010 on-site workshop). However, the EIS team was unable to obtain feedback from members of the IQ working groups in the five North Baffin communities at the time regarding the concepts of effects magnitude or significance., It can be difficult even within the EA practitioner/scientific community to reach consensus on these concepts (e.g., Canadian Environmental Assessment Agency, 2015). To that end, Baffinland has recently started to use another approach based on a risk assessment framework to determine significance from a perspective other than magnitude and proportions. These “IQ risk workshops” held in January to September 2019 have not provided any more clarification on Inuit participant perspective of a measure of significant habitat loss. Nonetheless, Baffinland and its EIS team remain committed to ongoing dialogue with Inuit on this subject.

The Qikiqtani Inuit Association (QIA) recently released its Tusaqtavut study for the community of Pond Inlet (QIA, 2019). While identifying concerns about the project’s impacts on caribou habitat, did not provide further insight to these authors on how significance is perceived. While the perceived risk of the project to caribou is acknowledged, there was no indication of the acceptability of any level of risk in the document that could be used to interpret as significance for the purposes of this impact assessment.

In the absence of a defined Inuit perspective of significance, the proportion of habitat loss with reference to the scientific literature and recognizing some level of uncertainty, will be used as the communication tool to discuss within all parties, including Inuit, the potential for Phase 2 Project and cumulative impacts on caribou. Without further information or direction from the QIA, given the best attempts by these authors to draw perspectives on significance from Inuit through engagement since 2008, and for the sake of this review, significance will be determined as per the EA methods of the Project - definitions that have been used in the review of the Mary River Project since 2012 or earlier. It is recognized that the definition is neither universal nor equitably interpreted among any of the parties and stakeholders reviewing this project (or generally any project as cited by CEAA (2015). It is a definition of the reference point used in part to base discussions and decisions and trigger reasonable action.

4.0 UPDATED MARINE MAMMALS ASSESSMENT

4.1 PROJECT SHIPPING TRAFFIC

The Phase 2 Proposal will involve an increase in shipping activities through the Northern Shipping Route compared to the Approved Project from an estimated 55 to 60 vessel trips per year as assessed for the Approved Project (Baffinland, 2013) during an approximate shipping season of July 15 to October 15, to an estimated 176 vessel trips over a shipping season that extends from approximately July 1 to November 15. Once the project is fully operational, up to 10 sealifts and 10 tankers could be required each season, although the majority of these would likely transfer to Steensby Inlet as the South Railway is approved to haul freight and fuel.

Other shipping within the CEA study area generally consists of the following:

- Annual resupply of fuel and dry cargo to communities and industrial projects during the open-water shipping season
- Transport of ore concentrate from operating mines (historic, current, and reasonably foreseeable), in open water and through ice
- Government icebreaking exercises
- Canadian military exercises
- Transit of cruise ships during the open water period
- Limited transit of commercial and recreational vessels (including cruise vessels) through the Northwest Passage

In terms of potential cumulative effects to marine mammals, shipping through Lancaster Sound, Navy Board Inlet, Eclipse Sound and Milne Inlet potentially interacts with the same populations of marine mammals affected by the Project.

Historic annual shipping traffic over a 16-year period (2002 to mid-September 2017) in the vicinity of the Northern Shipping Route, provided by Xpert Solutions Technologiques (2017), is summarized in Table 9. The information is derived from the Canadian Coast Guard's Vessel Traffic Management Information System, referred to as INNAV (Canadian Coast Guard, 2018).

The future shipping traffic shown in Table 10 indicates an increase of 270 Project vessel transits each year for the Phase 2 Proposal (122 to 392 vessel transits). Baffinland is currently investigating the feasibility of using Navy Board Inlet and Lancaster Sound as an alternate route to Eclipse Sound in certain conditions, however, the transits will vary, and the potential range has not yet been confirmed. Since the alternative route would still impact the same marine mammal populations, having all project shipping captured under Eclipse Sound is acceptable. Future shipping also predicts an increase of 29 additional non-project vessel transits in Eclipse Sound which will increase the annual total to 421 vessel transits. Sealifts associated with communities and mining projects in the Kitikmeot Region is expected to increase the overall shipping traffic in Baffin Bay to 469 vessel transits.

It is important to note that the historical shipping data, and hence the future shipping traffic is represented by the number of transits. As such, there are two shipping transits for each voyage to Milne Port.

Table 9 Historic Vessel Transits in Shipping Zones Near the Northern Shipping Route

Year	Baffin Bay	Eclipse Sound	Lancaster Sound	Milne Inlet	Navy Board Inlet	Non-Project Vessel Transits (Transits into Eclipse Sound Not Entering Milne Inlet)
2002	92	22	67		4	22
2003	74	21	30		3	21
2004	71	21	31	2	7	19
2005	68	24	38	1	9	23
2006	80	32	37	10	6	22
2007	75	35	42	7	6	28
2008	115	48	49	17	5	31
2009	76	25	41	2	8	23
2010	148	42	50	2	8	40
2011	140	42	50	11	7	31
2012	151	31	52	2	4	29
2013	189	76	73	31	11	45
2014	213	86	93	31	17	55
2015	226	102	104	43	13	59
2016	280	151	93	96	23	55
2017	233	172	111	96	18	76

NOTES:

1. SOURCE: CANADIAN COAST GUARD'S VESSEL TRAFFIC MANAGEMENT INFORMATION SYSTEM – INNAV (PROVIDED BY XPERT SOLUTIONS TECHNOLOGIQUES INC., 2017).

The estimated total shipping window is 79 days of open water (mid-July to October). The actual shipping window will be adjusted to adapt to annual fluctuations in weather and ice conditions. For the Phase 2 Proposal, shipping will also occur, as required, during periods of ice-break up (early July) and ice formation (up to mid-November) which will effectively extend the annual shipping window to approximately 137 days.

Vessels associated with the Project transit through Baffin Bay, Eclipse Sound and Milne Inlet while Navy Board Inlet or Lancaster Sound may be used as an alternative route to Eclipse Sound in the future. Most of the vessel traffic in Milne Inlet is thought to be related to the Project. Occasional sealifts occurred during the project definition phase (2006 to 2012), and then increased in 2013 when construction of the Project was initiated.

Table 10 Future Shipping Traffic by Zone

Project/Activity	Baffin Bay	Eclipse Sound	Lancaster Sound	Milne Inlet	Navy Board Inlet
Mary River Project - Phase 2 Proposal	392	392		392	
Cruise ships (2018 + 25 %)	23	23	23		23
Sealift Vessels					
Pond Inlet	6	6			
Arctic Bay	6		6		
Grise Fiord	6				
Resolute	6		6		
Kugaaruk	6		6		
Gjoa Haven	6		6		
Taloyoak	6		6		
Hope Bay Mine	6		6		
Back River Mine	6		6		
Nanisivik Naval Facility and Military Exercises	Unknown and unable to quantify				
Unknown Vessel Transit Adjustments[1]			46		
Totals	**469**	**421**	**111**	**392**	**23**
Unadjusted Baseline (2017; Table 9)	233	172	111	96	18
Adjusted Baseline (2017)[2]	259	198	111	122	18

NOTES:

1. VESSEL TRANSIT ADJUSTMENTS MADE BY SHIPPING ZONES UNAFFECTED BY THE PROJECT, TO CORRECT PROJECTED VESSEL TRANSITS TO ALIGN WITH HISTORIC VESSEL TRANSITS.
2. PROJECT SHIPPING TRAFFIC IN 2017 TOTALLED 122 VESSEL TRANSITS, AN ADDITIONAL 26 VESSEL TRANSITS THAN REPORTED FOR MILNE INLET. AS SUCH, 2017 SHIPPING TRANSITS WERE INCREASED BY 26 VESSELS FOR OTHER ZONES WITH PROJECT TRAFFIC (ECLIPSE SOUND, BAFFIN BAY).

Cruise ship travel is an increasing activity in Nunavut and Pond Inlet as well. The number of cruise ship visits to Pond Inlet has increased from 7 vessels in 2010 to 17 vessels in 2018. The number of visitors to Pond Inlet has increased from 864 in 2010 to 2,850 in 2017. Most of the cruise ships that enter the Pond Inlet area anchor and come ashore to the community of Pond Inlet, and some cruise ships navigate throughout Pond Inlet, Eclipse Sound, Milne Inlet and Navy Board Inlet, anchoring to transfer their passengers on shore using zodiacs to visit locations of interest including cultural sites and natural features such as the glaciers or Hoodoo rock formations in Sirmilik National Park. Transits through the area increase the risks of collisions.

Trends in cruise ship activity visiting Nunavut communities from 2010 to 2018 is shown on Figure 5. Cruise ship activity from 2010 to 2018 at Nunavut communities increased from 32 to 68 community visits. The expected trend in 2019 is a similar or increased number of tourists visiting the area by cruise ships (Sebastian Charge, pers. comm.). The GN has noted that while cruise ship passenger numbers have been trending upwards over the past several years, that it is a very niche market and explosive growth is not expected (Nunavut News, 2018). Nunavut cruise ship traffic in 2018 consisted of 10 operators sailing 11 unique vessels that were expected to complete 24 voyages, with a total of 70 community visits planned to 13 communities including Clyde River and Pond Inlet (Nunavut News, 2018).

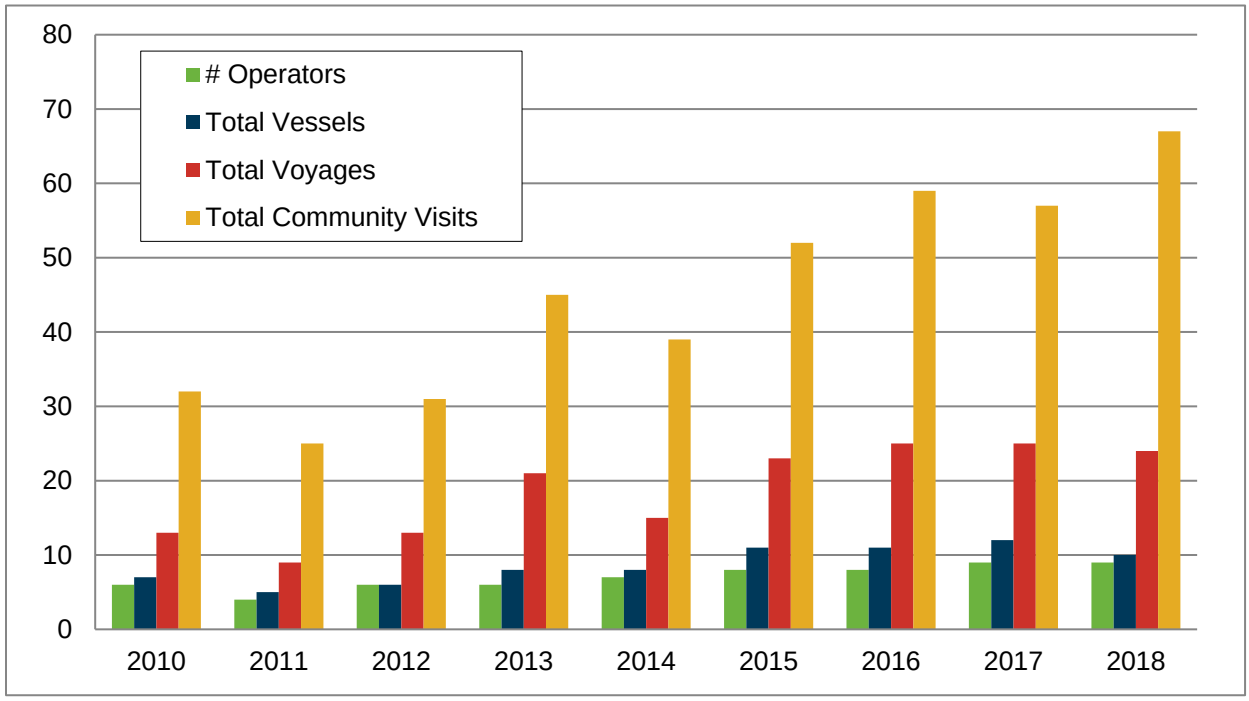

Figure 5 Cruise Ship Activity in Nunavut (2010-2018)

Most if not all the operators are members of the Association of Arctic Expedition Cruise Operators (AECO), which requires its members to comply with its guidelines related to environmental and social responsibility, including guidelines governing operations, clean-up, wildlife, biosecurity, visiting communities and protecting physical environments (AECO, 2018). AECO has also developed Guidelines for the development of Community Specific Guidelines, so that best practices can be tailored to specific communities if needed. In 2018, the GN passed Marine Tourism Regulations under Nunavut's *Tourism Act* (Commissioner of Nunavut, 2018). The regulations require cruise ship operators file community itineraries two days before arriving to a community and provide codes of conduct for both operators and passengers.

Figure 6 presents the routing of cruise ships transiting the Pond Inlet area in August and September. Based on the data presented in Figure 6, the cruise ships typically do not enter Milne Inlet. In theory this potentially increases the risks of collisions with ore ships from the Mary River Project. In practice a collision is considered highly unlikely. Mitigation would involve increased communications between Mary River Project ship traffic and cruise ships when they are present in the area.

Cruise ships, though smaller vessels than the ore carriers, have a marine footprint. The current volume of cruise ship traffic (17 vessels in 2018) representing about 10% of the vessel traffic associated with the Phase 2 Proposal is likely to increase over the temporal boundary of this assessment, but it is judged based on feedback from the GN not to increase more than 50% between now and 2044. Trips to shore have the potential to result in minor physical disturbances to the landscape that are not measurable at the regional scale. Unlike Project shipping traffic in which one voyage consists of two transits, cruise ship traffic passing through Pond Inlet, Eclipse Sound and Navy Board Inlet is assumed in Table 10 to consist of a single transit, based upon the available cruise ship routing information (Figure 6; AECO, 2018).

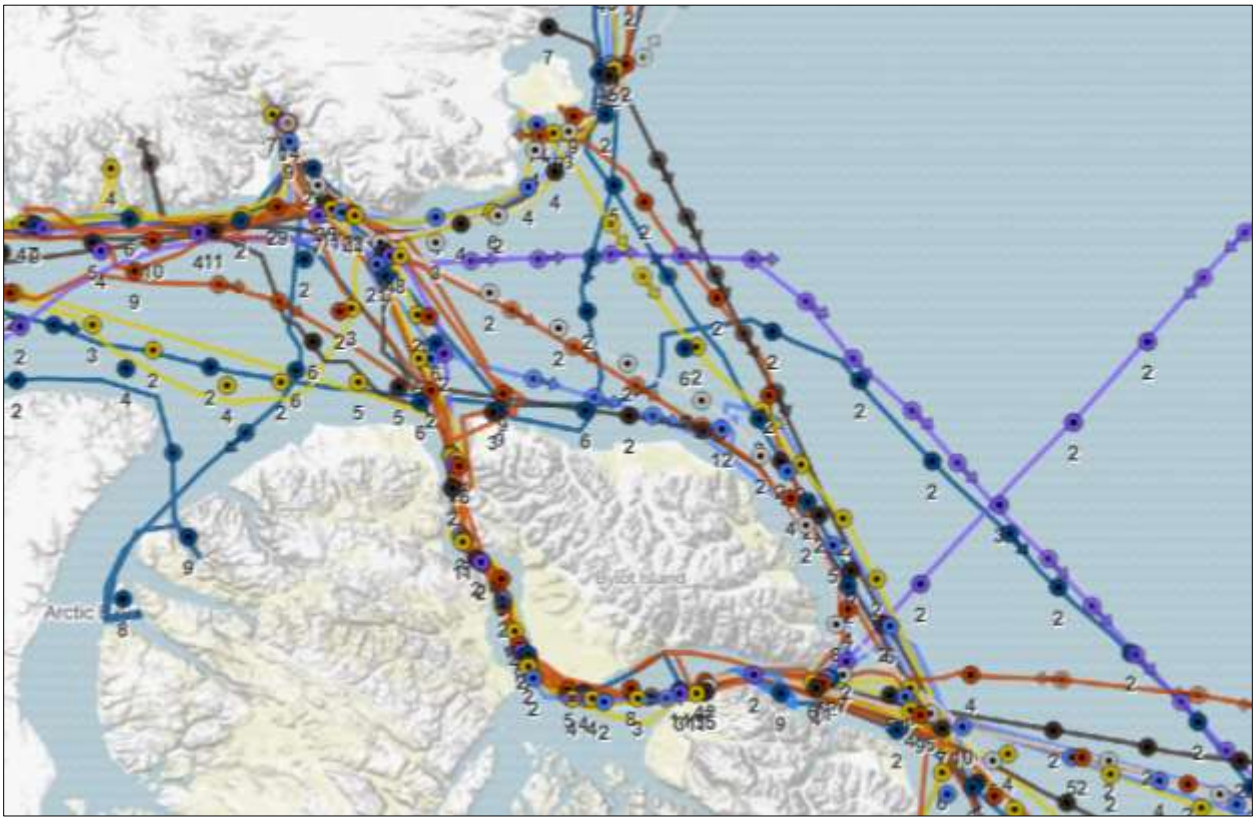

Figure 6 Cruise Ship Routing (from AECO, 2018)

4.2 PROJECT FLIGHTS

Aircraft flights to and from the community of Pond Inlet and to other communities will remain relatively unchanged between the current operation and the operating phase of the 12 Mtpa version of Phase 2, as the employment levels are the same. There will be an increase temporarily during construction, and then again when the 18 Mtpa project comes online. The total number of aircraft flights for the overall Phase 2 project will increase from 1.8 flights per day to 3.5 flight per day during construction, before decreasing to 1.4 flights per day during operations. Similar increases in the number of flights per day are expected in future during construction of the South Rail and Steensby Port.

4.3 CUMULATIVE EFFECTS TO MARINE MAMMALS

The future shipping traffic shown in Table 10 indicates an increase of 270 Project vessel transits for the Phase 2 Proposal (122 to 392 vessel transits). Baffinland is currently investigating the feasibility of using Navy Board Inlet and Lancaster Sound as an alternate route to Eclipse Sound in certain conditions, however, the transits will vary, and the potential range has not yet been confirmed. Since the alternative route would still impact the same marine mammal populations, having all project shipping captured under Eclipse Sound is acceptable. Future shipping also predicts an increase of 29 additional non-project vessels transits in Eclipse Sound which will increase the annual total to 421 vessel transits. Sealifts associated with communities and mining projects in the Kitikmeot Region is expected to increase the overall shipping traffic in Baffin Bay to 469 vessel transits.

The sound levels of cruise ships at speeds of 10 knots are below 185 dB re 1 µPA (Kipple, 2002). The source levels modelled for the ore carriers are 187 dB re 1 µPA (Postpanamax) and 190 dB re 1 µPA (Cape size). The addition of 23 cruise ships in future years to summer ship traffic in Eclipse Sound and Baffin Bay suggests that some interaction (overlap in noise fields when passing) will potentially occur between cruise ships and Mary River ore traffic. The expected transit distance if it does occur will be several hundred metres at minimum. The frequency and magnitude of these potential interactions are small and are not expected to result in cumulative noise effects to marine mammals. It will be important to have procedures in place to ensure that safe passing occurs, and the risk of collisions is mitigated.

The effects of concurrent shipping activity in the RSA have the potential to interact with the effects of Phase 2 Proposal shipping along the Northern Shipping Route, resulting in cumulative effects associated with acoustic disturbances and vessels strikes. It is anticipated that, should multiple vessels transit through a given area, the cumulative noise field will increase spatially (TSD-24; Golder, 2018a). However, given the physics of underwater sound, the cumulative sound level is not predicted to increase when multiple vessels are present in the same area (TSD-24). Therefore, in consideration of the relatively limited temporal and spatial scales of potential cumulative effects, it is not expected that marine mammals including species at risk would be affected at the population level. Additional discussion on marine wildlife key indicators is provided below.

4.3.1 Ringed Seal

For concurrent vessel activities along the Northern Shipping Route, it has been assumed that ore carrier movements and vessel mooring events in Milne Inlet will not directly overlap in space and time due to minimum safety distance requirements for shipping and anchoring. However, part of the noise fields from multiple vessels will overlap in space and time when passing each other, and the cumulative noise field is predicted to encompass a greater spatial area, potentially resulting in a larger area of avoidance by ringed seal. However, the cumulative sound level (‘loudness’) is not predicted to increase when multiple vessels are present in the same area – it would remain roughly equivalent to that of the single (larger) vessel at any single point within the zone of acoustic overlap. This is due to the logarithmic nature of sound underwater (i.e., the cumulative effect of multiple co-occurring noise sources is not linear in scale). Any avoidance behavior is predicted to be temporary and localized.

Potential behavioural effects on ringed seal from non-Project related underwater noise sources are anticipated to be like those described for the Phase 2 Proposal. Based on behavioral observations collected to date from the various monitoring programs and information provided in the available literature, ringed

seals are likely to tolerate/habituate to the short-term increased levels of underwater noise and remain in the area or leave temporarily and return once the noise subsides.

With the effective implementation of mitigation, the residual disturbance effects on ringed seal from cumulative underwater noise effects are predicted to be moderate in magnitude (Level II), confined to the LSA (Level I), intermittent (Level II) in frequency, short-term (Level I) for pile driving and medium-term (Level II) for shipping, and fully reversible (Level I). The residual environmental effect is predicted to be not significant.

4.3.2 Narwhal

For concurrent vessel activities along the Northern Shipping Route during the open water season, when narwhal are present in the area, it has been assumed that ore carrier movements and vessel mooring events in Milne Inlet will not directly overlap in space and time due to minimum safety distance requirements for shipping and anchoring. However, part of the noise fields from multiple vessels will overlap in space and time when passing each other, and the cumulative noise field is predicted to encompass a greater spatial area, potentially resulting in a larger area of avoidance by narwhal. However, the cumulative sound level ('loudness') is not predicted to increase when multiple vessels are present in the same area - it would remain roughly equivalent to that of the single (larger) vessel at any single point within the zone of acoustic overlap. This is due to the logarithmic nature of sound underwater (i.e., the cumulative effect of multiple co-occurring noise sources is not linear in scale). Any avoidance behavior is predicted to be temporary and localized.

Potential behavioural effects on narwhal from non-Project related underwater noise sources are anticipated to be like those described for the Phase 2 Proposal. Based on behavioral observations collected to date from the various monitoring programs and information provided in the available literature, narwhal is likely to tolerate/habituate to the short-term increased levels of underwater noise and remain in the area, or leave temporarily and return once the noise subsides.

Narwhal are not found in the Pond Inlet - Eclipse Sound - Milne Inlet area during periods of ice cover, and the Northern Shipping Route excludes shipping when narwhal may be congregating at the floe edge during the months of April, May and June. During winter, narwhals are widely distributed in heavy pack ice in offshore Baffin Bay, and to a lesser extent Hudson Strait (Koski and Davis, 1979). With the effective implementation of mitigation, the residual disturbance effects on narwhal from cumulative underwater noise sources are predicted to be moderate in magnitude (Level II), confined to the LSA (Level I), intermittent (Level II) in frequency, short-term (Level I) for pile driving and medium-term (Level II) for shipping, and fully reversible (Level I). The residual environmental effect is predicted to be not significant.

4.3.3 Beluga Whale

For concurrent vessel activities along the Northern Shipping Route, it has been assumed that ore carrier movements and vessel mooring events in Milne Inlet will not directly overlap in space and time due to minimum safety distance requirements for shipping and anchoring. However, part of the noise fields from multiple vessels will overlap in space and time when passing each other, and the cumulative noise field is predicted to encompass a greater spatial area, potentially resulting in a larger area of avoidance by beluga. However, the cumulative sound level ('loudness') is not predicted to increase when multiple vessels are present in the same area – it would remain roughly equivalent to that of the single (larger) vessel at any single point within the zone of acoustic overlap. This is due to the logarithmic nature of

sound underwater (i.e., the cumulative effect of multiple co-occurring noise sources is not linear in scale). Any avoidance behavior is predicted to be temporary and localized.

Potential behavioural effects on beluga from non-Project related underwater noise sources are anticipated to be like those described for the Phase 2 Proposal. Based on the available literature, beluga is likely to tolerate/habituate to the short-term increased levels of underwater noise and remain in the area, or leave temporarily and return once the noise subsides.

With the effective implementation of mitigation, the residual disturbance effects on beluga from cumulative underwater noise effects are predicted to be moderate in magnitude (Level II), confined to the LSA (Level I), intermittent (Level II) in frequency, medium-term (Level II) in duration, and fully reversible (Level I). The residual cumulative environmental effect is predicted to be not significant.

4.3.4 Bowhead Whale

For concurrent vessel activities along the Northern Shipping Route, it has been assumed that ore carrier movements and vessel mooring events in Milne Inlet will not directly overlap in space and time due to minimum safety distance requirements for shipping and anchoring. However, part of the noise fields from multiple vessels will overlap in space and time when passing each other, and the cumulative noise field is predicted to encompass a greater spatial area, potentially resulting in a larger area of avoidance by bowhead. However, the cumulative sound level ('loudness') is not predicted to increase when multiple vessels are present in the same area – it would remain roughly equivalent to that of the single (larger) vessel at any single point within the zone of acoustic overlap. This is due to the logarithmic nature of sound underwater (i.e., the cumulative effect of multiple co-occurring noise sources is not linear in scale). Any avoidance behavior is predicted to be temporary and localized.

Potential behavioural effects on bowhead from non-Project related underwater noise sources are anticipated to be like those described for the Phase 2 Proposal. Based on the available literature, bowheads are likely to tolerate/habituate to the short-term increased levels of underwater noise and remain in the area or leave temporarily and return once the noise subsides.

With the effective implementation of mitigation, the residual disturbance effects on bowhead from cumulative underwater noise effects are predicted to be moderate in magnitude (Level II), confined to the LSA (Level I), intermittent (Level II) in frequency, medium-term (Level II) in duration, and fully reversible (Level I). The residual environmental effect is predicted to be not significant.

4.3.5 Polar Bear

No residual effects from the Phase 2 Proposal on polar bear are anticipated. The potential for cumulative effects of the Project in concert with others regional projects and activities was therefore considered negligible.

5.0 CUMULATIVE EFFECTS TO THE WILDERNESS EXPERIENCE

5.1 WILDERNESS TOURISM IN THE REGION

Tourism activity in the vicinity of the Project was described by KP (2010), presented as Appendix 4C of the FEIS (Baffinland, 2012). Each year, tourists visit Pond Inlet and the surrounding communities to experience the rich Inuit culture, view birds and wildlife, and experience the quietness and solitude of the remote and

pristine arctic environment. Cruise ships visit the area each open water season as described in Section 4.1. A smaller number of visitors come to the area each year for a remote wilderness experience that involves being out on the land. Most often, such visitors will arrive in Pond Inlet or another nearby community and will have retained the assistance of an outfitter (local or otherwise) to supply gear and bring them to see local landmarks and view wildlife. Both Arctic Bay and Pond Inlet are access points to different parts of Sirmilik National Park.

During open water between late July and the end of September, sea kayaking tourists and sailboats can be present in the Milne Inlet/Eclipse Sound area (TSD 25, Baffinland, 2018b). Sea kayaking may occur throughout the area, including Milne Inlet and Koluktoo Bay within Milne Inlet, which has been identified as a prime viewing area for narwhal during the open water period.

Late winter or spring (April to June) is also an important time for tourists to visit to experience the natural beauty and abundance wildlife under winter conditions. Such visitors may travel on the landfast ice by snowmobile or by dog team with an outfitter to visit the floe edge or to hunt polar bear. Occasionally, small groups ski and camp across portions of Sirmilik National Park.

5.2 PROJECTS EFFECTS ON THE WILDERNESS EXPERIENCE

The wilderness experience is subjective and unique to each individual, strongly influenced by one's life experience as well as their expectations. Expectations are influenced by what they have been told or have learned on their own about the remote arctic destination they are travelling to. These are considerations when evaluating effects on the wilderness experience of people visiting the area.

Marine shipping is likely to be the main Project activity that will impair the wilderness experience expected by tourists, as a result of the Approved Project as well as the Phase 2 Proposal (Table 5.2 of TSD 25; Baffinland, 2018b). The Phase 2 Proposal will involve an increase in shipping activities through the Northern Shipping Route from an estimated 55 to 75 vessel trips per year during an approximate shipping season of July 15 to October 15, to an estimated 176 vessel trips over a shipping season that extends from approximately July 1 to November 15 (Section 4.1). This shipping traffic will occur adjacent to Sirmilik National Park and within the boundaries of the Tallurutiup Imanga/Lancaster Sound National Marine Conservation Area. Based on the number of vessels and length of the shipping season, approximately two vessels will be sailing to Milne Port and another two vessels will be leaving Milne Port on any given 24-hour period. Some of these Project vessels will be passing through the area during normal sleep hours, though 24-hour daylight is present in August and September when tourists are visiting the area. The vessels transit slowly through the area at a reduced speed of 9 knots. Project vessels will be removed from the coastal areas where kayakers may be present and will also be set back several kilometres from other vessels such as cruise ships.

5.2.1 Cruise Ship Passengers

Passengers aboard cruise ships stopping at Pond Inlet as well as passengers of private vessels such as sailboats will likely pass one or more ore carriers while transiting Pond Inlet and Eclipse Sound. They may be disappointed to see industrial activities including marine shipping in the area, having arrived with the expectation that the area would be empty and vacant of such activities. The vessels are not expected to come close to the other vessels, and therefore will be in most instances a silent object moving across the horizon, possibly passing the cruise ship several kilometres apart. Cruise ship passengers that select short distance excursions on secondary vessels may be more exposed to a passing ore carrier. Passengers may

feel that views are impaired with a Project vessel present, though given they are travelling aboard a vessel themselves, cruise ship and private vessel passengers are probably less likely to find the presence of the Project vessels an impairment of the wilderness experience compared to some other tourists. It may be that some passengers will find the presence of the vessels a curiosity or a positive experience.

5.2.2 Kayakers and Other Tourists

Other tourists that may be in the area during the shipping season include kayakers and people travelling in local outfitter boats. The impacts of a passing ore ship on sea kayakers is expected to be greater than that experienced by cruise ship passengers, as their wilderness experience is more localized and their expectations for a remote wilderness experience is likely greater. Sea kayaks travel slowly and will be more aware of the noise effects from passing ships. Kayakers travelling in Milne Inlet and Koluktoo Bay to view narwhal will be more acutely aware of the Project shipping traffic.

In terms of public safety, generally kayakers hug the coast, whereas Project vessels will be offshore and generally in the centre of the channel. The instance between Pond Inlet and Bylot Island at the narrowest point of Eclipse Sound is >10 km. The confines of Milne Inlet are closer, however. The slow vessel speeds of the Project vessels (9 knots) and their size make collisions highly unlikely. Ship wake modeling predicted that waves (wakes) generated by ore carriers would be minimal with maximum wave heights of 0.12 m near the sailing line and less than 0.05 m when reaching the shoreline (TSD 22; Golder, 2018b). The wake height is primarily constrained by the vessel speed limit of 9 knots. Wind generated waves have greater wave heights than expected ship wakes during both average and peak wind conditions. Therefore, the wakes produced by the Project vessels are unlikely to be greater than natural wave heights and are not expected to represent a meaningful additional risk to the safety of kayakers.

5.2.3 Visitors on the Landfast Ice in Late Winter or Spring

As noted in Section 5.1, tourists also visit the area in late winter or spring (April to June), travelling on the landfast ice by snowmobile, dog team or on skis. Tourists who travel out onto the ice during the ice-covered period may observe rough ice that is evidence of icebreaking during the earlier ice formation period (KP, 2019b). Rough ice can be found throughout Eclipse Sound and Pond Inlet depending on natural conditions during freeze up. Thus, the evidence of icebreaking may or may not be evident. It will likely have a negligible impact on the “wilderness experience” during the late winter / spring period.

5.2.4 Significance of Project Effects to the Wilderness Experience

The following criteria have been considered to assess the magnitude of impacts of the Project (and cumulative effects) on the wilderness experience of tourists:

- **Low -** Some measure of impairment to the wilderness experience may occur, but this does not discourage tourists from returning or recommending others visit the area.
- **Moderate -** Increased impairment of wilderness experience may occur, resulting in some tourists from not returning or recommending others visit the area.
- **High -** Significant impairment of the wilderness experience such that tourists would not return to the area or recommend others visit the area.

It is expected that most tourists visiting the area will see one or more ships in their views at some point during their visit to the area, but the ships will be silent and slowly-moving objects in the distance. The

Project vessels will not emit loud noises and are unlikely to be close to the observers. The magnitude of effects to their wilderness experiences are predicted to be low magnitude.

Kayakers spending time in Milne Inlet to view narwhal and other wildlife may experience greater exposure to project shipping and occasional helicopter use, and thus could experience a higher magnitude effect. Baffinland communicates its shipping activities within the community of Pond Inlet and on-line, and thus local outfitters will be aware. Alternative locations for narwhal viewing include Tremblay Sound and other fiords within Eclipse Sound. As such, low (Level I) to moderate (Level II) magnitude impacts are possible. High magnitude impacts are considered unlikely, as outfitters would provide their clients with options for wildlife viewing and would tend to steer away from the more heavily travelled areas by Project vessels.

The effects on the wilderness experience (i.e., viewing or coming close to Project vessels) will occur infrequently (Level I) or with some level of regularity (Level II). The duration of impacts is considered low as most interactions with Project vessels will be limited to one or more vessels visible on the horizon or passing relatively quickly. The effects are also confined to the open water period. The impacts are reversible as once project shipping stops. For this reason, Project effects to the wilderness experience are predicted to be not significant.

5.3 PROJECTS AND ACTIVITIES RELEVANT TO CUMULATIVE EFFECTS

Table 11 lists the relevant past, existing, and reasonably foreseeable projects or activities in the region that may act cumulatively with the Project on the wilderness experience. Of the projects/activities identified, the following were screened to be relevant for inclusion in the assessment of cumulative effects to the wilderness experience:

- **Nanisivik Naval Facility -** This facility is nearing completion of construction. Tourists visiting the Borden Peninsula portion of Sirmilik National Park will be aware of the Nanisivik Naval Facility, and vessels will be sailing through Admiralty Inlet at an unknown frequency.
- **Military Exercises -** These may be carried out throughout the region in any given year and their presence may become known with vessels and helicopter traffic in the area, though the frequency of such exercises, the specific location(s), and the number of vessels and aircraft involved is not known.
- **Regional Ship Traffic -** Forecasted traffic is presented in Table 10; the cumulative shipping traffic in Eclipse Sound including cruise ships and sealift vessels but not including military sailings represent only a marginal increase (an additional 7.5%) in shipping over and above the Phase 2 Proposal.
- **Regional Air Transport -** Regional air transport in the vicinity of Sirmilik National Park consists of twice daily scheduled commercial flights in and out of Pond Inlet, and thrice weekly flights from the Mary River Project. Helicopter traffic is described in Section 2.1 and includes periodic flights to the camp at Bruce Head associated with narwhal monitoring. The Phase 2 Proposal will not involve an increase in air traffic (charter flights to the communities and helicopter). There could be increased demand for air travel to Pond Inlet as a result of increased research and tourism induced by the Tallurutiup Imanga NMCA, though it may not be material and it is not possible to estimate.
- **Regional Monitoring Programs -** Regional monitoring programs include Baffinland's Bruce Head narwhal monitoring programs and aerial surveys conducted every few years for marine mammals by DFO and for caribou by the GN. It is possible that the future establishment of Tallurutiup Imanga NMCA (described below) may induce additional marine research in the area that may result in increased boat and/or aerial traffic in the area.

Table 11 Potential Interactions of Other Projects and Activities with Visitor Experience

Relevant Projects or Activities	Interaction with Wilderness Experience	Description
Past		
Nanisivik Mine (Decommissioned)		No interaction.
Mary River Project Definition Phase		No interaction with current and future tourism activities.
Diamond Exploration at Eriksen Lake		No interaction (no longer operating; minimal past physical disturbance).
Existing		
Nanisivik Naval Facility and Military Exercises	**X**	Shipping and air traffic; not possible to define its marine shipping traffic.
Back River and Hope Bay Projects		Shipping through Lancaster Sound; unlikely to be visible to tourists visiting the Pond Inlet – Eclipse Sound area.
Regional Ship Traffic	**X**	See Table 10.
Regional Air Transport	**X**	No change from Approved Project.
Communities, Traditional/Recreational Land Use		Inuit and communities are part of the environment.
Regional Monitoring Programs	**X**	DFO conducts periodic aerial surveys for marine mammals.
Baffinland Regional Exploration		Outside of park and NMCA areas normally visited by tourists.
Climate Change	**X**	Climate change is likely to be viewed as an anthropogenic impairment to the wilderness experience as it becomes more evident to tourists.
Reasonably Foreseeable		
Tullurutiup Imanga NMCA	**X**	$190 million infrastructure commitment; Inuit Guardian Program of marine monitoring; likely to induce more research and tourism.
Potential Future Development		
Future Development Scenario (mine Deposits No. 2 to 5 until 2055)	**X**	Could extend shipping through the North beyond the 17 years anticipated for the Phase 2 Proposal.

- **Climate Change -** Climate change is likely to be viewed as an anthropogenic impairment to the wilderness experience as it becomes more evident to tourists. Climate change is most evident in the arctic, and may be evident from shrinking glaciers, more indications of subsidence and mass-wasting as ice-rich soils thaw, and from feedback from Inuit who explain how climate change has been affecting

their lives. The extent to which climate change affects visitor's wilderness experience is difficult to quantify.

- **Tullurutiup Imanga NMCA -** Establishment of the Tallurutiup Imanga NMCA as a reasonably foreseeable project is likely to result in an increase in the amount of marine traffic, as the Government of Canada recently announced a $190 million infrastructure commitment, an Inuit guardian program of marine monitoring, and research programs (Nunatsiaq News, 2019). The presence of the NMCA could attract increased tourism to the area.
- **Future Development Scenario -** Future development of the Mary River Project, though not a reasonably foreseeable project, has the potential to increase air traffic between Pond Inlet and the mine, as well as marine traffic along the Northern Shipping Route within the same shipping window, for an additional 20 years.

Relative to the Project assessment, the cruise ship passengers and sea kayakers will experience less than 10% increase in shipping activity cumulatively, may hear about or experience some example of climate change, and will likely be aware of the NMCA and will be relatively accepting of regional research and monitoring programs associated with the protected area. The significance criteria ratings would be the same as those for the Project assessment: the impact magnitude would be low to moderate; viewing or coming close to Project vessels would occur infrequently (Level I) or with some level of regularity (Level II). The duration of impacts is considered low (Level I) as most interactions with Project vessels will be limited to one or more vessels visible on the horizon or passing relatively quickly. The effects are also confined to the open water period and the wilderness experience during late winter / spring would remain unchanged. The impacts are reversible as once project shipping stops. For this reason, the cumulative effects to the wilderness experience are predicted to be not significant.

6.0 EVALUATION OF THE CUMULATIVE EFFECTS OF ALTERNATIVES

Section 7.8 of the EIS Guidelines (NIRB, 2015) require the following:

> *Alternatives analysis: CEA requires the explicit creation of alternative development scenarios and analysis of potential cumulative effects associated with each option (Greig et al., 2002). Therefore, the Proponent should endeavour to ensure its CEA addresses the alternatives presented under Subsection 6.1 of these Guidelines.*

Section 1.2.4 of the CEA identifies three main alternative development scenarios that have been evaluated by Baffinland:

- A future without the Phase 2 Proposal
- A future with the Phase 2 Proposal
- Potential future development at the Mary River Project

The first development scenario is the Approved Project, assessed previously by Baffinland (2012 and 2013). The second development scenario is the implementation of the Phase 2 Proposal, assessed in this Phase 2 Proposal EIS. A potential third future development scenario for the Project was described in Section 1.3.6 and was assessed in Sections 1.4 and 1.5 of the CEA (Baffinland, 2018).

During the technical review of the Phase 2 Proposal, reviewers including CIRNAC requested that Baffinland should ensure its CEA addresses the alternatives presented in Section 6.1 of the EIS Guidelines. These alternatives were assessed in TSD-1, and these included:

- Shipping season
- Shipping route
- Methods of transporting ore overland from the Mine Site to Milne Port
- Railway routing
- Location of second ore dock
- Renewable energy sources

To complete a CEA on each individual alternative would result in approximately 36 different development scenarios, which is not practical or helpful in this assessment. Baffinland maintains that the intent of Section 7.8 of the EIS Guidelines focused on alternative development scenarios, which are listed above and have been assessed previously.

Similarly, Section 6.1 of the EIS Guidelines states the following:

> *When the Proponent assesses the economic viability for each alternative option, due consideration must be given to the vulnerability of the arctic ecosystem, as well as the potential for extension of the mine life and/or increased iron ore production rates. Also, the associated cumulative effects of each option should be discussed, in accordance with the requirements of Subsection 7.8, particularly the potential for cumulative impacts on the marine ecosystem and Inuit harvesting activities. In addition to CEA, alternatives assessment shall also include the following aspects: baseline data, VECs and VSECs and assessment boundaries.*

The environmental and social effects of Project alternatives have been described at a high level as is generally accepted practice for an alternatives analysis in the context of environmental impact assessment. The level of environmental and social analysis of the project alternatives do not support a meaningful evaluation of cumulative effects (i.e., residual effects of hypothetical alternatives overlapping with other past, present and reasonably foreseeable projects and activities). The resulting CEA of alternatives would be considered hypothetical and is generally not supportable as a meaningful or valid assessment of effects.

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8.0 CLOSING

We would like to acknowledge the technical contributions made by Michael Setterington of EDI and Phil Rouget of Golder in Sections 3 and 4, respectively.

We trust this meets with your present requirements. Please do not hesitate to contact the undersigned with questions.

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