Baffinland

TECHNICAL SUPPORTING DOCUMENT

Mary River Project | Phase 2 Proposal | FEIS Addendum | August 2018

TSD 27

Cumulative and Transboundary Effects Assessment

CUMULATIVE AND TRANSBOUNDARY EFFECTS ASSESSMENT TECHNICAL SUPPORTING DOCUMENT SUMMARY

The Cumulative and Transboundary Effects Assessment Technical Supporting Document provides an assessment of cumulative and transboundary effects related to the Phase 2 Proposal. The Phase 2 Proposal builds on the extensive baseline studies and assessments carried out since 2011 for the larger Approved Project and is thus closely linked to the FEIS and previous addendums. The cumulative effects assessment presented in the FEIS was revisited by updating the list of active and reasonably foreseeable projects and considering the temporal boundaries of the Phase 2 Proposal. The previous assessment of cumulative effects of components of the Project that are unaffected by the Phase 2 Proposal remain unchanged from the previous cumulative effects assessment presented in the FEIS.

The majority of biophysical cumulative effects identified are associated with the potential future development scenario and are not due to past, present or reasonably foreseeable projects or activities. Cumulative socio-economic effects are largely positive. Those socio-economic effects predicted to be adverse are generally associated with the potential future development scenario and are not due to past, present or reasonably foreseeable projects or activities.

Transboundary effects of the Phase 2 Proposal are predicted to be not significant. No meaningful adverse socio-economic effects are expected to occur outside of Nunavut, though positive transboundary effects are anticipated. The Project will employ workers based in southern Canada and will present business opportunities to businesses in southern Canada. The Project will also pay federal royalties (aggregate) and tax revenues will accrue to the federal and provincial governments through personal income taxes (including Nunavut's payroll tax), corporate taxes, fuel taxes and sales taxes.

RÉSUMÉ DU DOCUMENT D'ASSISTANCE TECHNIQUE SUR L'ÉVALUATION DES IMPACTS CUMULATIFS ET TRANSFRONTALIERS

Le document d'assistance technique sur l'évaluation des impacts cumulatifs et transfrontaliers comporte une évaluation des impacts cumulatifs et transfrontaliers liés à la proposition de la phase 2. La proposition de la phase 2 est fondée sur les études préliminaires et les évaluations complètes réalisées depuis 2011 pour l'ensemble du projet approuvé et est donc étroitement liée à l'énoncé des incidences environnementales (EIE) et aux addendas précédents. L'évaluation des impacts cumulatifs présentée dans le document Énoncé des incidences environnementales (EIE) a été revue en mettant à jour la liste des projets actifs et raisonnablement prévisibles et en tenant compte des limites temporelles de la proposition de la phase 2. L'évaluation précédente des impacts cumulatifs des composantes du projet qui ne sont pas touchées par la proposition de la phase 2 demeure inchangée par rapport à la précédente évaluation des impacts cumulatifs présentée dans le document Énoncé des incidences environnementales (EIE).

La majorité des impacts biophysiques cumulatifs identifiés sont associés au scénario de développement potentiel futur et ne sont pas liés à des projets ou activités passés, présents ou raisonnablement prévisibles. Les impacts socioéconomiques cumulatifs sont largement positifs. Les impacts socioéconomiques négatifs prédits sont généralement associés au scénario de développement potentiel futur et ne sont pas liés à des projets ou activités passés, présents ou raisonnablement prévisibles.

Les impacts transfrontaliers de la proposition de la phase 2 ne devraient pas être significatifs. Aucun impact socioéconomique négatif important ne devrait se faire sentir à l'extérieur du Nunavut, bien que des impacts transfrontaliers positifs soient prévus. Le projet emploiera des travailleurs du sud du Canada et présentera des occasions d'affaires aux entreprises du sud du Canada. Le projet paiera également les redevances fédérales (agrégées) et des recettes fiscales cumulatives iront aux gouvernements fédéral et provincial au moyen de l'impôt sur le revenu des particuliers (y compris les cotisations sociales du Nunavut), de l'impôt des sociétés, des taxes sur les carburants et des taxes de vente.

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ᐊᕐᒋᔫᒍᔪᑦ ᐆᒪᔪᑦ ᑕᑯᔅᓴᐅᔪᒃᑯᑦ ᑲᑎᖅᓱᖓᔪᑦ ᐊᒃᑐᐃᓂᕐᒥᑦ ᓇᓗᓇᐃᖅᑕᐅᓚᐅᖅᑐᑦ ᐊᒃᑐᖅᑕᐅᔪᓐᓇᖅᑐᑦ ᑕᑯᒃᓴᕈᑐᐃᓐᓇᕆᐊᓕᖕᓄᑦ ᓯᕗᓂᔅᓴᒥᑦ ᓴᓇᔭᐅᕙᓪᓕᐊᓂᕐᒍᑦ ᑕᐅᑐᙳᐊᕐᓂᕐᒍᑦ ᐊᒻᒪᓗ ᒪᓕᖅᑎᑦᑐᑦ ᐊᑐᖅᓯᒪᓂᑯᓄᑦ, ᐅᓪᓗᒥ ᐊᒻᒪᓘᓐᓃᑦ ᓂᕆᐅᒋᔭᒃᓴᓄᑦ ᓴᖅᑭᒃᑲᔭᖅᑐᑦ ᓴᓇᔭᐅᓂᐅᔪᑦ ᐊᒻᒪᓘᓐᓃᑦ ᐱᓕᕆᓂᐅᔪᓄᑦ. ᑲᑎᖅᓱᖓᔪᑦ ᐃᓅᖃᑎᒌᑦ–ᑮᓇᐅᔭᓕᐅᕋᓱᐊᕈᑏᑦ ᐊᒃᑐᐃᓂᕐᒥᑦ ᐊᕐᒋᔩᑦ ᐱᐅᔫᓂᖅᓴᐅᕙᑦ. ᑕᒪᒃᑯᐊ ᐃᓅᖃᑎᒌᑦ–ᑮᓇᐅᔭᓕᐅᕋᓱᐊᒍᑏᑦ ᐊᒃᑐᐃᓂᕐᒥᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᓂᑯᑦ ᐱᐅᔾᔮᕐᒥᓂᖅᓴᖅᓱᕐᒥᑦ ᑕᑯᓪᓗᕐᒥᑦ ᐊᒃᑐᐃᓂᖅᑲᖅᓂᖅᓴᐅᕙᑦ ᓴᖅᑭᑐᐃᓐᓇᕆᐊᓕᖕᓄᑦ ᓯᕗᓂᖅᓴᒥ ᓴᓇᔭᐅᖅᔪᐊᖅᑐᑦ ᑕᐅᑐᙳᐊᕙᖅᓚᓂᑦ ᐊᒻᒪᓗ ᒪᓕᖅᑎᑦᑐᑦ ᐊᑐᖅᓯᒪᓂᑯᓄᑦ, ᐅᓪᓗᒥ ᐅᕝᕙᓘᓐᓃᑦ ᓂᕆᐅᒋᔭᒃᓴᓄᑦ ᓴᖅᑭᒃᑲᔭᖅᑐᑦ ᓴᓇᔭᐅᓂᐅᔪᑦ ᐅᕝᕙᓘᓐᓃᑦ ᐱᓕᕆᓂᐅᔪᓄᑦ.

ᓄᓇᕐᑯᑎᑦᑕ ᑮᓪᓕᐊᑕ ᐅᖓᑖᓄᑦ ᐊᒃᑐᐃᓃᑦ ᐱᓕᕆᐊᒃ ᒪᕿᒋᓕᖅᑕᖓᓂᑦ ᐅᒃᑑᑎᖓᓂ ᓇᓚᐅᑦᑖᖅᑕᐅᙳᕆᓚᑦ ᐊᕐᒋᔫᓇᔭᕐᓂᕐᒋᓂᒃ. ᐊᑑᑎᓕᖅᓂᒃ ᐱᐅᙱᑦᑐᓂᒃ ᐃᓅᖃᑎᒌᑦ–ᑮᓇᐅᔭᓕᐅᕋᓱᐊᒍᑏᑦᑦ ᐊᒃᑐᐃᔾᔪᑎᖏᑦ ᓂᕆᐅᒋᔭᐅᕙᑦ ᓴᖅᑭᒃᑲᔭᕐᓂᖅᑕ ᓄᓇᕗᑉ ᓯᓚᑖᓂ, ᑭᓯᐊᓂᓕ ᐱᐅᔪᑦ ᓄᓇᕐᑯᑎᑦᑕ ᑮᓪᓕᐊᑕ ᐅᖓᑖᓄᑦ ᐊᒃᑐᐃᓃᑦ ᓂᕆᐅᒋᔭᐅᓪᓗᑎᒃ. ᐅᔭᕋᖅᓂᐊᖅᑐᑦ ᐃᖅᑲᓇᐃᔭᖅᑎᑦᑎᕙᑦ ᓴᓇᔨᓂᒃ ᖃᓪᓗᓈᑦ ᓄᓇᖓᓂᑦ ᐊᑐᐃᓐᓇᐅᑎᑦᑎᓂᐊᖅᑐᓂᒃ ᓇᖕᒥᓂᖅᑲᖅᑎᐅᔪᓄᑦ (ᐱᓯᓐᓄᑦ) ᒪᑐᐃᖓᔪᓂᒃ ᓇᖕᒥᓂᖅᑲᖅᑎᐅᔪᓄᑦ (ᐱᓯᓐᓄᑦ) ᑲᓇᑕᐅᑉ ᖃᑦᑐᓈᖅᑲᖅᕙᐊᓂ. ᐅᔭᕋᖅᓂᐊᖅᑐᑦ ᐊᑭᓖᖅᑕᖅᓯᓂᐊᕆᐊᒍᑦ ᒐᕙᒪᑐᖅᑲᒃᑯᓐᓄᑦ ᓂᖅᑭᐳᑎᖅᑭᓐᓂᒃ (ᐃᓗᐃᑦᑑᔪᒍᑦ) ᐊᒻᒪᓗ ᑖᒃᓯᒍᑦ ᐊᑭᓕᐅᑏᑦ ᓇᖅᓯᐅᑎᔭᐅᖅᑲᑦᑕᖅᓗᑎᒃ ᒐᕙᒪᑐᖅᑲᒃᑯᓐᓄᑦ ᐊᒡᒍᖅᓯᒪᔪᓪᓗ ᒐᕙᒪᖅᑲᒃᑯᓐᓄᑦ ᐃᖅᑲᓇᐃᔭᖅᑏᑦ ᓴᓇᓂᖅᑲᓄᑦ ᐃᓐᓇᒪᑖᕐᒥᑦᑐᒍᑦ (ᐱᖅᑲᓯᐅᑎᔪᖅ ᓄᓇᕘᑉ ᑮᓇᐅᔭᓕᐊᑦ ᑖᒃᓯᖓᓂᒃ), ᑎᒥᐅᔪᑦ ᑖᒃᓯᕐᒋᒍᑦ, ᐅᖅᓱᐋᓗᒃᓴᐅᑉ ᑖᒃᓯᕐᒋᒍᑦ ᐊᒻᒪᓗ ᓂᐅᕚᖅᓂᕐᒋᒍᑦ ᑖᒃᓯᕐᒋᒍᑦ.

TSD 27: Cumulative and Transboundary Effects Assessment
Mary Rive Project Phase 2 Proposal

Baffinland Iron Mines Corporation
Mary River Project
NIRB File No. 08MN053

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1 CUMULATIVE ENVIRONMENTAL EFFECTS

1.1 Background

A cumulative effects assessment (CEA) was presented in Volume 9, Section 1 of the FEIS (Baffinland 2012). That assessment was revisited by updating the list of active and reasonably foreseeable projects and considering the temporal boundaries of the Phase 2 Proposal. While the Project Development Area (PDA) boundaries will grow with the Phase 2 Proposal, the overall spatial boundaries of the previous assessments remain largely unchanged. As such, the previous assessment of cumulative effects of components of the Project that are unaffected by the Phase 2 Proposal (i.e., Steensby Port and the south shipping route) remain unchanged from the previous cumulative effects assessment presented in the FEIS.

1.2 Approach

1.2.1 Methodology

The methodology presented in the FEIS (Baffinland 2012) was used to assess the cumulative effects of the Phase 2 Proposal. Figure 1.1 illustrates the framework process applied in the current and previous CEA.

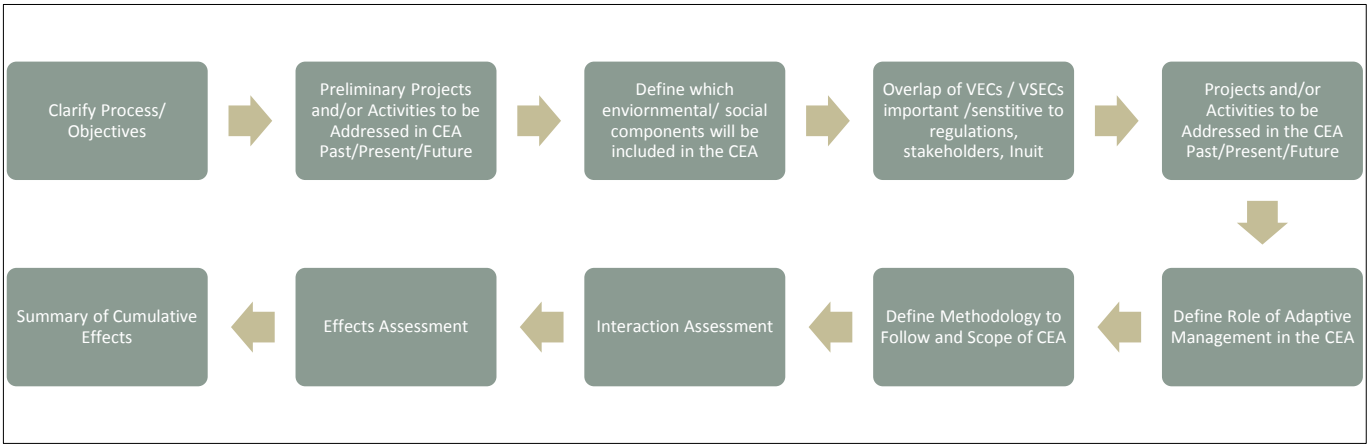


Figure 1.1 Cumulative Effects Assessment Framework

1.2.2 Spatial and Temporal Boundaries

Spatial boundaries remain unchanged from the FEIS assessment of cumulative effects. The Nunavut Settlement Area (NSA) remains an appropriate boundary for the CEA, as the scale is inclusive of any other projects or activities that could potentially interact with the Project, and it represents the NIRB's administrative boundary. Regional Study Areas (RSAs) are applied to specific valued ecosystem components (VECs) as appropriate; the range of the North Baffin caribou were used to assess caribou.

The temporal boundaries of the cumulative effects assessment span 41 years, and include the following time periods:

- **2004 to 2012 – Definition Phase** - Advanced exploration, bulk sampling, engineering studies and permitting;
- **2013 to 2014 – Initial Construction -** Construction of the ERP components of the Project;

- **2015 to 2035 – Construction/Operation -** Current mine operations at 4.2 Mtpa ERP, subsequent increases in mine production to 6 Mtpa, 12 Mtpa and 30 Mtpa (with the intervening construction activities for the 12 Mtpa North Rail operation and 18 Mtpa South Rail operation);
- **2036 to 2038** – 3-Year active closure phase for infrastructure associated with the exploitation of Deposit No. 1; and
- **2039 to 2044 –** 5-Year post-closure monitoring phase for Deposit No. 1.

These temporal boundaries are consistent with those used to assess cumulative effects of the Approved Project (Baffinland 2012).

1.2.3 Types of Cumulative Effects

How cumulative effects may interact and manifest assists in their identification and assessment of significance (Canadian Environmental Assessment Agency 2018). Key types of cumulative effects include:

- **Additive** – An additive cumulative effect is the sum of the two individual effects of two or more physical activities; i.e., combined loss of wildlife habitat from two or more projects or activities
- **Synergistic** – A synergistic cumulative effect occurs when the resultant combination of effects is greater or different than the addition of the effects; i.e., when the combined loss of wildlife habitat results in the loss of an important migratory corridor for wildlife
- **Compensatory** – Compensatory cumulative effects are from two or more physical activities that offset each other; i.e., climate change may increase vegetation growth and partially offset the loss of vegetative cover within a project area
- **Masking** – Masking cumulative effects may occur when the effects of one project mask the effects of another.

Cumulative effects are most often additive, but other types of cumulative effects are identified in this assessment where applicable.

1.2.4 Consideration of Alternative Development Scenarios

Three main alternative development scenarios 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 is described in Section 1.3.6 and is assessed in Sections 1.4 and 1.5.

1.2.5 Temporal Scenarios for Shipping

NIRB (2015) directed Baffinland to evaluate the effects related to different temporal scenarios for shipping, including an option for no ice-breaking in winter and spring. The following additional shipping season alternatives are possible with respect to shipping ore from Milne Port:

- **Shipping during open water** — This was evaluated for the Approved Project.
- **Shoulder season shipping** — Shoulder season shipping is being considered by Baffinland under the current Phase 2 Proposal, although it will only be implemented following engagement with the communities.
- **Shipping in ice** — An approximate 8.5-month shipping season, which included shipping in ice is a potential alternative development scenario that was considered in the initial Phase 2 Proposal (Baffinland 2014) and abandoned due to community concerns. As a proxy to the potential environmental effects of this scenario, the effects of ice breaking along the Southern Shipping route was assessed in the FEIS and the effects were predicted to be not significant.

These alternative shipping scenarios were evaluated in TSD-16 Ice Study Conditions and were further compared in TSD-1 Alternatives Analysis.

1.2.6 Assessing Significance of Cumulative Effects

The method of assessing the significance of cumulative effects also remains unchanged from the FEIS (Volume 9, Section 1.2).

1.2.7 Cumulative Effects of Accidents and Malfunctions and Other Projects

Project-related accidents and malfunctions are considered in the Project residual effects analysis presented in Section 10.2 of the Phase 2 Proposal EIS. Accidents and malfunctions are not planned activities, and as such, the significance of the residual effects of accidental events is not assessed using the conventional methodology that is applied to valued components of the environment. Instead, accidents and malfunctions are evaluated to establish the relative risk, which is a function of both the likelihood or probability of the unplanned event and the consequence severity should it occur. Accidents and malfunctions assessed to be high risk are rated as having both a high probability of occurring and high severity of consequences should they occur. Mitigation measures are identified for each potential accident or malfunction, and accidents and malfunctions that are assessed to remain high risk after applying all available mitigation measures become the focus of contingency planning.

Because accidents and malfunctions are not planned events, they are not appropriate for an assessment of cumulative effects. Additionally, there is no systematic inventory of historical accidents and malfunctions from other projects that could interact with the Mary River Project, so consequently it is not possible to quantitatively assess the potential contribution of cumulative effects of accidents and malfunctions from other projects.

1.3 Scope

1.3.1 Project Components

Project components in the assessment of cumulative effects include all elements of the Project located within the NSA, as well as socio-economic interactions such as employment, training, benefits and royalties that will occur outside of the NSA but within Canada. The Approved Project is described in Volume 3 of the FEIS (Baffinland 2012) and Addendum to the FEIS for

the ERP (Baffinland 2013), and the Phase 2 Proposal components are described in TSD-2 Project Description (Baffinland 2018a).

NIRB (2015) directed Baffinland to pay special attention to the cumulative impacts of increased road haulage, construction/operation of second ore dock, trans-shipping and ice-breaking activities on marine species and traditional harvesting activities. While Baffinland understands the importance of assessing impacts to traditional harvesting activities, the following comments are offered in regard to this direction:

- Increased road haulage is assessed as a Project effect; since there are not any other users of the Milne Inlet Tote Road, there are no cumulative effects.
- Cumulative effects of constructing and operating a second ore dock (in addition to the existing ore dock and approved freight dock) is assessed in Section 1.4.12.
- Trans-shipping and ice-breaking are no longer part of the Phase 2 Proposal.

Baffinland has assessed the effects of the remaining applicable activities on marine species in Sections 1.4.12 to 1.4.14, and effects on traditional harvesting are addressed in Section 1.5.5.

1.3.2 Screening of Other Projects and Activities

The following categories of projects and activities are relevant for screening to determine applicability in this CEA:

- **Past** — Projects and activities that have occurred in the past but are no longer active.
- **Existing** — Projects and activities that that already exist and are ongoing.
- **Reasonably Foreseeable** — Projects and activities that are currently under NIRB Review (not Screening), or that will be submitted for review in the near future, as determined by the existence of a proposed project description, of letter of intent, or any regulatory application filed with an authorizing agency.

An updated inventory of projects and activities considered potentially relevant to the CEA is presented in Table 1.1, and shown on Figure 1.2. The projects and activities that are being carried forward in the CEA are described in Sections 1.3.3 through 1.3.5.

Some projects/activities are excluded from the CEA because they are outside of the spatial or temporal boundaries of the CEA. Nevertheless, they are included in these sections so that adequate explanation of their exclusion is provided.

Projects and activities that spatially overlap only with Baffinland's southern shipping route are not applicable to evaluating cumulative effects of the Phase 2 Proposal. The reader is referred to the previous assessments of the Approved Project (Baffinland 2012 and 2013).

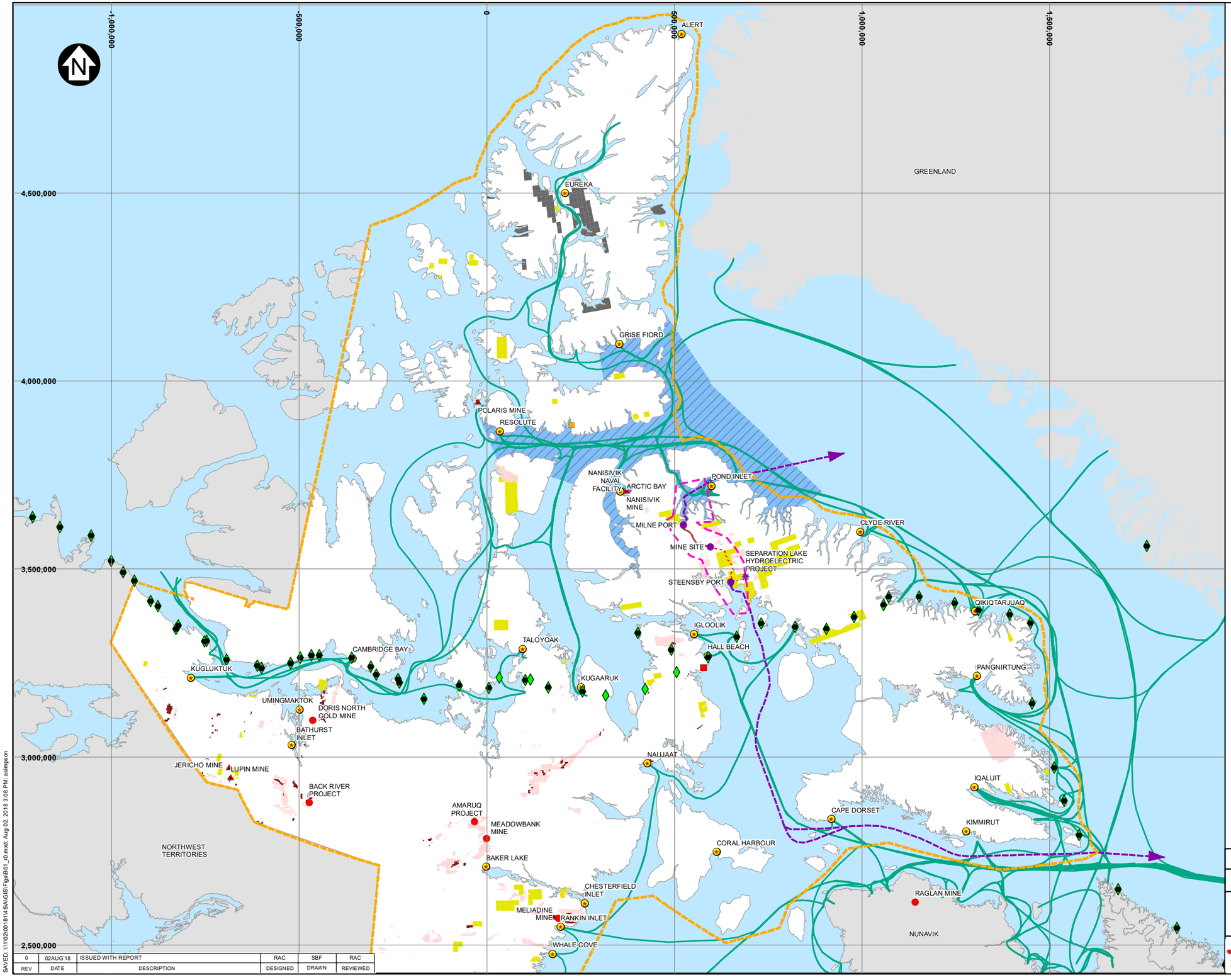
The following provides a description of other projects and activities and an evaluation of their potential to overlap with the Project's residual effects. Where there was a high degree of confidence that the other project or activity would not interact with any residual effects of the Project, it was removed from further consideration.

1.3.3 Relevant Past Projects and Activities

1.3.3.1 Decommissioned Nanisivik and Polaris Mines

The Nanisivik Mine is a decommissioned lead-zinc mine near Arctic Bay; it closed because of low metal prices and declining resources. Mine reclamation was undertaken between 2003 and 2008. Lead-zinc concentrate was shipped from Nanisivik from approximately 1976 to 2002 during both open water and occasionally during ice cover. Shipping associated with the former Nanisivik Mine occurred prior to activities beginning at Mary River in 2004, and therefore lie outside the temporal boundaries established for the CEA. Subsequent mine reclamation activities undertaken up to 2008, however, overlap with the temporal and spatial boundaries of the assessment.

Located 96 km north of the community of Resolute, the Polaris zinc mine was an underground mine on Little Cornwallis Island, over 600 km from the Mary River Project. It was approved for development in 1979 and closed in July 2002. Like Nanisivik, zinc concentrate was shipped from the Polaris Mine over the period of approximately 1976 to 2002 during both open water and occasionally during ice cover. Spatial overlap is limited to shipping along a portion of the northern shipping route; however, shipping associated with the Polaris Mine does not overlap with the temporal boundaries of the CEA. Mine reclamation activities undertaken in 2003 and 2004 marginally overlap with the temporal boundaries of the assessment. For this reason, the decommissioned Polaris Mine is not included in the CEA.



LEGEND :

PROPOSED PROJECT COMPONENTS

GENERAL
- MARY RIVER PROJECT FACILITY
- SEPARATION LAKE HYDROELECTRIC PROJECT
- MILNE INLET TOTE ROAD
- RAILWAY
- SEPARATION LAKE HYDROELECTRIC PROJECT TRANSMISSION LINE
- MARY RIVER PROJECT REGIONAL STUDY AREA

MARINE TRANSPORATION ROUTES
- MARY RIVER PROJECT SHIPPING ROUTES

NON-PROJECT COMPONENTS

GENERAL
- COMMUNITY
- RCMP OUTPOST - HISTORIC
- PROPOSE NAVAL REFUELING STATION
- NUNAVUT SETTLEMENT AREA BOUNDARY
- TALLURUTIUP IMANGA NATIONAL MARINE CONSERVATION AREA

MARINE TRANSPORATION ROUTES
- EXISTING SHIPPING ROUTE

MINERAL EXPLORATION
- PROSPECTING PERMITS (ACTIVE)
- MINERAL CLAIM (ACTIVE)
- MINING LEASE (ACTIVE)
- MINING LEASE (PENDING)
- COAL CLAIMS (NIRB REJECTED PROJECT)

MINING
- ACTIVE MINE
- PROPOSED MINE
- DECOMMISSIONED MINE

DEW LINE FACILITIES
- NORTH WARNING SYSTEM
- DEW LINE SITES

NOTES :

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. CO-ORDINATE GRID IS IN METRES.
   DATUM: NAD83
   PROJECTION: CANADA LAMBERT CONFORMAL CONIC
3. MINING LEASE AND MINERAL CLAIM DATA PROVIDED BY THE DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT (INAC). UPDATED JANUARY 2017.
4. EXISTING ARCTIC SHIPPING ROUTES OBTAINED FROM TRANSPORT CANADA, NOVEMBER, 2010. MARINE ACTIVITY DATA FOR CANADA WAS BASED ON NORDREG REPORTS AND CCG ROC CONTACTS. VESSELS NOT REPORTING TO THE VOLUNTARY NORDREG SYSTEM MAY NOT BE INCLUDED.
5. DEW LINE SITES OBTAINED FROM DEPARTMENT OF NATIONAL DEFENCE SEPTEMBER 30, 2010.
6. FIGURE CREATED BY KNIGHT PIESOLD LTD.

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BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

EXISTING AND FUTURE INDUSTRIAL PROJECTS AND ACTIVITIES IN NUNAVUT

Baffinland

P/A NO.	REF NO.
NB102-181/45	1

FIGURE 1.2 REV 0

Table 1.1 Projects and Activities with the Potential to Interact with the Project

Phase	Project	Description	Company/ Organization	Distance from Project	Operational Period	Temporal Overlap	Spatial Overlap	Inclusion in CEA for Phase 2 Proposal
Past	Nanisivik Mine (Decommissioned)	Former Lead-Zinc Mine	Breakwater Resources Inc.	~ 180 km NW of Milne Port	Operated 1976 to 2002; decommissioned 2003 to 2008	Yes; 2004 to 2008	Northern shipping route	Yes, mine decommissioning temporally overlaps, and Project spatially overlaps with Project's terrestrial and marine RSAs
	Polaris Mine (Decommissioned)	Former Zinc Mine	Teck Cominco	~ 650 km NW of Milne Port	Operated 1981 to 2002; decommissioned in 2003 and 2004.	No temporal overlap	A portion of the northern shipping route	No, mine decommissioning occurred outside CEA temporal boundaries
	Mary River Project Definition Phase	Advanced exploration; bulk sample; geotechnical drilling; environmental baseline studies; regional exploration	Baffinland Iron Mines Corporation	Same Project	2004 to 2012	Within CEA temporal boundaries	Spatial boundaries overlap (same project)	Yes, within CEA temporal boundaries and also spatially overlaps with the Project
	Diamond Exploration	Diamond exploration programs south west of the Mine Site	DeBeers Canada Inc.	~ 50 km SW of Mine Site	2004 to 2008	Within CEA temporal boundaries	Spatial boundaries within terrestrial RSA	Yes, overlaps with the Project temporally and spatially
Existing	Raglan Mine	Operating nickel mine in Deception Bay, Nunavik including the 2 new mining phases called the Sivumut Project (Glencore 2017)	Glencore Canada Corporation	~ 1000 km SSE from Steensby Port	1997 to 2041	Within CEA temporal boundaries	Shipping overlaps with southern shipping route	Not applicable to this CEA; overlap with southern shipping route was assessed in the FEIS
	Nanisivik Naval Facility and Military Exercises	Naval Refueling Facility at the former Nanisivik Mine	Department of National Defence	~ 180 km NW of Milne Port	2018 onwards	Within CEA temporal boundaries	Unknown; likely to overlap with northern shipping route	Yes, overlaps with the Project temporally and spatially

Table 1.1 Projects and Activities with the Potential to Interact with the Project

Phase	Project	Description	Company/ Organization	Distance from Project	Operational Period	Temporal Overlap	Spatial Overlap	Inclusion in CEA for Phase 2 Proposal
	Military Radar Stations	DEW Line system remediation concluded in 2014. The current NWS consists of unmanned stations (radar tower, building and airstrip).	Department of National Defence	Closest station is ~ 500 km SE of Mine Site	1950s onwards	Within CEA temporal boundaries	Outside of terrestrial RSA	No, does not overlap with the Project's terrestrial RSA
Existing	Meadowbank Mine (including Whale Tail and Amaruq extensions)	Operating gold mine 100 km from Baker Lake, Kivalliq, Nunavut (Agnico Eagle Mines Ltd., 2017a,b)	Agnico Eagle Mines Ltd.	~ 1000 km SW from the Mine Site	2010-2024	Within CEA temporal boundaries	Shipping overlaps with southern shipping route	Not applicable to this CEA; overlap with southern shipping route was assessed in the FEIS
	Meliadine Project	Proposed gold project, 25 km from Rankin Inlet (Agnico Eagle Mines Ltd., 2017c)	Agnico Eagle Mines Ltd.	~ 1000 km SW from Steensby Port	2019 onwards	Within CEA temporal boundaries	Shipping overlaps with southern shipping route	Not applicable to this CEA; overlap with southern shipping route was assessed in the FEIS
	Back River Project	Planned gold mine in the Western Kitikmeot Region of Nunavut	Sabina Gold and Silver Corporation	~ 1200 km WSW from the Mine Site	2019-2035	Within CEA temporal boundaries	Shipping overlaps with northern shipping route	Yes, overlaps with the Project temporally and spatially
	Hope Bay Project (Doris North Gold Mine and the Phase 2 Hope Bay Belt Project	Operating gold mine in the Kitikmeot region, Nunavut	TMAC Resources Inc.	~ 1200 km SW of the Mine Site	Doris North: 2017-2022; Phase 2: 2019-2035	Within CEA temporal boundaries	Shipping overlaps with northern shipping route	Yes, overlaps with the Project temporally and spatially
	Regional Ship Traffic	Ship traffic from community sealifts, cruise ships and military exercises	Various	~ 100 km NE of Milne Port	Ongoing	Within CEA temporal boundaries	Shipping overlaps with northern shipping route	Yes, overlaps with the Project temporally and spatially
	Regional Air Traffic	Air transport servicing communities	Various	~ 150 to 400 km from the Mine Site	Ongoing	Within CEA temporal boundaries	Potentially within terrestrial and marine RSAs	Yes, overlaps with the Project temporally and spatially

Table 1.1 Projects and Activities with the Potential to Interact with the Project

Phase	Project	Description	Company/ Organization	Distance from Project	Operational Period	Temporal Overlap	Spatial Overlap	Inclusion in CEA for Phase 2 Proposal
	Communities and Traditional/Recreational Land Use	Five communities near the Project; land use associated with local residents	Arctic Bay, Clyde River, Hall Beach, Igloolik and Pond Inlet	Various	Ongoing	Within CEA temporal boundaries	Within terrestrial and marine RSAs	Yes, overlaps with the Project temporally and spatially
	Regional Monitoring Programs	Marine mammal, caribou, bird and freshwater environmental effects monitoring programs	DFO, Government of Nunavut, Baffinland	Within the Terrestrial and Marine RSAs	Ongoing	Within CEA temporal boundaries	Within terrestrial and marine RSAs	Yes, overlaps with the Project temporally and spatially
Existing	Sirmilik National Park	Tourist visits to experience the ecology and remoteness of the area, backcountry camping, ski touring, wildlife viewing and boating (May-September)	Parks Canada	~ 175 km N of Milne Port	Ongoing	Within CEA temporal boundaries	Within marine RSA	Yes, overlaps with the Project temporally and spatially
	Bylot Island Migratory Bird Sanctuary	Federally designated as a Category IV Habitat Species Management Area by the International Union for the Conservation of Nature. Activities include harvesting and bird research.	Environment and Climate Change Canada	~ 175 km N of Milne Port	Ongoing	Within CEA temporal boundaries	Within marine RSA	Yes, overlaps with the Project temporally and spatially
	Baffinland Regional Exploration	Baffinland conducts ongoing regional exploration, and aims to establish an exploration camp and drilling program at Eqe Bay in 2019.	Baffinland Iron Mines Corporation	~ 200 km SE of Mine Site; ~90 km ESE of Steensby Port	2019 onwards	Within CEA temporal boundaries	Within terrestrial RSA	Yes, overlaps with the Project temporally and spatially

Table 1.1 Projects and Activities with the Potential to Interact with the Project

Phase	Project	Description	Company/ Organization	Distance from Project	Operational Period	Temporal Overlap	Spatial Overlap	Inclusion in CEA for Phase 2 Proposal
	Climate Change	There is documented evidence that climate change is occurring globally and in the region, and that these trends will continue into the future (TSD-6).	N/A	Global	N/A	Within CEA temporal boundaries	Within terrestrial and marine RSAs	Yes, overlaps with the Project temporally and spatially
Reasonably Foreseeable	Roche Point Iron Ore Project	This Project has been abandoned, as the Project owner dissolved (Advanced Explorations Inc., 2015)	N/A	~ 250 km SW of Steensby Port	N/A	N/A	N/A	No, Project has been abandoned.
	Tullurutiup Imanga/ Lancaster Sound NMCA	Future National Marine Conservation Area, final boundary was agree upon in August 2017, IIBA negotiations are underway	Government of Canada, Government of Nunavut, and QIA	~ 270 km N of Milne Port	Ongoing	Expected to be within CEA temporary boundaries	Within marine RSA	Yes, overlaps with the Project temporally and spatially
	Grays Bay Road and Port Project (GBRP) (Withdrawn)	Proposed all-season road linking the northern terminus of the Tibbitt-Contwoyto Winter Road to a deep-water port at Grays Bay. Intended to improve regional resupply and induce mining in the Slave Geological Province.	Government of Nunavut and Kitikmeot Inuit Association	~ 1,200 km from Milne Port	Unknown; assumed to be 2020	Does not overlap with CEA temporal boundaries	Within marine RSA	No, this project proposal has been withdrawn (Section 1.3.5.3).
	Separation Lake Hydroelectric Project	A potential hydroelectric project at the pre-feasibility study stage that may be found to feasibly provide power to Steensby Port	Baffinland Iron Mines Corporation	~ 100 km SE of Steensby Port	Future (undetermined timelines)	Potentially within CEA temporary boundaries	Within terrestrial RSA	Does not qualify as a reasonably foreseeable project.

Table 1.1 Projects and Activities with the Potential to Interact with the Project

Phase	Project	Description	Company/ Organization	Distance from Project	Operational Period	Temporal Overlap	Spatial Overlap	Inclusion in CEA for Phase 2 Proposal
	Mary River Project – Potential Future Development	Future development of other known deposits (Deposits No. 2 through 9)	Baffinland Iron Mines Corporation	Within 1 to 25 km of the Mine Site	Future (undetermined timelines)	Potentially within CEA temporary boundaries	Within terrestrial and marine RSAs	Does not qualify as a reasonably foreseeable project.

1.3.3.2 Definition Phase of the Mary River Project

Baffinland initiated its exploration program at Mary River in 2004. The following activities were undertaken between 2004 and 2012:

- Exploration started in 2004 with the establishment of an exploration camp at Mary River and drilling of Deposit No. 1
- Drilling extended to adjacent Deposits No. 2 and 3 in 2007
- A bulk sampling program was undertaken in 2007 and 2008, involving the mining of 113,000 t of iron ore, upgrade of the Milne Inlet Tote Road to all-season capability, establishment of camp and ship-loading facilities at Milne Port and shipment of supplies and ore in and out of Milne Port
- Geotechnical investigations at Project development sites and along the South Railway (helicopter-supported drilling program) over 2007 and 2008
- Comprehensive environmental baseline studies from 2005 through 2008, including terrestrial and marine aerial surveys for wildlife, and
- Regional exploration programs, operation of established camp facilities, road maintenance and environmental monitoring programs over the period of 2009 through 2012.

These activities physically overlap with the Phase 2 Proposal and are within the temporal boundaries of the assessment.

1.3.3.3 Diamond Exploration

Diamond exploration activities were undertaken southwest of the Mine Site by De Beers Canada Inc. (De Beers) between approximately 2004 and 2008. The mineral claims associated with this diamond exploration work, located south-southwest of the Mine Site (Figure 1.5), remain active claims though no exploration camp remains. These past activities are included in the scope of the assessment, and have the potential to contribute cumulatively on effects to vegetation, migratory birds and terrestrial wildlife.

1.3.4 Relevant Existing Projects

1.3.4.1 Nanisivik Naval Facility and Military Exercises

The former dock has been undergoing refurbishment by the Canadian government since 2014 and is expected to open as the Nanisivik Naval Facility in the fall of 2018. It will serve as a refuelling station for military and government ships in the Arctic. The presence of this facility will presumably increase naval traffic in the area during the open water season when the facility is operating. The extent of ship traffic increases that may result from operation of the refuelling facilities is unknown, but it is assumed that the naval facility will support annual military exercises such as Operation Nanook, a joint exercise undertaken annually by the Canadian Armed Forces (CAF) and the Canadian Coast Guard. From 2007 to 2018, the CAF conducted a number of different operations in the North (National Defence and the Canadian Armed Forces 2018):

- Operation Nunalivut focused on land operations, cooperating with international partners, and supporting research and development in the High Arctic during late winter or early spring.
- Operation Nunakput focused on operating with government partners along northern waters in the summer.
- Operation Nanook included one or two major activities, and took place across the North in the late summer.

Now, these activities are all combined under Operation Nanook.

1.3.4.2 Military Radar Stations

The Distant Early Warning (DEW) Line was a system of 63 radar stations positioned along a line across the north from Alaska to Baffin Island. Decommissioning activities were undertaken by the Department of National Defence and were concluded in 2014. A 25 year monitoring program of the decommissioned DEW Lines is in place.

While the DEW Line sites would qualify as a past project/activity, it has been included as an existing project/activity because it has been replaced by the North Warning System (NWS), a chain of unmanned radar sites located at a portion of the former DEW Line Stations (Figure 1.2). Within Canada, the NWS consists of 47 radar sites of 11 long-range and 36 short-range radar sites. These sites are operated remotely but do require periodic visits for inspection and maintenance.

1.3.4.3 Back River and Hope Bay Projects

Construction of the Back River Project began in 2018 and is expected to require three to four sealift vessels and one tanker delivering materials and fuel respectively to the Back River marine laydown area in Bathurst Inlet during the construction and operation phases (Sabina Gold & Silver Corporation 2015). This shipping may originate from Vancouver through the western shipping route, or may occur through the eastern shipping route which includes shipping through Lancaster Sound and Baffin Bay.

The Hope Bay Project requires a similar level of shipping, which also may originate from the west or from the east. Any shipping through the east will potentially interact with marine mammals that may interact with the Phase 2 Proposal.

1.3.4.4 Regional Ship Traffic

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, and
- Limited transit of commercial and recreational vessels (including cruise vessels) through the Northwest Passage.

Annual shipping traffic over a 16-year period (2002 to mid-September 2017) in the vicinity of the Northern Shipping Route is summarized in Table 1.2 and illustrated in Figure 1.3.

Table 1.2 Vessel Transits in Shipping Zones Near the Northern Shipping Route (2002 to 2017)

Year	Baffin Bay	Eclipse Sound	Lancaster Sound	Milne Inlet	Navy Board Inlet
2002	92	22	67		4
2003	74	21	30		3
2004	71	21	31	2	7
2005	68	24	38	1	9
2006	80	32	37	10	6
2007	75	35	42	7	6
2008	115	48	49	17	5

Table 1.2 Vessel Transits in Shipping Zones Near the Northern Shipping Route (2002 to 2017)

Year	Baffin Bay	Eclipse Sound	Lancaster Sound	Milne Inlet	Navy Board Inlet
2009	76	25	41	2	8
2010	148	42	50	2	8
2011	140	42	50	11	7
2012	151	31	52	2	4
2013	189	76	73	31	11
2014	213	86	93	31	17
2015	226	102	104	43	13
2016	280	151	93	96	23
2017	233	172	111	96	18

NOTES:

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

Monthly shipping statistics for the same period are presented in Table 1.3 and on Figure 1.4. The information is derived from the Canadian Coast Guard's Vessel Traffic Management Information System, referred to as INNAV (Canadian Coast Guard 2018).

Table 1.3 Shipping Statistics in Shipping Zones Near the Northern Shipping Route (2002 to 2017)

Month	Statistic	Baffin Bay	Eclipse Sound	Lancaster Sound	Milne Inlet	Navy Board Inlet
January	min	4				
	mean	4				
	max	4				
February	min	1				
	mean	1.3				
	max	2				
March	min	1				
	mean	1				
	max	1				
April	min	1				
	mean	1				
	max	1				
May	min	1				
	mean	1				
	max	1				
June	min	1				
	mean	1.2				
	max	2				
July	min	8	1	2	1	1
	mean	16.2	4.1	4	4.4	1.5
	max	31	14	10	12	5

Table 1.3 Shipping Statistics in Shipping Zones Near the Northern Shipping Route (2002 to 2017)

Month	Statistic	Baffin Bay	Eclipse Sound	Lancaster Sound	Milne Inlet	Navy Board Inlet
August	min	27	11	18	1	1
	mean	63.8	35.4	35.3	16.5	4.9
	max	160	134	75	71	13
September	min	20	3	7	2	1
	mean	42.8	16.9	19.1	11.0	3.1
	max	89	50	39	37	7
October	min	5	1	1	1	1
	mean	14	3.8	2.4	3.3	1.3
	max	32	8	7	7	2
November	min	1				
	mean	2.4				
	max	9				
December	min	1				
	mean	2				
	max	4				

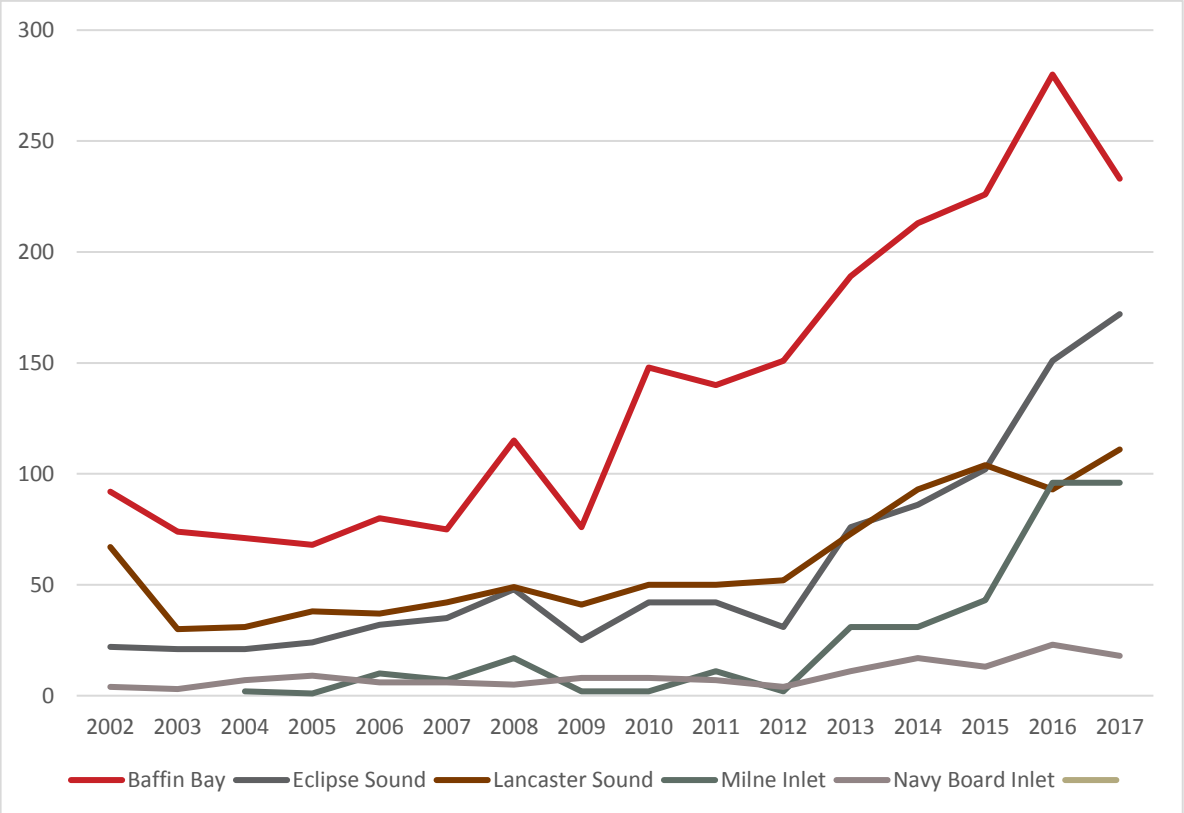

Figure 1.3 Annual Shipping Traffic Near the Northern Shipping Route (2002 to 2017)

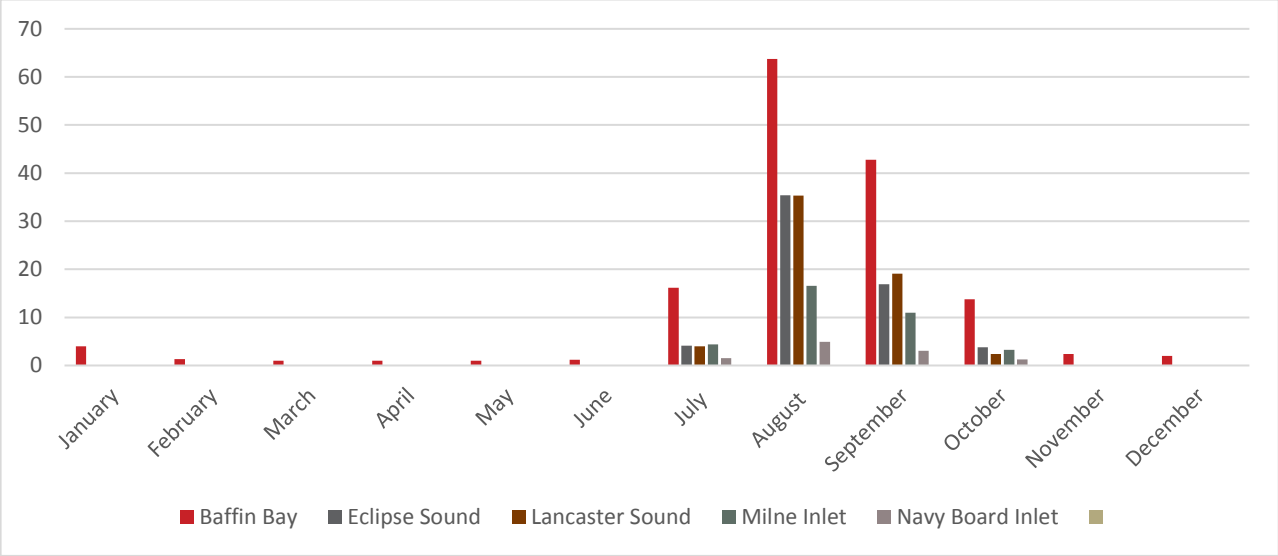

Figure 1.4 Mean Vessel Transits by Month Near the Northern Shipping Route (2002 to 2017)

Vessels associated with the Project transit through Baffin Bay, Eclipse Sound and Milne Inlet, but not Navy Board Inlet or Lancaster Sound. The majority of 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 (Figure 1.3).

Vessel traffic in Eclipse Sound will be from the Project as well as from non-Project related vessels. As such, the difference in vessel traffic (Eclipse Sound traffic minus Milne Inlet traffic) largely represents shipping traffic not related to the Project.

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 open water shipping season of July 25 to October 15, to an estimated 176 vessel trips over a shipping season that extends into the shoulder season (approximately July 1 to November 15). The number of vessels cited is inclusive of ore carriers, sealift vessels and tankers.

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.

Shipping activities for the Phase 2 Proposal are not expected to induce the use of the same shipping corridors for other projects. The Project's shipping activities do not require the use of navigational aids that can make the shipping route more accessible. Supplementary bathymetric surveys have been completed by Baffinland in the immediate vicinity of the port, but this bathymetry does not improve accessibility for other marine traffic. In terms of the potential to induce additional shipping in the Arctic, the Project will provide Baffinland and other parties with an example of what is technically and commercially feasible in terms of shipping large quantities of a bulk commodity in this part of the Arctic during the open water and shoulder season shipping window. Similar projects in the future may refer to the Project's shipping activities when assessing the viability of other mining developments involving a similar level of shipping.

1.3.4.5 Regional Air Transport

Air transport continues to be a lifeline of Nunavut committees. As in the FEIS, air transportation is considered in general terms for the CEA, where it could contribute to GHG emissions and/or sensory disturbance to terrestrial wildlife and/or marine mammals. The impacts of regional air transport are expected to be confined to a relatively compact area surrounding each community or industrial project, since these aircraft generally fly at high altitudes outside of the approach to airstrips.

Air transport related to mineral exploration involves more local use of fixed wing aircraft and helicopters. This is considered under exploration activities (Sections 1.3.3.3 and 1.3.4.9).

1.3.4.6 Communities and Traditional and Recreational Harvesting

Communities have a terrestrial footprint and represent a human presence in the region. Ongoing traditional sustenance and recreational (sport) hunting, fishing and foraging activities occur in the terrestrial and marine environments, concentrated mainly concentric to the communities but also extending outward hundreds of kilometres, primarily targeting game species. The potential for interactions exists with Project effects on traditional and recreational hunting species and thus on traditional sustenance. Land use and Inuit Qaujimajatuqangit (IQ) information supporting the Phase 2 Proposal is included in the following technical supporting documents: TSD-3 Community Workshops Report (Jason Prno Consulting Services Ltd. 2017); TSD-4 Public Consultation Report; and TSD-5 IQ Mapbook (Knight Piésold 2014). Perhaps the most informative presentation of contemporary Inuit harvesting patterns are harvest locations from the Nunavut Wildlife Harvest Study (Priest and Usher 2004) presented in FEIS Appendix 4C (Knight Piésold 2010).

1.3.4.7 Tourism and Commercial Recreation Activities

Tourism and commercial recreation activities on northern Baffin Island are primarily:

- Adventure tourism, where participants engage with the natural and cultural uniqueness of the area (e.g., kayaking, hunting, hiking and nature watching). Tourism numbers are low and generally confined to the summer months.
- Cruise ships, which sail through Pond Inlet and past Sirmilik National Park several times each summer.
- An increasing trend in use of the Northwest Passage by private and commercial recreation vessels.

Historic ship traffic related to tourism is included in the ship traffic statistics presented in Section 1.3.4.4.

1.3.4.8 Regional Monitoring Programs

Various monitoring programs are underway in Nunavut, by Baffinland and other parties. A large number of Baffinland's monitoring programs were listed in the CEA for the Approved Project, but most of those monitoring programs do not have a measureable impact. The relevant monitoring programs warranting consideration in this CEA include the following:

- **Marine mammal aerial surveys and narwhal tagging program** – A number of marine mammal surveys have been and continue to be conducted in the Milne Inlet / Eclipse Sound area:
    - Fisheries and Oceans Canada (DFO) conducts aerial surveys of marine mammal populations and is currently tagging narwhal in the region. Baffinland provides field and logistical support to this program. Monitoring activities typically take place in August every year. Baffinland conducted aerial surveys for marine mammals as part of its environmental baseline studies program.
    - Since 2013, Baffinland has been conducting non-intrusive line of sight marine mammal surveys in Milne Port from a vantage point on the Bruce Head peninsula.

- **Caribou surveys** - The Government of Nunavut (GN) conducts caribou monitoring through periodic aerial surveys, the last survey having been conducted island-wide in 2014 (Campbell et al. 2015). These surveys have been undertaken every few years and typically occur in late winter, when caribou are visible against the snow and the animals are not yet calving. Baffinland also conducts annual line of sight caribou surveys and snowbank height monitoring, both of which are non-intrusive.

- **Environmental effects monitoring under the Metal and Diamond Mining Effluent Regulations (MDMER)** – Fish population surveys are conducted within watercourses receiving mine effluent every three years; the first survey was completed in 2017 and the next survey will be in 2020 (Minnow Environmental Inc. 2018). Non-destructive fish population sampling is being undertaken, however, which is assumed to have a negligible effect on local fish populations.

The disturbances associated with marine mammal and caribou monitoring programs that involve aerial surveys and/or tagging warrant consideration in the CEA.

1.3.4.9 Baffinland's Regional Exploration Activities

Baffinland has been undertaking regional exploration activities within the mineral claim blocks shown on Figure 1.3 since approximately 2013. These activities have 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.

Baffinland is currently seeking approval to establish an exploration camp and conduct exploration drilling at the Eqe Bay Prospect, located along the coast of Foxe Basin and approximately 200 km south of the Mine Site.

1.3.4.10 Climate Change

There is ample evidence that climate change is occurring and will continue to affect the North Baffin Region. Potential effects from climate change are not traditionally considered within a cumulative effects assessment but the pathways are similar. Global emissions of greenhouse gases (GHGs) are expected to cause an overall warming trend, with more rapid changes in polar latitudes such as the Arctic (Larsen et al. 2014). Over time, effects to species and ecosystems are likely to be widespread but will vary relative to realized emissions pathways (Field et al. 2014). Climate change effects interact with the project identically to cumulative effects: they result from external activities that are beyond control of the Project but have the potential to interact with direct and indirect project effects. Climate change effects include:

- An increase in ambient air temperatures
- An increase in ground temperatures and thawing of permafrost
- An increase in precipitation and evaporation, resulting in more extreme flow events
- Changes to sea ice (thickness, extent, duration of ice-covered period)
- Warming of freshwater and marine waters, and consequent ecological changes
- Changes to vegetation, migratory birds and wildlife (terrestrial and marine) resulting from the above effects to the physical environment, and
- Changes to Inuit land use and harvesting arising from effects to the physical environment and wildlife.

A Climate Change Assessment is presented as TSD-6, and additional information on climate change impacts to VECs are provided in individual VEC assessments presented as part of the Phase 2 Proposal EIS, and summarized as necessary throughout Sections 1.4 and 1.5 of this document.

1.3.5 Relevant Reasonably Foreseeable Projects

NIRB (2007) defines reasonably foreseeable projects as those 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, a letter of intent, or any regulatory application filed with an authorizing agency.

The only reasonably foreseeable projects or activities that temporally and spatially overlap with the Phase 2 Proposal is the proposed Tullurutiup Imanga National Marine Conservation Area (NMCA). Extraction activities (minerals, oil and gas, aggregate) are prohibited within an NMCA under the *National Marine Conservation Areas Act* (Minister of Justice 2018).

Several projects and activities were considered but determined to not meet the definition of reasonably foreseeable. Nonetheless, a description of several projects and activities considered as potentially reasonably foreseeable projects and activities are described below.

NIRB (2015), however, requested that Baffinland consider the following:

- Effects of potential future development of other identified deposits (Deposits No. 2, 3 and 4), and possible new deposits to be identified from the ongoing exploration program at or near Mary River
- Effects of an increased lifetime for the railway and port facilities resulting from possible expansion of the currently proposed project.

Potential exists in the future to increase the production rate and/or extend the life of the Project by developing additional deposits. Neither of these scenarios meet the criteria of a reasonably foreseeable project, and Baffinland currently has no development plans that consider such scenarios. Nonetheless, a future development scenario has been described in Section 1.3.6 and is evaluated in the cumulative effects assessment (Sections 1.4 and 1.5).

1.3.5.1 Proposed Tullurutiup Imanga National Marine Conservation Area

The Tullurutiup Imanga National Marine Conservation Area (NMCA) is a proposed marine conservation area that encompasses Lancaster Sound, Pond Inlet, Navy Board Inlet, Eclipse Sound and Milne Inlet. In August 2017, the Government of Nunavut, the Government of Canada and the Qikiqtani Inuit Association (QIA) agreed upon a boundary of the conservation area (QIA 2017). The NMCA protects approximately 109,000 km^2 of ocean and extends into Eclipse Sound and Milne Inlet. Shipping activities associated with the Phase 2 Proposal will transit through the proposed Tullurutiup Imanga NMCA. Resource exploitation activities for hydrocarbons, minerals and aggregates within marine conservation areas are prohibited in NMCAs (Minister of Justice 2018). Establishment of the NMCA will restrict these activities from occurring and potentially interacting cumulatively with the Project.

1.3.5.2 Separation Lake Hydroelectric Project

Early in the definition phase, Baffinland investigated opportunities to provide hydroelectric power to the Project (Knight Piésold 2006). A promising site was identified on the Rowley River at Separation Lake, located roughly 100 km east of the proposed Steensby Port (Figure 1.2). The project is too removed to cost-effectively construct a transmission line to the Mine Site, but may be worth further investigation of its feasibility once Steensby Port is constructed, however, Baffinland does not have plans to do this at this time. The project would involve constructing a small dam at the outlet of Separation Lake to create a modest sized reservoir, a tunnel to a lower elevation lake, a powerhouse and transmission line to Steensby Port.

The Separation Lake Hydroelectric Project does not qualify as "reasonably foreseeable project", according to the definition.

1.3.5.3 Grays Bay Road and Port Project

The Grays Bay Road and Port Project (GBRP) consists of an all-season road linking the northern terminus of the Tibbitt-Contwoyto Winter Road to a deep-water port at Grays Bay on the Northwest Passage. The GBRP is intended to improve regional resupply and induce mining in the Slave Geological Province. The proponents are the Government of Nunavut and the Kitikmeot Inuit Association (KIA). A project proposal was submitted to the NIRB in July 2017 (Grays Bay Road and Port Engineering & Environmental Consultants 2017), and in January 2018 the INAC Minister referred the project to NIRB for a full environmental review (Nunatsiaq News 2018a). In April 2018, however, the Nunavut government pulled its resources out of the Project after a federal funding request was denied (CBC 2018). Shortly thereafter, the NIRB halted the environmental assessment at the request of the KIA (Nunatsiaq News 2018b). For this reason, the GBRP is not included in the CEA as a reasonably foreseeable project.

1.3.6 Potential Future Development of the Mary River Project

The Approved Project and the Phase 2 Proposal both focus on the extraction of iron ore from Deposit No. 1. Since the 1960s, Deposit No. 1 was one of four known high-grade iron ore deposits (Deposits No. 1 through 4). Baffinland's regional exploration program has identified a number of other iron deposits including Deposits No. 5 to 9, Eqe Bay, Isortoq, and others (Figure 1.5). Although their viability to support mining has not yet been proven, exploration findings are promising and could result in changes in the sequence of future mining development.

Baffinland aims to mine other iron ore deposits in the area, and to further increase its production rate over time, subject to successive approval processes. This was assessed previously in the FEIS. Possibilities for future development of the Mary River Project are discussed below.

Deposits No. 2 and 3 are located within the Mary River watershed upstream of Deposit No. 1. Given the close proximity of these deposits to mining infrastructure of Deposit No. 1, these deposits are the most likely to be exploited next, based on current information. Limited additional infrastructure would be required to mine these deposits. The Mine Site PDA would expand to incorporate the footprint of the open pits and the associated waste rock stockpiles. A conceptual expansion to the PDA is shown on Figure 1.6.

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 changes would be required to the Phase 2 Proposal facilities.

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 close 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 of these deposits could occur. Ore from these deposits could be transported to Milne Port over the Milne Inlet Tote Road, which is close by, or could be accessed by an approximately 6 km and 3 km long railway spurs from the North Railway. Unlike Deposits No. 2 and 3, Deposits No. 4 and 5 would require dedicated ore stockpiling, crushing and rail loading facilities and would 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.

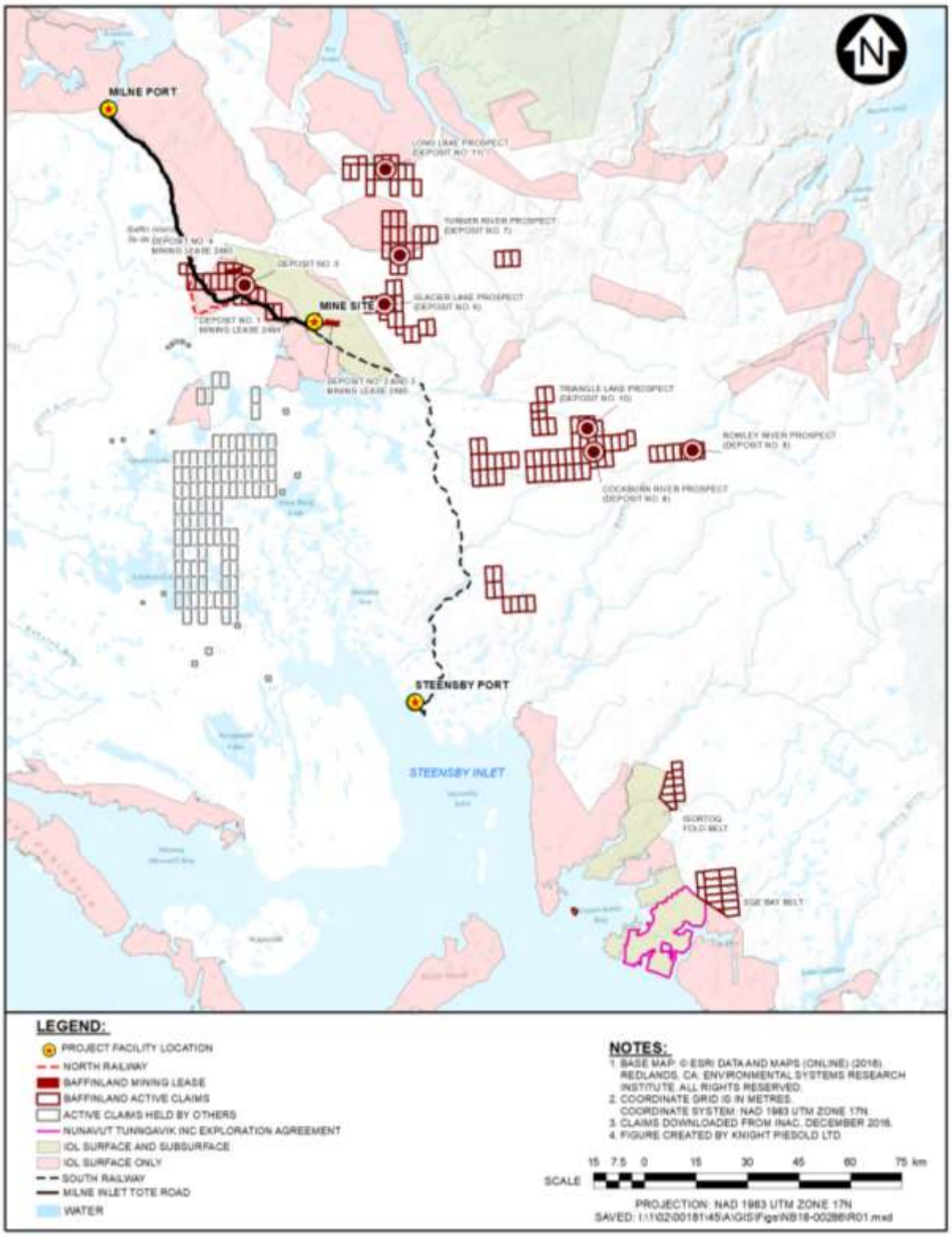

Figure 1.5 Mineral Leases in Claims in the Vicinity of the Project

Other deposits (Deposits No. 6 through 11) were discovered in 2010 and have been sampled at surface only. These deposits are located within tens of kilometres (up to 50 km) of either the Mine Site or 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. Additional exploration activities at these deposits could result in changes in the sequence of future mining development contemplated above.

The abundance of high grade iron ore deposits in the North Baffin region ensure that the Mary River Project will be a multigenerational development, with numerous phases of development to respond to market conditions and expectations of the impacted North Baffin communities. Although a specific future development scenario cannot be detailed at this time, Baffinland is committed to the future development and expansion of the Mary River Project.

The future development scenario in this cumulative effects assessment is similar to that previously evaluated in the FEIS and FEIS Addendum: that nearby deposits will be developed resulting in a doubling in production rate and a doubling of the Project life through the development of Deposits No. 2, 3, 4 and 5. Baffinland reiterates that this development scenario is entirely speculative, since resource estimates do not exist for any of these four deposits, or other potential deposits. It is therefore not possible to predict the production rate nor the Project Life.

The additional PDA that would result from this future development scenario is presented in Table 1.4 and on Figure 1.6.

Table 1.4 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 2 and 3 would increase the total PDA area by roughly 18.5%, and development of Deposits 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.

The cumulative effects of increase ore shipments through Steensby Port (doubling of shipment to 36 Mtpa) was previously assessed by Baffinland (2012) so that future development scenario is not revisited.

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.

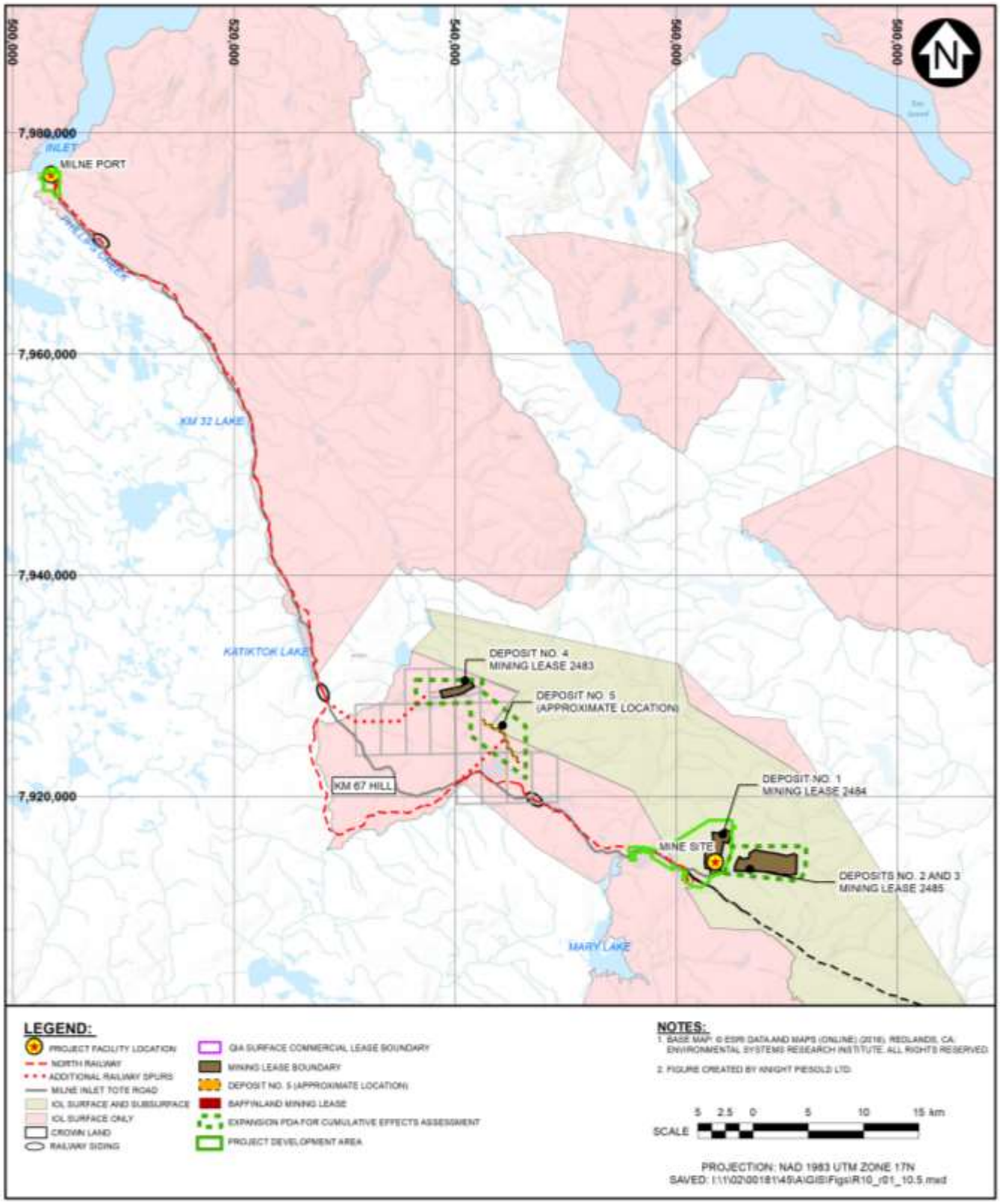

Figure 1.6 Potential Development of Nearby Iron Ore Deposits

Thus the future development scenario considered in this cumulative effects assessment is a production rate of up to 60 Mtpa, from Deposits No. 1 through 5 over an additional 20 years, i.e., the operation phase changing from 2035 to 2055. Of the 60 Mtpa of ore mined, 36 Mtpa would be transported over the South Railway to be shipped year-round from Steensby Port, as contemplated in the Approved Project CEA (Baffinland 2012), with the remaining 24 Mtpa of ore transported over the North Railway to Milne Port and shipping occurring over an approximate 8.5-month shipping season (July 1 to March 15).

1.4 Assessment of Cumulative Effects to Valued Ecosystem Components

1.4.1 Assessment of Project-VEC Interactions

The potential interactions between past and existing projects and activities and VECs carried forward in the CEA are shown in Table 1.5. The interactions identified are independent of whether or not the Phase 2 Proposal will result in residual adverse effects to the VEC. Items identified as having a likely interaction are identified in Table 1.5 by an "X" and discussed in the following sections by VEC.

Table 1.5 Potential Interactions of Other Projects and Activities with VECs

Relevant Projects or Activities	Climate Change	Air Quality	Noise and Vibration	Landforms, Soil and Permafrost	Vegetation	Migratory Birds and Habitat	Terrestrial Wildlife and Habitat	Water Quantity	Water Quality	Freshwater Fish, Fish Habitat and Biota	Marine Ice, Water and Sediment Quality	Marine Habitat and Biota	Marine Mammals
Past													
Nanisivik Mine (Decommissioned)	X												X
Mary River Project Definition Phase	X			X	X	X	X	X	X	X	X	X	X
Diamond Exploration	X				X	X	X						
Existing													
Nanisivik Naval Facility and Military Exercises	X												X
Back River and Hope Bay Projects	X												X
Regional Ship Traffic	X					X						X	X
Regional Air Transport	X		X			X	X						X
Communities, Traditional/Recreational Land Use	X		X			X	X			X			X
Regional Monitoring Programs	X	X	X			X	X						X
Baffinland Regional Exploration	X			X	X	X	X	X	X	X		X	X
Climate Change				X	X	X	X	X	X	X	X	X	X
Reasonably Foreseeable													
Tullurutiup Imanga/ Lancaster Sound NMCA													
Potential Future Development													
Mine Deposits No. 2 to 5 until 2055	X	X	X	X	X	X	X	X	X	X	X	X	X

1.4.2 Meteorology and Climate Including Climate Change

The Project will generate GHG emissions and thus contribute incrementally to global climate change. The Phase 2 Proposal's forecast of GHG emissions is presented in TSD-6 (Baffinland 2018b). The Project will generate 12.4 Mt CO_2e cumulative emissions over the LOM (2013 to 2038). Based on the National Research Council's high estimate of global warming of 0.68°C per 1,000,000 Mt CO_2e, the Project's contribution to global warming would therefore be 12.4 Mt CO_2e x 0.68°C /

1,000,000 Mt CO_2e ≈ 0.000008°C (Baffinland 2018b). Currently, routine measurements of ambient temperatures are performed with an accuracy of about 0.1°C. Given environmental noise and natural variability in temperature time series, the warming associated with the Project's cumulative GHG emissions is not detectable. The Project's individual contribution to climate change is therefore not detectable, and the effect of the Project on climate change is not significant.

Climate change is considered a global cumulative effect that is being driven by the combination of global GHG releases from human activities. As reported by the Intergovernmental Panel on Climate Change (IPCC) in their 5th assessment report, in recent decades, changes in climate have caused impacts on natural and human systems on all continents (IPCC, 2014a,b). Regional air transport and the possible expansion of the Mary River Project will contribute to increased greenhouse gas (GHG) emissions, contributing to the Phase 2 Proposal's contributions.

Assuming the future development scenario of increased production to 60 Mtpa, the GHG emissions would roughly double, as would the Project's contribution to global warming (0.000016°C instead of 0.000008°C). The Project's individual contribution to climate change, even under the doubling of production scenario considered in this cumulative effects assessment, would be not detectable and not significant. While other past, present and reasonably foreseeable projects and activities will also generate GHG emissions, it was assumed that these are captured under the global total emissions.

1.4.3 Air Quality

Residual effects to air quality will occur as a result of the Project. There are no other projects or activities within the same Local Study Area as the Project. As such, there is limited potential for cumulative effects to air quality, with the exception of the possible doubling in production of the Project. Future expansion including a doubling in production would require the development of adjacent deposits, and would expand the temporal boundaries of the Project, as described in Section 1.3.6.

The adjacent deposits could be mined using the same transportation infrastructure. If Deposits No. 2 and 3 were to be developed, the same stockpiles and rail loading facilities would be used. Most particulate matter emissions are related to ore handling, and the quantity of ore requiring handling (and possibly the rate at which it is handled) would increase with an increase in the mine production rate. Ambient air quality concentrations of particulate matter would likely increase at the Mine Site and at ports used to ship more ore. Dust deposition at the Mine Site and the ports would also increase. Air emissions along the railways would not increase meaningfully; more rail cars and locomotives would be added and transits would become more frequent but will not overlap. Ambient concentrations of gaseous emissions (i.e., SO_2, NO_2, CO) may increase if additional power generation and mobile equipment operate within the same area. Air contaminant concentrations cannot be estimated without quantitative air dispersion modelling. The cumulative effects on air quality would be re-assessed as part of any future proposal to expand the Project. It is likely, though, that additional mitigation measures will be available to reduce additional air contaminant emissions, including relocation of secondary crushing for the 18 Mtpa South Rail operation indoors, the use of conveyors over mine haul trucks, etc.

Deposits No. 4 and 5 are located outside of the Mine Site and Milne Port airsheds. The use of rail is expected to reduce emissions along the Northern Transportation Corridor; if there were cumulative effects to air quality due to mining at the deposits and transportation activities along the Northern Transportation Corridor at a distance of 3 to 6 km away, the cumulative effect to air quality is likely marginal.

It is expected that a doubling in production is unlikely to result in significant effects to air quality.

1.4.4 Noise and Vibration

Residual effects to noise and vibration will occur as a result of the Project. Similar to the discussion on air quality above, there are no current or reasonably foreseeable projects or activities that would overlap with the noise impacts of the Phase 2 Proposal. Under the scenario of a doubling in production, the footprint of noise effects would increase. Within Projects

sites, the increase in production may require upsizing of material handling facilities that will result in modest increases in noise levels that are likely to be not significant.

1.4.5 Landforms, Soil, and Permafrost

Residual effects to landforms, soil and permafrost will occur as a result of the Project, though these will be largely mitigated through engineering design and post-construction mitigation measures, such that these residual effects will be not significant (TSD-8; Knight Piésold 2018a).

The projects and activities that have the potential to act cumulatively on landforms, soil and permafrost within the terrestrial RSA include:

- Mary River Project definition phase
- Diamond exploration
- Baffinland regional exploration
- Climate change, and
- Potential future development scenario.

Regional exploration by Baffinland and others, past, present and future have the potential for effects to landforms, soils and permafrost, though if these effects are likely to be minor and highly localized. The definition phase of the Project, however, resulted in residual impacts to landforms, soils and permafrost. A number of former roadside borrow areas used to supply aggregate for road construction during the 2007-2008 bulk sample program have experienced thaw-settlement and erosion. Work has been undertaken to assess and prioritize the former borrow areas that require remediation to address thaw-settlement and erosion issues (Tetra Tech EBA Inc. 2015). A small proportion of these borrow areas lie within or immediately adjacent to the North Railway right of way, and thus will require remediation and thermal stabilization as part of rail construction. Other former borrow areas are expected to be used to dispose of soil spoils that will be generated during construction of the North Railway, which will assist in their remediation (TSD-8).

Climate change also has the potential to affect landforms, soil and permafrost cumulatively with the Project. The potential changes to permafrost and soils that may occur due to climate change have been considered in the design of the Project. This includes geotechnical approaches to constructing the railway embankment (Knight Piésold 2018a), and sizing of culverts to accommodate potential increases in runoff (TSD-13; Knight Piésold 2018b). Unexpected effects to soils and permafrost will be mitigated (i.e., stabilized) because such effects have the potential to undermine and significantly affect Project infrastructure.

The potential future development scenario will result in an increase in the Project's overall footprint as described in Section 1.3.6. The geology and terrain in these areas is similar to that encountered by the Approved Project and Phase 2 Proposal.

With Baffinland's precautionary approach to project design incorporating changes that may result due to climate change, cumulative effects to landforms, soil and permafrost are not predicted to be significant.

1.1.1 Vegetation

1.1.1.1 Potential Climate Change Effects on Vegetation

Potential climate change effects to vegetation on Baffin Island include an increase in vegetated area, an increase in the abundance and biomass of deciduous shrubs and graminoids and a northward movement in the shrubline (TSD-6). A trend

toward greening has been observed pan-arctic over the period of 1982 and 2012, with the greatest change reported in the North American high arctic (TSD-6). Significant increases of tall shrubs and grasses have been recorded in many areas in the Arctic and was reported by elders in Pond Inlet.

Colonization of currently unvegetated areas may increase due to greater vegetation production, caused by more rapid decomposition and higher nutrient availability (Dormann and Woodin 2002, Weintraub and Schimel 2005). Responses of plant species in the high Arctic may favour investments in reproduction rather than growth; an investment in producing greater seed crops under a higher temperature scenario may help species colonize unvegetated ground (Arft et al. 1999).

On average, vegetation biomass is expected to increase as a result of warming in the Arctic (Larsen et al. 2014). In particular, shrubs are expected to increase at the expense of other plant functional types. Shrub biomass, cover and distribution have expanded in many areas of the Arctic over recent decades, likely as a result of climate change (Sturm et al. 2001, 2005, Tape et al. 2006, Myers-Smith et al. 2011, Ropars and Boudreau 2012).

Warmer climate in the Canadian Arctic increased plant biomass in summer pastures but there was a decline in caribou populations, suggesting the quality of forage had diminished. This may signal a transition from a system with low plant biomass modulated by cyclic caribou populations to one dominated by low quality or non-edible shrubs and diminishing caribou populations (Fauchald et al. 2017). Not all studies support an expansion of shrub coverage in the Arctic: a meta-analysis of responses of tundra plants to experimental warming found a stronger positive response of herbaceous plants than woody plants to warming (Arft et al. 1999).

1.1.1.2 Potential Project Effects on Vegetation

An assessment of the Phase 2 Proposal on vegetation are presented in TSD-9 (EDI 2018a). The following are the predicted residual impacts that will occur to vegetation:

- Reduced vegetation abundance and diversity, and
- Reduced vegetation health due to the deposition of dust and other atmospheric emissions.

Each of these effects are Level I magnitude (not distinguished from natural variation) and extent (confined to the PDA and immediately adjacent area).

1.1.1.3 Potential Cumulative Effects on Vegetation

The Projects and activities that have the potential to act cumulatively on vegetation within the terrestrial RSA include:

- Mary River Project definition phase
- Diamond exploration
- Baffinland regional exploration
- Climate change, and
- Potential future development scenario.

Cumulative effects on vegetation through changes in vegetation abundance and diversity will occur. Activities associated with the definition phase of the Mary River Project is confined to the PDA of the Phase 2 Proposal. Regional exploration by Baffinland and others has and will result in a disturbance footprint that will affect vegetation, but this cumulative area is small in the context of the Phase 2 Proposal PDA. The potential future development scenario, however, will result in

measurable additional direct vegetation loss due to a potential 38.5% (4,060 ha) increase in the size of the PDA (Table 1.4) if future development scenarios occur.

Climate change may interact with effects to vegetation from the Project and the potential future development scenario. An increase in biomass (one aspect of abundance), expected as a result of climate change, may provide a minor compensatory cumulative effect that offsets reductions in vegetation abundance that will occur due to ground disturbance. Climate change is also expected to alter the species composition of vegetation with an expansion of shrub and graminoid coverage, and this effect will overlap with changes in vegetation diversity that will occur via the loss of vegetation from ground disturbance activities and effects to vegetation health that result from dust and other air emissions. If this occurs, it will be limited to areas adjacent the PDA that are exposed to greater dust deposition.

Applying the assumptions used in the Project assessment for the Phase 2 Proposal that all vegetation within the PDA will be lost, the extent can be expected to remain a Level I impact. The Phase 2 Proposal will not remove greater than 1% of any of the vegetation cover classes within the terrestrial RSA (TSD-9). Hence the expansion scenario being considered for cumulative effects is unlikely to remove significant quantities of any one vegetation class.

Cumulative effects on vegetation will also occur through changes in vegetation health, as the deposition extent of dust and other atmospheric emissions similarly increase. Effects of TSP deposition outside of the PDA due to the Phase 2 Proposal will be a Level I magnitude: indistinguishable from natural variation, and Level I extent: confined to the PDA and immediately adjacent areas (TSD-9). This is unlikely to change under the expansion scenario.

Based on the above, the effects of the expansion scenario on vegetation are not significant. Uncertainty associated with these conclusions include the realized emissions pathways over the lifetime of the Project, the accuracy of climate models to predict responses within the Arctic, the response of vegetation to dust deposition and the direction and magnitude of interaction of this response and climate change.

1.1.2 Migratory Birds and Habitat

1.1.2.1 Climate Change Effects on Migratory Birds and Habitat

Climate change will likely have a disruptive effect for many bird species on northern Baffin Island. Effects on bird species population parameters such as survival, fecundity, abundance and distribution are likely but difficult to predict, as the vulnerability to climate change varies broadly by species.

Habitat vulnerability refers to potential changes in habitat quantity or quality that may affect survival or reproduction. Responses to changes in habitat from climate change will vary broadly depending on species. The expansion of shrub distribution through the Arctic, at the expense of other plant types, may negatively impact the nesting habitats of ground nesting species. Predator species that are not flexible in their prey selection will be vulnerable to fluctuations in prey composition and availability. Migratory terrestrial birds are expected to be resilient to climate change within their summer habitat but effects to winter habitat are highly variable depending on location and extent. Migratory marine birds are at risk due to fluctuations in prey availability.

Physiological vulnerabilities are related to direct effects on survival and reproduction, including the potential for exceedances of physiological thresholds, exposure to weather-related disturbance, survival during resource fluctuations and energy requirements. Overall, the greatest physiological vulnerabilities to climate change are primarily associated with exposure to extreme weather events such as increased frequency of heavy rain. These can have both direct and indirect effects on reproductive and foraging success. Behavioural plasticity may confer an advantage to species that can take advantage of warmer temperatures to alter breeding timing and changes in prey sources.

Phenological vulnerabilities can result from mismatches in timing between species' behaviour and biology and critical resources. This can occur where species rely on an environmental cue to initiate activities such as migration or breeding, or where a species' fitness is tied to a discrete resource peak that is expected to change. Phenological processes may be a substantial source of vulnerability, particularly for migratory species and those that time activities to environmental cues or discrete resource peaks. Migratory birds can adapt if environmental cues are present; however, the lag time of behavioural change compared to environmental change may be a concern for some species.

Vulnerabilities relating to biotic interactions stem from changes in interactions with food sources, predators, diseases, symbionts and competitors. Overall, vulnerability associated with changes in biotic interactions mainly relate to food sources. Primarily terrestrial species may see an increase in the abundance of food sources but food quality for some species may diminish. Other biotic interactions such as predators, symbionts, disease and competitors are either not expected to have a large influence on vulnerability or the results are highly uncertain.

Changes in environmental processes as a result of climate change will occur independently of the Project. Therefore, potential interactions of climate change with the Project and their effects on birds are limited. Changes in vegetation composition and distribution will affect the balance of direct and indirect habitat loss on each species assessed for the Phase 2 Proposal (TSD-12; EDI 2018b). It is difficult to predict and quantify these changes at the scale of the TRSA. However, assessments of changes in habitat along with their effects on the habitats of key indicator species can be conducted periodically through the life of the Project. Adaptive management plans could then be implemented if necessary. The current suite of mitigations presented in the Terrestrial Environment Mitigation and Monitoring Plan (TEMMP; Baffinland 2016a) to alleviate disturbance to nesting birds will prevent exacerbating the effects of physiological vulnerabilities. Vulnerabilities related to phenology and biotic interactions are completely independent of the Project and as a result cannot be mitigated. Their effects on bird species will depend mainly on the plasticity of individual species and their ability to adapt timing of activities (e.g., migration, nesting) through their life cycle.

1.1.2.2 Project Effects to Migratory Birds and Habitat

Bird distribution, abundance and breeding associated with the Project area on northern Baffin Island are well characterized. Baseline and post-production surveys included studies on all major bird groups found in the TRSA and the MRSA. Sixty-four bird species have been confirmed within the Project RSAs from 2006 to 2016, with forty-nine species documented in the TRSA and thirty-five species recorded in the MRSA. Of the 49 species present within the TRSA, forty were confirmed to nest in the TRSA.

The diversity of marine-associated species documented to date within the MRSA is greater along the southern route than the northern route — 35 species and 24 species documented respectively.

The Phase 2 Proposal's residual effects on migratory birds include:

- Direct terrestrial habitat loss due to the Project footprint
- Indirect habitat loss due to sensory disturbances within a zone of influence (ZOI) adjacent to the Project footprint and shipping activities
- direct mortality of a few individuals due to collisions with road, rail, aircraft and shipping traffic, and
- direct or indirect mortality or health effects from the chronic release of contaminants or accidental fuel spills.

1.1.2.3 Cumulative Effects on Migratory Birds and Habitat

The Projects and activities that have the potential to act cumulatively on migratory birds include:

- Mary River Project definition phase
- Regional exploration (past, present and future)
- Regional ship traffic
- Regional air transport
- Communities and traditional or recreational land use
- Regional monitoring programs
- Climate change, and
- Potential future development scenario.

Direct and Indirect Habitat Loss

Project-related activities could potentially alter bird behavior and cause displacement during all Project phases but will be confined to the footprint, a relatively small area in relation to the availability of suitable habitat in the TRSA, to a zone of influence (ZOI) adjacent to the PDA, and along the northern shipping route.

Densities of bird key indicators (KIs) are expected to decline within the terrestrial Project footprint, and possibly within adjacent zones of influence. However, these changes are expected to be a result of displacement out of the affected areas and not a result of mortalities to the birds or their offspring. Baseline and post-development surveys and habitat modeling indicated that there is an abundant supply of suitable habitats for predominantly terrestrial species within the TRSA. Because of the amount of available suitable habitat nearby, the overall effect of the Project to bird KIs (bird species at risk are KIs), and to all bird species in general, is expected to be minimal. Some birds affected by disturbance in the PDA may forego breeding for a year while they spend time seeking new breeding habitat and establishing a nesting territory or they may simply be able to move to nearby suitable habitat. The residual effects of Project activities on bird KIs include habitat changes such as localized direct habitat loss and chronic disturbance; however, overall effects are not likely to have serious implications for the regional populations of any species. Species abundance and habitat use will almost certainly be altered within the port footprint, and to some extent within a certain zone of influence around the port and some individuals may relocate to less-disturbed neighboring areas.

Ship movements along shipping lanes will have negligible effects on foraging marine birds because collisions with ships are unlikely, and the periodic requirement to move out of a ship's path should not be a significant energetic stress to birds.

Habitat loss for all bird KIs was rated as Level I magnitude (indistinguishable from natural variation) and extent (limited to the PDA or immediately adjacent area).

Under the future development scenario described in Section 1.3.6, the total PDA would increase by roughly 38.5% (4,060 ha). The additional habitat to be lost is similar to the existing lost habitat. Other applicable projects and activities (i.e., regional exploration) is comparatively minor and have not been included in the estimate of additional habitat loss. The expanded PDA under the future development scenario remains small (a low magnitude effect) relative to the TRSA. The cumulative effect of the future development scenario is expected to remain a Level I magnitude effect.

Direct mortality of a few individual birds because of collisions with Project vehicles or infrastructure is expected to occur. Other projects and activities including the potential future development scenario will similarly result in direct mortality of a few individual birds. The cumulative effect of bird mortalities is expected to remain as a few individuals and not measurable at the population level.

Increase in contaminants levels that could adversely affect bird health are not expected. The risk of accidental spills is very low, and increased traffic associated with the potential future development scenario and other projects and activities will result in an increase in the likelihood that will remain statistically low. It is recognized that an accidental fuel spill, particularly in the marine environment in areas where seabirds congregate, could be significant. Unplanned events are not part of the project and are not assessed for residual effects.

The cumulative effects to migratory birds as a result of the Project and other projects and activities (excluding climate change) are not significant. As described above, the potential effects of climate change on bird habitats is difficult to quantify. Should the effects of climate change on various bird species be significant, then the cumulative effects to migratory birds in that case would be significant.

1.1.3 Terrestrial Wildlife and Habitat

1.1.3.1 Climate Change Effects to Terrestrial Wildlife and Habitat

Climate change will likely 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.

Overall, North Baffin caribou are expected to exhibit a relatively neutral response to climate change. Key factors that make them vulnerable to climate change include changing snow conditions and increases in rain-on-snow icing events that can restrict access to winter forage, changes to forage quality, including a transition to greater shrub abundance at the expense of other plant types, and slow population growth. Some resilience to climate change is conferred by variation in movement, forage and the timing of breeding. Major uncertainties in this assessment include the degree to which climate change will limit forage availability through snow conditions and increased rain-on-snow events, as well as the ability of caribou to adapt through changes in behaviour such as movement to higher quality habitat, adaptation to different forage species or types and delaying or foregoing breeding during poor conditions.

1.1.3.2 Project Effects to Terrestrial Wildlife and Habitat

Key indicators used to assess Project effects on terrestrial wildlife and habitat include caribou and arctic wolf (TSD-10, EDI 2018c). The Project assessment for caribou identified the following residual effects:

- Direct habitat loss within the PDAs
- Reduced habitat effectiveness within a ZOI of project activities
- Impacts to movement due to physical barriers, traffic, and high snow banks
- Potential mortalities due to collisions with vehicles/trains, interactions with project infrastructure, etc.
- Indirect potential mortalities due to increased harvests resulting from increased access and improved knowledge of the region that could lead to increased harvester success, and
- Potential impacts to health from exposure to metals in ore dust.

With respect to habitat loss, direct habitat loss to the PDA represents a small proportion of the overall habitat effect (TSD-10, EDI 2018c). Over the entire range of the north Baffin Island caribou, habitat effectiveness due to direct and indirect habitat loss is predicted to be reduced by 2.4% during the calving season, 4.8% during the growing (summer) season, and by 5.0% during the winter season.

With respect to impacts to caribou movement, the North Railway does not travel through any areas where caribou movement may otherwise be restricted. No individual section of rail poses an absolute barrier to caribou movement, and only two sections of rail were rated as low permeability to caribou: 1) The section at Milne Port as the rail ascends through deeper rock cuts, and a section at ~km 47 that traverses coarse undulating terrain where several cuts and fills are greater than 2 m. Using the same design mitigation proposed for the South Railway (FEIS Volume 6, Section 5.2.2) should prove equally effective for the North Rail. During or after construction, the alignment can be reviewed at documented caribou trails to determine if embankment adjustments need to be made to allow for caribou crossing using best design practices indicated in the FEIS.

Project-related direct mortality on caribou is readily reduced by adjusting speed limits, seasonal traffic limits, regular monitoring of caribou numbers and proximity to transportation corridors, and a no-hunting policy for staff while on-site. There are no known features of the Phase 2 Proposal that will reduce health to a level of increased mortality for the north Baffin Island caribou herd. There are no expected residual effects of the Phase 2 Proposal on caribou mortality. Mortality, if it occurs, will be limited to individuals within the PDA.

No residual effects of the Project on caribou health are anticipated due to metal exposure from dustfall.

Wolf was the other terrestrial wildlife KI assessed. Effects to wolf include the potential loss of denning habitat; infrastructure associated with the Phase 2 Proposal will require disturbance of 2.8% of the 942 km^2 of glaciofluvial terrain in the TRSA, compared to disturbance of 2.4% with the Approved Project (TSD-10, EDI 2018c).

1.1.3.3 Cumulative Effects to Terrestrial Wildlife and Habitat

The Projects and activities that have the potential to act cumulatively on terrestrial wildlife and habitat include:

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

As described for vegetation, most of the above activities are minor contributors to habitat loss and/or sensory disturbance to terrestrial wildlife within the 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.

The potential future development scenario has the potential to effect caribou cumulatively. The expanded PDA associated with this scenario is 38.5% larger than that of the Phase 2 Proposal. As noted in TSD-10, direct habitat loss represents a small proportion of the overall habitat effect (Section 1.4.8.2). Habitat effects also consider reduced habitat effectiveness using a model to estimate reduced habitat effectiveness within a conservatively (i.e., likely over-estimated) identified ZOI. Considering loss to the PDA and reduced effectiveness in the ZOI, the Phase 2 Proposal would reduce habitat effectiveness by 2.4% during the calving season, 4.8% during the growing (summer) season, and by 5.0% during the winter season. The increased PDA, if future development scenarios occur, may trigger a Level III extent effect in winter habitat. However, given the complexity of a ZOI analysis, consideration would have to be given to a reduced ZOI where project activities no longer occur at abandoned and reclaimed deposit sites, consideration of transport by rail, and observed effects after monitoring and adaptive mitigation measures have been applied through successive Project phases.

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. 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 limited and likely not measurable within the life of the Project.

1.4.6 Water Quantity

Residual effects to water quantity will occur as a result of the Project, as a result of water withdrawals, diversions and effluent discharges; the effects are not significant (TSD-13; Knight Piésold 2018b). Given that there are no other developments or activities occurring or expected to occur within the catchments affected by the Project, cumulative effects to water quantity are not expected.

Additive cumulative effects to water quantity may occur as the result of the potential future development scenario, if for example expanded camps under this scenario require additional water withdrawals from the same sources proposed for the Phase 2 Proposal, such as Camp Lake. If an increased water withdrawal from Camp Lake was determined to result in an unacceptable adverse impact, water could alternatively be drawn from David Lake or other nearby waterbodies to avoid a significant effect.

Climate change is expected to result in increased precipitation and evaporation, resulting in a net increase in runoff. Annual precipitation is projected to increase by 4 to 5% by 2035, and by 6 to 12% by 2065 (Baffinland 2018b). The current project design considers this effect from climate change in the sizing of culverts. It is unlikely that the potential future development scenario would act cumulatively with climate change effects to water quantity to cause a significant effect.

Cumulative effects to water quantity, should it occur, can be mitigated to ensure they will not be significant.

1.4.7 Surface Water Quality

Residual effects to surface water quality will occur as a result of the Project as a result of mine effluent discharges, dust deposition and sedimentation, quarries and rock cuts to be developed along the North Railway, and other sources such as camps, sewage discharges, fuel storage, etc. These residual effects are predicted to be not significant (TSD-13; Knight Piésold 2018b).

Given that there are no other developments or activities occurring or expected to occur within the catchments affected by the Project, cumulative effects to water quality are not expected.

Cumulative effects to water quality could likely occur as the result of the potential future development scenario if additional effluents are discharged to existing receiving waters such as the Mary River. A larger or more likely second waste rock facility (WRF) would be constructed to mine Deposits No. 2 and 3. Additional mine effluent would be generated from this second WRF, and pit water from these deposits will be generated due to mainly precipitation. The obvious receiving water for these additional effluents is the Mary River. An expanded Mine Site camp would generate larger volumes of treated sewage effluent that currently report to the Mary River. This increase in loadings to the Mary River has the potential to result in additive cumulative effects to water quality. Water quality modelling to support this CEA is not possible due to the number of unknowns, including effluent qualities and quantities, but this can be completed in a future assessment once a mine plan and other details become available. There are mitigation measures available, however, such that a significant effect to water quality can be avoided. The most obvious mitigation measure is water treatment. It may be possible to redirect a portion of the additional mine effluent to another receiving water.

It is possible that climate change increases erosion of soils resulting in higher concentrations of total suspended solids (TSS) and nutrients in freshwater environments. If this effect was realized within Phillips Creek, it could be additive to Project contributions of runoff from the site, such that TSS concentrations near the mouth of Phillips Creek increase. Additional mitigation can be implemented to control TSS runoff from project-affected areas into Phillips Creek, to reduce this cumulative effect.

Cumulative effects to surface water quality, should it occur, can be mitigated to ensure they will not be significant.

1.4.8 Freshwater Fish, Fish Habitat and Biota

Residual effects to freshwater fish and fish habitat that may result from the Phase 2 Proposal will be addressed by implementing offsetting measures to achieve no-net-loss of fish habitat, authorized under the *Fisheries Act*.

Given that there are no other developments or activities occurring or expected to occur within the catchments affected by the Project, cumulative effects to fish and fish habitat are not expected.

Cumulative effects to freshwater fish and fish habitat may occur as the result of the potential future development scenario, but it can be assumed that through design changes and offsetting of serious harm, the residual effects to freshwater fish habitat will be not significant.

Freshwater fishes are potentially vulnerable to climate change. Water temperature is a critical factor that influences the global distribution and ecological niche of Arctic char. The optimal temperature for growth with unlimited food supply of Arctic char lies between 14.4 and 17.2°C (Elliott and Elliott 2010), however, under natural conditions the optimum is likely much lower (Elliott 1982). Chu et al. (2005) have developed a model scenario predicts that Arctic char will potentially lose more than have of its current southern distribution range in Canada by 2050 given projected temperature and precipitation patterns. Arctic char occurs further north than all other freshwater fish species with limited opportunity to expand their range northward in response to climate change.

The residual effects of the Mary River Project on freshwater fish are not significant and unlikely to persist beyond temporal boundaries of the project. Thus, the opportunity for residual effects to interact with the future long term effects beyond 2040 on climate change on fish and fish habitat are limited, and cumulative effects are not anticipated.

1.4.9 Marine Ice, Water and Sediment Quality

1.4.9.1 Climate Change Effects on Marine Ice, Water and Sediment Quality

There is agreement between elders in Pond Inlet (and in other communities further south) that sea ice is thinner and weaker (Gérin-Lajoie et al. 2016). Generally, multi-year ice (sea-ice that has survived at least one melting season) is stronger than first-year ice, suggesting that elders are observing more first-year sea-ice now than in the past. The IPCC (2014a,

Chapter 4) summarizes that the annual Arctic sea ice extent decreased over the period 1979 to 2012 by about 3.5 to 4.1% per decade (0.45 to 0.51 million km^2 per decade). The perennial sea ice extent (summer minimum) decreased between 1979 and 2012 at 11.5 ± 2.1% per decade (0.73 to 1.07 million km^2 per decade) and the multi-year ice (that has survived two or more summers) decreased at a rate of 13.5 ± 2.5% per decade (0.66 to 0.98 million km^2 per decade). The average winter sea ice thickness within the Arctic Basin decreased between 1.3 and 2.3 m between 1980 and 2008. These observations fully support the observations by elders in Gérin-Lajoie et al. (2016).

Predictions from GCM runs agree that the Arctic sea ice cover will continue to shrink and thin all year round during the 21st century as the annual mean global surface temperature rises (IPCC, 2014a, Chapter 11). Under the RCP8.5 high emission scenario, it is projected that the Arctic Ocean will become nearly ice-free in September before the middle of the century. More seasonally detailed quantitative predictions were unavailable. It is reasonable to assume that the trends that have been recently observed by elders will continue: earlier ice break-up in the spring, later freeze-up in the fall/winter, and thinner and weaker winter ice. The specifics will depend on factors that are difficult to quantify such as future anthropogenic GHG emissions, natural variability, and additional regional factors such as wind speed and wind direction.

Climate change may affect water and sediment quality through increase in water temperature, decrease in salinity due to an increase in freshwater input, more intensive sea ice melt, and change in water pH (TSD-17; Golder 2018a). Increase in precipitation and more intensive snow and permafrost melt may increase freshwater discharge from land and terrestrial sediment and nutrient load into the marine environment increasing seawater turbidity and TSS concentrations, and nutrients and changing sediment composition. Increased frequency and intensity of storms may intensify coastal erosion and therefore also affect water and sediment quality by resuspension of particulate matter. These effects may cause associated impacts on the biological environment, such as habitat alteration, invasive species and biodiversity transformations (TSD-17; Golder 2018a).

1.4.9.2 Project Effects to Marine Water and Sediment Quality

The Phase 2 Proposal will not result in meaningful effects to marine ice; shipping will occur in the shoulder season but not during full ice cover. Residual effects to marine water and sediment quality were predicted to result from the Phase 2 Proposal (TSD-24; Golder 2018b). The following effects of the following activities on marine water and sediment quality were assessed:

- Ore dock construction
- Disruption and erosion of sediment due to increased shipping traffic (prop wash)
- Increased ballast water discharges
- Increased deposition of ore dust from stockpiles and shiploading, and
- Increased wastewater and site water discharges.

Effects of the Phase 2 Proposal on marine water and sediment quality are confined to the area surrounding the dock for most of the above activities, with the exception of ballast water discharges, which will affect water quality throughout Milne Inlet and beyond. Of the above effects, dock construction was assigned a Level II or moderate magnitude rating, whereas the operational issues were assigned a Level I (low magnitude) rating. Impacts of the Phase 2 Proposal on marine water and sediment quality are predicted to be not significant (TSD-24; Golder 2018b).

1.4.9.3 Cumulative Effects to Marine Ice, Water and Sediment Quality

The Projects and activities that have the potential to act cumulatively on marine water and sediment quality include:

  - Mary River Project definition phase
- Climate change, and
- Potential future development scenario.

The definition phase of the Project involved annual sealifts and fuel tankers, and the temporary stockpiling and loading of 113,000 t of ore onto barges using grasshopper conveyors positioned on temporary spud barges during a bulk sample program in 2008. Baseline environmental studies completed in the dock area in support of the Marine Environmental Effects Monitoring Plan did not identify any aquatic effects in the port area that could be attributed to the definition phase of the Project, such as bulk sampling program or sealift activities (MEEMP; Baffinland 2016b). As such, the potential contribution of this activity to cumulative effects on water and sediment quality are deemed to be negligible.

The potential future development scenario of transporting 24 Mtpa from Milne Port would not involve any further changes to docks but would require an expansion of ore stockpiles, higher throughput shiploaders, and more ship traffic, including shipping in ice.

While the extent of landfast ice varies from year to year, the area of landfast ice encompassing Pond Inlet, Navy Board Inlet, Eclipse Sound and all inlets including Milne Inlet is in the order of 7,900 km^2 (Figure 1.7). The length of the northern shipping route in landfast ice is approximately 228 km.

Effects of shipping in ice on marine ice via its key indicator landfast ice, was assessed for shipping through Steensby Inlet for the Approved Project in Volume 8, Section 2.6.2.1 of the FEIS (Baffinland, 2012). The FEIS calculated minimum and maximum widths of disturbance of landfast ice of 0.34 km (20 repeat transits per ship track) and 1.5 km (5 repeat transits per ship track), to estimate what proportion of the available landfast ice in Steensby Inlet would be disturbed due to the Approved Project. Vessel passage during the period of ice freeze up can act to delay ice formation and can produce relatively rough ice surface within the area affected by the ships passage.

Dock-side icebreaking or disruption will occur when the ore carriers approach, remain and depart the dock, through heated ballast water discharge. Use of a bubbler system was contemplated at the Steensby Port docks, and contingency ice management measures at Steensby Port called for the use of two to four ice re-enforced tugs at the dock during the first year of operation. If used, these vessels will operate within the port area and are not likely to expand the spatial extent of ice disruption. In the absence of a technical design for ice breaking to Milne Port, it is not known what ice management measures will be implemented.

In the absence of a detailed analysis and applying the minimum and maximum width of ship track disturbance calculated for shipping from Steensby Port, the area of landfast ice disrupted annually by ships approaching Milne Port under the potential future development scenario will be in the order of 80 km^2 to 340 km^2. This represents approximately 1% to 4% of the available landfast ice within the landfast area demarcated on Figure 1.7. This is less than the threshold established in the FEIS of 10% (FEIS Volume 8, Section 2.6.2.1). The amount of ice disturbance is even less in the context of the 51,000 km^2 marine RSA. The effects of the potential future development scenario on landfast ice are predicted to be not significant. The effects of such disturbance on Inuit land use is considered in Section 1.5.5.

Under the potential future development scenario, the same effects to marine water and sediment quality assessed in TSD-17 would occur at a higher intensity. Given the low magnitude ratings assigned to effects on water and sediment quality as a result of the Phase 2 Proposal, it is unlikely the higher intensity effects would be rated more than Level II or moderate magnitude, and therefore the effects would not be significant.

Figure 1.7 Potential Shipping Through Landfast Ice Under the Potential Future Development Scenario

The potential effects of climate change on water and sediment quality are described in Section 1.4.12.1. It is unlikely that the effects from climate change will be additive to effects of the potential future development scenario in terms of TSS at the dock, since erosion will not occur at the dock face. The possible exception is where climate change effects of increased TSS due to higher erosion rates could be additive to Project contributions of runoff from the site, and the outflow of Phillips Creek change TSS concentrations in the immediate marine environment. Additional mitigation can be implemented to control TSS runoff from project-affected areas into Phillips Creek, such that the effect is unlikely to be significant.

1.4.10 Marine Habitat and Biota

1.1.3.4 Climate Change Effects on Marine Habitat and Biota

In addition to what has been described in terms of climate change effects to marine water and sediment quality (Section 1.4.12.1), climate change may affect marine biota through changes in sea ice. This may disrupt primary phytoplankton production and consequently alter the entire marine food web (TSD-17; Golder 2018a). There are two distinct categories of primary producers: ice algae (sympagic algae) which grow within and on the underside of sea ice, and phytoplankton growing in open waters. There are two peaks of primary production with the first occurring in late April at the onset of the ice algal bloom and the second occurring in early July just after ice break-up at the onset of the phytoplankton bloom. Reproduction and growth of the dominant zooplankton species (copepod *Calanus glacialis*) coincides perfectly with these two bloom events. A reduction in sea ice thickness and coverage area will likely alter this primary production regime due to earlier ice break-up and onset of the phytoplankton bloom, resulting in a mismatch between primary production and the zooplankton. A shift in zooplankton communities towards dominance by smaller and more numerous copepods will likely occur, which will in turn result in less energy transfer through the food chain, and thus lower biological production of the ecosystem in general (TSD-17; Golder 2018a).

Most species in the Arctic benthos are deposit feeders and therefore their food supply depends on the import of organic matter that ultimately originates from primary production in the upper euphotic layers of the water column, either from pelagic/sympagic production or in the form of large food falls. The dependence of the food supply on vertical flux of organic matter to the seabed means that if climate change results in a shift from a diatom-dominated to picoplankton-dominated algal community as described above, less food may be available to benthic species. This in turn may affect food availability to high trophic levels; walrus and bearded seals feed primarily on benthic invertebrates.

Calanus and its main predator pelagic amphipod *Themisto libellula* constitute the bulk of the diet of arctic cod, an important component of the regional fish community. Cod in turn constitutes the majority of the diet of ringed seal, narwhal, beluga and harp seal (Welch et al. 1992). One estimate is that arctic cod could account for as much as 75% of the transfer of energy between the zooplankton and vertebrate predators. Gaston et al. (2012) speculated that rapid decline in bird nesting observed at Coats Island, Nunavut in the mid-1990s was associated with switching of bird diet from one dominated by Arctic cod to one dominated by capelin, caused by a step change of ice cover in June and November in northern Hudson Bay. Arctic cod is strongly associated with seasonally ice-covered waters and capelin typically have a more subarctic distribution. The length of the open water season was a good predictor of the switch between Arctic cod and capelin.

Arctic char is assessed to be vulnerable to climate change (Golder 2017a). Among factors determining its vulnerability are complexity in reproductive strategy, slow growth rate, and dependence on stream hydrologic regimes and temperature during critical reproductive life stages (Scott and Crossman 1973), which makes Arctic char susceptible to changes in air temperature and precipitation. In addition, Arctic cod is an important food source for Arctic char and a decrease in Arctic cod population due to reduction of sea ice is likely to affect Arctic char, although the latter has a remarkably diverse diet (Scott and Crossman 1973).

1.1.3.5 Project Effects on Marine Habitat and Biota

Residual effects to marine water and sediment quality were predicted to result from the Phase 2 Proposal (TSD-24; Golder 2018b). The following effects of the following activities on marine water and sediment quality were assessed:

- Change in habitat (habitat loss) due to ore dock construction
- Habitat alteration (changes in water and sediment quality) related to:
  - Construction activities associated with ore dock construction
  - Increased shipping resulting in increased propeller wash effect
  - Increased ballast water discharges
  - Increased wastewater and site drainage, and
  - Increased dust deposition.
- Underwater noise disturbance related to construction activities (pile driving) and increased shipping.

With offsetting of serious harm via an authorization under the *Fisheries Act*, habitat-related residual effects to marine habitat and biota that may result from the Phase 2 Proposal will be addressed by implementing offsetting measures to achieve no-net-loss of fish habitat. With mitigation such as ballast water treatment and management of runoff, the non-habitat related effects were assigned a negligible to Level I (low) magnitude rating and were deemed to be not significant (TSD-24; Golder 2018b).

1.1.3.6 Cumulative Effects on Marine Habitat and Biota

The Projects and activities that have the potential to act cumulatively on marine habitat and biota include:

- Mary River Project definition phase
- Climate change, and
- Potential future development scenario.

The definition phase of the Project appears to have had a negligible effect on marine habitat and biota (MEEMP; Baffinland 2016b). The potential future development scenario of transporting 24 Mtpa from Milne Port would not involve any further changes to docks but will involve a higher intensity of the Phase 2 Proposal operations (i.e., larger stockpiles, higher throughput shiploaders and more ship traffic).

Increased shipping activity will result in more ballast water discharges that may result in the introduction of aquatic invasive species to the local receiving marine environment. However, all ships arriving to Canadian waters have to comply with the IMO Convention D-2 requirements and eliminate unwanted organisms from ballast water. Therefore, the risk of introduction of AIS with ballast water from activities is considered low. In consideration of the relatively limited temporal and spatial scales of potential cumulative effects, it is not expected that marine biota and habitat will be affected at the population level (TSD-17; Golder 2018a).

Increased wastewater discharges and dust deposition are likely to occur under the potential future development scenario. Given the negligible magnitude ratings assigned to these habitat alteration effects as a result of the Phase 2 Proposal, it is

unlikely the higher intensity effects would be rated more than Level II or moderate magnitude, and therefore the effects would not be significant.

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. It is anticipated that, should multiple vessels transit through a given area, the cumulative noise field will increase spatially. 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; Golder 2018b).

1.4.11 Marine Mammals

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 2018b). 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.

1.4.11.1 Climate Change and Marine Mammals

Climate change models predict a decline in sea-ice extent due to delays in ice formation in late summer and autumn. In some areas, changes in sea-ice have been manifested as an increase in year-to-year variability rather than a steady decline of ice cover in time or space. Lack of predictability in sea-ice can lead to reduced survival of species that depend on the occurrence of winter refugia or microhabitats that remain ice-free during the coldest part of the winter. The physical generation of open-water microhabitats by upwelling, wind or tide in the same locations year after year has allowed Arctic marine mammals to utilize habitat areas that otherwise would not be accessible.

Other environmental changes that may occur due to climate change include:

- Accelerating temperature increases and melting of ice
- Increasing light levels in the water columns
- Declining salinity due to permafrost thawing and increasing precipitation
- More storm activity
- Decrease in pH and reduced carbonate concentrations, and
- Altered contaminant pathways.

Life in the Arctic Ocean ultimately depends on the production of marine microalgae, which include ice algae (sympagic algae) growing within and on the underside of the sea ice, and phytoplankton growing in open-waters. Reduction in sea ice thickness and coverage area is expected to alter this primary production regime due to earlier ice break-up and onset of the phytoplankton bloom, resulting in a mismatch between primary production and the zooplankton with possible repercussions throughout the food web.

A detailed evaluation of climate change impacts on marine mammals in the RSA was conducted in support of the present assessment (Golder 2017a). Following is a summary of the key findings:

- Beluga whale and narwhal benefit from ice in two ways: they are adapted to prey that live in association with sea ice, and the ice may help protect them from killer whales. Narwhals primarily feed on Greenland halibut in winter. A shift to prey with lower lipid content may not provide adequate energy for these whales.

- Killer whales have been extending their northward range and duration of stay in Arctic waters. This species may replace polar bear as the dominant apex predator in areas with reduced sea ice.

- It is uncertain how bowhead whale will respond to climate change. To date, populations have been increasing steadily despite two decades of sea ice loss.

- Walrus give birth and mate on sea ice, and use it seasonally to reach bivalve beds that are far from shore. Walrus benefit from the existing pelagic-benthic coupling of productivity transferred to the sea floor.

- Bearded seals birth young on the ice and have a long lactation period during which the mothers must feed pups. As the pups mature, they learn to feed by following the females into the water. Thus, this species requires sea-ice over shallow benthic habitat supporting a rich benthic food supply during the nursing period.

- Ringed seal are dependent on landfast ice as their exclusive breeding and haul-out platform. Snow on the surface of landfast ice is essential for the construction of lairs. Ringed seal has a six-week lactation period during which the mothers feed on polar and Arctic cod, and large zooplankton species.

- Harp and hooded seals breed and give birth on ice. These are species with the potential to extend their range north.

- Polar bears are heavily dependent on sea ice. The length of the ice season is a key requirement as it affects the duration of the winter fasting period and the reproductive success of females.

In summary, predicted changes in ice cover that may occur as a result of global climate change and have the potential to affect, directly or indirectly, all aspects of the marine ecosystem in the Project area.

1.4.11.2 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, in the event that multiple vessels overlap in space and time, 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 similar to 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 seal 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.

The potential future development scenario would involve shipping in ice as late as mid-March, which is the time that ringed seals establish their birth lairs (FEIS Volume 8, Section 5.1.1). Pups are born in April. Shipping will not be undertaken during the pupping season. Ringed seals will nonetheless experience changes to its habitat due to disturbed ice. The habitat change was estimated at 4% to 6% of the available landfast ice in Section 1.4.14.2, which less than the 10% threshold applied in the ringed seal habitat loss assessment in the FEIS (Volume 8, Section 5.6.2.1).

The FEIS also evaluated disturbance effects to ringed seal from ice breaking (Volume 8, Section 5.6.2.2). It was predicted that ice breaking may cause ringed seals may exhibit temporary avoidance during each vessel passage at estimated distances of 0.3–0.7 km based on an 80-dB sensation level criterion. This temporary disturbance due to ice breaking to Steensby Port would affect an estimated 220 ringed seals, with another ~17 ringed seals avoiding the port area due to changed ice. The effects of ice breaking to Milne Port can be expected to be comparable, though the temporary disturbance effects will occur over an 8.5-month shipping season at Milne Port, compared to year-round at Steensby Port. It is quite likely that at least some of the same ringed seals will be affected multiple times by icebreaking during the course of a single ice-cover season. Based on available evidence, ringed seals seem tolerant of industrial activity, and disturbance effects are expected to be localized and temporary.

Based on the above, effects of ice breaking on ringed seal from ice breaking associated with the potential future development scenario are predicted to be not significant.

1.4.11.3 Narwhal

For concurrent vessel activities along the northern shipping route during the open water season, when narwhal is 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, in the event that multiple vessels overlap in space and time, 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 similar to 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 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.

Narwhal are not found in the Pond Inlet – Eclipse Sound – Milne Inlet area during periods of ice cover, and the 8.5-month shipping season 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). The potential future development scenario will involve shipping through Baffin Bay during winter. A detailed effects assessment would be required to accurately assess the effects of shipping through Baffin Bay on over-wintering narwhal. The effects of winter shipping through Hudson Strait on narwhal was previously assessed to be not significant (FEIS Volume 8, Section 5.9.2).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.

1.4.11.4 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, in the event that multiple vessels overlap in space and time, 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 similar to those described for the Phase 2 Proposal. Based on the available literature, beluga 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 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.

Beluga are present in the Pond Inlet – Eclipse Sound – Milne Inlet area in low numbers during open water and are absent during periods of ice cover. The potential future development scenario will involve shipping through Baffin Bay during winter. A detailed effects assessment would be required to accurately assess the effects of shipping through Baffin Bay on over-wintering beluga. The effects of winter shipping through Hudson Strait on beluga was previously assessed to be not significant (FEIS Volume 8, Section 5.9.2).

1.4.11.5 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, in the event that multiple vessels overlap in space and time, 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 similar to those described for the Phase 2 Proposal. Based on the available literature, bowhead 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.

Bowhead are absent in the Pond Inlet – Eclipse Sound – Milne Inlet area during periods of ice cover. The potential future development scenario will involve shipping through Baffin Bay during winter. A detailed effects assessment would be required to accurately assess the effects on over-wintering bowhead of shipping through Baffin Bay. The effects of winter shipping through Hudson Strait on beluga was previously assessed to be not significant (FEIS Volume 8, Section 5.10.3).

1.4.11.6 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.

1.5 Assessment of Cumulative Effects to Valued Socioeconomic Components

1.5.1 Project-VSEC Interactions

The potential interactions between past, existing and reasonably foreseeable projects and activities with the VSECs assessed for the Phase 2 Proposal is presented in Table 1.6. The interactions identified are independent of whether or not the Phase 2 Proposal will result in residual adverse effects to the VSEC. Items identified as having a likely interaction are identified in Table 1.6 by an “X” and discussed in the following sections by VSEC.

Table 1.6 Potential Interactions of Other Projects and Activities with VSECs

Relevant Projects or Activities	Population Demographics	Education and Training	Livelihood and Employment	Economic development and self-reliance	Human Health and Well-Being	Community Infrastructure and Public Service	Culture, Resources and Land Use	Contracting and Business Opportunities	Benefits, Taxes and Royalties	Governance and leadership
Past										
Nanisivik Mine (Decommissioned)							X			
Mary River Project Definition Phase							X			
Diamond Exploration							X			
Existing										
Nanisivik Naval Facility and Military Exercises							X			
Back River and Hope Bay Projects										
Regional Ship Traffic							X			
Regional Air Transport							X			
Communities, Traditional/Recreational Land Use										
Regional Monitoring Programs							X			
Baffinland Regional Exploration							X			
Climate Change							X			
Reasonably Foreseeable										
Tullurutiup Imanga/ Lancaster Sound NMCA		X	X		X					X
Potential Future Development										
Mine Deposits No. 2 to 5 until 2055	X	X	X	X	X	X	X	X	X	X

Residual effects of the Phase 2 Proposal are summarized in Table 1.7, along with the direction of the effects and relevant projects and activities that can be expected to act cumulatively for each VSEC. The majority of socio-economic effects of the Project (the Approved Project and the Phase 2 Proposal) are positive.

Table 1.7 Intersection of Project Residual Socio-economic Effects with Other Relevant Projects and Activities

VSECs	Project Residual Effects		Other Relevant Projects and Activities
	Description	Direction	
Population Demographics	Demographics changes (migration of non-Inuit into the LSA and Inuit out of the LSA)	-	Potential future development scenario
Education and Training	Improvement of life skills among LSA residents; change in incentives related to school attendance and success; change in opportunities to gain skills	+	Potential future development scenario, Tullurutiup Imanga/ Lancaster Sound NMCA
Livelihood and employment	Creation of jobs in the LSA; change in employment of LSA residents; new career paths	+	Potential future development scenario, Tullurutiup Imanga/ Lancaster Sound NMCA
Economic development and self-reliance	Increased economic opportunities; increased self-reliance	+	Potential future development scenario

Table 1.7 Intersection of Project Residual Socio-economic Effects with Other Relevant Projects and Activities

VSECs	Project Residual Effects		Other Relevant Projects and Activities
	Description	Direction	
Human Health and Well-Being	Changes in parenting (+/-) Household income and food security (+) Transport of substances though Project sites (-) Affordability of substances (neutral) Attitudes toward substances and addictions (+) Absence from the community during work rotation (-)	+/-	Potential future development scenario, Tullurutiup Imanga/ Lancaster Sound NMCA
Community Infrastructure and Public Services	Competition for skilled workers (-) Improvement in labour force capacity (+)	+/-	Potential future development scenario
Culture, Resources and Land Use	Disturbance of archaeological sites due to ground disturbance Impacts on Inuit harvesting of caribou Impacts on Inuit harvesting of marine mammals Effects on safe travel within Pond Inlet, Eclipse Sound, Milne Inlet during open water Sensory disturbance at camps Safe travel inland through Milne Port Sensory disturbance along the Milne Inlet Tote Road Difficulty and safety relating to railway crossing	-	Nanisivik Mine, Mary River Project definition phase, diamond exploration, Nanisivik Naval Facility and military exercises, regional ship traffic, regional air traffic, regional monitoring programs, Baffinland regional exploration, climate change, Potential future development scenario
Contracting and Business Opportunities	Increased contracting and business opportunities	+	Potential future development scenario
Benefits, Taxes and Royalties	Positive economic impact	+	Potential future development scenario, Tullurutiup Imanga/ Lancaster Sound NMCA
Governance and Leadership	Positive strategic value on governance and leadership	+	Potential future development scenario, Tullurutiup Imanga/ Lancaster Sound NMCA

For those VSECs for which effects are predominantly or exclusively positive, other industrial developments such as the potential future development scenario will increase the magnitude and extend the duration of these positive impacts. Consistent with the FEIS (Volume 9, Section 1.4.5), the assessment of cumulative socio-economic effects focuses on negative or adverse effects. Four VSECs that will be experiencing a mix of positive and negative effects or solely negative residual effects from the Phase 2 Proposal include:

- Population demographics
- Human health and well-being
- Community infrastructure and public services, and
- Culture, resources and land use.

These are discussed further below.

1.5.2 Population Demographics

Socio-economic monitoring to date has shown that in-migration of non-Inuit into North Baffin communities has not occurred. While up to five known Inuit employees/contractors have migrated out of the North Baffin direct hire communities to date, it is not possible to discern whether or not Project employment was a contributing factor (TSD-25; Baffinland 2018c). Implementation of the Phase 2 Proposal is not expected to meaningfully change this potential residual effect.

Under the potential future development scenario, the Project's demand for labour would increase. This is not expected to result in in-migration of non-Inuit into the North Baffin LSA, as this potential effect was thought to be unlikely in previous assessments and has not occurred to date. It remains to be seen whether or not the Approved Project and the Phase 2 Proposal will induce Inuit working at the Project to migrate out of the LSA. It is expected that the Project will make out-migration easier and more attractive as workers with good income seek improved services and access to goods, and implementation of the potential future development scenario may further exacerbate this effect, but the effect will remain not significant.

1.5.3 Human Health and Well-Being

Six residual effects to human health and wellbeing are expected to occur as the result of the Phase 2 Proposal (Table 1.7). Three of these effects are negative (or variable), including:

- Changes in parenting
- Transport of substances though Project sites, and
- Absence from the community during work rotation.

Additional project employment that would result from the potential future development scenario may increase the number of people that may experience these effects, but this will be limited to individuals and up to the available workforce who are ready, able and willing to work at the Project. The adverse effects to human health and well-being will be not significant.

1.5.4 Community Infrastructure and Public Services

There is potential for adverse residual effects on community infrastructure and public services due to competition for skilled workers, as a result of the Phase 2 Proposal. Other projects or activities could draw employment from the same communities and may add to competition for skilled workers, including the potential future development scenario. As noted above, additional employment within the LSA communities may increase but only up to the available workforce who are ready, able and willing to work at the Project. The competition for skilled workers could increase under the future development scenario, but there is a limit to how many people this affects, and over the long-term a positive effect of increasing the capacity of the local workforce will be realized. The cumulative effects on community infrastructure and public services will be not significant.

1.5.5 Culture, Resources and Land Use

The following residual effects on culture, resources and land use were identified for the Phase 2 Proposal (TSD-25):

- Disturbance of archaeological sites due to ground disturbance
- Impacts on Inuit harvesting of caribou

- Impacts on Inuit harvesting of marine mammals
- Sensory Disturbance at Camps
- Sensory Disturbance along the Milne Inlet Tote Road
- Potential effects on safe travel within Pond Inlet, Eclipse Sound, Milne Inlet during open water
- Safe Travel Inland through Milne Port, and
- Difficulty and Safety relating to Railway Crossing.

The Projects and activities that have the potential to act cumulatively on migratory birds include:

- Nanisivik Mine
- Mary River Project definition phase
- Diamond exploration
- Nanisivik Naval Facility and military exercises
- Regional ship traffic
- Regional air traffic
- Regional monitoring programs
- Baffinland regional exploration
- Climate change, and
- Potential future development scenario.

Impacts on archaeology are conservatively assessed to be negative and low magnitude, though the expectation is that through mitigation that there will be no residual effects. It remains possible that sites may be inadvertently be disturbed through chance finds. Other projects in the region have the potential (or may already have) affected cultural heritage resources. An archaeological site was inadvertently disturbed by Baffinland during the definition phase of the Project. It is not possible for Baffinland to assess impacts of other projects and activities on cultural heritage. The additional footprint of the potential future development scenario will require detailed surveys and mitigation, resulting in no or low magnitude residual effects that are not significant.

Residual adverse low to moderate magnitude effects were assessed related to sensory disturbance in the vicinity of the Project, such as at HTO cabins at Milne Port and the Mine Site and along the Tote Road. Increased production and expanded PDAs associated with the potential future development scenario have the potential to increase noise and air contaminant emissions at adjacent areas to the Project such as the HTO cabins. It is expected that these impacts can be mitigated by implementing measures to reduce air contaminant and noise emissions and/or by other means (installing barriers, relocating cabins and other compensatory measures), such that these effects will be not significant.

Residual adverse low to moderate magnitude effects were also assessed for the Phase 2 Proposal related to safe travel due to Project infrastructure and activities, including shipping and railway operation. Activities that potentially involve an increase in shipping include military exercises and the potential future development scenario. Increased shipping through the Northwest Passage is not expected to affect Inuit safe use of waters, since Inuit boat travel does not typically extend into Lancaster Sound or Baffin Bay. Increases in shipping within Eclipse Sound, Pond Inlet and Milne Inlet have the potential to affect safe travel but only marginally. Project vessels would continue to apply the same safety measures, including the public reporting of vessel locations and speed reductions within this area. It is reasonable to expect that military exercises will be very well coordinated with a high emphasis on public safety. The cumulative effects of increased shipping on public safety would be not significant.

Potential effects to public safety when travelling through the Milne Port area during open water, or across the railway will remain unchanged under the potential future development scenario, relative to the Phase 2 Proposal. The potential future development scenario would, however, involve ice breaking through Milne Inlet, Eclipse Sound and Pond Inlet, passing in front of the community of Pond Inlet. The potential impact of such shipping on the landfast ice is quantified and assessed in Section 1.4.12.3.

Because ice breaking over an 8.5-month period was contemplated in the initial Phase 2 Proposal (Baffinland 2014), community workshops were held in Pond Inlet and Arctic Bay (TSD-3; Jason Prno Consulting Services Ltd. 2017). The second workshop, *Shipping Through Ice*, focused on obtaining community feedback pertaining to the shipping through ice component of Phase 2. Concerns about the effects of Phase 2 on the marine environment (including marine mammals) were raised, as were concerns on Inuit travel routes and land use activities being impeded by ice breaking activity and the creation of a ship track. However, various mitigation, monitoring and research, and compensation and benefits recommendations were made by workshop participants. Interest was expressed in the use of ship track crossing methods (e.g. removable bridges) and workshop participants discussed a number of ship track safety, crossing, and marking considerations. Workshop participants also commented on preferred timing, routing, and notification methods for shipping through ice activities, in addition to other related topics.

The presence of a ship track in front of the community would restrict or make on-ice travel more difficult, and this in turn would affect Inuit harvesting. Various mitigation measures were discussed with the community of Pond Inlet, as described above. These mitigation measures would reduce but would likely not fully offset the impacts of the ship track on Inuit travel. Further mitigation through compensation (i.e., through the Wildlife Compensation Fund established under the IIBA and administered by the QIA) would be an option. Based on the assumption that that the mitigation measures identified in the community workshops are implemented, and further compensation can be provided as necessary, it is expected that the residual impacts of ice breaking associated with the potential future development scenario would be not significant.

Cumulative Effects Summary

A number of cumulative effects have been identified in this assessment, all of which are predicted to be not significant. Table 1.8 summarizes the biophysical cumulative effects and significance rating by VEC.

The majority of biophysical cumulative effects identified are associated with the potential future development scenario, and are not due to past, present or reasonably foreseeable projects or activities. Where this is the case, they are not truly cumulative effects. Instead, they represent a high level assessment of a future development scenario that if realized as some point in the future will be subject to its own environmental assessment by the NIRB. Climate change was identified to potentially contribute to cumulative effects, though for several VECs the effects of climate change are highly uncertain, and the potential interactions with the Project and other projects and activities are complex and not well understood.

Cumulative socio-economic effects are largely positive, as with the Approved Project and the Phase 2 Proposal. Those socio-economic effects predicted to be adverse are generally associated with the potential future development scenario and are not due to past, present or reasonably foreseeable projects or activities. Ice breaking associated with the potential future development scenario may have meaningful but not significant effects to Inuit land use.

Baffinland is committed to mitigation, environmental management, adoption of best management practices, and monitoring in order to:

- Avoid, eliminate, or reduce adverse potential environmental effects of the Project, including cumulative effects
- Verify the effectiveness of mitigation
- Confirm effects predictions, including cumulative effects, and
- Contribute to a better understanding of the effects of mine development and shipping in Arctic regions, and of potential cumulative effects in the North Baffin Region.

The adaptive management approach taken by Baffinland is made evident through the company's environmental management system. Baffinland is able to examine the accuracy of predicted impacts through its various monitoring programs, assess the effectiveness of its monitoring programs and plans, and adjust and/or revise programs and plans as necessary to effectively manage and monitor potential effects. An example of applying adaptive management to the Approved Project includes the implementation of a freshet monitoring program and additional mitigation measures as the result of monitoring and inspections undertaken in accordance with the Type A Water Licence and Baffinland's Aquatic Effects Monitoring Plan (AEMP; Baffinland 2015).

Because most of the cumulative effects identified are the result of the potential future development scenario, no modifications to mitigation and monitoring plans are warranted at this time. Baffinland has not identified the need for mitigation measures and adaptive management that should be employed by other projects or entities.

Table 1.8 Cumulative Effects Summary

VEC	Key Indicator	Cumulative Effects	Significance Rating	Additional Follow-up Required (Mitigation or Monitoring)
Meteorology and Climate (including Climate Change)	Greenhouse gases (GHGs): • Carbon dioxide (CO2) • Methane (CH4) • Nitrous oxide (N_2O)	The Project will contribute to global GHG emissions and consequent effects on climate change. While other past, present and reasonably foreseeable projects and activities will also generate GHG emissions, it has been assumed that these are captured under the global total emissions. Assuming the future development scenario that roughly doubles GHG emissions, the Project's individual contribution to climate change would not be detectable and not significant.	Not significant	None required
Air Quality	Criteria air contaminants (CACs): • Total suspended particulate (TSP) • Sulphur dioxide (SO_2) • Nitrogen dioxide (NO_2) • Carbon monoxide (CO) • Sulphur and nitrogen deposition and potential acid input (PAI) • Particulate matter <2.5 µm ($PM_{2.5}$) • Particulate matter <10 µm (PM_{10}) • Fugitive dust and metal concentrations and deposition	There are no current or reasonably foreseeable projects or activities within the Project's airshed that can act cumulatively. The potential future development scenario for the Project would increase air contaminant concentrations but with additional mitigation the effects can be expected to be not significant.	Not significant	None required
Noise and Vibration	Noise and vibration levels	There are no current or reasonably foreseeable projects or activities that would overlap with the noise impacts of the Phase 2 Proposal. Under the potential future development scenario, the footprint of noise effects would increase modestly to levels unlikely to be significant.	Not significant	None required

Table 1.8 Cumulative Effects Summary

VEC	Key Indicator	Cumulative Effects	Significance Rating	Additional Follow-up Required (Mitigation or Monitoring)

Landforms, Soils, and Permafrost	• Landforms:
	• Glaciofluvial deposits
	  ○ Eskers
	  ○ Drumlins
	  ○ Bedrock outcrops (cliffs)
	• Geochemistry
	• Paleontology
		Climate change also has the potential to affect landforms, soil and permafrost cumulatively with the Project. With Baffinland's precautionary approach to project design incorporating changes that may result due to climate change, cumulative effects to landforms, soil and permafrost are not predicted to be significant. The potential future development scenario is unlikely to result in significant cumulative effects to landforms, soils and permafrost.	Not significant	None required

Vegetation	• Vegetation abundance and diversity • Vegetation health • Culturally valued vegetation	Cumulative effects on vegetation through changes in vegetation abundance and diversity will occur, though the contribution of other projects and activities is minor. The potential future development scenario, however, will result in measurable additional direct vegetation loss, but losses to individual vegetation cover types will remain small. Cumulative effects to vegetation health will also be minor. Cumulative effects to vegetation are expected to be not significant.	Not significant	None required
Migratory Birds and Habitat	• Red-throated loon • Snow goose • Common eider • King eider • Thick-billed murre • Lapland longspur • Harlequin duck • Peregrine falcon • Red knot • Buff-breasted sandpiper • Red-necked phalarope	The cumulative effect of habitat loss due to the potential future development scenario is expected to remain a low magnitude effect that is not significant. Other projects and activities including the potential future development scenario, like the Phase 2 Proposal, will result in direct mortality of a few individual birds. The cumulative effect of bird mortalities is expected to remain as a few individuals and not measurable at the population level. Increase in contaminants levels that could adversely affect bird health are not expected. The cumulative effects to migratory birds as a result of the Project and other projects and activities (excluding climate change) are not significant. As described above, the potential effects of climate change on bird habitats is difficult to quantify. Should the effects of climate	Not significant	None required

Table 1.8 Cumulative Effects Summary

VEC	Key Indicator	Cumulative Effects	Significance Rating	Additional Follow-up Required (Mitigation or Monitoring)
	• Ivory gull • Ross's gull • Short-eared owl	change on various bird species be significant, then the cumulative effects to migratory birds in that case would be significant.		
Terrestrial Wildlife and Wildlife Habitat	• Caribou • Wolf	Most of the additional projects and activities are minor contributors to habitat loss and/or sensory disturbance to terrestrial wildlife within the TRSA or the range of North Baffin caribou. The exceptions include the harvesting of wildlife by communities. With the GN's total allowable harvest limit, harvesting will have reduced impacts. The potential future development scenario has the potential to effect caribou cumulatively. An expanded PDA associated with this scenario will result in additional direct habitat loss that represents a small proportion of the overall habitat effect. Reduced habitat effectiveness will also occur. Using a conservative ZOI, the future development scenarios (i.e., both Deposits No. 2/3 and 4/5) may trigger a Level III extent effect in winter habitat. However, this does not account for a reduced ZOI ZOI where project activities no longer occur at abandoned and reclaimed deposit sites, consideration of transport by rail, and observed effects after monitoring and adaptive mitigation measures have been applied through successive Project phases. 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. 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 limited and likely not measurable within the life of the Project.	Not significant	None required
Surface Water	• Water quantity • Water quality	Given that there are no other developments or activities occurring or expected to occur within the catchments affected by the Project, cumulative effects to water quantity are not expected. Additive cumulative effects to water quantity may occur as the result of the potential future development scenario; however, significant effects can be avoided by seeking other water sources. It is unlikely that the	Not significant	None required

Table 1.8 Cumulative Effects Summary

VEC	Key Indicator	Cumulative Effects	Significance Rating	Additional Follow-up Required (Mitigation or Monitoring)
		potential future development scenario would act cumulatively with climate change effects to water quantity to cause a significant effect. Given that there are no other developments or activities occurring or expected to occur within the catchments affected by the Project, cumulative effects to water quality are not expected. Cumulative effects to water quality could likely occur as the result of the potential future development scenario due to increased loadings to existing receiving waters such as the Mary River. These potential effects can be assessed using water quality modelling in a future assessment, once sufficient model inputs are available. Mitigation measures such as water treatment would be available to avoid a significant effect. Climate change could result in higher TSS loadings that are additive to the project; though additional mitigation measures can be implemented.		
Freshwater Biota and Habitat	• Arctic char	Given that there are no other developments or activities that may result in cumulative effects to fish and fish habitat. Cumulative effects to freshwater fish and fish habitat could occur as the result of the potential future development scenario, but it can be assumed that through design changes and offsetting of serious harm, the residual effects to freshwater fish habitat will be not significant. Freshwater fishes are potentially vulnerable to climate change. The residual effects of the Project to freshwater fish are minor and not significant, and are unlikely to persist beyond temporal boundaries of the project. Thus, the opportunity for residual effects to interact with the future long term effects beyond 2040 on climate change on fish and fish habitat are limited.	Not significant	None required
Marine Ice, Water, and Sediment Quality	• Marine ice • Marine water quality • Marine sediment quality	The potential future development scenario of transporting 24 Mtpa from Milne Port would not involve any further changes to docks but would require an expansion of ore stockpiles, higher throughput shiploaders, and more ship traffic. The same effects would occur at a higher intensity. Given the low magnitude ratings assigned to effects on water and sediment quality as a result of the Phase 2 Proposal, it is unlikely the higher intensity effects would be rated more than Level II	Not significant	None required

Table 1.8 Cumulative Effects Summary

VEC	Key Indicator	Cumulative Effects	Significance Rating	Additional Follow-up Required (Mitigation or Monitoring)
		or moderate magnitude, and therefore the effects would not be significant. Increased TSS due to climate change is unlikely to meaningfully contribute to cumulative effects to marine water and sediment quality.		
Marine Habitat and Biota	• Marine fish habitat • Arctic char	Increased shipping activity associated with the potential future development scenario will result in more ballast water discharges that may result in the introduction of aquatic invasive species to the local receiving marine environment. Compliance with new ballast water requirements will reduce the risk such that the residual impact is negligible. Increased wastewater discharges and dust deposition are likely to occur under the potential future development scenario. Given the negligible magnitude ratings assigned to these habitat alteration effects as a result of the Phase 2 Proposal, it is unlikely the higher intensity effects would be rated more than Level II or moderate magnitude, and therefore the effects would not be significant. 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. It is anticipated that, should multiple vessels transit through a given area, the cumulative noise field will increase spatially. 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.	Not significant	None required
Marine Mammals	• Ringed seal • Walrus • Beluga whale • Narwhal • Bowhead whale • Polar bear	Potential behavioural effects on marine mammal species due to underwater noise arising from cumulative increases in shipping traffic are anticipated to be similar to those described for the Phase 2 Proposal.	Not significant	None required

Table 1.8 Cumulative Effects Summary

VEC	Key Indicator	Cumulative Effects	Significance Rating	Additional Follow-up Required (Mitigation or Monitoring)
Population Demographics	• Migration in and out of the LSA	Other projects and activities have to potential for minor contributions to these low magnitude effects.	Not significant	None required
Human Health and Well-being	• Changes in parenting • Household income and food security • Substances abuse • Absence from the community during work rotation	Other projects and activities have to potential for minor contributions to these low magnitude effects.	Not significant	None required
Community Infrastructure and Public Services	• Competition for skilled workers • improvement in labour force capacity	Other projects and activities have to potential for minor contributions to these low magnitude effects.	Not significant	None required
Culture, Resources and Land Use	• Effects on travel, public safety and harvesting	Ice breaking associated with the potential future development scenario would have greater magnitude impacts on Inuit travel on the landfast ice and on harvesting.	Not significant	None required

2 TRANSBOUNDARY EFFECTS TRANSBOUNDARY EFFECTS

2.1 Background

The Amended NIRB Guidelines (NIRB 2015) define transboundary impacts as:

"Any impact, not exclusively of a global nature, within an area under the jurisdiction of a Party caused by a proposed activity, the physical origin of which is situated wholly or in part within the area under the jurisdiction of another Party."

The NIRB guidelines define transboundary effects as those effects that occur outside the Nunavut Settlement Area (NSA) which are directly linked to the activities of the Project. These effects may occur across territorial/provincial or international boundaries. Although the Project is located entirely within the NSA, transboundary effects from the Project can occur when wildlife (i.e., migratory birds and marine mammals) move across jurisdictional boundaries, or when project activities themselves, or their zone of influence, cross jurisdictional boundaries (e.g., transportation and economic benefits). Transboundary effects of the Project have the potential to act cumulatively with other projects and activities outside the NSA.

NIRB directed Baffinland to consider the potential for transboundary impacts for all VECs and VSECs with any residual effects that have the potential to occur outside of the NSA. Additionally, NIRB requested that specific consideration be given to the potential for transboundary impacts associated with marine shipping on marine mammals and migratory birds. Residual effects which have the potential to occur outside of the NSA shall also be included. This direction would have had more relevance to the original Phase 2 Proposal, which involved shipping in ice and trans-shipment off the coast of Greenland (Baffinland 2014). These elements have been removed from the current Phase 2 Proposal.

Transboundary effects that are predicted to occur due to the Approved Project were identified in FEIS Volume 9, Section 4. Effects of the Project (including transboundary effects) that do not change from activities associated with the Phase 2 Proposal have not been revisited. This includes potential transboundary effects associated with project effects to marine mammals resulting from shipping along the southern shipping route to and from Steensby Port.

2.2 Assessment Methodology

The following systematic process was used to determine which VECs and VSECs would be included in the transboundary effects assessment:

- Conduct a screening to identify Project residual adverse effects that may result in transboundary effects
- Determine whether the residual effects of the Project may operate cumulatively in a transboundary context with the environmental effects of projects or activities located in other jurisdictions
- Assess whether the Project will interact cumulatively in a meaningful way (i.e., is "likely" to heighten effects)
- Describe mitigation measures, where feasible, that may be applied where measurable effects are anticipated
- Describe the significance of the residual effect after mitigation is applied

If a VEC or VSEC is predicted to experience a residual effect with the potential to interact with projects and activities outside of the NSA, a discussion of transboundary effects is provided.

2.3 Assessment of Transboundary Effects to VECs

2.3.1 Screening

Table 2.1 identifies the residual effects of the Phase 2 Proposal for each VEC that may result in transboundary effects. VECs where there is potential for transboundary effects are discussed below.

Table 2.1 Residual Project Effects on VECs that May Result in Transboundary Effects

VECs	Residual Effects	Potential for Transboundary Effects	Type of Effect
Climate Change	GHG Emissions	Unlikely, GHG emissions are small relative to other sources	Cumulative
Air Quality	Air Contaminants	Emissions will not be measurable outside the NSA (TSD-7; KP, 2018x)	n/a
Noise and Vibration	Noise Levels	Effects confined to LSA (TSD-7; KP, 2018x)	n/a
Landforms, Soil and Permafrost	Loss of landforms; degradation of soil and permafrost	Effects confined to LSA (TSD-8; KP, 2018x)	n/a
Vegetation	Vegetative cover loss/alteration	Effects confined to PDA (TSD-9)	n/a
Migratory Birds and Habitat	Habitat loss/alteration; mortalities; health impacts	Effects confined to within the TRSA and MRSA (TSD-12) on migratory birds that live outside of the NSA	Cumulative
Terrestrial Wildlife and Habitat	Habitat loss/alteration; mortalities; health impacts	Effects confined to within the TRSA (TSD-10)	n/a
Water Quantity	Reduced stream flow	Effects confined to LSA	n/a
Water Quality	Degradation of water quality	Effects confined to LSA	n/a
Freshwater Fish, Fish Habitat and Biota	Loss/alteration of habitat	Effects confined to LSA	n/a
Marine Ice, Water and Sediment Quality	Degradation of water quality/sea ice	Effects confined to LSA	n/a
Marine Habitat and Biota	Loss/alteration of habitat	Effects confined to RSA	n/a
	Introduction of invasive species	Yes, possible	Cumulative
Marine Mammals	Loss/alteration of habitat	Yes, possible	Cumulative

2.3.2 Climate Change

Global GHG emissions cause climate change, and hence the Project's GHG emissions cumulatively represent a transboundary effect. The Project's GHG emissions and its potential impact on climate change is discussed briefly in Section 1.4.2 and in more detail in TSD-6 Climate Change Assessment (Baffinland 2018b). The Project's GHG emissions are not significant in the context of global GHG emissions, and the impact of these emissions on climate change are not significant.

2.3.3 Migratory Birds and Habitat

The overall effects of the Phase 2 Proposal to the key indicator species specifically and to all migratory bird species in general are not predicted to have serious implications for the regional populations of any species and their habitats. Bird mortalities because of collisions with Project infrastructure and vehicles are expected to be limited to a few individuals of the most abundant species annually, with no measurable effect on regional populations (TSD-12, EDI 2018). Transboundary

effects to migratory birds will occur, but will likely not be measurable at the population level, and hence will be not significant.

2.3.4 Marine Habitat and Biota

The accidental introduction of aquatic invasive species (AIS) at Milne Port or at destination ports within Canada and internationally represents a potential transboundary effect.

A Project effect resulting in a transboundary effect could occur under the following scenarios:

- A local aquatic invertebrate species was to be introduced accidentally in another jurisdiction, or
- If an AIS was accidentally introduced at Milne Port and was then subsequently transmitted to the marine waters in another jurisdiction via Milne Port.

Both scenarios have the potential to occur only in instances where vessels calling on Milne Port take on ballast water at Milne Port and then discharge that ballast water at another port location. The only vessels that this applies to are sealift vessels and fuel tankers, which travel to Milne Port under load and subsequently take on ballast water upon departing Milne Port. These vessels primarily sail within Canada and most often are returning to ports in the St. Lawrence Seaway (i.e., Valleyfield, QC) or to other ports on the east coast (i.e., fuel refineries in Saint John, NB).

The second scenario would only occur if an AIS was introduced at Milne Port from an ore carrier, which discharge ballast water at or near the dock at Milne Port as ore is loaded into the ore carrier's holds. This risk was assessed for the Approved Project and more recently for the Phase 2 Proposal in TSD-17 (Golder 2018a) and TSD-21 (Golder 2017b). These studies evaluated the potential for an AIS from another jurisdiction to colonize at Milne Port.

Currently, all foreign ships entering Canadian waters must undertake exchange ballast water in open seas, away from coastal waters (i.e., 200 nautical miles from land and in water at least 200 metres deep). Under this scenario, Golder assessed the risk of AIS invasion risk posed by ballast water to be high.

However, the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (Convention; IMO 2017) ratified by Canada that came into force in 2017 requires that all ships implement a Ballast Water Management Plan and comply with the D-2 performance standard that specifies the maximum amount of organisms and indicator microbes allowed to be discharged to the receiving marine environment. According to the Convention, ships entering Canadian waters from abroad will need to be equipped with an on-board system to treat ballast water and eliminate unwanted organisms to meet the D-2 performance standard according to the schedule set by the IMO (MEPC 2017). The requirements of the reference to the D-2 standard will reduce the risk of AIS introduction in the Milne Inlet ecosystem.

Overall, the effect of ballast water discharge on marine water quality was assessed to be low in magnitude, local, frequent, medium term in duration and fully reversible; the effect was determined to be not significant (Golder 2018a). Hence the potential transboundary effects of ballast water on sediment quality will have the same rating of not significant.

2.3.5 Marine Mammals

Whale species (narwhal, beluga and bowhead whale) overwinter of the coast of Greenland, and hence residual effects to these marine mammal species will result in transboundary effects. The effects of the Phase 2 Proposal to these species are low magnitude and are not predicted to have serious implications for the regional populations (TSD-24; Golder 2018b). Transboundary effects to these species will occur, but will likely not be measurable at the population level, and hence will be not significant.

2.4 Assessment of Transboundary Effects to VSECs

2.4.1 Screening

Table 2.2 identifies the residual effects of the Phase 2 Proposal on VSECs that may result in transboundary effects. VSECs where there is potential for transboundary effects are discussed below.

Table 2.2 Residual Effects on VSECs that May Result in Transboundary Effects

VSECs	Project Residual Effects		Potential for Transboundary Effects
	Residual Effects	Direction	
Population Demographics	Demographics changes (migration of non-Inuit into the LSA and Inuit out of the LSA)	-	Effects confined to the NSA
Education and Training	Improvement of life skills among LSA residents; change in incentives related to school attendance and success; change in opportunities to gain skills	+	Yes, a portion of the workforce portion reside in other Canadian provinces and territories; the Project will provide training to southern workers, though this effect will not be detectable in the context of the population of southern Canada.
Livelihood and employment	Creation of jobs in the LSA; change in employment of LSA residents; new career paths	+	Yes, a portion of the workforce portion reside in other Canadian provinces and territories; the Project will provide employment to southern workers, though this effect will not be detectable in the context of the population of southern Canada.
Economic development and self-reliance	Increased economic opportunities; increased self-reliance	+	Yes, the Project represents increased economic opportunities (and consequently increased self-reliance) to residents of southern Canada
Human Health and Well-Being	Changes in parenting; household income and food security; substances though Project sites; affordability of substances; attitudes toward substances and addictions; absence from the community during work rotation	+/-	Yes, effects will be most apparent within the NSA but will extend to the households of workers living in southern Canada
Community Infrastructure and Public Services	Competition for skilled workers; improvement in labour force capacity	+/-	Effects confined to the NSA
Contracting and Business Opportunities	Increased contracting and business opportunities	+	Yes, the Project provides contracting and business opportunities to companies and individuals in southern Canada
Culture, Resources and Land Use	Disturbance of archaeological sites; impacts on Inuit harvesting; effects on safe travel; sensory disturbance	-	Effects confined to the NSA
Benefits, Taxes and Royalties	Positive economic impact	+	Yes, the Project will result in the payment of federal and provincial (in addition to territorial) taxes.
Governance and leadership	Positive strategic value on governance and leadership	+	Effects confined to the NSA

2.4.2 Summary of Transboundary Impacts to VSECs

Transboundary effects will occur for six of 10 VSECs, as noted in Table 2.2. The Project will employ workers based in southern Canada and will present business opportunities to businesses in southern Canada. The Project will also pay federal royalties (aggregate) and tax revenues will accrue to the federal and provincial governments through personal income taxes, corporate tax, fuel taxes and sales taxes. No meaningful adverse socio-economic effects are expected to occur outside of Nunavut.

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