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Appendix G-1
Project Alternatives

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Bathurst Inlet Port and Road Project Alternatives

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ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations

BIPR	Bathurst Inlet Port and Road
EIS	Environmental Impact Statement
GBPR	Grays Bay Port and Road
GNWT DOT	Government of the Northwest Territories Department of Transportation
NIRB	Nunavut Impact Review Board
NWT	Northwest Territories
the Project	the Bathurst Inlet Port and Road Project
SGP	Slave Geological Province
TCWR	Tibbitt to Contwoyto Winter Road

PROJECT ALTERNATIVES

Project Alternatives

1. Introduction

As described in the Final Environmental Impact Statement (EIS) Guidelines for the Review of the Proposed Bathurst Inlet Port and Road (BIPR) Project prepared by the Nunavut Impact Review Board (NIRB, 2004), one of the ten minimum requirements for an EIS is the consideration of project alternatives. Consideration of the alternatives to the BIPR Project (the Project) should identify alternate means by which the Project's goals can be met, the preferred alternative and the "no-go" alternative.

Transportation delays on the Tibbitt to Contwoyto Winter Road (TCWR) due to warm weather in the winter of 2006 led the TCWR joint venture partners to undertake a comprehensive transportation alternatives study. The primary study objective was to explore options to improve reliability and capacity for the re-supply to the operating mines in the Slave Geological Province (SGP) region (EBA Engineering Consultants Ltd., 2007). This study concluded that, in the context of a climatic warming trend and the increasing traffic demand in the SGP, the continued reliance on the TCWR as the sole transportation corridor for re-supply of the regional diamond mining industry is not a viable option. Seventeen alternatives to supplement the TCWR in meeting re-supply demands were initially proposed. From these seventeen, the study short-listed three alternatives as the best options to pursue to the planning stage. The Project was among the three short-listed options.

As described below, the Project option has been identified as the best alternative since it offers considerable economic, technical, and social advantages and the environmental issues have already been studied and described. Several road alignments were investigated to determine the most feasible route west from Bathurst Inlet. The current alignment offers several economic and environmental advantages and is, therefore, considered the best option.

2. Transportation Alternatives

The seventeen alternatives to the TCWR that were developed satisfied at least one of the following four overriding transportation requirements:

- supply energy without relying on roads;
- alternative energy transport systems on roads;
- upgrade or parallel winter road routes; or
- new infrastructure that relieves traffic pressure on the existing road.

The EBA study (2007) recommended the following three options to be pursued to the implementation planning stage:

a) Seasonal (Winter Only) Overland Road – Tibbitt to Lockhart:

- a new 156 km winter road from the end of the Ingraham Trail at Tibbitt Lake to Lockhart Lake, entirely overland but generally parallel to the existing TCWR;
- an initial capital cost of $112 million;

- option would add 30 days to the normal winter road operating season and improve operating efficiency; and
- option would have least environmental impacts, as no incremental territory would be opened for recreation or hunting.

b) Grays Bay Port and Road (GBPR):

- a port at Grays Bay on the Coronation Gulf;
- a 53 km section of all-weather road between Grays Bay and High Lake is part of the High Lake mining proposal submitted by Wolfden Resources to the NIRB for environmental assessment in November 2006;
- other components of the project (still in conceptual stage) include winter road connection to Ulu and Jericho mines with connection to TCWR at Jericho; technical and financial feasibility, to be studied by Zinifex Canada Inc.;
- potential technical difficulty resulting from diverse topography; and
- cost and length of new road comparable to the BIPR Project, but port located further away existing diamond mines in the NWT and most potential mining projects in the region.

c) BIPR:

- port and road infrastructure as described in this DEIS;
- technical and financial feasibility complete, and potential environmental impacts well defined;
- complementary to existing TCWR, with alternate fuel and cargo delivery from the Arctic; and
- strong support from Kitikmeot communities and most favourable altertiave for long-term economic development of the Kitikmeot Region of Nunavut.

2.1 Recommended Options Evaluation

A preliminary evaluation of the recommended three options is summarized in Table 2-1.

Table 2-1
Project Alternatives Evaluation Matrix

	Seasonal Overland Road Tibbitt to Lockhart	Grays Bay Port and Road	Bathurst Inlet Port and Road
Capital Cost	●	◎	◎
Operating and Maintenance Cost	◎	●	●
Technical Feasibility (Engineering Certainty)	●	○	●
Freight and Re-supply Efficiency	○	◎	●
Operating Reliability	○	◎	●
Community Support	◎	○	●
Socio-Economic Effects	○	◎	●
Environmental Effects	●	◎	◎
Overall Ranking	◎	○	●

Legend: ● **= More Favourable;** ◎ **Favourable;** ○ **Less Favourable**

the Bathurst Inlet Port and Road Project

FIGURE 2-1

Transportation Alternatives

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The Tibbitt to Lockhart option is identified in Table 2-1 as having the lowest capital cost. Since it is currently proposed as a winter (not all-weather) road, it is not as remote as the other two options and its construction can largely be facilitated by the adjacent TWCR. The technical feasibility and environmental effects of this option are also favourable, as no new territory is being opened up which would increase human access to wildlife and habitat. The freight and re-supply efficiency of the Tibbitt to Lockhart option is the least favourable of the three, since it is currently proposed as a winter road.

GBPR is located further away from most of the mines in the Kitikmeot Region, and will incur additional truck travel to and from current and potential mines. The BIPR Project option is most favourable by this criterion, as it is close to the many potential mines and most efficient for freight transport and annual re-supply. The operational reliability of the Tibbitt to Lockhart option is also the least favourable for the reasons described above. The Grays Bay road will connect to the TCWR near the Lupin mine site and, compared to the Bathurst Inlet road, will require more travel on the winter road to reach the mines in the Northwest Territories (NWT).

The operating and maintenance costs of the GBPR and the BIPR Project options are similar. Although the Tibbitt to Lockhart option has a lower capital cost, both the northern options have the advantage of a much greater potential for attracting additional funding from prospective users. The BIPR Project option will facilitate several future mine projects west of Bathurst Inlet (*i.e.*, Hackett River, George Lake, Goose Lake and Yava) in addition to several projects west of Contwoyto Lake (*i.e.* Izok and Gondor). The proposed route of the GBPR all-weather road would run directly north from the Izok mine site, isolated from the majority of the existing and potential mineral properties. Potential properties which could benefit the most from this option are limited to Gondor, Hood River and Wreck Lake (base metal), and Jericho (diamonds). Since the BIPR Project option is located closest to most of the mines in Kitikmeot, it will be most conducive to socio-economic development in the region.

The technical feasibility of the BIPR Project option is more favourable than the GBPR option primarily because of terrain differences. Compared to the BIPR Project option, the topography south of Grays Bay to the north end of Contwoyto Lake is more challenging from an engineering perspective and would also involve several major river crossings.

Both the GBPR and the BIPR Project options are ranked in Table 2-1 as favourable with respect to environmental impacts. However, the greater complexity in engineering the GBPR route may increase the probability of environmental impacts. Wildlife that would be most affected by any development in the West Kitikmeot region is the barren-ground caribou (*Rangifer tarandus*), a keystone species in the Arctic both biologically and culturally. The creation of an all-weather road may disrupt movement patterns of caribou, but the magnitude of this effect depends on the road structure, traffic levels on the road, and the season of the caribou migration and use of the area in question.

Three caribou herds are present in the GBPR area during certain periods of the year: the Bathurst herd, the Ahiak herd (although the western range of this herd is poorly defined), and the Dolphin and Union herd. The creation of a road between Grays Bay and the north end of Contwoyto Lake would overlap with the ranges of the Bathurst herd and the Dolphin and Union herd, and possibly the western range of the Ahiak herd. The Bathurst herd may be present in the GBPR area during the highly sensitive calving period, from early June to early July. Thus, the proposed GBPR road may have potential adverse effects on the Bathurst herd. The GBPR road does overlap almost entirely with the winter range of the Dolphin and Union herd who spend their winters on the Nunavut mainland along the south side of Coronation Gulf. If road operations take place during the winter, between January and April, this will coincide with the period when the Dolphin and Union herd are present in the GBPR area (early December to the end of April). Thus, the GBPR option may have significant adverse effects on the Dolphin and Union herd, and on the Bathurst herd. Potential effects of the GBPR option on caribou include a disruption of movement patterns (both from the physical presence of the road structure and vehicle traffic), disturbances to feeding and breeding (Bathurst herd), and direct mortality due to collisions with vehicles.

The proposed BIPR Project overlaps with the ranges of the Bathurst herd and Ahiak herd. The potential for the BIPR Project to act as a barrier to movement during early spring migration—specificially from April 15 to April 30—is considered a potential effect on the Bathurst and Ahiak caribou. The potential disturbance to the Ahiak herd is expected during the winter haul season due to heavy vehicle traffic (Appendix D-3 of the DEIS).

Other wildlife in the West Kitikmeot region, such as muskox, grizzly bear, wolverine, wolf and birds, are unlikely to experience any difference in the magnitude and significance of effects between the two northern options. However, this assessment is preliminary and requires more research of the GBPR option before any statements can be made with high confidence.

3. Alternatives within the BIPR Project Option

Previous studies have examined several road alignments from the Slave Geological Province to a marine shipping terminal on Bathurst Inlet. The Izok Project investigated a port site 20 km east of Kugluktuk and a 270 km all-season road to the Izok Project base metal deposit (Metall Mining Co., 1994).

In 1998, Geowest Environmental Consultants Ltd. was contracted by the Government of the Northwest Territories Department of Transportation (GNWT DOT) to examine the feasibility of an all-season road between the Yellowknife area and Bathurst Inlet. Results from this study were presented to the GNWT DOT in 1999 (Geowest, 1999). After reviewing existing information, a route was flown from Yellowknife to Exeter Lake to Contwoyto Lake to Bathurst Inlet to Contwoyto Lake to Snare Lake to Rae-Edzo and back to Yellowknife. Potential routes were delineated based on various criteria (*i.e.*, topography, bedrock surface, lake locations, river crossings, wet organic terrain, granular borrow sources and permafrost) and qualitatively ranked for aggregate potential. Four delineated routes (I, J, K and L) resulted in the Contwoyto Lake/Lupin Mine to Bathurst Inlet work area. Route J in the study is equivalent to the current alignment for the Project. This route was identified as having the fewest bridge crossings, good aggregate potential throughout the route and favourable topography (slope of less than 15%) over approximately 75% of the route.

In 1999, Nishi-Khon/SNC-Lavalin and J.D. Mollard and Associates conducted a comprehensive route selection and terrain analysis of the study area to identify a feasible all-weather route among competing alternatives between a port on Bathurst Inlet and the south end of Contwoyto Lake (Nishi Khon/SNC-Lavalin and Kitikmeot Geosciences, 2000). As shown in Figure 3-1, a number of competing alternative route corridors were investigated based on construction, operating costs, terrain controls plus the following factors:

- location of existing and possible future mine and mineral resource developments in western Nunavut;
- locations of small and large lakes and major river valleys along prospective alignments;
- terrain types and conditions, including topography, landforms, soils and rocks and their characteristics, surface drainage, permafrost and wetland conditions;
- distribution of rock and granular borrow for construction on and near the route;
- environmental controls, impacts and mitigative measures;
- location of environmentally sensitive areas (*i.e.*, caribou calving grounds);
- cultural and heritage resources; and
- comparative lengths of haul routes.

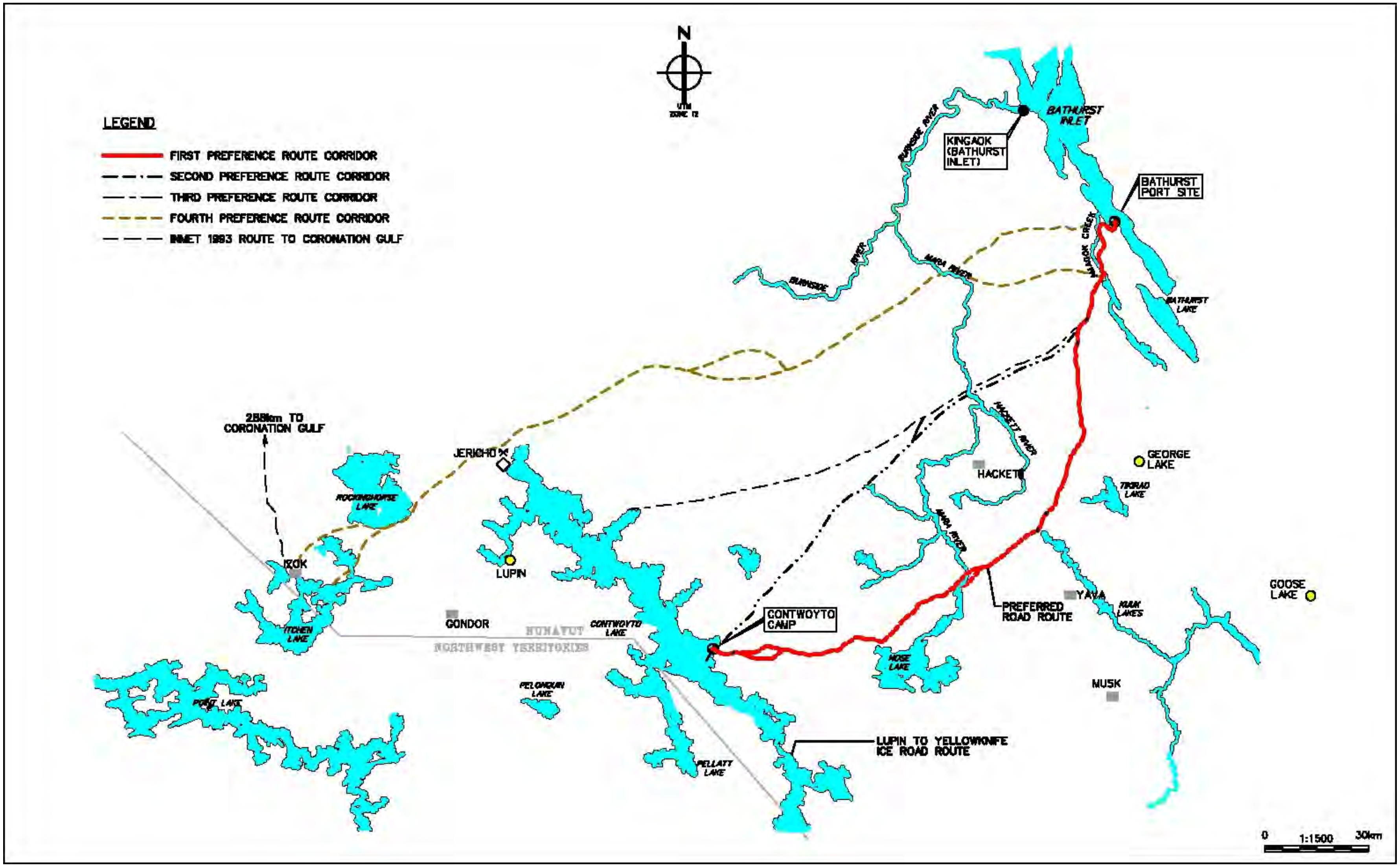
The rationale for the current project configuration is its reduced construction and operating costs due primarily to flatter topography over the length of the road alignment, thereby requiring less terrain disturbance for construction, as well as reduced borrow and quarry material needs. The proposed road alignment is amenable to serving existing mines in Nunavut and NWT, and prospective mine sites in Nunavut currently in the advanced exploration phase. The current Project is also better aligned to serve other mineral deposits whose economic potential may be enhanced by the lower development and operating costs as a direct result of the project.

The selection of the current Project transportation route addresses the issues raised in the draft West Kitikmeot Regional Land Use Plan by the Nunavut Planning Commission (NPC, 2005) with respect to route selection for a transportation corridor and guidelines for developing a transportation corridor. The BIPR Project option has the support of the West Kitikmeot Inuit organizations (NPC, 2005).

No new and/or untried design and construction methods, or transportation techniques, are contemplated for any aspect of the Project.

4. No-go Options

The prospect of a no-go option for the Project has several serious implications. The trend in global warming reduces the reliability of the TCWR and has already increased economic and environmental costs via the shipping of fuel by air to projects in need. It has been estimated that 80% of the fuel imported by mines into the SGP would come from a northern port and road, if constructed (Arthur Andersen *et al.*, 1999). The absence of transportation infrastructure encourages the continued isolation of remote communities and restricts access of goods and



Source: Nishi Khon/SNC-Lavalin and Kitikmeot Geosciences (2000).

Figure 3-1 Route Alternatives for All-weather Road

services. The cost of moving commodities in northern areas has considerably inhibited the development of new mining properties in the Arctic. It is generally accepted that all-weather transportation infrastructure and a northern port would facilitate further mineral development by lowering the transport costs of goods and services. Conversely, without this access, only large high-grade gold and diamond ore bodies would be available for development. The Project would bring a substantial positive economic impact to the Kitikmeot region and Nunavut by facilitating the industry endeavours in the area, increasing job opportunities in local communities, and increasing the potential for future economic growth in Nunavut. This is especially the case since this option is relevant to a considerable number of mining claims and leases.

Several disadvantages are inherent in the GBPR moving forward, if the BIPR Project option is a no-go. Primary among these is that an all-weather road extending from the northern end of Contwoyto Lake would be extremely difficult to construct due to the local topography. These technical difficulties may negatively affect construction costs in currently unforeseeable ways. A key factor in the viability of the chosen option is the date by which permitting is likely. Currently, the permitting process is further along for the BIPR Project option. Although an Environmental Assessment has been submitted to NIRB for the proposed road from Grays Bay to High Lake, the baseline studies for the area between High Lake and the northern end of Contwoyto Lake have not been completed. A baseline study of this scale may take at least two years.

The option of a winter overland road from Tibbitt to Lockhart Lake in place of any northern port option has considerable disadvantages from the Nunavut perspective. Although the seasonal overland road to Lockhart Lake is considered the most feasible option in terms of environmental permitting, the northern port options, as described above, offer significant long-term benefits to Nunavut and mineral properties in the region. The Tibbitt to Lockhart Lake overland route would not likely facilitate longer term base metal mine developments in Nunavut at Izok and Hackett River. In addition, it is likely that projects close to an arctic port would experience greater savings in fuel transport costs from the BIPR Project than from over the southern Tibbitt to Lockhart Lake option.

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An explanation of the acronyms used throughout this reference list can be found in the *Acronyms and Abbreviations* section.

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Appendix G-2
Effects of the Environment on the Project

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Bathurst Inlet Port and Road
Effects of the Environment on the Project

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ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations

AO	Arctic Oscillation
BC	British Columbia
BC MOFR	British Columbia Ministry of Forests and Range
BIPR	Bathurst Inlet Port and Road
CCIS	Canadian Climate Impacts and Scenarios
DEIS	Draft Environmental Impact Statement
GCM	general circulation models
GHG	greenhouse gas
GPS	global positioning system
NAO	North Atlantic Oscillation
NDT	natural disturbance type
NRCan	Natural Resources Canada
the Project	the Bathurst Inlet Port and Road Project
the proponent	Bathurst Inlet Port and Road Project Joint Venture Ltd.
RISC	Resources Information Standards Committee, BC
UIUC	University of Illinois Urbana-Champaign (Department of Atmospheric Sciences)
US FWS	United States Fish and Wildlife Service

EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Effects of the Environment on the Project

1. Introduction

The Bathurst Inlet Port and Road (BIPR) Project (the Project) can be affected by small events, such as minor storms, as well as large-scale environmental changes due to climate change. Depending on the type and scale of the environmental event, one or more components of the Project could be affected. This report discusses the environmental factors that could potentially affect the Project, their likelihood of occurrence and severity, and possible mitigation.

1.1 Climate Change Background

Over the past several decades an increasing body of evidence has identified a warming trend in the global climate. Global observations suggest a number of climate trends during the twentieth century, including increased average surface temperature, precipitation, frequency of heavy precipitation events and cloud cover, together with reductions in the length of the freeze season, the frequency of extreme low temperatures, and the extent of snow cover and mountain glaciers. Although the global climate naturally fluctuates over time, numerous studies and models are suggesting that current climate change is being accelerated by anthropogenic emissions of greenhouse gases (GHG) (Meehl *et al.*, 2007).

2. Climate Change

2.1 Climate Change Background

Over the past several decades an increasing body of evidence has identified a warming trend in the global climate. Global observations suggest a number of climate trends during the twentieth century, including increased average surface temperature, precipitation, frequency of heavy precipitation events and cloud cover, together with reductions in the length of the freeze season, the frequency of extreme low temperatures, and the extent of snow cover and mountain glaciers. Although the global climate naturally fluctuates over time, numerous studies and models are suggesting that current climate change is being accelerated by anthropogenic emissions of greenhouse gases (GHG) (Meehl *et al.*, 2007).

2.1.1 Climate Change Information

Climate variables fluctuate over different temporal scales. Climate change refers to trends that occur over decades, centuries or millennia, whereas climate variability refers to trends that occur over shorter time periods of decades, years and shorter. Two significant natural cycles that affect the climate of the Canadian Arctic are the Arctic Oscillation (AO) and the North Atlantic Oscillation (NAO). The AO effect can last between 30 to 40 years and the NAO up to 50 years. Both cycles represent climate variability rather than climate change and mask, but do not diminish, long-term climate change trends. Superimposed on both long-term climate change and longer-term climate variability such as AO or NAO are annual or seasonal fluctuations in climatic variables resulting from chance occurrences of the numerous process that drive the climate. These annual and seasonal fluctuations are also considered to represent climate variability. It is this climate variability of a system that is described by return-period estimates of variables such as precipitation and runoff. The following discussion relates to climate change only.

Several global climate change observations have been documented in Canada's Arctic, and these trends are expected to continue throughout the twenty-first century. Mean annual temperatures have increased since the 1950s by up to 3ºC (Huntington and Weeler, 2005). In fact, regions in the higher latitudes of the Northern Hemisphere have exhibited some of the clearest evidence of climate change over the past century.

2.1.2 Climate Change Predictions

The most commonly used tools to project climate trends and climate change into the future are general circulation models (GCMs), which simulate many climatologically significant processes as well as the interactions between the atmosphere, oceans, cryosphere and land surface (Taylor and Barton, 2004). GCMs model the change in climate parameters as a result of climate forcers, such as changes in the atmospheric concentration of greenhouse gases and aerosols, and calculate changes in the long-term average, or normal, of a given parameter (*e.g.*, temperature and precipitation).

Projections presented in this assessment were obtained from the Canadian Climate Impacts and Scenarios (CCIS) website. Because uncertainty in climate projections is very high, a number of GCMs and emission scenarios were considered (29 combinations of GCMs and emission scenarios in total) to provide ranges of projections of air temperature and precipitation. To supplement the GCM data, the 2007 report by the Intergovernmental Panel on Climate Change was used (Christensen *et al.*, 2007). Projections for the Arctic region suggest the following changes by the middle of the twenty-first century:

- average summer temperature increases of 1.9º to 3.5ºC;
- average winter temperature increases of 3.2º to 3.7ºC;
- precipitation increases of 5 to 30%;
- increased frequency of warm wet winters and summers; and
- increases in active layer depths of 30-40% with greater changes expected at higher latitudes.

Despite the high degree of uncertainty associated with climate change projections, the evidence that climate change is occurring is sufficient to necessitate a consideration of its impact on the Project. Of special concern are the impacts on the winter season and its ramifications such as active layer depth runoff distribution changes from altered snow pack depths.

2.1.3 Traditional Knowledge on Climate Change

Within a study of Traditional Knowledge (TK) of the Bathurst Caribou changes were identified with regards to climate. Changes identified were as broad as "everything is changing" (Thorpe et al., 2001) to observations on the timing of freeze-up. Observations related to climate change were made on the timing of the seasons; the variability of weather; changes in the tundra; changes to water, ice and snow; changes in water levels; temperatures and fires. For more TK on sea-ice conditions along the shipping route see Appendix F-5 of the Draft Environmental Impact Statement (DEIS). Interviewees made observations on climate changes in the Bathurst Inlet area:

> *"The weather has changed too. It is not hard to tell. The usual time spring comes around seems to come later… (Frank Analok)."*
>
> *"It seems to be getting warmer. The ocean freezes over later than usual (John Akana)."*
>
> *"…The land is changing, that is why on [Victoria] Island there is more growth…. There was no vegetation around here. There was only gravel and pebbles long ago. Nowadays it seems to be continuing to get more vegetation…(Moses Koihok)."*
>
> *"…The water level seems to have dropped. It seems like there is less water. The lakes seem to be smaller and dry out…(Annie Kaosoni)."*

These changes are important as they affect the planning for weather, the safety of travel and caribou population levels.

2.2 Change in Ground Temperatures

The Project lies in the continuous permafrost region of the Canadian Arctic. Predictions suggest that in areas where permafrost is thin and ground mean annual ground temperatures are warmer than -2ºC there is the potential of substantial loss of permafrost over time and greater extents of discontinuous permafrost. While in areas with thicker permafrost and ground temperatures of -5ºC or cooler the result of global warming will be the thickening of the active layer (Smith and Burgess, 2004).

Permafrost thickness in the Project area is generally greater than 150 m. It is a generally accepted correlation that permafrost ground temperatures are typically 4º to 6ºC warmer than the mean annual air temperature. Given this relationship, it is expected that the mean ground temperatures along the road corridor would be approximately -5º to -7ºC. The depth of the active layer in unconsolidated glacial till across the Project is generally between 1 and 2 m, and is approximately 4 to 6 m in bedrock outcrops.

The suggested increases in active layer depth for the road area would be almost 1 and 2.4 m at the maximum for unconsolidated till and bedrock areas, respectively. This would increase active layer depths to approximately 3 m in unconsolidated soils and 8.5 m for bedrock substrates.

2.2.1 Effects on the Project

The effects of ground temperature increases in the Project area are primarily related to active layer depths. Infrastructure that is designed to remain stable on current estimates of active layer thickness may become questionable if depths increase due to climate change related phenomena. Of particular concern is the road, which crosses significant distances of tundra, and unconsolidated deposits that could cause road infrastructure to weaken and potentially fail over time.

2.2.2 Mitigation Measures

Road design suggests building the road to a minimum thickness of the maximum expected active layer depth in unconsolidated substrates. This would ensure the ground under the road would remain frozen year-round, which would allow it to remain stable and not collapse or fail during summer months. If adequate error margins and climate change estimates of increases in active layer depth are considered then effects on the road infrastructure are minimized by ground temperature increases for the life of the Project. In addition, limiting heavy loads on the road during summer and early fall months will limit damage to the road when it is weakest.

2.3 Change in Water Volumes

Change in water volume is a combination of effects from temperature and precipitation. The Arctic is estimated to exhibit temperature increases and therefore increases in precipitation, of which more will fall as rain than snow. This will not only increase annual runoff, but change the timing and distribution of volumes. Assuming that the Project area receives approximately 280 mm of precipitation per year, it is expected that by the mid twenty-first century, precipitation may range from 294 mm to 364 mm, resulting in increases of annual runoff of between 8 and 50 mm, assuming that 0.6 is a reasonable estimate as a runoff coefficient for the area.

Arctic hydrology is dominated by the spring freshet, which accounts for more than 70% of the annual runoff volume and is the peak runoff event of the year. Rainstorms can produce runoff in the Arctic, but rarely of magnitudes similar to those caused by spring freshet. The increased temperature will cause freshet to occur earlier in the season, a longer open-water season, and potentially a longer low flow period for rivers or no flow period for smaller streams. Increases in precipitation as rain will cause a reduced snow pack and therefore a potentially reduced peak during the freshet period, as well as a greater likelihood of larger runoff events throughout the open-water season due to rain events. Whether climate change will cause reductions in peak discharge is unknown, but it must be assumed the maximum increase of 50 mm by mid twenty-first century will be in addition to freshet volumes.

2.3.1 Effects on the Project

Runoff volumes will be of no effect to the port site since no streams are present. Therefore, this discussion will focus on the road and stream crossings that may be affected. Increased runoff volumes should have no effect on the road infrastructure, given that there is no change in peak discharge rates. However, since this cannot be predicted accurately, there is a potential for peak discharges to increase. If not accounted in water crossing designs, these increases can cause water to be dammed on the upstream side of structures. This will cause a reduction of peak flow during the freshet period as flows are dammed by the structure on the upstream side of the road and a potential for the structure to fail if flows are great enough.

2.3.2 Mitigation Measures

The primary mitigation measure is to incorporate the increased precipitation amounts that are expected from climate change in the design of watercourse crossings. This will prevent structures to be overtopped and potentially fail during large runoff events. Secondly, monitoring and maintenance especially during freshet to remove and prevent ice snow and debris from blocking or partially obstructing structures is essential to prevent watercourse crossing structures to fail.

2.4 Change in Sea Ice Cover

Seasonal freezing usually starts around mid-September on Victoria Island, and about a week later in the coastal and mainland areas. The melt season generally begins around mid-June on Victoria Island and approximately a week earlier on the mainland. By mid-December, ice covers most of the Coronation and Queen Maud Gulfs. There is significant spatial variation in the timing of break-up (when an area is 100% free of ice) and freeze-up within the study area. Ice break-up at either end of the shipping route (*i.e.,* Bathurst Inlet and Barrow Strait) occurs early in the season: usually by June 18. In the intermediate area (*i.e.,* Franklin Strait), break-up may not occur until late August, if at all (Environment Canada, 2007).

Sea ice covers about 7% of the world's oceans. Recent observational evidence indicates that the sea ice in the Arctic is retreating and thinning. Currently, the retreat of sea ice has increased the practicality of navigation in Canada's Arctic.

Recent data on the concentration of ice cover collected between 2000 and 2007 for each area show varying trends:

- by mid-June in Barrow Strait, less than 50% of the area is ice-covered; break-up is occurring earlier each year;
- Franklin Strait has recently remained over 50% ice-covered through the summer; however, in 2007, the area became completely ice-free; and
- variation in ice cover in the Coronation to Queen Maud Gulfs area is very consistent year to year, with less than 50% of the area covered by ice at the end of July.

2.4.1 Effects on the Project

Overall the effect of reduction in sea ice due to climate change has no detrimental effect on the Project. Reduction in extent of sea ice and a longer open water season would allow shipping traffic to navigate the route more safely and potentially for a longer period of time.

2.4.2 Mitigation Measures

Since no negative effects are expected from the reduction in sea ice, no mitigation measures are required.

3. Extreme Weather Events

Extreme weather events could include droughts, storms, floods and heat waves and cold snaps. These events could affect all Project components including surrounding areas. Related consequences in terms of floods resulting from extreme weather are also discussed in the following sections.

3.1 Drought

Considering the low annual precipitation of the continental Arctic with relatively low precipitation occurring in the months of June and July, dry conditions in the road and port area are not uncommon.

3.1.1 Effects on the Project

None of the Project components are dependent on continued water supply. Therefore, the only likely effect on the Project will be dust production during summer droughts from the road surface. This effect is not expected to have significant ramifications on the operation of the Project.

3.1.2 Mitigation Measures

Dust suppression during drought periods may be required to maintain air quality standards, by watering road surfaces during these periods. Particulate sizes on the road surface may also be controlled to minimize dust-producing materials around the port.

3.2 Storms

Storms events can include rainstorms, thunderstorms, snowstorms, damaging winds and waves. The potential for storms to affect the Project and mitigation measures are discussed below.

3.2.1 Severe Rainstorms

Effects on the Project

Precipitation in the Project area is low, with desert-like precipitation rates. Still, severe rainstorms and related surface runoff are possible, and could potentially affect the road and create washouts. Due to the low topographic relief of the terrain, this is unlikely to have a large effect. Therefore, the threat to infrastructure integrity is low.

Mitigation Measures

Weather forecasts will be monitored for advanced warning of severe rainstorms to allow appropriate preparation of structures and equipment. Drainage ditches, culverts, and other site drainage elements, have been sized for a 25 year event. Facility locations have been selected to avoid geohazard areas.

The road has been designed to accommodate storm-induced geohazard events. Where avoidance is not possible, mitigation measures will be incorporated in designing watercourse crossings. All culverts and bridges will be constructed to a 25-year design flood. Maintenance crews and equipment will be stationed at both ends of the road to allow rapid response to storm-induced problems.

Monitoring of fuel pumping operations will show drop in pressure which is the result of a major leak. Also no pipelines will remain full when not in use (other than in tank farm area). Transmission line tower locations have been selected to avoid geohazard areas. Spare conductors will be stored at the Project site for minor repairs, should the 5 kv line be damaged.

3.2.2 Thunderstorms

Effects on the Project

Thunderstorms may be accompanied by hail, and damaging winds. A thunderstorm is classified as severe when it contains hail larger than ¾" (1.9 cm), winds gusting in excess of 50 knots (92.6 km/h) and/or a tornado. Cases involving either slow moving thunderstorms or a series of storms that move repeatedly across the same area (sometimes called train-echo storms) frequently result in flash flooding (UIUC, 1999). Large hail from severe thunderstorms could damage building infrastructure and create unsafe working conditions. High-velocity winds related to thunderstorms could create large waves at the port and damage port infrastructure, ships, and buildings. Lightning could cause fires under dry conditions, or damage infrastructure such as buildings and power lines.

Mitigation Measures

Weather forecasts will be monitored for advanced warning of incoming thunderstorms to allow time for extreme storm preparation such as securing buildings and equipment, mobilizing equipment to key areas for maintenance and shutting down operations if necessary.

To help mitigate the effects on all infrastructure (shipping infrastructure, buildings, power poles, bridges) from hail, high-velocity winds, lightning strikes and various building supplies and power cable will be stored at site to facilitate timely repairs and reconstruction.

The port structures will be designed to withstand earthquake forces based on Geological Survey of Canada data and National Building Code. They will provide strong resistance to extreme storm events and protection against waves created by high-velocity winds. The port infrastructure is designed to resist wave erosion.

3.2.3 Snowstorms

Effects on the Project

The mean annual temperature is -11ºC. Precipitation rates are low for this area and severe winter snowstorms, though not likely, are possible. High levels of snowfall could impede the movement on the road. Related problems could include reduced traction and visibility during snowstorms. Fog could also be a problem with respect to visibility. Reduced movement can be expected when visibility is severely restricted.

Mitigation Measures

Removal of excess snow from roadways will be managed to maintain safe operating conditions without interfering with production. The road maintenance fleet will include equipment, such as graders, loaders, trucks, and scrapers, to manage snow and maintain operations. Operating protocols will ensure safe and efficient traffic flow during periods of reduced visibility. In case of white-outs, all traffic and outside activity stops. No road lighting except at port site dock, camp area and fuel tank truck loading area.

The power cables are designed to be suspended above the snow pack on pole stands.

3.3 Floods

Floods in the Arctic are primarily produced by the spring freshet; smaller flood events can occur due to rain events during the summer months, but are rarely of magnitudes similar to the spring freshet floods.

3.3.1 Effects on the Project

Floods are not expected to have effects on the port site or the shipping route; however, floods may be of concern for the road. Flooding along the road alignment could result in access road closures due to excess water on the road surface, erosion of the road surface, damage to stream crossings, or debris blocking the road. Under the most extreme flood conditions there is the potential for drainage structure washouts (bridges, culverts and fords). Stream crossings are designed to pass the 1 in 25 year instantaneous peak flood flow. All bridges are designed with an additional freeboard of at least 0.3 m to provide clearance for ice carried by the floodwaters. Rip-rap will be placed at the inlet and outlet of the water crossings to protect structures from erosion.

The probability of a Q_{25} occurring at any water crossing during the 20-year lifetime of the Project is 56% (Table 3.3-1). For flood events in excess of the design criteria there is the potential for the crossings to partially obstruct flows, resulting in elevated upstream water levels (backwatering) and overtopping of water onto the road surface. Crossings have been designed to limit the likelihood of failure (washout) during a flood event. Since the road is not in use during summer months a washout would result in road closures but repairs would be able to be conducted before the road is required during the winter months.

Table 3.3-1
Exceedance Probabilities of Flood Events with Varying Return Periods

Event	Probability for Any Single Year	Probability over 20 Year Project Life
1 in 10 year	0.1	0.88
1 in 25 year	0.04	0.56
1 in 50 year	0.02	0.33
1 in 100 year	0.01	0.18

3.3.2 Mitigation Measures

All culverts and bridges will be constructed to a 25-year design flood. In addition, at least 0.3 m of clearance above the design flood elevation has been incorporated into bridge design to allow for ice passage and prevent bridge washout. The road maintenance program will include ice and debris clearance and ensure that the structures are able to convey design flows. However, under extreme flood conditions in excess of the design flow has the potential to washout the crossing.

3.4 Temperature Extremes

Temperature extremes can occur at any time of year and in either positive or negative temperature extremes. The severity of these events can depend on the antecedent conditions and what is affected by the extremes.

3.4.1 Effects on the Project

Extended periods of higher temperatures could bring on heat waves and fewer frosts, increase the active layer depth, and possibly trigger a wetter climate. With warmer temperatures, more precipitation would fall as rain than as snow, and earlier melting of the snow pack would cause proportional increases in runoff during the winter and early spring. Higher precipitation and runoff levels could also potentially increase the costs of maintaining the road and keeping it open during the four months operation period.

Extended cold spells could result in more precipitation falling as snow than as rain, thus increasing the amount of snow and ice to be managed along the road corridor. Extended cold spells could also cause later melting of the winter snow pack, delaying spring runoff and reducing the time period available to bring ships into Bathurst Inlet. Increased snow depths could also cause flooding conditions during freshet or simply larger amounts of water in the stream crossing structures. Lower temperatures could also increase the amount of fuel required to heat the buildings and keep all equipment running and operational.

3.4.2 Mitigation Measures

Bridges and culverts used as stream crossings along the road corridor are designed for the 25 year flood with additional freeboard to accommodate increased flows.

The effects of higher temperatures on the continuous permafrost are expected to pose no problems for the shipping route but potentially for the road. If extreme temperatures increase, the depth of the active layer may increase, however, additional fill could be used to maintain the permafrost throughout summer periods along the road corridor.

Overall, cold temperatures should not pose significant challenges for equipment operation because all equipment will be designed for these conditions.

4. Seismic Activity

The seismicity of this area is important because of the potential effect on the Project. The importance of seismic activity and its effects on the Project pertains to structural integrity and subsequent performance of the structures after a large seismic event.

4.1 Susceptibility of the Project Area to Seismic Activity

The Project is within an area of low seismic hazard according to the 2005 Seismic Hazard Map produced by the Geological Survey of Canada (Figure 4.1-1).

For the purposes of finding seismic activity within the Project area, the latitude and longitude were defined as 66° 5’0’’N and longitude 107° 5’0’’W. Within the last twenty years, there have been 15 events with epicentres within 500 km of the Project area (Figure 4.1-2). Of these events, not one was potentially damaging (*i.e.*, greater than a magnitude of 5). Only three were within 200 km, and these were of magnitudes less than 2. Within the last twenty years, there have been 16 events within 1,000 km of magnitude 5 or 6.

4.2 Effects on the Project

The naturally occurring seismicity of an environment has a potential to affect Project developments. All of the Project components could be affected by a seismic event. However, a seismic event is unlikely to occur at the Project based on past seismic events in the area. Therefore, the Project will not be affected by seismic activity.

4.3 Mitigation Measures

The proponent will be aware of any warnings in the area. In the case of a seismic event all structures will be thoroughly inspected to assess the stability and ongoing integrity.

5. Tundra Fires

Tundra fires within Nunavut are not common. As such, tundra fires are not subjected to the same degree of evaluation as forest fires in other territories or provinces. Unlike in British Columbia, there is no natural disturbance type (NDT) classification.

Within BC, the number and size of forest fires in a region each year vary with annual weather (dry or wet years) and NDT. All biogeoclimatic subzones have been classified into NDTs that characterize different natural disturbance regimes (including fire, wind, insects and disease) (RISC, 1998). The Project study area could be compared to the alpine and subalpine parkland of BC with NDT5.

5.1 Susceptibility of the Project Area to Fires

The Project study area is located completely within the Southern Arctic Terrestrial Ecozone, one of three Arctic ecozones defined in Nunavut. This ecozone supports the highest diversity of species (both plant and wildlife) and has the most extensive vegetative cover. The climate is characterized as cold, dry Arctic. Summers tend to be short and cool while winters are long and very cold. Vegetation within this ecozone is dominated by dwarf birch, willow, heath species, and lichen, with sedge-moss wetlands occupying low-lying areas. For more information on vegetation, see Appendix D-4 of the DEIS.

Though tundra areas receive little precipitation, they are often moist because of low evaporation rates and the water cannot seep into frozen permafrost soils. The soil contains a high amount of organic material. Because the organic layer underneath the surface vegetation is moist and will not easily burn, fires often travel fast, burning only plants that are above ground (US FWS, 2007).

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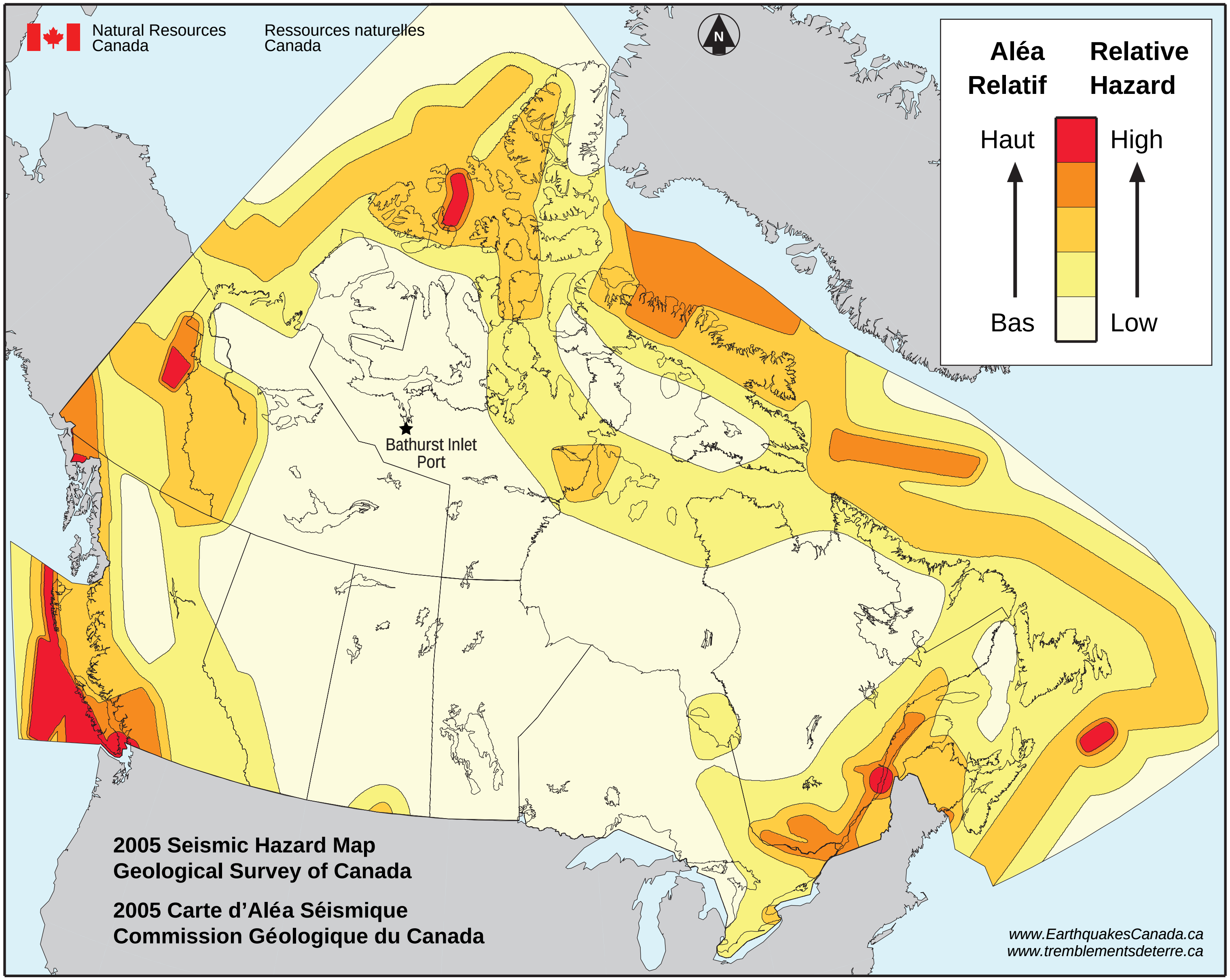
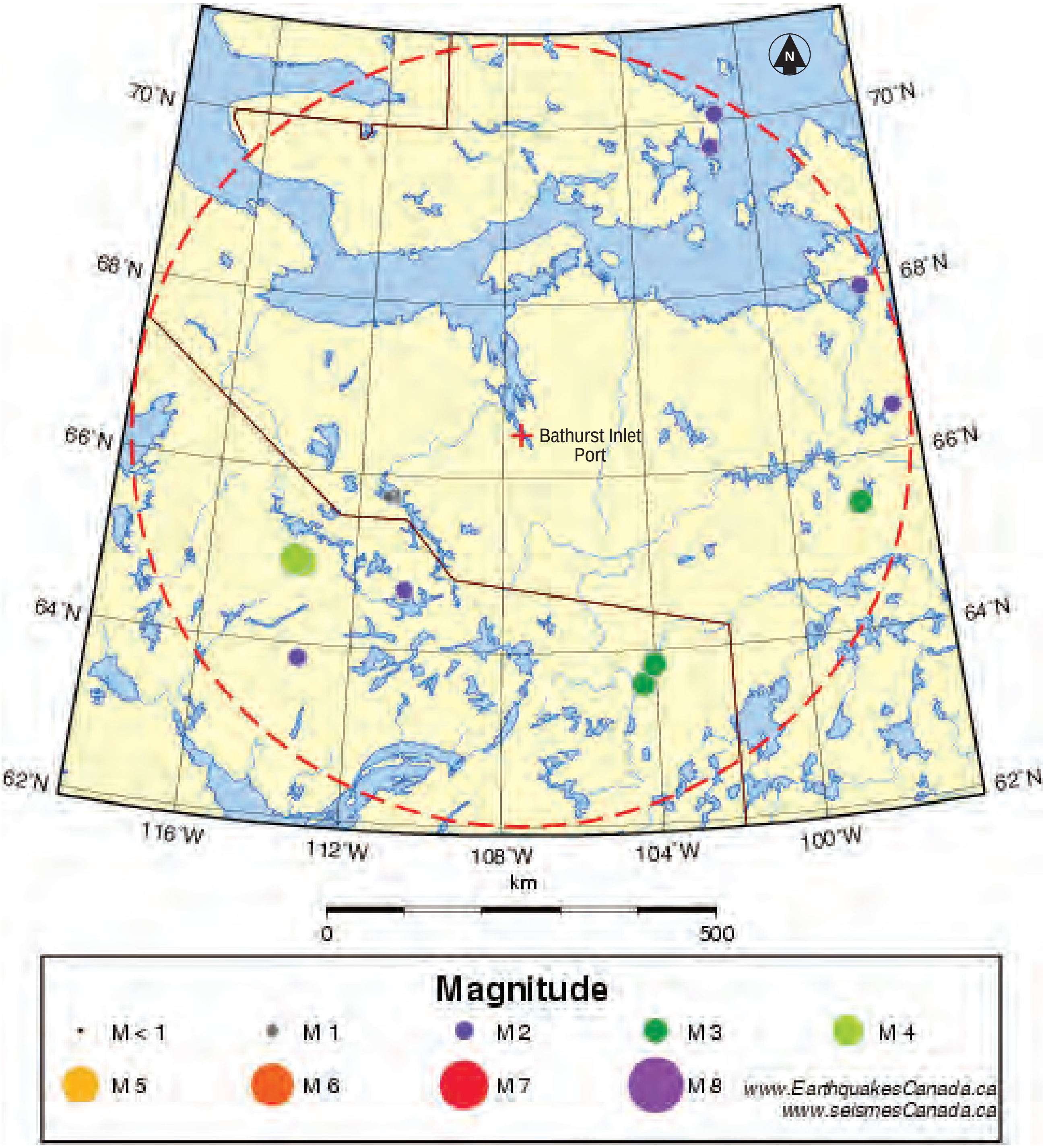


Source: NRCan (2007b).

FIGURE 4.1-1

Canadian Seismic Hazard Map



Source: NRCan (2007b).

**Earthquakes within 500 km
for Last 20 Years**

FIGURE 4.1-2

Tundra fires may be started directly by lightning. They usually occur during late May, June, and early July when temperatures are warm and fuels are dry. If it has been a dry year, there is more fuel for fires to be ignited by lightning. Also, there may be fires later in the summer, which could develop into a creeping ground fire that sustains itself on the organic layer of the tundra and continues for many months, even occasionally through the winter (US FWS, 2007).

5.2 Effects on the Project

In the case of tundra fire, the potential effects would be a loss of infrastructure and/or a loss of operating time/work days. Loss of infrastructure is not likely as all infrastructure will be built on pads of rock. Operating time could be lost if workers were required to help contain the fire and also if working conditions became unsafe as a result of dust and smoke.

A fire would also have secondary effects related to the loss of surface vegetation cover in the local area.

With climate change resulting in potentially longer, drier summers, tundra fires could become more of a threat (NRCan, 2007a; NRCan, 2007b).

5.3 Mitigation Measures

A safety plan will be developed for the Project, which will outline and describe appropriate procedures and protocols to effectively deal with hazards such as a tundra fire. The plan will address hazard evaluation, appropriate control procedures and protocols (including action levels), personal protective equipment to be used, air and water monitoring protocols and specifications, confined space entry procedures and detailed fire-fighting procedures.

In the event of a fire threat, all personnel not involved in containing the fire will evacuate their work area or camp and gather at muster stations. Muster stations will be clearly identified around the Project area, and site personnel will be made aware of them during orientation and follow-up training programs.

To decrease the chance of infrastructure loss/damage:

- water pumps and fire-fighting equipment will be located strategically around the site to help contain/extinguish any fire.

6. Monitoring the Effects of the Environment on the Project

Any monitoring required is part of long-term monitoring program for the Project. Environmental changes associated with climate change will be monitored and assessed as part of the overall monitoring for the Project. A meteorology station is already in operation and will be used for monitoring.

Weather forecasts will be monitored for advanced warning of incoming storms to allow time for extreme storm preparation such as securing buildings and equipment, mobilizing equipment to key areas for maintenance and shutting down operations if necessary.

7. Conclusions

Potential effects of the environment on the Project have been considered. Appropriate design, mitigation, and monitoring will be implemented as well as remain adaptive. These measures, as well as Project management plans and regulator requirements will ensure the safety of the Project.

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Appendix G-3
Trans-boundary Effects Analysis

Author: **Rescan Environmental Services Ltd.**
Date: **December 2007**

Bathurst Inlet Port and Road Trans-boundary Effects Analysis

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Trans-boundary Effects Analysis

1. Introduction

An Environmental Impact Statement (EIS) must consider all significant adverse biophysical or socioeconomic trans-boundary effects. Trans-boundary effects refer to those effects which occur across municipal, provincial, territorial or international boundaries and are felt outside of the Nunavut settlement area. The Nunavut Land Claims Agreement requires the Nunavut Impact Review Board (NIRB) to assess potential trans-boundary environmental effects of project proposals.

NIRB lists ten minimum requirements in the Final EIS Guidelines for the Bathurst Inlet Port and Road Project (the Project). The tenth requirement listed by the NIRB is a trans-boundary effects analysis. The following effects analysis is presented to meet this requirement. All valued ecosystem components (VECs) and valued socio-economic components (VSEC) identified in the Project EIS that have the potential to contribute to trans-boundary effects have been included in this analysis. A residual effect that has the potential to occur outside Nunavut would be referred to a trans-boundary effect. The following VECs and VSECs are discussed below and have the potential for trans-boundary effects:

- caribou;
- grizzly bears;
- wolves;
- migratory birds;
- marine mammals;
- air quality and climate change; and
- social and economic.

2. Caribou

Three caribou herds—Bathurst, Ahiak, and Dolphin and Union—have the potential to cross territorial or provincial boundaries. On the mainland, the winter range of the Bathurst and Ahiak herds extend into the Northwest Territories and as far south as Saskatchewan during the winter. The calving range of the Dolphin and Union herd also extends into the Northwest Territories.

Table 2-1 presents the potential significant residual effects for each these herds.

Table 2-1
Potential Significant Residual Effects of the Project on Bathurst, Ahiak, and Dolphin and Union Caribou

VEC	Habitat Loss	Disruption to Movement	Disturbance	Features Acting as Attractants	Mortality (direct and indirect)	Reduction in Reproductive Productivity
Bathurst	Low	Low	Low	Negligible	Negligible[1]	Low
Ahiak	Negligible[1]	Low	Low	Negligible	Negligible[1]	Low
Dolphin and Union	--	Low	--	--	Negligible[1]	--

[1] **Negligible with mitigation.**

2.1 Bathurst Herd

Potential effects on Bathurst caribou were rated as significant, with low magnitude, regional geographic extent, and with a duration rated as medium or far future. Some of these effects were reversible in the long term (Table 4-1 of Appendix D-3 of the DEIS). The sum of these potential effects on Bathurst caribou are rated as **Low**: a decline in the condition of the VEC below baseline conditions, but the effect will be removed at closure and the VEC will recover.

If this prediction is accurate, low-level population effects on Bathurst caribou may extend across boundaries into the Northwest Territories and Saskatchewan only during the life of the Project.

2.2 Ahiak Herd

Potential effects on Ahiak caribou were also rated as significant and with low magnitude, regional geographic extent, with a duration that was medium or into the far future, and were reversible on the long term or were irreversible, in the case of mortality (Table 4-1 in Appendix D-3 of the DEIS). The sum of these potential effects on Ahiak caribou are rated as **Low**. Therefore, there is the potential of low-level trans-boundary effects for Ahiak caribou during the life of the Project.

2.3 Dolphin and Union Herd

One significant residual effect was identified for the Dolphin and Union herd: disruption to seasonal movements from the mainland to Victoria Island. This effect has been rated low due to the potential alterations of ice dynamics along their migration corridor as a consequence of shipping. Shipping is restricted to the open water season, but uncertainty over the timing of ice melt and freeze-up and caribou migration timing reduce the certainty of this assessment, resulting in a higher potential rating. Hence, the total effect of the project on this herd is rated as **Low**. This effect is regional in scale, extends into the far future and is reversible in the long term. Therefore, low-level trans-boundary effects are expected for Dolphin and Union Caribou since this herd may be adversely affected and part of its summer range extends into the Northwest Territories on Victoria Island. This potential effect would last only during the operations phase.

3. Grizzly Bears

Grizzly bears have very large home ranges and are known to disperse over wide areas. Through these long-distance movements, the population of grizzly bears resident in the BIPR RSA will be contiguous with the population in the Northwest Territories (Figure 11.5-1 in Appendix G-5 of the DEIS). Hence, effects on grizzly bears, including cumulative effects on the population due to other developments such as EKATI and Diavik have the potential to affect grizzly bears across territorial boundaries.

The total effect on grizzly bear was rated as significant and **Low** due to features acting as an attractant being rated as low. Other effects on grizzly bears were rated as negligible, including: reduction to productivity, indirect mortality, attractants and disruption to movements. Two of these effects, indirect mortality and reduction in wildlife productivity, are regional in scale and only reversible in the long term.

However, trans-boundary effects occurring in the Northwest Territories are expected to be minimal for a number of reasons. First, the boundaries determined in Figure 11.5-1 in Appendix G-5 of the DEIS were delineated for sub-adult males in order to be conservative in the cumulative effects assessment, as sub-adult males have the potential to move over the widest distance. However, adult females or breeding age are of the greatest consequence to population resiliency, and few, if any females found within the Project regional study area would likely travel as far as the Northwest Territories. Third, grizzly bears that travel between the Project regional study area and the Northwest Territories represent a small proportion of the overall number of individuals in the Northwest Territories and therefore these effects will not likely reduce the number of grizzly bears in the Northwest Territories in a way that is statistically detectable.

4. Wolves

Outside of the summer period when wolves are rearing pups, wolves in the regional study typically follow the caribou herds. Many wolves shift position south during the winter (Figure 11.7-1 and Section 11.9 in Appendix G-5 of the DEIS) and can cross into the Northwest Territories. The total effect of the project on wolves is rated as **Negligible**. Therefore, the trans-boundary effects are considered **Negligible**.

5. Migratory Birds

Migratory birds that arrive to breed in the regional study area typically migrate very long distances from wintering sites in the south. For example, yellow warblers that are known to breed in riparian habitat near the north end of the road overwinter as far south as Central and South America. The total effect of the project on migratory birds is rated as **Negligible**. Therefore, no trans-boundary effects are expected.

6. Marine Mammals

The assessment of effects on marine mammals of vessel traffic along the shipping route in Nunavut is included in Section 4.2 in Appendix E-5 of the DEIS. In keeping with the final EIS guidelines for this project (NIRB, 2004), only the shipping route from Lancaster Sound to the proposed port location, which has not been used previously for the regular shipping of fuel, is included in this assessment.

Most of the marine mammals in the regional study area likely would not come into close contact with vessels on the shipping route because of their distribution or preferred habitats. The shipping route is located well offshore or in mid-channel except in Bathurst Inlet itself, whereas many of the marine mammals are coastal, and some are found only in low numbers along the shipping routes.

Three types of potential effects on marine mammals were assessed: 1) injury or mortality from collisions with vessels during operations, 2) alteration of movement patterns and distributions resulting from disturbance caused by vessel noise during operations, and 3) increased potential for exposure to contaminants, possibly leading to injury or mortality, resulting from a spill during operations. Given the spatial distribution of marine mammals along the shipping route (*i.e.*, mainly along shorelines), and the mitigation measures proposed (Section 5 in Appendix E-5 of the DEIS), the only likely effect of any encounter with ships is alteration of movement patterns and distributions. Each of the potential effects listed above was predicted to be of negligible or low significance because it would:

- have a low or moderate probability of occurrence;
- be of negligible or low magnitude;
- have a local or landscape spatial extent;
- be short term or sporadic, if at all; and
- be reversible in the short term.

Trans-boundary effects could occur because the shipping route may enter extra-territorial waters after leaving Nunavut. Based on the assessment summarized above, trans-boundary effects are predicted to be of **Negligible** or **Low** significance.

7. Climate and Air Quality

Assessments of potential climate and air quality effects associated with the development and operation of the Project are presented in Appendices B-1 and B-2 of the DEIS, respectively. In addition, cumulative climate and air quality effects were discussed in the Cumulative Effects Assessment (Sections 3.2 and 3.3 in Appendix G-5 of the DEIS).

The Climate Effects Assessment focused on net emissions of greenhouse gasses (GHGs), predominantly CO_2, that would be associated with the construction and operation of the Project. Because of the relatively long atmospheric lifetime of CO_2 (50 to 200 years), GHGs emitted by the Project will disperse throughout the global atmosphere and thereby contribute to global warming (IPCC, 2001). Therefore, climate effects must be considered trans-boundary effects.

Climate effects for the Project were rated **Moderate** because GHG emissions from the Project emissions would constitute only approximately 1% of total emissions for the Northwest

Territories and Nunavut; GHG emissions from the Project would be negligible compared to national or global emissions. Therefore, emissions from the Project will not have a measurable effect on the trend of increasing concentrations of GHGs in the global atmosphere and as a result, **Negligible** potential to cause trans-boundary effects.

Some air contaminants such as carbon monoxide and coarser fractions of total suspended particles (TSP) have atmospheric lifetimes ranging from a few seconds to several hours, while others, such as inhalable particulates ($PM_{2.5}$) and sulphate or nitrate aerosols, are more persistent and are transported over hundreds to several thousands of kilometres. Thus, persistent air contaminants emitted by Project activities has the potential to cause trans-boundary effects.

Air quality effects are typically evaluated by comparing predicted ambient air contaminant concentrations to territorial, provincial or national standards or objectives. If air contaminant concentrations are below applicable standards or objectives it can be assumed that air quality is unlikely to affect human health. The Air Quality Effects Assessment completed for the Project (Appendix B-2 of the DEIS) was based on an air quality modelling study completed for the Project (Appendix B-4 of the DEIS).

The results of the air quality modelling study showed that occasional exceedances of ambient 24-hour and 1-hour NO_2 concentrations could occur in areas close to the port site during the construction phase of the project. Also, the modelling results indicated that 24-hour concentrations of ambient TSP could exceed Nunavut's standard near the road. Ambient concentrations of other air contaminants for the scenarios considered were below applicable guidelines and objectives. The modelling results also showed that the ambient concentrations of air contaminants declined rapidly with distance from the sources as a result of atmospheric dispersion. Therefore, although some air contaminants will be transported across the boundaries of Nunavut, concentrations will be negligible and are very unlikely to be measurable in jurisdictions outside of Nunavut. Therefore, potential trans-boundary effects were considered to be **Negligible**.

8. Social and Economic Effects

Potential trans-boundary effects on the Valued Social and Economic Components (VSEC) for the Project are minimal and **Positive**. In addition to bringing job opportunities in Nunavut, the Project will contribute to GDP growth in the Northwest Territories and all of Canada.

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Appendix G-4
Environmental Management Plan for Road, Port, Camp and Shipping

Author: **SNC Lavalin and SL Ross Environmental Research Ltd.**
Date: **November 2007**

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SNC•LAVALIN
Engineers & Constructors

BATHURST INLET PORT AND ROAD

ENVIRONMENTAL MANAGEMENT PLAN

FOR ROAD, PORT, CAMP AND SHIPPING

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ACRONYMS AND ABBREVIATIONS

BIPR	Bathurst Inlet Port and Road
CCG	Canadian Coast Guard
DFO	Department of Fisheries and Oceans
INAC	Indian and Northern Affairs Canada
MSDS	Material Safety Data Sheets
OSRP	oil spill response plan
SOPEP	shipboard oil pollution plan
the Project	the Bathurst Inlet Port and Road Project
the proponent	Bathurst Inlet Port and Road Joint Venture Ltd.

1.0 INTRODUCTION

The Bathurst Inlet Port and Road (BIPR) project includes building a port and fuel storage depot on Bathurst Inlet, a 211 km road to Contwoyto Lake, and a camp on Contwoyto Lake. The project would interconnect with the existing Yellowknife to Contwoyto Winter Road (YCWR) as shown in Figure 1.1-1. Currently, a Draft Environmental Impact Assessment (DEIS) is being prepared by the Bathurst Inlet Port and Road Joint Venture Ltd (BIPR JV) following the Final Environmental Impact Statement (EIS) Guidelines for the Review of the Proposed Bathurst Inlet Port and Road Project (“EIS Guidelines”)[1] issued by the Nunavut Impact Review Board (NIRB) in December 2004. This Environmental Management Plan (EMP) will address the requirements of the EIS Guidelines related to the project infrastructure at the proposed Bathurst Inlet port, road and Contwoyto Lake camp.

The detailed EMP will be developed prior to the start of construction and is intended to provide a framework and general guidance for environmental management for the duration of the project. The EMP will be periodically reviewed and updated as the Project moves through construction, operations, and final closure and reclamation. The BIPR JV will update this Plan once a construction management team has been hired and a communication system developed to support the planned construction activity. The Plan will again be updated once the operational management team has been hired and a permanent project communication system developed.

The Environmental Objectives of the project are summarized in Section 2.

Section 3 provides an outline of the detailed plans to be developed for the project infrastructure, including the port facilities, road and Contwoyto Camp.

Section 4 provides an outline for contingency planning in the case of oil spills associated with this project.

Section 5 provides an outline of the Fuel and Explosives Management Plan.

Section 6 provides information on management of accidents and malfunctions and provides a matrix correlating the types of event with the applicable management plan.

Section 7 provides a summary of the project’s waste management strategies.

This Plan will be structured for use in conjunction with other existing field and corporate response plans as necessary. These plans include:

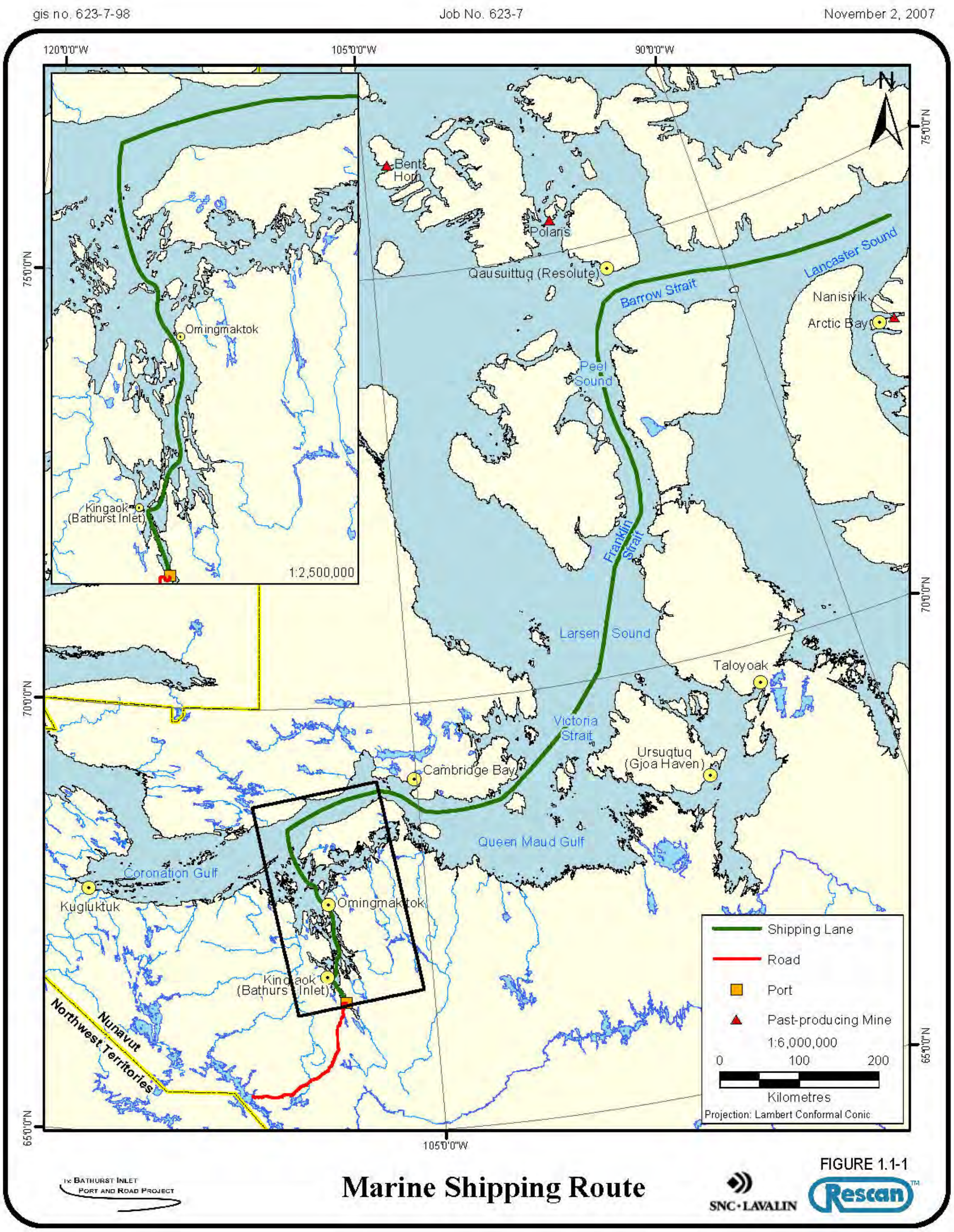
- BHP Billiton Ekati Diamond Mine Spill and General Contingency Plan
- DDMI Emergency Response and Environmental Contingency Plans

[1] “Final Environmental Impact Statement (EIS) Guidelines for the Review of the Proposed Bathurst Inlet Port and Road Project”, Nunavut Impact Review Board, December 2004.

- Jericho Diamond Mine Continency Plan
- DeBeers Canada Contingency Plans
- Nuna Logistics Emergency Spill Response Plan
- Tibbitt to Contwoyto Winter Road Materials Management Plan
- Tibbitt to Contwoyto Winter Road Wildlife Protection Plan
- Tibbitt to Contwoyto Winter Road Archaeological Management Plan

In addition, the BIPR JV will propose to establish mutual aid agreements with other agencies such that additional resources can be made available in the case of a serious spill or incident in the project area. These agencies will include the Coast Guard, Northern Transportation Company Limited (NTCL), the Governments of Nunavut and NWT, and others as required.

Figure 1.1-1: Project Key Map



2.0 ENVIRONMENTAL OBJECTIVES

The BIPR JV is committed to sustainable development and will ensure that all phases of the project are carried out in compliance with the following objectives.

- Ensure that responsible and effective environmental management planning is carried out for all aspects of this project.
- Meet or exceed all regulatory environmental requirements.
- Ensure that Inuit traditional knowledge is incorporated into detailed EMPs for the project.
- Ensure that an integrated approach is followed through all phases of the project, including planning, design, construction, operations and decommissioning/reclamation.
- Monitor project activities through all phases for environmental compliance and follow up in a timely and highly effective manner.
- Implement/enforce strategies for efficient use of energy, resources and materials through all project phases and activities.
- Improve environmental performance through monitoring and evaluation.
- Identify, assess and manage project activities to reduce environmental risks.
- Develop, maintain and test emergency preparedness plans to ensure protection of the environment, workers.
- Require contractors and consultants to comply with corporate environmental requirements and monitor their environmental performance.
- Ensure there is appropriate training for all staff, contractors and consultants, to ensure understanding for risk to the environmental and related community concerns.
- Develop mutual aid agreements with mining companies, Coast Guard, NTCL, Government of Nunavut, Government of NWT and other agencies in the case of a serious spill that requires more capacity than the BIPR JV has instantly available.

3.0 INFRASTRUCTURE MANAGEMENT PLANS

3.1 Road Management Plan

Road design and operation will incorporate a number of safety features to reduce the risk of accidents and/or environmental incidents. These include:

1. The road will be designed and constructed to a resource road standard with pullouts every kilometre and at every bridge location. Speed limit signs, curve signs, chevron markers and roadway delineators will be used.

2. The flat terrain allows a gentle alignment with large radius curves for excellent sight distances.

3. Access to the road will be controlled and monitored at both Contwoyto Camp and Bathurst Port.

4. All vehicles using the road will be radio-controlled and will be dispatched in convoys. A repeater system will be provided and a protocol for radio communications will be developed for the road. Typically this will involve truck operators reporting their location and direction at prescribed intervals.

5. Operational procedures will be developed to halt traffic movements during extreme weather and white-out conditions.

6. Locations of animal crossings will be clearly signed and other operational restrictions imposed (for example, reduced speed limits in certain areas).

7. Standard operating procedures will be established for all construction and operations phases.

A comprehensive and detailed Road Management Plan will be developed to ensure safe operating conditions along the road. This plan will include spill response and training plans and provide accident/incident management plans and the reporting framework. The plan will be designed to enable/ensure the efficient and effective response to medical emergencies and/or accidental spills associated with road operations. The plan will clearly identify the training, notification responsibilities and communication structure necessary to initiate the appropriate level and type of response needed to effectively respond to any emergency on the road.

The Road Management Plan will include the following components:

Emergency response framework

1. Spill Response Theory
2. Spill Response Action Plans: General

3. Action Plan for Liquid Spills on Land
4. Action Plan for Fuel Spills on Water
5. Action Plan for Fuel Spills on Snow
6. Action Plan for Fuel Spills on Ice
7. Accident Response Plan

In any emergency response, actions by all parties involved follow three main priorities in order:

1. Safety of personnel
2. Protection of the environment
3. Safety of equipment

The scope of the plan will encompass the range of incidents that may require the initiation of an emergency medical or environmental response. The plan will also consider the possibility that more than one type of response may be required for any one incident. Response preparedness will be maintained for incidents involving: collision, medical, fire, ice rescue, and spills.

The need for an airlift evacuation of casualties (injured personnel) will also be included with consideration for rapid transportation of injured personnel to medical aid and/or the rapid transportation of medical aid to the scene of the incident.

The communication structure identified in the plan will provide a structure/framework for efficient and clear communication on the project.

The plan will include a detailed map of the road with kilometre markings and other field landmarks to easily describe locations for reporting purposes. It will include a command structure and the general roles and responsibilities for responding effectively to any medical emergency and/or environmental incident on the road. For most incidents either the BIPR JV lead hands or nearby company site personnel will initiate response. In some cases additional company and outside resources may need to be brought in to support the emergency response. For a major incident, company, contractor and outside expertise and resources would be mobilized for the response.

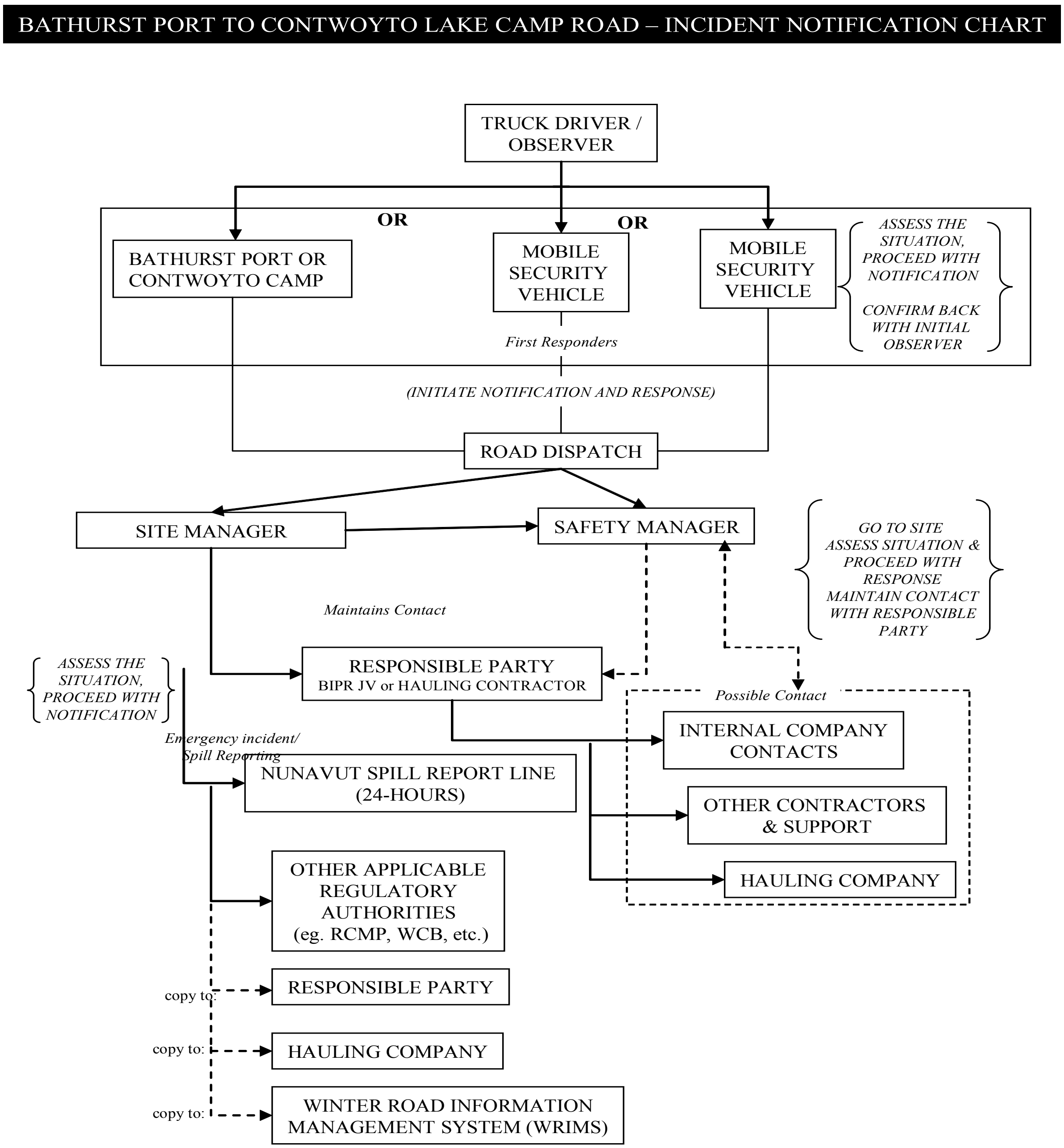
The plan will outline the initial emergency response organization, as well as responder course of action.

In general, the equipment operator, driver of incident observer will be responsible for:

1. Notification to dispatch center, including name, truck I.D. location of incident, brief description of incident and nature of assistance required (medical, fire, spill or other environmental).

2. Ensure the scene is safe and begin the required emergency response.

The diagram below provides a typical Incident Notification Chart.



The dispatch center will notify the appropriate people or agencies as per a complete Dispatch Call List. Based on initial information provided by and together with the first responder, determine the severity of the incident. If a Code 1 classification is warranted, an incident commander or designate will be notified immediately. Code 1-related information, including directions and/or updates as appropriate to commercial users of the road, will be issued.

The dispatch center will provide ongoing information and support to incident commander, emergency/spill operations supervisor and others as directed. If the incident is serious, a response team will be dispatched to the site. Examples of this type of response are all medical emergencies, fire and/or spill incidents, etc. Steps taken by the response team will include:

1. Report the arrival time and give an initial report on the scene, including an assessment of the situation and recommended actions.

2. Take over control of the situation from the first responder (driver) and assess the safety of the scene. Obtain information from the driver on the number of casualties, the product contained in the load, etc.

3. If possible, determine if assistance from the closest support group is required and contact Dispatch with an updated report.

4. Assess the hazards to the rescuers and to the casualties and make the scene as safe as possible. Determine the extent of the spill. If rescuers must contact the spilled product in order to rescue casualties, put on personal protective equipment. Shut off all ignition sources within the plume of the fuel vapours if there is a potential for fire or explosion. Extinguish the fire.

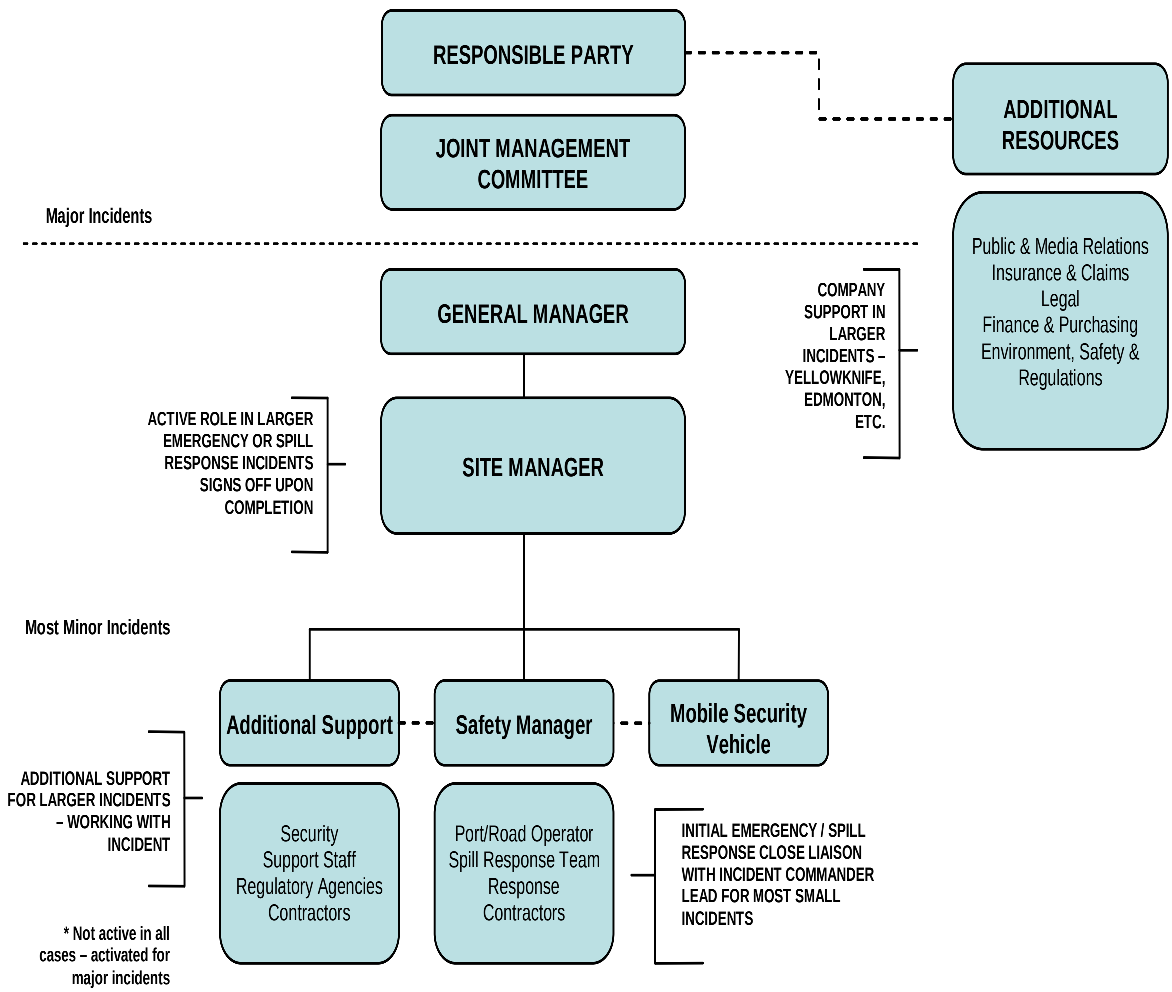
5. Extricate and immobilize casualties. Complete initial first aid treatment and determine if the casualty is capable of continuing the trip. Begin extensive first aid treatment and prepare for Medivac aircraft.

6. Contact Dispatch with a report on the casualties. Request a Medivac aircraft if required.

7. Begin spill containment as detailed in the plan.

The figure below provides a typical incident response organization for the project.

BATHURST PORT TO CONTWOYTO CAMP ROAD – TYPICAL INCIDENT RESPONSE ORGANIZATION



Quarries and Borrow Pits

Borrow pits and quarries will only be developed and operated to make up material shortfalls not available along the road alignment. Borrow pits and quarries will be developed, operated and decommissioned in full compliance with all regulatory requirements.

Prior to opening a borrow pit or quarry, the site will be surveyed and investigated to ensure the expected quantity and quality of material is available. Pit and quarry development plans will be developed and strictly adhered to by all workers operating in the pits and quarries. Pit development plans will include, but not be limited to, the following:

1. Listing of all regulatory requirements for development and operation.

2. Safe operating procedures for activities within the pit or quarry.

3. Pit access plan, including access back to the all-weather road.

4. Excavation plans to ensure materials are removed safely and efficiently with a minimum of waste.

5. Spill and accident contingency plans to deal with unexpected events.

6. Drainage management plans to ensure adequate drainage of the pit or quarry and acceptable water quality at the receiving water course. In general drainage will be directed to the nearest natural water course and the water quality ensured by temporary settlement ponds, biofiltration swales, silt fencing or other approved means.

7. Decommissioning plans, including safe sloping of excavated areas, re-vegetation as required, decommissioning of access roads and removal of all equipment, storage bins, etc. to return the pits and quarries to as natural state as possible.

If large blocks of ice or permafrost are encountered that require removal to access underlying sources of usable material, the ice will be drilled and lightly blasted or broken up with equipment sufficient to break the mass into workable size pieces. The ice will be excavated and moved to a section of the pit or quarry that will facilitate the release of thaw water through appropriate sediment control measures, such as settlement ponds or biofiltration swales, prior to release into natural watercourses.

3.2 Port Management Plan

Prior to undertaking any activities pertaining to the site development, construction or operation of the port facilities, a detailed emergency response and contingency plan will be developed that will provide:

- Spill response and training plan;

- Fire prevention and training plan;

- A clear chain of command, contacts and reporting procedures to be followed for all responses to spills and other emergencies;

- A framework to be followed to ensure that accountability for the performance of the spill and emergency response activities is defined and communicated to site staff before an event occurs;

- Training plans in fire prevention, spill response and emergency management;
- Information on available resources and potential operational hazards/risks that may be encountered during spill clean up and emergency response activities; and
- The reporting structure and record keeping requirements for spill and emergency response to facilitate tracking emergency response progress and incident investigation and mitigation planning.

Prevention Strategy

The BIPR JV is committed to a prevention strategy of ongoing maintenance, inventory control, staff training and vigilance of all aspects of the work. The following will be standard practice on the Bathurst Inlet Port site:

- Inventory control: All hazardous materials will be subject to strict inventory control from the time the materials are received at the site. Logs will be kept as required for inspection by the regulatory agencies.
- Storage: All hazardous goods will be stored in a manner required for the individual product as set out in the manufacturers' Material Safety Data Sheets (MSDSs).
- Daily inventory Balance: All liquid products will be checked on a daily basis and a balance sheet of inflow and outflow maintained.
- Disposal: All hazardous materials will disposed in strict compliance with the laws and regulations of Nunavut. If such laws and regulation do not exit, use similar regulations for other provinces within Canada (for specific products etc).
- Staff Reminders: Pre-Job meetings/safety meetings will contain a component to constantly remind employees to be on the look out for innovative ways to improve environmental and safety performances.

The detailed emergency response and contingency plan will be available at strategic areas on the property as a reference for all employees. Copies of this report will be distributed to all stakeholders including the Nunavut Water Board, the Nunavut Impact Review Board, the Kitikmeot Inuit Association (KIA), Environment Canada (EC), Fisheries and Oceans Canada, RCMP Cambridge Bay and the Nunavut Department of Environment (GNDoE).

Training

All employees, contractors and visitors will be introduced and instructed on the policies and procedures established within this plan. Area specific inductions will be given to individuals working in high risk activity areas or in handling hazardous materials. A job hazard analysis procedure will be developed to assess specific hazards on a job-to-job basis.

Safety and environmental concerns and awareness will also be discussed at every safety meeting and at the start up of any new operations that may affect the environment. If an incident happens all employees will be informed and re-instructed and retrained as deemed necessary.

The training for spill response will be part of the worker orientation at the Bathurst Inlet Port. All personnel will be made aware of the products present on site through the orientation program and the availability of Material Safety Data Sheets (MSDSs) wherever appropriate. Supervisors who may be called upon to fill the roll of Spill Response Coordinator, Spill Response Supervisor and personnel who will be called on to act as the Clean up Crew will receive additional training preparing them to respond quickly and safely to any spill on the port site. All employees on site will have valid WHMIS certificates and will be familiar with the layout and content of MSDSs for the hazardous materials on site. Each employee will be made aware of the locations of storage facilities and the locations of spill containment and recovery equipment.

The plan will include an organization chart identifying the ultimate responsibility for up-to-date emergency training plans. This authority or designate will review the emergency preparedness and response procedures on an annual basis or as required. Review of the emergency response procedures will include the periodic verification of any telephone number contacts for the various organizations that may be needed. Such verification shall be undertaken at a minimum of once per year. Revisions will be made to the procedures where necessary to comply with changing site conditions and any new relevant legislation. Personnel will be notified of any changes and if necessary retraining will take place.

Personnel at the site will undertake periodic testing of the emergency response procedures. These tests will be undertaken on a twice-yearly basis. These intervals shall be more frequent if there is a high turnover of employees at the site. The outcome of each exercise is to be recorded, and reviewed for areas of improvement.

Emergency preparedness training will, at a minimum, address the following:

- Medical emergency, accident or fatality;
- Fuel spill or chemical spill, effluent spills or leaks;
- Fire prevention and response;
- Flood;
- Extreme cold;
- Extreme cold emergency;
- Equipment or people falling through ice;

- Aircraft missing or crash;
- Missing person(s);
- Winter survival training; and,
- Incidents on the water.

The BIPR JV believes that all incidents and near misses are preventable. An employee safety handbook will be developed and will be given to each employee upon completion of the site orientation process. The handbook will be updated from time to time as new information or experience comes available.

Recognizing that spills or leaks of petroleum products, chemical substances and sewage have the potential of posing a variety of hazards and can endanger both short or long term public health and the environment, the BIPR JV will develop and implement a spill response plan to address accidental releases of hazardous substances.

The objectives of the plan are to minimize the following:

- danger to persons;
- pollution to watercourses;
- area affected by the spill or fire;
- degree of disturbance to the area and watercourses during clean-up; and
- degree of disturbance to wildlife.

The spill response plan will include the following:

- Spill Response Theory
- Spill Response Action Plans - General
- Action Plan for Liquid Spills on Land
- Action Plan for Fuel Spills on Water
- Action Plan for Fuel Spills on Snow
- Action Plan for Fuel Spills on Ice
- Fire Prevention and Response Plan

- Fuel Storage and Transfer Systems Spill Preventative Measures
- Hazardous Materials Storage - Spill Preventative Measures
- Hazardous Materials Storage – Spill Response Actions
- Sewage Treatment System - Spill Preventative Measures
- Sewage Treatment Plant - Spill Response Actions
- Auxiliary Systems (Pipelines) – Spill Prevention

3.3 Contwoyto Camp Management Plan

Safety and environmental management at the Contwoyto Camp will be developed and implemented in similar fashion as identified above for the port. Prior to undertaking any activities pertaining to the site development, construction or operation of the camp facilities, a detailed emergency response and contingency plan will be developed. The plan will provide:

- Spill response and training plan;
- Fire prevention and training plan;
- A clear chain of command, contacts and reporting procedures to be followed for all responses to spills and other emergencies;
- A framework to be followed to ensure that accountability for the performance of the spill and emergency response activities is defined and communicated to site staff before an event occurs;
- A defined list of responsibilities to be followed in conducting spill clean up and emergency response activities established and communicated to site staff before an event occurs;
- Information on available resources and potential operational hazards/risks that may be encountered during spill clean up and emergency response activities; and
- Reporting and record keeping requirements for spill and emergency response to facilitate tracking of response progress and incident investigation and mitigation planning after the event.

The detailed emergency response and contingency plan will be available at strategic areas on the property, as this will be a controlled document, to all employees for reference. Copies of this report will be distributed to all stakeholders including the Nunavut Water Board, the Nunavut Impact Review Board, the Kitikmeot Inuit

Association (KIA), Environment Canada (EC), Fisheries and Oceans Canada, RCMP Cambridge Bay and the Nunavut Department of Environment (GNDoE).

All employees, contractors and visitors will be introduced and instructed on the policies and procedures established within this plan. Area specific inductions will be given to individuals working in high risk activity areas or in handling hazardous materials.

Safety and environmental concerns and awareness will also be discussed at every safety meeting and at the start up of any new operations that may affect the environment. If an incident happens all employees will be informed and re-instructed and retrained as deemed necessary.

The training for spill response will be part of the worker orientation at the Contwoyto Lake Camp. All personnel will be made aware of the products present on site and those passing through the site on trucks through the orientation program and the availability of Material Safety Data Sheets (MSDSs) in prominent locations. Supervisors who may be called upon to fill the roll of Spill Response Coordinator, Spill Response Supervisor and personnel who will be called on to act as the Clean up Crew will receive additional training allowing them to respond quickly and safely to any spill on the port site. All employees on site will have valid WHMIS certificates and will be familiar with the layout and content of MSDSs for the hazardous materials to be used on site. Each employee will be made aware of the locations of storage facilities and the locations of spill containment and recovery equipment.

The plan will include an organization chart identifying the ultimate responsibility for up-to-date emergency training plans. This authority or designate will review the emergency preparedness and response procedures on an annual basis or as required. Review of the emergency response procedures will include the periodic verification of any telephone number contacts for the various organizations that may be needed. Such verification shall be undertaken at a minimum of once per year. Revisions will be made to the procedures where necessary to comply with changing site conditions and any new relevant legislation. Personnel will be notified of any changes and if necessary retraining will take place.

Personnel at the site will undertake periodic testing of the emergency response procedures. These tests will be undertaken on a twice-yearly basis. These intervals shall be more frequent if there is a high turnover of employees at the site. The outcome of each exercise is to be recorded, and reviewed for areas of improvement.

Emergency preparedness training will, at a minimum, address the following:

- Medical emergency, accident or fatality;
- Fuel spill or chemical spill, effluent spills or leaks;
- Fire, both prevention and response;

- Flood;
- Earthquake;
- Extreme cold emergency;
- Equipment or people falling through ice;
- Aircraft missing or crash;
- Missing person(s); and
- Winter survival training.

4.0 OIL SPILL RESPONSE PLANNING

The development of a detailed contingency plan is neither warranted nor practical at this stage of the proposed Bathurst Inlet Port and Road (BIPR) Project (the Project). If the project is approved, an oil spill response plan (OSRP) will be prepared for the Project. The purpose of the following is to guide the future development of a contingency plan, and presents the key considerations that will be taken into account in developing the plan, as well as a table of contents for the plan.

4.1 General Considerations

Ships that transit Canadian waters are required to have a shipboard oil pollution emergency plan that is in accordance with Regulation 26 of Annex I of MARPOL 73/78, which requires that oil tankers of 150 tons gross tonnage or more and all ships of 400 tons gross tonnage or more carry an approved shipboard oil pollution plan (SOPEP). The International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990, also requires such a plan for certain ships. When operating in Canadian waters south of the 60th parallel the Canada Shipping Act also requires them to have an arrangement with a certified response organization that would respond to a spill on the polluter's behalf.

Through legislation such as the Canada Shipping Act, the Arctic Waters Pollution Prevention Act, the Oceans Act, and subject to various inter-agency agreements, the Canadian Coast Guard (CCG) of the Department of Fisheries and Oceans (DFO) has lead agency responsibility for ensuring responses to ship-source spills, mystery spills, and ship-source pollution incidents that occur as a result of loading or unloading to or from ships at oil handling facilities in waters of Canadian interest. In the Arctic, Indian and Northern Affairs Canada (INAC) assumes this last responsibility.

The CCG Marine Spills Contingency Plan defines the scope and framework within which the CCG will operate to ensure a response to marine pollution incidents. The polluter is expected to respond to incidents, while the CCG will monitor and, whenever necessary, augment or assume management of the response when it is in the interest of the public.

In addition, oil handling facilities, or anyone who loads and unloads oil and oil products, are required to have an oil pollution emergency plan, as well as response equipment on site during the transfer. INAC would be the lead agency responsible for response to spills for oil handling facilities in the Arctic, with the CCG acting as a resource agency to INAC.

4.2 Contingency Planning Outline

The vessel operator is responsible for reporting, responding, and paying for all ship-based spills based on their Ship Oil Pollution Emergency Plan. The vessel operator also acts as the Incident Commander unless the CCG takes over the spill response. The Canadian Coast Guard Marine Spills Contingency Plan defines the scope and framework within which the CCG will operate to ensure a response to marine pollution incidents. The polluter is expected to respond to incidents, while the CCG will monitor and, whenever necessary, augment or assume management of the response when it is in the interest of the public.

The planning focus for the Project will be on the port's oil handling operation since the vessel operators delivering the oil to the port must have their own spill response contingency plans in place before they can operate in Canadian waters, as described above.

4.3 Bathurst Inlet Fuel Supply Port Spill Planning

The plan for the Project will contain all the elements of a modern OSRP including: descriptions of the spills likely to occur from the operation; actions to be taken in cleaning up these spills; decision trees and checklists used to implement the response; and comprehensive lists of contacts and resources needed to conduct cleanup and monitoring programs.

Under legislation such as the *Territorial Lands Act*, the *Arctic Waters Pollution Prevention Act*, and the *Nunavut Waters and Surface Rights Tribunal Act*, INAC have responsibilities for the protection of land and water resources in Nunavut. To facilitate compliance with their objectives, they have published, *Guidelines for Spill Contingency Planning* (INAC, 2007), a comprehensive guide to contingency planning for developments such as the Project. The guidelines describe the requirements for an acceptable contingency plan, and provide detailed recommendations for:

- response organization description;
- action plan;
- resource inventory; and
- description of training programs.

The Proponent will develop an up-to-date OSRP for the Bathurst Inlet development as follows.

1. The plan will be based on the guidelines in the SOPEP and INAC documents;
2. Information will be included on potential spills and spill behaviour, including spill volume, oil properties, spill location, and receiving environment (marine and land-based spills), *etc*.
3. Up-to-date information concerning reporting of spills will be included. This is detailed in the INAC guideline, including a recommended spill reporting form and a telephone and email link for the Northwest Territories 24-hour spill reporting line.
4. Lists for contacts and providers of materials and services will be provided including: government contacts, spill responders, technical experts, providers of specialized services and equipment, and providers of logistic support services.

The 24-hour reporting line is to be used to immediately notify the appropriate agencies of a spill that exceeds the “reportable quantity”, which varies with the nature of the contaminant (note that the 24-hour line is used to inform all relevant government departments (federal, territorial and/or Aboriginal) that a spill has occurred.) For flammable liquids, including diesel and gasoline the reportable quantity is 100 L (INAC, 2007). In addition to this initial report, a detailed spill report is required within 30 days of the incident. A reporting form for the latter is included in the INAC document, and includes reporting on causes of the incident and actions taken to mitigate the spill.

An example of the Table of Contents of an OSRP for the Project, as listed in the INAC guidelines, is included in Table 4.3-1, below.

Table 4.3-1
Proposed Table of Contents for Bathurst Inlet Port Oil Spill Contingency Plan

1.	**Introduction and Project Details**	
	1.1	Company name, site name, site location and mailing address
	1.2	Effective date of spill contingency plans
	1.3	Last revisions to spill contingency plans
	1.4	Distribution list
	1.5	Purpose and scope
	1.6	Company environmental policy
	1.7	Project description
	1.8	Site description
	1.9	List of hazardous materials on-site – amount normally stored and storage capacity – types and number of storage containers – storage location – Material Safety Data Sheets (MSDSs) for materials (in Appendices)
	1.10	Existing preventive measures (*e.g.*, secondary containment, fuel handling)
	1.11	Additional copies – how to obtain
	1.12	Process for staff response to media and public enquiries
2.	**Response Organization**	
	2.1	Flow chart of response organization
3.	**Action Plan**	
	3.1	Potential spill sizes and sources for each hazardous material on site
	3.2	Potential environmental impacts of spill (include worst case scenario)
	3.3	Procedures (incl. alternative action in case of impeding environmental conditions): A. Procedures for initial actions B. Spill reporting procedures C. Procedures for containing and controlling the spill (*e.g.*, on land, water, snow, ice) D. Procedures for transferring, storing, and managing spill-related wastes E. Procedures for restoring affected areas
4.	**Resource Inventory – describe all resources available for responding to spills:**	
	4.1	On-site resources (*e.g.* spill kits, booms, sorbent materials, earth moving equipment)
	4.2	Off-site resources (*e.g.* contact numbers for deployment and time estimate)

(continued)

Table 4.3-1
Proposed Table of Contents for Bathurst Inlet Port Oil Spill Contingency Plan (completed)

Source: ***Guidelines for Spill Contingency Planning*** **(INAC, 2007).**

4.4 Overall Response Strategies

4.4.1 Spills in Port

For spills in port, there may be an opportunity to implement an active spill response, depending on the nature of the incident and the weather and sea conditions at the time. Containment and recovery equipment to deal with small and modest-sized spills should be pre-staged in the area of the dock facility such that it can be quickly deployed in the event of a spill. The reality of dealing with a relatively light and fluid product such as diesel is that a containment-based response must be implemented within hours if it is to be effective in any significant way. The response strategy will be to:

- Visually monitor relatively high-risk activities (tanker arrivals and unloadings) such that an immediate response can be implemented in the event of a spill.
- Pre-stage containment equipment in the area of the loading area to facilitate rapid deployment.
- Pre-spill: Identify potential control points based on prevailing wind and current directions.

- In the event of a spill, deploy containment boom to surround spill. Depending on the conditions at the time of the spill, this may be in the immediate vicinity of the unloading area, or at some downstream or downwind control point. A small outboard-equipped vessel would be adequate for the purpose of boom deployment.

- If the spill can be contained, a small portable skimmer could be used to collect the oil. Temporary portable storage would be required for any locations other than dockside.

- For oil that escapes containment, slick movements should be monitored to determine the location and extent of any shoreline oiling. Depending on the severity of oiling, it may be necessary to implement a shoreline cleanup response. Given the nature of the shorelines in the area, and the nature of diesel fuel oil, this would likely be the case only if areas close to the spill source were affected by a large spill.

4.4.2 Spills along the Tanker Route

For spills along the tanker route, it is unlikely that an effective marine-based response could be implemented unless the spilled oil is naturally contained within a bay or cove, or by ice. For both diesel and fuel oil spills, the oil would quickly spread and cover a wide area making on-water containment difficult unless the response were implemented within hours.

The reality of spill response along the tanker route is that it will be difficult, if not impossible, to mount an active marine-based response within 24 hours, given the range of possible locations for a spill and the lack of response infrastructure. By the time a credible response effort could be assembled and delivered to the spill scene, the oil will have naturally spread out to cover unmanageable areas. At the same time, for diesel spills, the oil would have largely evaporated and dispersed. For spills of fuel oil, the oil does not readily evaporate or disperse, but would disperse laterally and form discontinuous patches and blobs that would be impractical to recover with booms and skimmers.

As a result, the response strategy for spills along the tanker route will be to use a combination of visual surveillance, aerial surveillance, and computer modeling to monitor slick movements to determine the location and extent of any shoreline oiling. Depending on the severity of oiling, it may be necessary to implement a shoreline cleanup response in the days or weeks following a spill, and in extreme cases, perhaps in the following open-water seasons. Many of the shorelines along the route are high relief, and almost all of the shorelines have a high degree of wave exposure.

As a result, and given the nature of diesel fuel oil, it is likely that the oil will be largely dispersed within a few days or weeks of the spill, and an active shoreline cleanup effort may not be warranted. For spills of fuel oil, the oil will be more persistent and may remain as scattered blobs and patches some distance from the spill site. Depending on the size of the spill and its location relative to shorelines, an active cleanup effort may be required to remove this oil from the environment.

4.4.3 Spill Response Equipment Requirements: Port Oil Handling Facility

Under the Canada Shipping Act, the terminal will be designated as an oil handling facility, which commits an operator to several planning requirements. First, the operator must have a contingency plan; however, the specific requirements of the plan (Transport Canada, 1995) are all contained within the above table of contents, so they are not repeated here.

The guidelines for oil handling facilities also specify that an inventory of equipment be maintained that is commensurate with the size of the facility. Based on the maximum transfer rate of 908 m3/h, the facility will be classed as a Level III facility, and will therefore be required to consider a 15 m3 spill for planning purposes.

The spill behaviour modeling for this size of spill indicates an initial slick width (of thick oil) of 31 m (See Appendix G-3). Based on this, and the planning standards for this size of spill, a reasonable amount of boom for initial spill containment would be 200 m of a 24” boom. In all, a basic inventory of equipment for the facility should include:

- 200 m of protected water containment boom;
- small workboat for deploying and positioning the boom;
- skimmer suitable for recovering diesel fuel;
- temporary storage, and a pump and hose to transfer the recovered product to on-land storage; and
- sorbent boom and pads for recovering sheen and lesser concentrations of oil.

4.3.4 Training of Response Personnel

It is recognized that the effectiveness of response to major offshore spills is highly dependent on the knowledge, skills and capabilities of persons on the response team. It is essential that an adequate number of personnel be designated to fulfill spill response functions. The required level of preparedness with respect to the training of these personnel is discussed below.

It is worth identifying the various response team positions in a "generic" response structure (Figure 4.4-1) and discussing the requirements for each.

Category A1: Emergency Director: The contingency plan should identify a senior company official in charge of the entire emergency response effort. This Emergency Director is responsible not only for all phases of spill response but also for other related emergency response actions (*e.g*., source control, tanker salvage). He is the chief spokesperson *vis-à-vis* other companies, the government, the press, and, of course, higher executives within his own company. In most company plans he is the senior manager in the involved area and hence already has a good understanding of the region, outstanding managerial skills, established authority over those in the response organization, and a high degree of spending control on behalf of the company. His base of operations during the spill control effort would usually be at his normal regional headquarters and not in the field at the scene of the accident. Although the Emergency Director does not require in-depth knowledge of oil spill countermeasures, he must fully understand his role in a major oil spill incident, the specific roles of others in the response team, and the need to support and participate in pre-spill activities, including simulated exercises, which will improve his company's state of preparedness.

Figure 4.4-1. Generalized Response Organization

CATEGORY A1
Emergency Director

CATEGORY A2
Spill Superintendent

CATEGORY B

B1	B2	B3	B4	B5
Tracking & Surveillance Supervisor	Containment & Recovery Supervisor	Chemical Dispersal Supervisor	Shoreline Cleanup Supervisor	Disposal Supervisor

CATEGORY C
Foremen

CATEGORY D

ADVISERS
- Safety
- Security
- Public Affairs
- Legal
- Government Liaison
- Claims/Complaints

SUPPORT SERVICES
- Logistics
- Air Services
- Marine Services
- Communications
- Administration & Finance
- Procurement
- Manpower

CATEGORY E

Spill Countermeasures Expert

Environmental Impact Expert

Category A2: Spill Superintendent: This person manages all primary spill response activities in the field and reports to the Emergency Director on a regular basis. The position requires managerial skills, an ability to make important decisions under stress, and a high level of knowledge regarding oil spill control strategies and techniques. In most companies this position would be filled by a senior operations manager in the district office who already has an important field responsibility *vis-à-vis* the company's operations in the involved district, and considerable established authority over those who are selected to work for him during a spill.

Some companies combine the functions of the two management categories, A1 and A2, into one position. Others have three positions to cover these functions. In any case, the main characteristic that distinguish the two categories is that the top category, A1, mainly requires strong executive and managerial skills and a strong authority within the company (as many as 10 responsibility centers could report to him in a major spill response effort, such as legal, public relations, administration, logistics, communications, and spill superintendent) but requires only basic or broad training in the spill response area. The A2 position, on the other hand, is a more specialized position that requires a comprehensive knowledge of spill management itself, and an in-depth knowledge of all aspects related to spill behaviour and spill response.

The in-depth knowledge requirements of this position cannot hope to be addressed through basic familiarization exercises and response drills. If a company-designated person is to fill this role he will require in-depth training on: oil-spill behaviour, oil-spill response organization and strategies, management aspects of large spills, and the range of possible countermeasures operations at his disposal.

Category B: Field Supervisors: This category involves the supervisors who direct the main field activities and who report to the Spill Superintendent. The distinct activities are spill surveillance and monitoring (B1); containment and recovery (B2); chemical dispersal (B3); shoreline protection and cleanup (B4); and disposal (B5). Many companies simply have two positions to cover these activities, one for on-land shoreline cleanup and disposal, and the other for offshore duties, that is, spill surveillance, recovery and treatment. In any case, individuals with a comprehensive working knowledge of these five specialized areas are required in a proper spill response organization. In areas where expertise is lacking, contractors with expert knowledge and experience in the field are often used.

Category C: Workcrew Foremen: The workcrew foremen conduct the different activities for the field supervisors. They must know specific techniques and equipment thoroughly and have practical experience in their use. In addition, equipment that was brought into the response effort from outside would have to include operators who were equally skilled in its use.

Category D: Secondary Support Positions: Contingency plans should identify positions at the superintendent, supervisor and adviser level with responsibilities for services such as marine and logistics support, communications, safety, security, legal advice, and public relations. These persons should already be experts in their required functions and would only require an understanding of the basic elements of oil spill response and of their responsibilities during a spill. Familiarization training and participation in response exercises is the basic requirement.

Category E: Spill Countermeasures and Spill Impact Experts: Of crucial importance to a spill response organization, especially when dealing with major spills, are the two positions of spill countermeasures expert and environmental impact expert. These positions are highly specialized and are usually held by professionals with several years of experience in spill-related jobs. Should companies wish to fill these positions, they must be prepared to train them over the long-term by having them participate actively in conferences, specialized workshops, field trials, and other educational experiences that will serve to increase their knowledge to the expert level. An alternative that is used by most companies is to contract consultants on an as-required basis.

For the Project, the main active response effort will be in response to small and modest-sized spills at or near the loading facility, which will not require an extensive spill management structure. Many of the above functions can be combined. At a minimum will be the following functions, with their training requirements summarized:

Emergency Director: Senior company manager, not necessarily on-scene for the incident response, requires minimal spill-related training other than familiarization with the contingency plan.

Spill Superintendent: Senior operations superintendent in charge of normal operations at the facility, and would continue this role in the event of a spill response. Requires working knowledge of the contingency plan and prescribed response procedures.

Field Supervisors: Operational supervisors that would normally be directing personnel involved in loading operations at the facility, would assume a similar function in directing the response effort. Require working knowledge of these activities.

Work Crew Foremen: Operational personnel involved in loading operations at the facility, would directly be involved in boom deployment and recovery measures. Require training and practice in these activities.

Secondary Support Positions: Logistics and support positions within the company, with similar roles in their day-to-day activities. Requires minimal spill-related training other than familiarization with the contingency plan.

Spill Countermeasures and Spill Impact Experts: May be required in the event of a spill, depending on its severity. External experts that should be identified prior to the spill, listed in the contingency plan, and contracted on as-needed basis: no training needed other than familiarization with the Project contingency plan.

Exercises and Drills: Once the response team has been established and the training requirements met, response exercises should be carried out on a regular basis. Exercise objectives are to ensure that all members of the response organization are thoroughly familiar with their respective roles in an emergency, to practice those roles and the key decision-making functions, and to identify any possible deficiencies in the response planning and preparations. Two general types of exercise are required: spill management simulations and operational response drills.

Spill Management Simulations: These are used to exercise the important management aspects of spill response. Participants in such exercises should include the Emergency Director, Spill Superintendent, the Field Supervisors, the Support Advisers, and the designated Expert Advisers, that is, all members of the response team except Foremen and strictly operational personnel. The key areas to be covered in the simulation are outlined below:

Spill Assessment

- alerting and notification procedures, internal and external;
- assessment of initial spill requirements, manpower and equipment;
- initial response actions; and
- initial response management structure.

- Resource Mobilization
- establishment of command post;
- specify detailed response actions, with priorities and resource allocations appropriate to those available; and
- identify and arrange required response gear.

Response Operations

- remedy ineffective aspects of response operation;
- deal with unexpected problems in response (i.e., equipment shortfalls, weather changes, spill behaviour anomalies);
- address all logistics requirements;
- address financial, legal, and government interaction issues; and
- detail public information plans

The success of spill management simulations hinges on two main factors: having prepared an exercise that will challenge participants in such a way that they can actively improve both their personal level of preparedness as well as the overall contingency planning process; and secondly, having a highly-motivated Emergency Director whose authority ensures that the training and contingency planning processes are comprehensive.

Operational Response Drills: These are used to practice countermeasures strategies and techniques, and should be held on a regular basis with all operational staff. Topics to be covered include:

- initial at-source actions;
- communications;
- spill tracking exercises;
- nearshore containment and recovery; and
- shoreline protection and containment.

Drills can be carried out on a scheduled or surprise basis. It is often instructive to invite external experts (*i.e.*, managers of other response teams or cooperatives) to attend scheduled drills and audit the strategies and techniques. In any case, comprehensive debriefings should follow any drill to ensure that any possible deficiencies are noted and then corrected.

For the Project, the main active response effort will be a containment and recovery response for oil that may be spilled at or near the loading facility. This may involve the deployment of boom to contain spilled oil, deployment, and operation of a skimmer to recover the oil, deployment of a temporary storage device, and use of pumps and hoses to transfer the oil to storage for recycling or disposal. Drills should be carried out on an annual basis to practise boom deployment to ensure that personnel are familiar with the procedures and to ensue that the equipment is in a ready condition.

5.0 FUEL AND EXPLOSIVES MANAGEMENT PLAN

Prior to the start of construction of the Bathurst Inlet Port, road and Contwoyto Lake Camp, a comprehensive explosives management plan will be developed. The plan will focus on how explosives are stored and used on site to minimize any potential environmental impact resulting from the presence and use of these explosive agents on site. The reader is referred to other documents for specific information on safe handling procedures, specifically:

1. The Canadian Explosives Act ;
2. Explosives Use Act ;
3. Mine Health and Safety Act (Nunavut); and
4. Mine Health and Safety Regulations (Nunavut).

Control and use of explosives are covered by federal and Nunavut regulations:

- Transportation of Dangerous Goods Act
- Canada Explosives Act and Regulations
- Canada Transportation Act, Ammonium Nitrate Storage Facilities Regulations
- Northwest Territories/Nunavut Mine Health and Safety Act and Regulations
- Nunavut Explosives Use Act
- Consolidation of Explosives Regulation.
- Natural Resources Canada.

Explosives management at the BIPR sites will focus on two goals, both equally important:

- safety; and
- environmental stewardship.

The explosives used during construction will consist of ANFO (a mixture of ammonium nitrate prills and fuel oil), pre-packaged explosives (AMEX in 25 kg bags) and stick explosives (EXEL, GELDYNE in 20 kg cases). The ANFO will be batch mixed as needed in an on-site explosives mixing plant. The peak annual supply of bulk ammonium nitrate prills is estimated to be 500,000 kg. It is anticipated that the explosives mixing plant will produce a maximum amount of 10,000 kg of ANFO at any one time.

The ammonium nitrate prills will be barged or trucked to site in 1.5 tonne tote bags, packed in containers. Ammonium nitrate is stable and requires no special storage facility. Pre-packaged explosives will be barged or trucked to site and stored within modular pre-fabricated storage magazines (modified containers) for this specific purpose. Explosives magazines will be able to store up to 38,000 kg of blasting powder and 39,000 kg of detonators. The storage magazines are required to meet the appropriate codes for fire and security protection. The actual explosives and detonator magazines will be Type 4 prefabricated magazines.

Natural Resources Canada (NR Can) Regulations, which govern the storage and mixing of explosives, requires that powder and detonators will be stored in independent magazines and that all bulk ammonium nitrate storage, explosives and detonator magazine and the mixing plant be separated by a minimum distances based on the amounts that are being stored.

NR Can regulations also require the explosives storage and mixing facilities to be separated by minimum distances from permanently occupied buildings and roadways. The transportation of explosives is required to be in accordance with the Explosives Act.

All explosives storage and product delivery systems will be approved and subject to inspection under Part IV – Explosives at Mines of the Northwest Territories/Nunavut Mines Health and Safety Act and Regulations and under federal regulations (The Canadian Explosives Act) administered by Natural Resources Canada, Explosives Division. BIPR JV personnel will conduct weekly inspections of the explosives storage and delivery systems. In addition BIPR JV on-site environmental staff and/or third-party consultants will perform periodic safety and environmental audits of these facilities.

6.0 ACCIDENTS AND MALFUNCTIONS

This section describes the potential effects of accidents and malfunctions in the project area. Accidents and malfunctions are unforeseen and unintentional events that happen to project personnel, equipment, or infrastructure. Hypothetical examples could be a truck accident on the road or a fuel leak at the port. Accidents and malfunctions could damage property, disrupt operations, affect the health and safety of the work force and local community, or cause the release of contaminants into the surrounding environment.

The following matrix outlines the major environmental and safety risks identified on the project and identifies the source documentation that will describe prevention, mitigation and response.

Risk Description	Risk Mitigation
Fuel spill at Bathurst Port	Port Management Plan - Action Plan for Liquid Spills on Land - Action Plan for Fuel Spills on Water - Action Plan for Fuel Spills on Snow - Action Plan for Fuel Spills on Ice
Fuel spill on road or roadside, various conditions	Road Management Plan - Action Plan for Liquid Spills on Land - Action Plan for Fuel Spills on Water - Action Plan for Fuel Spills on Snow - Action Plan for Fuel Spills on Ice
Fuel spill at Contwoyto Camp	Contwoyto Camp Management Plan - Action Plan for Liquid Spills on Land - Action Plan for Fuel Spills on Water - Action Plan for Fuel Spills on Snow - Action Plan for Fuel Spills on Ice
Explosives theft	Fuel and Explosives Management Plan
Explosives spill during use	Fuel and Explosives Management Plan
Accidents or medical emergencies at Bathurst Port	Port Management Plan - Emergency Response Plan

Accidents or medical emergencies on Road	Road Management Plan - Emergency Response Plan
Accidents or medical emergencies at Contwoyto Camp	Contwoyto Camp Management Plan - Emergency Response Plan
Fire at Bathurst Port	Port Management Plan - Fire Prevention and Response Plan
Fire on Road	Road Management Plan - Fire Prevention and Response Plan
Fire at Contwoyto Camp	Contwoyto Camp Management Plan - Fire Prevention and Response Plan
Weather risks, including white-outs and extreme cold	Port, Road and Camp Management Plans - Emergency Response Plans and preparedness training
Marine barging risks	Shipping companies' operating plans
Fuel storage leaks	Mitigated by design as described in Feasibility Study Section 4.4.6 - monitoring
Sewage leaks or spills	Mitigated by design as described in Feasibility Study Section 4.4.8 Port and Camp Management Plans - monitoring - Sewage Spill Preventative Measures and Response Plans

7.0 WASTE MANAGEMENT PLAN

Generation of waste during the construction, operation and decommissioning of the Bathurst Inlet Port and Road Project will be minimized whenever possible by applying the principles of Reduce, Reuse, Recycle, and Recover. As a waste generator, the BIPR JV will always be held responsible for how it manages its waste, therefore, when disposal of waste is required, the following elements must be met:

- Workers who perform waste management, transportation, and storage duties must be suitably trained;
- The waste generated must be identified and accurately characterized;
- The waste must be classified , based on appropriate regulatory criteria;
- The waste must be stored and handled properly;
- Only approved facilities capable of managing the waste properly will be used;
- The public and environment must be protected from effects of improper waste management, including spills and transportation-related accidents (see prepare contingency measures and emergency response plans)
- Records to demonstrate appropriate disposal will be completed and retained.

Prior to the start of construction a detailed Waste Management Plan will be developed that includes the above elements and meets the project environmental objectives.

REFERENCES

An explanation of the acronyms used throughout this reference list can be found in the *Acronyms and Abbreviations* section.

INAC. 2007. *Guidelines for spill contingency planning*. Prepared by INAC Water Resources Division. http://nwt-tno.inac-ainc.gc.ca/pdf/wr/INAC_Spill_guidelines_web.pdf (accessed October, 2007).

Transport Canada. 1995. *Canada Shipping Act, Response Organizations and Oil Handling Facilities Regulations SOR/95-405*. Transport Canada, Ottawa. www.tc.gc.ca/acts-regulations/GENERAL/C/csa/regulations/100/csa101/csa101.html (accessed October, 2007).

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Appendix G-5

Cumulative Effects Assessment

Author: **Rescan Environmental Services Ltd.**
Date: **November 2007**

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Bathurst Inlet Port and Road Cumulative Effects Assessment

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ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations

AMEC	AMEC Earth and Environment
BIPR	Bathurst Inlet Port and Road
CAP	Cultural Awareness Program
CEA Agency	Canadian Environmental Assessment Agency
CO	carbon monoxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
De Beers	De Beers Canada Mining Inc.
DEIS	Draft Environmental Impact Statement
DEW Line	distant early warning line
Diavik	Diavik Diamond Mines Inc.
DND/CF	Department of National Defence/Canadian Forces
EA	environmental assessment
EIRB	Environmental Impact Review Board – Inuvialuit Settlement Region
EIS	Environmental Impact Statement
EISC	Environmental Impact Screening Committee – Inuvialuit Settlement Region
FEIS	Final Environmental Impact Statement
GHG	greenhouse gas
INAC	Indian and Northern Affairs Canada
KIA	Kitikmeot Inuit Association
L_{eq}	equivalent continuous sound level
LSA	local study area
Miramar	Miramar Hope Bay Ltd.
ML/ARD	Metal Leaching and Acid Rock Drainage
MVEIRB	Mackenzie Valley Environmental Impact Review Board
NIRB	Nunavut Impact Review Board
NLCA	Nunavut Land Claims Agreement
NO_2	nitrogen dioxide
NPC	Nunavut Planning Commission

NRCan	Natural Resources Canada
NWS	North Warning System
NWT	Northwest Territories
PAH	polycyclic aromatic hydrocarbons
$PM_{2.5}$	particulates with aerodynamic diameter of less than 2.5 µm
the Project	the Bathurst Inlet Port and Road Project
Rescan	Rescan Environmental Services Ltd.
RMCC	Royal Military College of Canada
RSA	regional study area
SARA	*Species at Risk Act*
SO_2	sulphur dioxide
STD	sexually transmitted disease
TCWR	Tibbitt-Contwoyto Winter Road
TSP	total suspended particulates
VEC	valued ecosystem components
VSEC	valued socio-economic components
Wolfden	Wolfden Resources Inc.
WKRLUP	West Kitikmeot Regional Land Use Plan

1. INTRODUCTION

1. Introduction

The concept of cumulative effects recognizes that while the effects of an individual action may be relatively small, the effects of two or more actions may combine to produce cumulative effects that could be considered significant. The Canadian Environmental Assessment Agency (CEA Agency) defines cumulative environmental effects as:

> *…changes to the environment that are caused by an action in combination with other past, present and future human actions*…(CEA Agency, 1999).

Under this definition, "human actions" include projects (developments) and activities. Projects are typically commercial or industrial developments that are planned, constructed and operated, and are typically identified by a specific name: for example, the Bathurst Inlet Port and Road (BIPR) Project (the Project). Activities may either be part of a project or may arise over time due to ongoing human presence in an area. A mine development, a resource access road, or both together are examples of a project; while public traffic, hiking, and hunting along the road are examples of activities (CEA Agency, 1999).

In Nunavut, cumulative effects must be analyzed for all projects reviewed under Part 5 of Article 12 of the Nunavut Land Claims Agreement (NLCA). A typical cumulative effects assessment considers four questions (EISC and EIRB, 2002):

1. Is the project under review likely to have effects on valued ecosystem components (VECs) or valued socio-economic components (VSECs)?
1. If so, will the residual effects (effects that remain after mitigation) combine with the effects of other projects past, present or future?
2. What is the significance of the overall cumulative effects, including the effects of the project?
3. If there are significant cumulative effects, are there further mitigation measures that could reduce or eliminate the project's contribution to these effects so that the combined effect is not significant?

The objective of the following sections is to address these questions in relation to the Project.

Dowlatabadi *et al.* (2003) suggest an approach for taking into account induced developments in cumulative effects assessments. Their approach estimates the probabilities that different types of developments will be induced by the project under review based on historical patterns of development, and then calculates a "cumulative impact multiplier" that is applied to each effect being assessed. This approach was not taken for the Project's cumulative effects assessment for the following reasons:

- For the Project assessment, data were available about potential future developments that made it possible to provide quantitative predictions of factors such as future truck and shipping traffic.

- Based on the precautionary principle, it was assumed that **all** identified reasonably foreseeable future developments proceeded to operations and that their operational periods would overlap, thus generating a "worst case scenario" and providing a more conservative assessment. Of the future developments that were considered, two can be categorized as "induced" because they are facilitated by development of the Project.
- The cumulative effects of multiple human actions may be complex and not simply a linear function of the number of developments, or the likelihood of future developments, in a specified area.
- For VECs such as caribou herds, the location, timing and type of future development is important when considering the severity of cumulative effects; a simple numerical impact multiplier cannot take these biological characteristics into account.

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2. METHODOLOGY

2. Methodology

2.1 Overview

The cumulative effects assessment process established a hypothetical but realistic future scenario and compared this scenario with existing (baseline) conditions. The future scenario was developed using the best information that is currently available regarding closed (past), existing (present), and potential (future) developments in the Project area.

The methodology for the cumulative effects assessment can be broken into four main stages:

1. identify human actions (projects and activities) to be included in the assessment;
2. develop a future scenario;
3. identify the environmental and socio-economic components to be assessed; and
4. assess the effects on each VEC and VSEC based on the future scenario.

2.2 Human Actions included in the Assessment

2.2.1 Approach

2.2.1.1 Study Area

The area considered when identifying other human actions around the Project extended from north of Great Slave Lake to the Coronation Gulf (approximately latitude 63^{o} to 70^{o} N), and from the eastern edges of Victoria Island to Kugluktuk (approximate longitude 101^{o} to 116^{o} W). This area includes the existing diamond mines that use the Tibbitt-Contwoyto Winter Road (TCWR), the proposed road, and the proposed shipping lane from the port through Coronation Gulf and Queen Maud Gulf. Developments along the shipping corridor between Queen Maud Gulf and Lancaster Sound were also identified. Also, it includes most of the annual range of the Bathurst caribou herd.

2.2.1.2 Inclusion Criteria

The Project Environmental Impact Statement (EIS) Guidelines require the cumulative effects assessment to consider "past, current, or Reasonably Foreseeable Future Developments," where reasonably foreseeable future developments are defined as:

> *…those future projects or activities which are currently under regulatory review or will be submitted for regulatory review in the near future, as determined by the existence of a proposed project description, letter of intent, or any regulatory application filed with a government department or agency.* (NIRB, 2004).

All past (closed) and existing (currently active) developments within the study area were included for consideration in the cumulative effects assessment. Existing land use activities were also included. Potential future developments were included as "reasonably foreseeable" if they:

- have entered into the Nunavut Impact Review Board (NIRB) environmental assessment (EA) process;
- have entered into the Mackenzie Valley Environmental Impact Review Board (MVEIRB) EA process;
- are an expansion of an existing project or of a project that has entered an EA process; or
- have pending EISs with publically announced planned submission dates.

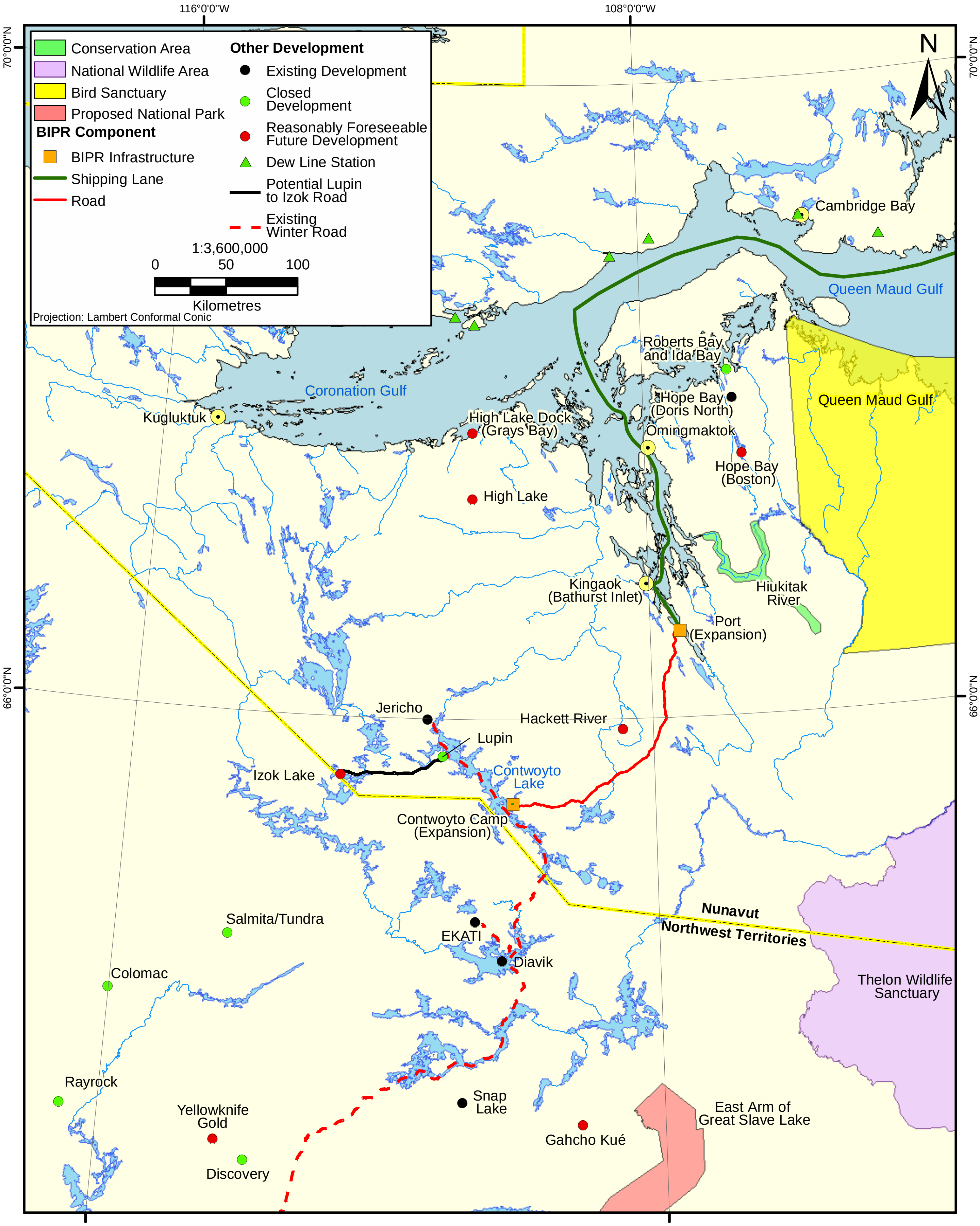
2.2.2 Closed Developments

Closed developments in the study area include precious metal mines, lead/zinc mines, one uranium mine and the distant early warning line (DEW line) of radar stations (Table 2.2-1, Figures 2.2-1 and 2.2-2). Although no longer operational, reclamation activities are ongoing at many of these sites and closed projects may still exert an influence on their surrounding environments.

Table 2.2-1
Closed Developments

Project	Type	Coordinates	Features	Operations	Status
Lupin	Gold mine	65° 46' N 111° 15' W	Underground mine and mill, tailings containment Connected to existing winter road	1982 to 2005	Surface infrastructure remains in place - potential for this to be used if the Ulu deposit is developed
Nanisivik	Lead and zinc mine	73° 02' 5" N 84° 32' 13" W	Underground Mine and mill, tailings containment Dock for shipping	1976 to 2002	Ongoing reclamation. Site to be converted to a Canadian naval station, operating by 2012.
Polaris	Lead and zinc mine	75° 23' N 96° 68' W	Underground Mine and mill, tailings containment Dock for shipping	1980 to 2002	Decommissioned and reclaimed. Ongoing monitoring
Colomac	Gold mine	64° 12' N 116° 1' W	Open pit mine workings, mill, tailings impoundment	1989 to 1997	Remediation ongoing, expected to be complete in 2010.
Bent Horn	Production Oil well	103° 53' N 76° 19' W	Oil production, storage and marine transportation	1985 to 1996	Closed
Tundra	Gold mine	10 km from Salmita mine	Underground mine workings, mill, tailings containment	1964 to 1968 Re-opened briefly in 1990s	Care and maintenance. Remediation plan is being developed.
Salmita	Gold mine	64° 36' N 114° 21' W	Underground mine workings	1984 to 1989	Remediated
Roberts Bay and Ida Bay	Silver mine	68° 10' 45" N 106° 33' 29" W	Mine openings, equipment, waste rock and tailings pond	1973 to 1975	Remediation work being coordinated by INAC. Expected to be complete by 2010
Discovery	Gold mine	63° 11' N 113° 55' W	Underground mine workings, tailings impoundment	1950 to 1969	Reclaimed. Potential for property to be further developed as part of the Yellowknife Gold Project
Rayrock	Uranium Mine	63° 45' N 116° 54' W	Underground mine workings and tailings containment	1957 to 1959	Remediated: long-term monitoring
DEW Line	Radar stations across Alaska and Canadian Arctic	21 sites across Nunavut (15) and Inuvialuit Settlement Region (6)	Radar and communications equipment. Accommodation buildings	1957 to 1995	A number of sites have been converted into unmanned North Warning System (NWS) stations Site reclamation began in 1996, and scheduled to be completed by 2013.

Sources: Zinifex Ltd (2007); NRCan (2004); NRCan (2006); Teck Cominco Ltd (2006); Canadian Navy (2007); INAC (2005a); INAC (2005b); INAC (2007); AMEC (2004); CEA Agency (2007); Lackenbauer *et al.* (2005); RMCC (2005); DND/CF (2005); Tyhee Development Corp. (2007a); Seabridge Gold Inc (2007); Canadian Centre for Energy Information (2004); Infomine.com.

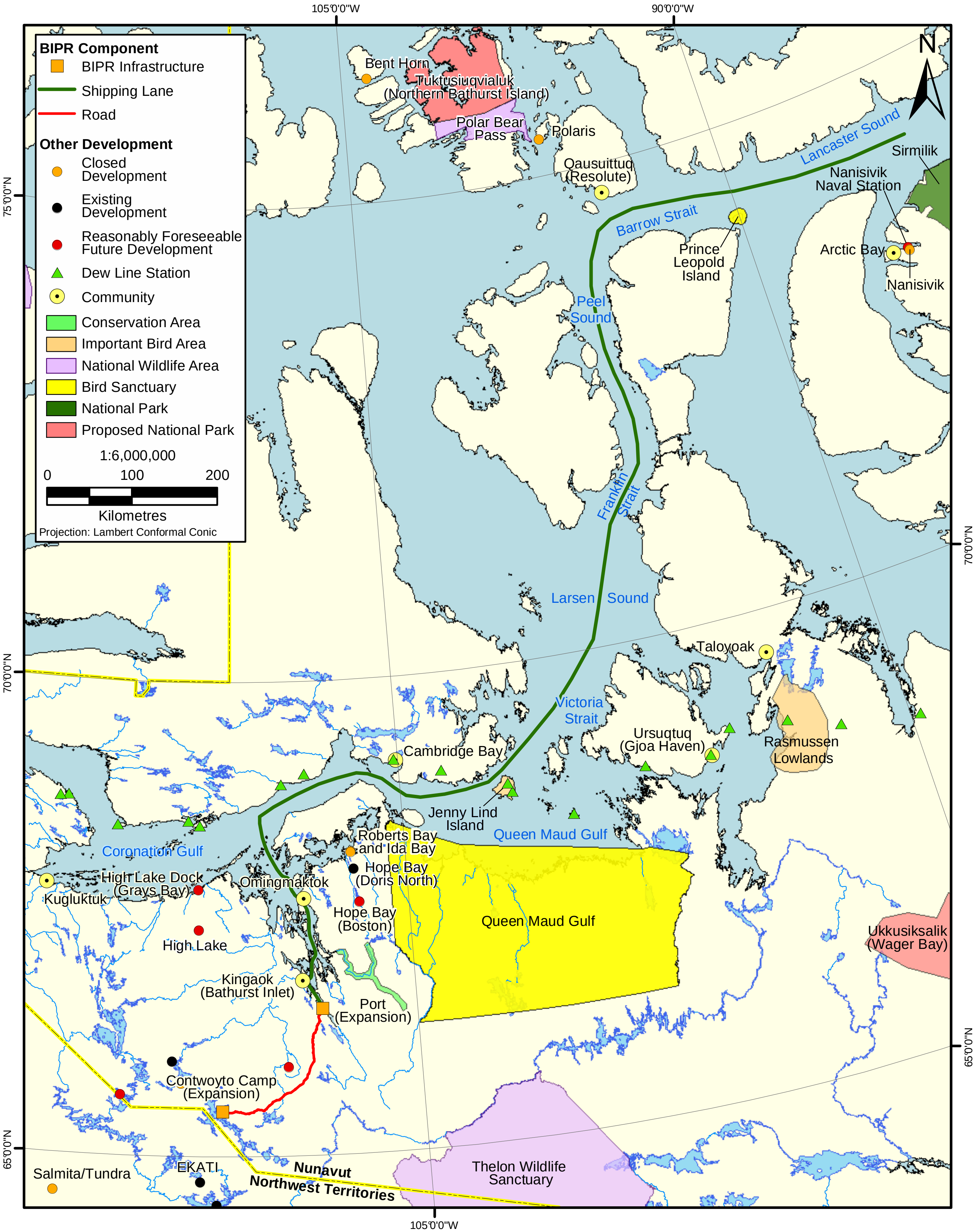


the Bathurst Inlet Port and Road Project

FIGURE 2.2-1

Past, Existing and Reasonably Foreseeable Future Developments in the Cumulative Effects Assessment Area

Rescan



Past, Existing and Reasonably Foreseeable Future Development along the Shipping Lane

FIGURE 2.2-2

The Bathurst Inlet Port and Road Project

Rescan

2.2.3 Existing Developments

Existing (active) projects in the study area comprise four diamond mines, one gold mine, and the NWS stations (Table 2.2-2, Figure 2.2-1).

Table 2.2-2
Existing Developments

Project	Type	Coordinates	Relationship with Project	Projected Operational Period
EKATI	Diamond mine	64° 44' N 110° 36' W	Will use to import fuel and supplies	1998 to 2020
Diavik	Diamond mine	64° 30' N 110° 20' W	Will use to import fuel and supplies	2003 to 2025
Jericho	Diamond mine	65° 59' N 111° 28' W	Will use to import fuel and supplies	2006 to 2014
Snap Lake	Diamond mine	63° 35' N 111° 15' W	Will use to import fuel and supplies	Construction began in 2005 Scheduled to be operating in 2008 22 year mine life
Hope Bay (Doris North)	Gold mine	68° 09' N 106° 40' W	Fuel and supplies will be delivered from the Project by ocean barge	Construction began in 2007 Operations scheduled for 24 months, from 2008 to 2010
NWS Stations	Unmanned radar stations	47 stations across Canadian Arctic	Some stations along the Project shipping land	Foreseeable future

Sources: BHP Billiton (2007); De Beers (2002); De Beers (2007); Diavik (2007); Tahera Corporation (2003); Tahera Diamond Corporation (2007); Infomine.com.

2.2.4 Reasonably Foreseeable Future Developments

There are nine proposed developments that qualify as "reasonably foreseeable" under the criteria outlined previously (Table 2.2-3, Figure 2.2-1). Two of the projects may be classified as being induced by the Project: Izok Lake and Hackett River. The Project may facilitate improved access for surface transport to these projects, thus enhancing their feasibility.

Two of the reasonably foreseeable future developments would require expansion of the Project itself by way of developing concentrate storage at the port and may expand the Contwoyto Lake Camp to include a summer barge dock. The barge dock would allow the transportation of materials between Izok Lake and the Project facilities during summer months when Contwoyto Lake is not ice covered. These expansions are contingent on the Izok Lake and Hackett River projects proceeding, and therefore can also be considered induced developments.

Looking further into the future, there may be other projects whose feasibility is improved by commissioning the Project. These include, but are not limited to:

- Back River Project (Goose Lake and George Lake);
- Gondor property;
- Lupin property;
- Ulu property;
- Yava property;

Table 2.2-3
Reasonably Foreseeable Future Developments

Project	Type	Coordinates	Features	Projected Life-Span	Relationship with Project	Status
Hope Bay (Boston)	Gold mine	67° 30' N 107° 0' W	Mine workings Haul road to Hope Bay (Doris North) process plant Second stage in exploiting the Hope Bay deposits, after Doris North	Anticipated that development of the Hope Bay (Boston) deposit will commence as the Doris North Project nears closure	Fuel and supplies will be delivered from the Project by ocean barge May also use existing barge routes from Hay River NWT (via Mackenzie River)	Exploration, pre-feasibility and environmental baseline studies. Will use Doris North infrastructure
Gahcho Kué	Diamond mine ~120 km spur road to winter road	63° 30' N 109° 30' W	Open pit diamond mining 120 km spur winter road from existing winter road Airstrip	Construction scheduled to begin in 2009 Operational from 2011 Estimated 16 year mine life	Import fuel and supplies	In MVEIRB process: Active Environmental Impact Review
Nanisivik	Canadian naval station and coastguard station	73° 04' 08' N 84° 32' 57' W	Conversion of existing deep-water berthing facility originally built for the Nanisivik mine Docking and refuelling facility for naval ships Coastguard station	Construction scheduled for 2010 Operational from 2012 into foreseeable future	Nanisivik is located at the eastern end of the Project shipping lane, south of Lancaster Sound	Project definition, technical and environmental studies Construction scheduled for 2010 Initial operations from 2012 Fully operational 2015
Hackett River	Base metal mine ~25 km spur road to BIPR road	65° 55' N 108° 30' W	Access road from BIPR Open pit mining Process plant and tailings impoundment	Construction scheduled to begin in 2011 Operational from 2013 Estimated 14 year mine life	Import fuel and supplies Export concentrate	Pre-feasibility and environmental baseline studies Draft EIS scheduled to be submitted in 2008
Izok Lake	Base metal mine 80 km all-weather road to Lupin	65° 27' N 115° 5' W	Open pit mining; Process plant and tailings impoundment	First concentrate production could begin in 2014 Estimated 12 + years mine life	Import fuel and supplies Export concentrate	Exploration and environmental baseline studies ongoing Pre-Feasibility study due in 2008, planned EIS submission in 2010

Sources: De Beers Canada Mining Inc. (2005); Miramar (2005); MVEIRB (2006); Sabina Silver Corporation(2007); Wolfden (2006); Zinifex Limited (2007); Tyhee Development Corp. (2005); Tyhee Development Corp. (2007b).

(continued)

Table 2.2-3
Reasonably Foreseeable Future Developments (completed)

Project	Type	Coordinates	Features	Projected Life-Span	Relationship with Project	Status
High Lake	Base metal mine Dock	Mine Site: 67° 22' 46" N 110º 50' 39" W Dock: 67° 48' 19" N 110º 52' 9" W	Dock facility at Grays Bay to accommodate 50,000 DWT ships and freight barges 53 km all-season road 2,000 m gravel airstrip Open pit and underground mining Process plant and tailings impoundment	Possible first concentrate production in 2016 Estimated 12+ years production Current owner (Zinifex Limited) plans to develop this deposit after Izok Lake	May use same shipping route to Lancaster Sound Will use existing barge routes from Hay River, NWT (via Mackenzie River)	Draft EIS submitted to NIRB in November 2006 Accepted for a Part 5 Review in June 2007 12-18 month review process expected
Yellowknife Gold Project	Gold mine spur road to winter road	63° 18' N 114° 21' W	Underground mining Ore processing Tailings Impoundment	Not stated	No direct link anticipated at this stage May use existing winter road from Yellowknife	In MVEIRB process: Active Environmental Impact Review Ongoing exploration
Expansion of Bathurst Inlet Port	Addition of concentrate storage / loading facilities	66° 32' 45" N 107° 31' 25" W	Concentrate Storage Ship loading/unloading	Dependent on mining operations	Expansion of the Project	Potential development: dependent on needs of future mining operations
Expansion of Contwoyto Camp	Barge dock	65° 28' N 110° 11' W	New barge dock: barges will connect Izok Lake with BIPR when Contwoyto Lake is not frozen	Dependent on mining operations	Expansion of the Project	Potential development: dependent on needs of future mining operations

Sources: De Beers Canada Mining Inc. (2005); Miramar (2005); MVEIRB (2006); Sabina Silver Corporation(2007); Wolfden (2006); Zinifex Limited (2007); Tyhee Development Corp. (2005); Tyhee Development Corp. (2007b).

- Musk property; and
- Silvertip property.

It is not possible to accurately predict any development that may be induced by the Project or by other reasonably foreseeable developments, and as such a detailed assessment of these potential developments cannot be included in the cumulative effects assessment. Where applicable, the possibility that one or more of these properties does proceed to operations is discussed in the applicable section.

2.2.5 Land Use Activities

Land-use activities in the study area were identified by review of the Draft West Kitkmeot Regional Land Use Plan (WKRLUP) (NPC, 2005) and traditional knowledge baseline studies (Appendix F5 and F6 of the Draft Environmental Impact Statement (DEIS)). Major land use activities are:

- subsistence harvesting of fish and marine and terrestrial wildlife;
- commercial harvesting of fish and wildlife and sale of game and pelts;
- ecotourism, including lodges, river canoeing, wildlife and bird viewing, dog-sledding, cruise ship stopovers, and Inuit and northern culture and history;
- sports hunting and fishing, including guided hunting and fishing excursions; and
- mineral and diamond exploration.

In addition to these subsistence and economic activities, there are a number of national and territorial parks and conservation areas within the study area (Figures 2.2-1 and 2.2-2). These areas are managed to protect certain terrestrial and marine habitats and ecosystems, and to provide wilderness recreation opportunities. None of the past, existing or reasonably foreseeable future developments are predicted to directly affect parks or conservation areas. However, the shipping lane passes the Queen Maud Bird Sanctuary and Jenny Lind Island, both of which are identified as areas of critical migratory bird habitat in the draft WKRLUP. The shipping lane also passes the Prince Leopold Island bird sanctuary and Sirmilik National Park, which hosts coastal lowlands and seabird colonies (Parks Canada, 2007).

2.3 Future Scenario

2.3.1 Overview

Because the cumulative effects assessment requires that plausible scenarios are developed for future development, the future scenario makes numerous assumptions about how such development may occur. These assumptions may differ from development proposals put forth by the proponents for those projects in the future.

The future scenario for the cumulative effects assessment assumes that all existing developments identified in Table 2.2-2 would stay operational until the end for their projected life spans, and that all reasonably foreseeable developments in Table 2.2-3 proceed to operations (Figure 2.3-1).

The scenario also assumes that the reclamation of closed sites proceeds as planned, thus resulting in improvements in the condition of these sites compared to existing conditions.

The Hope Bay (Doris North) Project has an anticipated mine life of 24 months (Miramar, 2005), and it was assumed that mining at this property will have ceased before other projects commence operations. However, it is expected that the infrastructure at Doris North will be used to process ore extracted from the Hope Bay (Boston) deposit.

The future scenario would include expansion of the Project itself, including construction of concentrate storage facilities at the port, expansion of Contwoyto Camp, additional ship movements, and extension of operational periods if one or more base metal mines are commissioned.

The following sections detail the projected development activity under the future scenario.

2.3.2 Projected Project Imports and Exports

The volume of material that would move through the Project facilities varies each year according to the needs of the developments that the Project might serve. For example, the needs of existing developments are projected to peak in 2013 (Year 3 of Project operations) at 336,654 tonnes of fuel and cargo, compared to the lowest projected needs of 196,955 tonnes in 2027 (Appendix A-3 of the DEIS). Therefore, there will always be a degree of uncertainty about projecting future volume levels.

The annual average volumes were projected for each existing and reasonably foreseeable project that may use the Project, and these average values summed to generate total projected annual average volumes. Although this method does not provide the theoretical annual maximum tonnage, it does provide a conservative assessment because, based on the current schedules (Figure 2.3-1), the only year when all projects would be in their operational phase is 2014.

Based upon currently available information, under the future scenario an average 553,300 tonnes of materials will be imported every year, and an average 804,300 tonnes of concentrate will be exported (Table 2.3-1).

2.3.3 Projected Shipping Traffic

2.3.3.1 Bathurst Inlet

Assuming that vessels delivering fuel and bulk materials will also be used to backhaul concentrate, the number of ship movements is determined by the amount of concentrate that needs to be exported. The Project port is designed to receive vessels with a capacity up to of 50,000 DWT, meaning that at a minimum 17 ship loads will be required each year to export 804,330 tonnes of concentrate. Depending on vessel availability, it may be necessary to use vessels with smaller capacities for some movements. As a worst-case scenario, if vessels have an average capacity of 30,000 DWT, 27 ship loads would be required. Overall, use of the port is predicted to generate between 17 and 27 return shipping movements along the shipping lane each year.

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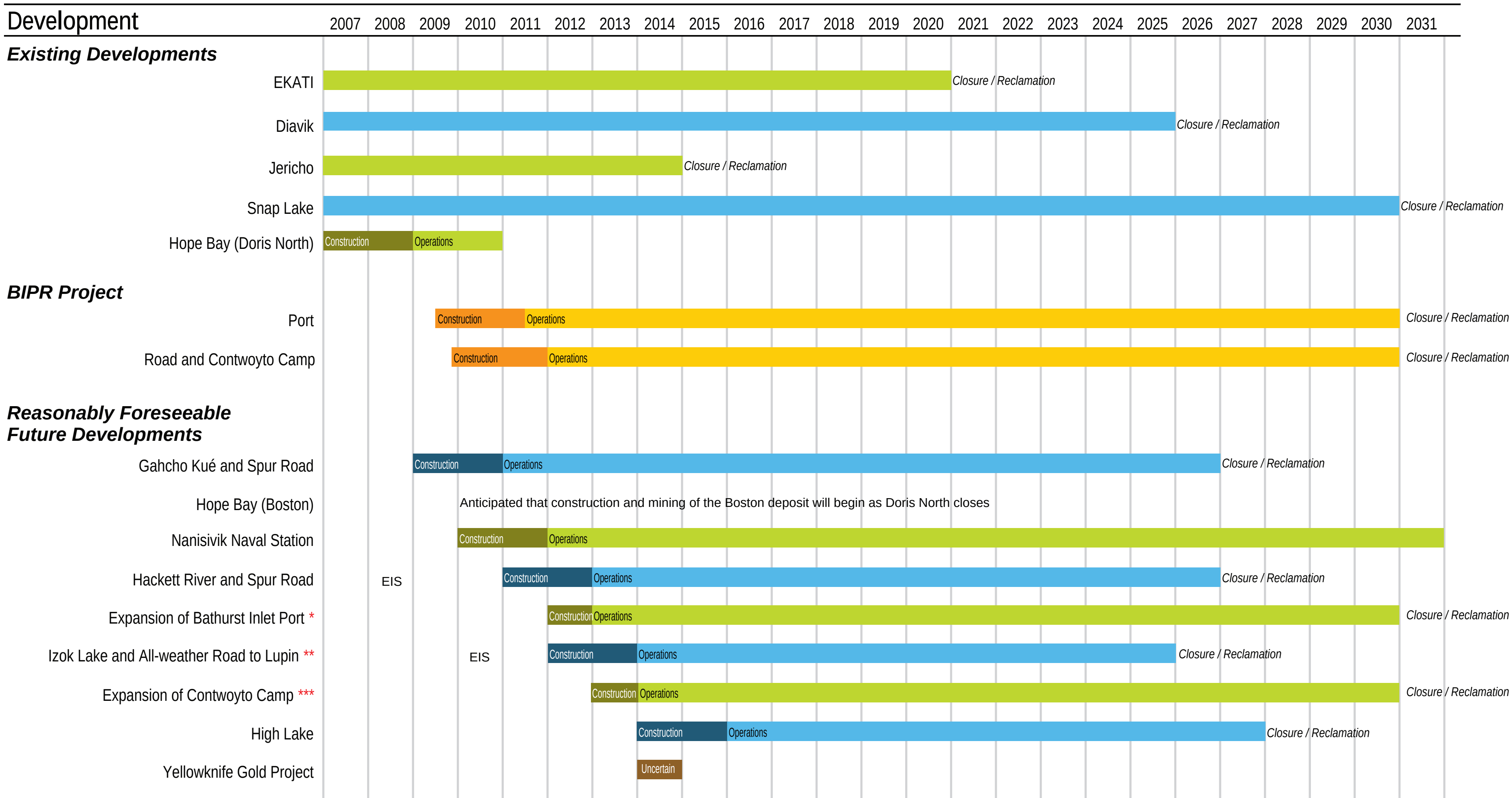

Notes: * Based on Hackett River schedule.
** Assumed schedule based on a planned 2010 EIS submission.
*** Based on Izok Lake schedule.

the Bathurst Inlet Port and Road Project

FIGURE 2.3-1

Projected Operational Periods for Existing and Reasonably Foreseeable Future Developments

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Table 2.3-1
Predicted Annual Average Project Imports and Exports under the Future Scenario (Tonnes/year)

	Imports		Exports
Mine/Community[a]	**Fuel**	**Cargo**	**Concentrate**
Operating Mines and Nunavut Communities (Potential Users)			
EKATI	81,305	27,990	0
Diavik	54,880	32,175	0
Jericho	10,955	4,230	0
Snap Lake	36,995	16,020	0
Gjoa Haven	5,100	100	0
Cambridge Bay	8,500	200	0
Kugluktuk	3,400	100	0
Taloyoak	1,700	100	0
Subtotal	***202,835***	***80,915***	***0***
Reasonably Foreseeable Future Mines (Possible Users)			
Gahcho Kué	44,660	20,430	0
Hope Bay (Boston)	90,100	9,800	0
Hackett River	46,130	23,895	339,750
Izok Lake	22,505	12,015	464,580
Subtotal	***203,395***	***66,140***	***804,330***
Totals	**406,230**	**147,055**	**804,330**
Total Imports/Exports	**553,285**		**804,330**

[a]Resupply quantities for Kingaok (Bathurst Inlet) and Omingmaktok were not included in the Feasibility Study due to the small volume required. It was assumed that the Hope Bay (Doris North) Project has closed under the future scenario, succeeded by the larger Hope Bay (Boston) Project.
Source: SNC Lavalin (obtained from potential and possible users).

2.3.3.2 High Lake Project

During operations approximately 140,000 tonnes per year of concentrate will be exported from the Grays Bay dock (Wolfden, 2006). The concentrate will be collected by between four and six vessels each with a capacity of between 30,000 and 50,000 tonnes, generating between eight and twelve one-way shipping movements. These vessels will also deliver supplies to the Project. Ships will either follow a route from the west through Bering Strait to the Coronation Gulf, or from the east through Davis Strait to the Coronation Gulf (Wolfden, 2006).Total

The High Lake Project eastern shipping route option is the same as the Project shipping route. Therefore, under this cumulative effects assessment future scenario there is potential for between 42 and 66 one-way cargo vessel movements along this route each shipping season. In addition, cruise ships travel the Northwest Passage once or twice per year and often stop at Cambridge Bay and Kugluktuk (NPC, 2005). Additional ship movements may derive from operations at the Nanisivik naval base. Overall, there is potential for in excess of 70 one-way shipping movements along the Project shipping lane (beyond Bathurst Inlet) each arctic shipping season.

2.3.3.3 Shipping Season

The assumed shipping season for the purposes of the cumulative effects assessment is the normal open-water season from July 1 to October 15, as defined in Conformity Requirement 6.2 of the draft WKRLUP (NPC, 2005).

2.3.4 Projected Barge Traffic

Ocean barges will distribute fuel and bulk materials from the Project port to Kitikmeot communities and to the Hope Bay site (Table 2.3-2). The High Lake Project will also generate an estimated two barge sailings per year during construction and operations. Each High Lake barge trip will use the existing route from Hay River, NWT, via Mackenzie River, and will comprise one tug pulling three barges each with 3,000-tonne capacity (Wolfden, 2006).

Table 2.3-2
Predicted Annual Average Ocean Barge Traffic under the Future Scenario

Mine/Community[a]	Fuel (Barge Sailings/Yr)[c]	Cargo (Barge Sailings/Yr)[c]
Operating Mines and Nunavut Communities (Potential Users)		
Gjoa Haven	1	0.1
Cambridge Bay	1.7	0.2
Kugluktuk	0.6	0.1
Taloyoak	0.3	0.1
Hope Bay (Doris North) [b]	Closed	Closed
Subtotal	***3.6***	***0.5***
Reasonably Foreseeable Future Mines (Possible Users)		
Hope Bay (Boston)	17.7	3.3
Totals	**22**	**4**
Total barge traffic	**26 sailings (52 one-way journeys)**	

[a]Resupply quantities for Kingaok (Bathurst Inlet) and Omingmaktok were not included in the Feasibility Study due to the small volume required.
[b]It is projected that the Hope Bay (Doris North) Project has closed under the future scenario, succeeded by development of the Hope Bay (Boston) deposit.
[c]Ocean Barge Sailings Capacity and Assumptions:
Fuel: 1,700 tonnes per barge, tug pulls three barges per sailing
Operating Supplies: 1,000 tonnes per barge, tug pulls three barges per sailing
Source: SNC Lavalin (obtained from potential and possible users).

2.3.5 Projected Truck Traffic

It is estimated that an average 20,475 truckloads per year will be hauled along the Project road (Table 2.3-3). If there were no backhaul of concentrate, this would generate 40,950 one-way truck journeys per year.

Table 2.3-3
Predicted Annual Average Truck Traffic under the Future Scenario

Development	Imports		Exports
	Fuel (Truck Loads/Yr)	Cargo (Truck Loads/Yr)	Concentrate (Truck Loads/Yr)
Operating Mines (Potential Users)			
EKATI	2,323	622	0
Diavik	1,568	715	0
Jericho	313	94	0
Snap Lake	1,057	356	0
Subtotal	***5,262***	***1,787***	***0***
Reasonably Foreseeable Future Mines (Possible Users)			
Gahcho Kué	1,276	454	0
Hackett River	1,318	531	3,775
Izok Lake	643	267	5,162
Subtotal	***3,237***	***1,252***	***8,937***
Totals	**8,499**	**3,039**	**8,937**
Total Truck Loads		**20,475**	

Note: Load Capacity and Assumptions:
Ore and Concentrate Trucks, 90 tonnes
General Cargo Trucks, 45 tonnes
Fuel Trucks, 35 tonnes
Source: SNC Lavalin (obtained from potential and possible users).

2.3.6 Projected Road Operational Periods

The Project has been designed to deliver fuel and supplies to existing and future developments. The timing of delivery of these materials is dictated by logistic constraints imposed by the seasons of the Arctic. Road haul to existing developments on or south of Contwoyto Lake is determined by the availability of the TCWR from Yellowknife to Jericho, open from mid-January to April.

The future scenario includes two base metal projects (Hackett River and Izok Lake) that would produce concentrate for export. Neither has advanced to the stage where project details other than estimates for volumes of imports and exports are available from project owners. The location of Hackett River could give it year round road access to the port; Izok Lake however would require the TCWR for winter access (mid-January to April) and, if summer access were necessary, a barge on Contwoyto Lake for access during the ice free period (mid-July to mid-October).

2.3.7 Projected Traffic Densities

The road traffic pattern and season of use for future projects will in large part depend on site specific storage capacities for fuel and concentrate. It is in all operators' economic interests to keep redundant storage capacities to a minimum. In the absence of project-specific details, any further comment on future road use and seasonal traffic patterns would be conjecture other than to suggest that projects that are not tied to the TCWR are expected to propose hauling schedules to facilitate strategies for optimal storage capacities for fuel and/or concentrate. These projects, like BIPR, will be subject to the NIRB screening and review process.

2.3.8 Land Use Activities

2.3.8.1 Subsistence and Commercial Fish and Wildlife Harvesting

Hunting and trapping for food and for pelts remains an important component of Inuit life, both for subsistence and for economic purposes. In particular caribou, and the act of caribou hunting, are central to Inuit culture, identity, recreation, and kinship. Further information about harvesting is provided in:

- **Appendix D-3 of the DEIS:** Environmental Setting, Wildlife and Wildlife Habitat Effects Assessment;
- **Appendix D-3 of the DEIS:** Environmental Setting, Freshwater Fish and Fish Habitat Effects Assessment;
- **Appendix D-3 of the DEIS:** Environmental Setting, Marine Fish and Fish Habitat Effects Assessment;
- **Appendix D-3 of the DEIS:** Environmental Setting, Marine Mammals Effects Assessment;
- **Appendix D-3 of the DEIS:** Traditional Knowledge of Wildlife, Fish and Water Quality;
- **Appendix D-3 of the DEIS:** Inuit Heritage and Cultural Use of the Bathurst Inlet Port and Road Project; and
- **Appendix D-3 of the DEIS:** Socio-Economic Baseline Studies.

Harvesting levels can vary with human population trends, cultural and lifestyle changes, demand for harvested products, abundance of the species' harvested, economic circumstances of harvesters, and management measures to conserve certain species. As such, it is difficult to accurately predict future harvest levels. For the purpose of this cumulative effects assessment it is assumed that subsistence and commercial fish and wildlife harvesting will continue into the future at the same level of intensity as at present.

2.3.8.2 Eco-tourism and Sports Hunting

Tourism features in West Kitikmeot include lodges, parks, and wilderness activities including canoeing, wilderness camping, guided sports hunting and fishing, wildlife viewing, dog-sledding, and skiing. There is a tourism lodge in Bathurst Inlet that offers a variety of activities from June to August (Bathurst Inlet Lodge, 2007). Other attractions include the Queen Maud Gulf Migratory Bird Sanctuary and the Uvajuaq (Mount Pelly) Territorial Park.

The draft WKRLUP shows that there has been a substantial increase in arctic tourism in the past few years, and the plan identifies tourism as "excellent economic opportunity for the region" (NPC, 2005). There are already several community based businesses that run excursions for activities such as sport hunting, fishing, sightseeing, wildlife viewing and photography, and there is an interest in establishing more outfitting companies in the communities (NPC, 2005). For the purpose of the cumulative effects assessment, it is assumed that tourism will continue to be developed in the region, and that visitor numbers and activities will continue to increase.

2.3.8.3 Mineral and Diamond Exploration

The West Kitikmeot region has large potential for mineral development, and indication of significant diamond deposits have been found in West Kitikmeot and the NWT (NPC, 2005). Extensive exploration activity has been ongoing over the past decade, and assuming that the price of diamonds and metals remains favourable, exploration activity is expected to continue at its current level into the foreseeable future.

2.4 VECs and VSECs

For cumulative effects to occur, the Project must have a residual effect on a VEC/VSEC and that component must also be affected by one or more other actions. The components included in the cumulative effects assessment were based on the results of the environmental effects assessment. All VECS/VSECS subject to residual effects that were assessed to be of **Low**, **Moderate**, or **High** significance at any stage of the Project were included in the cumulative effects assessment. In addition, all VECs that are potentially affected by the operation of the Project (*i.e.*, by shipping movements, materials handling and truck traffic) were also included in the cumulative effects assessment. This is because under the projected future scenario the operating conditions of the Project change, including greater volumes of imports, the addition of concentrate exports, extended road operational periods, and increased volumes of road and shipping traffic.

2.5 Effects Assessment

2.5.1 Overview

The assessment of cumulative effects for each VEC or VSEC followed seven steps:

1. establish the spatial boundary;
2. establish the temporal boundary;
3. establish interactions between the Project and other developments;
4. describe the combined effects of human actions on the VEC/VSEC being assessed;
5. assess the significance of cumulative effects;
6. assess the confidence levels of the assessment; and
7. investigate additional mitigation measures, if required.

2.5.2 Spatial Boundaries

A spatial boundary, or study area, is defined as the area examined in an assessment (CEA Agency, 1999). Study areas were established on a case-by-case basis for each VEC and VSEC or subject area, based on the "zone of influence" beyond which the residual effects of the Project are expected to diminish to a negligible state. The expected zone of influence for each VEC and VSEC was determined using the results of the effects assessment, baseline studies, Traditional and Community Knowledge, consultation, and expert knowledge of the characteristics of the VEC and VSEC being assessed.

Table 2.4-1
VECs and VSECs Included in the Cumulative Environmental Effects Assessment

Component	VEC/VSEC
Atmospheric Components	
Climate and Meteorology	Climate
Air Quality	Ambient Air Quality
Noise	Noise
Freshwater Components	
Surface Water Quantity	Surface Water Quantity
	Fluvial erosion and sediment transport
Surface Water and Sediment Quality	Freshwater Water Quality Freshwater Sediment Quality
Freshwater Aquatic Resources	Freshwater Aquatic Resources
Freshwater Fish and Fish Habitat	Arctic grayling (*Thymallus arcticus*)
	Lake trout (*Salvelinus namaycush*)
	Arctic char (*Salvelinus alpinus alpinus*)
	Whitefish (general)
	Fish habitat
Navigable Waters	Navigable waters
Terrestrial Components	
Ecosystems and Vegetation	Plant Communities and Associations (with emphasis on those with particular ecological functions)
	Plant Species/Groups with Particular Ecological Functions and of Value to the Inuit and Wildlife
Bedrock Geology, Surficial Material and Soils	Soil Quality Permafrost
Wildlife and Wildlife Habitat	Grizzly Bear (*Ursus arctos horribilis*)
	Caribou (*Rangifer tarandus*) Bathurst Herd; Ahiak Herd; Dolphin and Union Herd; Peary Caribou
	Muskox (*Ovibos moshatus*)
	Wolverine (*Gulo gulo*)
	Wolf (*Canis lupus*)
	Migratory Birds (excluding raptors and waterfowl)
	Cliff-Nesting Raptors (tundra peregrine falcon selected as proxy)
	Waterfowl (long-tailed duck selected as proxy)
Marine Components	
Marine Water and Sediment	Marine Water Quality
	Marine Sediment Quality
Marine Aquatic Resources	Marine Aquatic Resources
Marine Fish and Fish Habitat	Arctic Char (*Salvelinus alpinus)*
	Bering Wolffish (*Anarhichas orientalis*)
	Fourhorn Sculpin (*Myoxocephalus quadricornis* - marine form)
	Marine Fish Habitat
Polar Bear and Seabirds	Polar Bear (*Ursus maritimus*)
	King Eider (*Somateria spectabilis*)
	Thick-billed Murre (*Uria lomvia*

(continued)

Table 2.4-1
VECs and VSECs Included in the
Cumulative Environmental Effects Assessment (completed)

Component	VEC/VSEC
Marine Components (cont'd)	
Marine Mammals	Bowhead Whale (*Balaena mysticetus*)
	Beluga (*Delphinapterus leucas*)
	Narwhal (*Monodon monoceros*)
	Walrus (*Odobenus rosmarus*)
	Ringed Seal (*Pusa hispida*)
Socio-Economic and Heritage Resources Components	
Heritage Resources	Heritage sites
Socio-economic	Health and Wellness
	Economic Development
	Aboriginal Culture

2.5.3 Temporal Boundaries

A temporal boundary is the period of time examined in an assessment (CEA Agency, 1999). The temporal boundary of the cumulative effects assessment begins at the onset of construction of the Project, and ends in 2031 when the Project is scheduled to close (Figure 2.3-1). This period of time has been chosen because many of the expected and potential future developments are directly related to the development of the Project.

However, the residual cumulative effects on a VEC or VSEC may extend beyond 2030. For example, the cumulative effects on air quality of truck traffic using the road will end shortly after Project closure, but the combined effects of a number of projects disturbing terrestrial ecosystems may extend further into the future. Where an effect is predicted to extend beyond closure of the Project, the expected duration of the effect is described in the assessment.

2.5.4 Interactions between the Project and Other Developments

To produce a cumulative effect, the residual effects of the Project must act in combination with the residual effects of one or more other developments or human actions. A key step in the assessment process was therefore to establish these linkages. Cumulative effects can occur in the following ways (CEA Agency, 1999), all of which were considered when evaluating the potential for links between the residual effects of the Project and other developments:

- **physical-chemical transport:** a physical or chemical constituent is transported from the action under review where it then interacts with another action (*e.g.*, air emissions, waste, water effluent, sediment).
- **nibbling loss:** the gradual disturbance and loss of land and habitat.
- **spatial and temporal crowding:** cumulative effects can occur when too much is happening within too small an area and in too brief a period of time. A threshold may be exceeded and the environment may not be able to recover to pre-disturbance conditions.

Spatial crowding results in an overlap of effects among actions. Temporal crowding may occur if effects from different actions overlap or occur before the VEC has time to recover.

- **Growth-inducing potential:** each new action can induce further actions to occur. The effects of these 'spin-off' actions (*e.g.*, increased vehicle access into a previously inaccessible area) may add to the cumulative effects already occurring near the proposed action.

Where applicable, a matrix was used to identify and summarize potential interactions between the residual effects of the Project and the residual effects of other developments under the future scenario.

2.5.5 Description of Predicted Effects

The likely condition of each VEC or VSEC under the future scenario was evaluated, taking into account the combined effects of the identified human actions. Wherever possible, quantitative data and regional baseline information were used to evaluate the future condition of the VEC or VSEC. When this information was not available qualitative descriptions and professional judgement were used. Community and Traditional Knowledge were used alongside scientific knowledge to help identify and described potential cumulative effects.

The potential effects were described with reference to their direction, duration, magnitude, geographic extent, and frequency. Areas where insufficient data were available to provide an assessment were highlighted, with the potential cumulative effects being described as uncertain in these instances.

The analysis of effects took into account all mitigation measures proposed for the Project, and any known mitigation measures for other existing or reasonably foreseeable future developments.

2.5.6 Assessment of Significance

The significance of each cumulative effect was evaluated based on the expected change in condition of the VEC or VSEC being assessed, taking into consideration how the combined effects of multiple developments could affect the sustainability of that component (Table 2.5-1, Figure 2.5-1). Where applicable, the expected future condition of a VEC/VSEC was compared against threshold criteria. When determining the significance of the effect, the following criteria were taken into consideration (CEA Agency, 1999):

- magnitude;
- geographic extent;
- duration;
- frequency;
- reversibility;
- biophysical or social/cultural context (resilience); and
- probability of occurrence.

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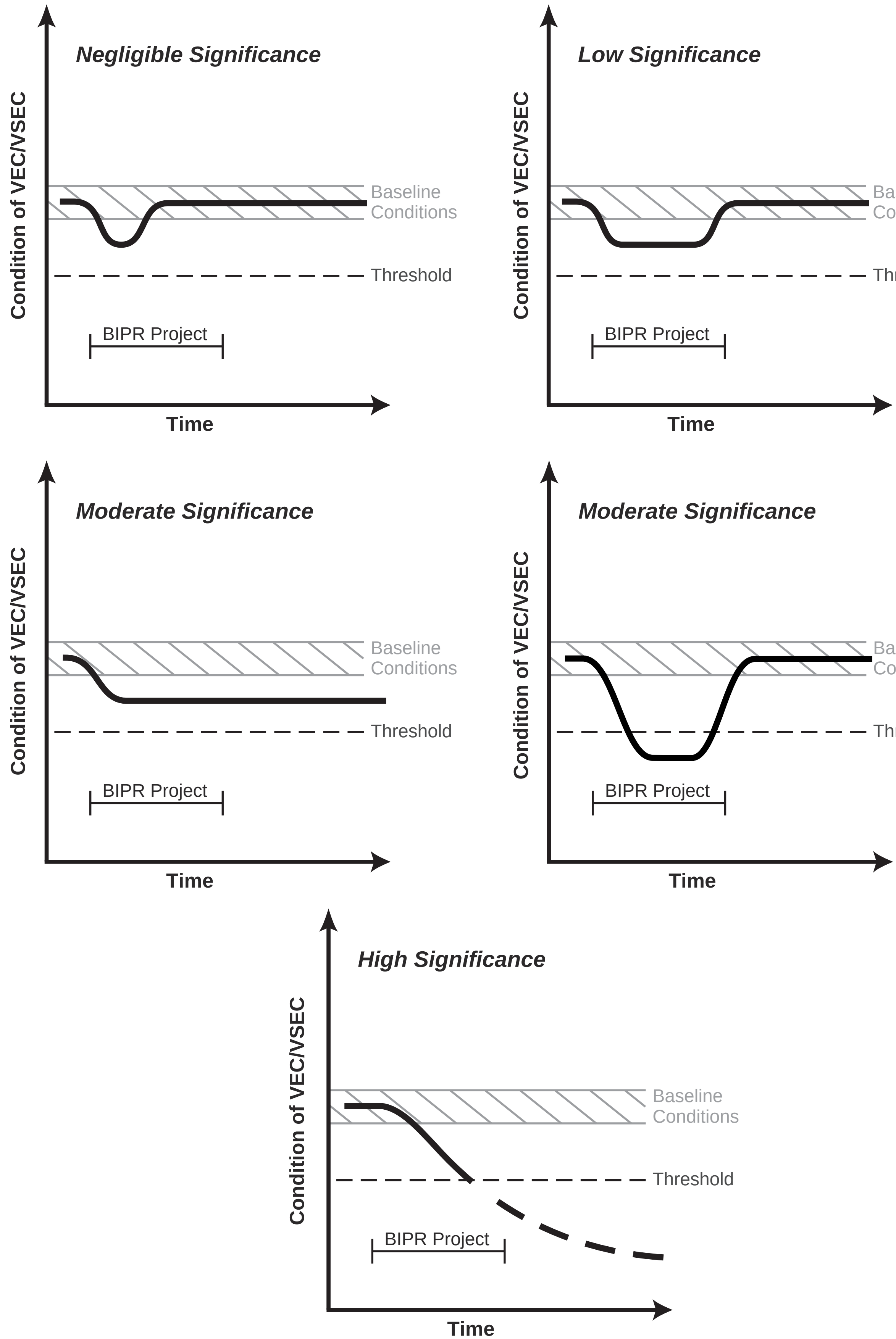

the Bathurst Inlet Port and Road Project

Cumulative Effects Assessment Significance Criteria

FIGURE 2.5-1

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Table 2.5-1
Significance Definitions for Adverse Cumulative Effects

Level of Significance	Definition	
	Adverse Effects	**Beneficial Effects**
Negligible	Cumulative effects may result in a slight decline in condition of the VEC/VSEC in the study area for a short temporal period, but the VEC/VSEC should return to baseline conditions within the operational lifetime of the Project No threshold is reached.	Cumulative effects may result in a slight improvement in the condition of the VEC/VSEC in the study area for a short temporal period, but the VEC/VSEC is likely to return to baseline conditions within the operational lifetime of the Project.
Low	Cumulative effects may result in a slight decline in condition of the VEC/VSEC in the study area during the life of the Project, but the VEC/VSEC should return to baseline conditions after closure of the Project. Research, monitoring and/or recovery initiatives would not normally be required. No threshold is reached.	Cumulative effects may result in slight improvement in condition of the VEC/VSEC in the study area during the life of the Project, but the VEC/VSEC is likely to return to baseline conditions after closure of the Project. Research and monitoring initiatives would not normally be required.
Moderate	Cumulative effects could result in a decline in condition of the VEC/VSEC to lower-than-baseline, but stable, levels in the study area after Project closure and into the foreseeable future. No threshold is reached, but the condition of the VEC/VSEC is closer to a threshold than previously. **OR** Cumulative effects could result in a decline in condition of the VEC/VSEC such that a threshold is exceeded for a discreet period of time, *e.g.*, air quality guidelines, but the VEC/VSEC should return to baseline conditions. Regional management actions such as research, monitoring and/or recovery initiatives may be required.	Cumulative effects could result in an improvement in condition of the VEC/VSEC to greater-than-baseline levels in the study area during the life of the Project. Research and monitoring initiatives may be required.
High	Cumulative effects could threaten the sustainability of the VEC/VSEC and should be considered a management concern. A threshold is exceeded. Research, monitoring and/or recovery initiatives should be considered.	Cumulative effects could result in an improvement in condition of the VEC/VSEC to greater-than-baseline levels in the study area after Project closure and into the foreseeable future.

2.5.7 Confidence Levels

There will often be some uncertainty associated with the information and methods presented in an assessment (CEA Agency, 1994). This is especially so when considering cumulative effects because the assessment process requires that predictions be made about whether future developments will take place, and about the effects of those developments.

For each potential cumulative effect, the limitations and uncertainties associated with the data and their analyses were documented, including the reliability or variability of results or conclusions. Where possible, a quantitative description of the uncertainty and error was made. Where data or models were not available, the evaluation of confidence levels was carried out using best professional judgement and expertise. The descriptors for confidence levels are defined in Table 2.5-2.

Table 2.5-2
Confidence Levels Definitions

Descriptor	Definition
High	There is a good understanding of the cause-effect relationship and all necessary data are available for the study area; thus, there is a low degree of uncertainty that the conclusions of the assessment are accurate
Intermediate	The cause-effect relationships are not fully understood **or** data for the study area are incomplete; thus, there is an intermediate degree of uncertainty that the conclusions of the assessment are accurate
Low	The cause-effect relationships are poorly understood **and** data for the study area are incomplete; thus, there is a high degree of uncertainty that the conclusions of the assessment are accurate

2.5.8 Mitigation, Monitoring and Adaptive Management

If moderately or highly significant cumulative effects were predicted, investigations were made into additional mitigation and management measures that could be taken to reduce or eliminate the Project's contribution to these those effects.

The need for management and monitoring on a scale beyond the scope of the Project was suggested where appropriate.

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3. CLIMATE, AIR QUALITY AND NOISE

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3. Climate, Air Quality and Noise

3.1 Valued Ecosystem Components

The E for climate, air quality and noise (Appendices B-1, B-2 and B-3) assessed the potential effects of the Project on the following VECs:

- climate, measured as annual emissions of greenhouse gasses (GHGs);
- ambient air quality, measured as atmospheric concentrations of nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), total suspended particulates (TSP), fine particulates ($PM_{2.5}$) and dustfall, and
- noise, measured as equivalent continuous sound level (L_{eq}) for daily and hourly time intervals.

Residual effects were predicted for all three VECs, thus climate, air quality and noise were selected for the cumulative effects assessment. In addition, the future scenario for the cumulative effects assessment predicts that there will be a substantial increase in traffic volumes along the road, and as such it is prudent to re-examine the potential effects on atmospheric components.

The parameters used to measure the effects of the Project on climate, air quality, and noise were assessed separately in the Project EA, but will be assessed together in the cumulative effects assessment to reduce redundancy.

3.2 Climate

3.2.1 Residual Effects of the Project

The residual effects of the Project on climate include the direct emissions of GHGs, predominantly CO_2, that are associated with Project activities. The significance of the effect of CO_2 equivalent emissions was rated moderate.

3.2.2 Spatial Boundary

CO_2 emitted by Project activities will be dispersed globally. Therefore, effects of CO_2 emissions do not have spatial boundaries.

3.2.3 Temporal Boundary

The temporal boundary of the potential effects related to CO_2 emissions on climate is set to 200 years, which is the approximate mean lifetime of CO_2 in the atmosphere. Any climate effects attributed to these emissions are assumed to last for this period.

3.2.4 Interactions with Other Developments and Activities

The Project will interact with existing mines (*e.g.*, EKATI and Diavik diamond mines) and potential future developments (*e.g.*, Hackett River and Izok Lake), which would use the Bathurst Inlet port facility and road to transport products, goods, supplies, and fuel.

3.2.5 Combined Effects of Human Actions

The development of the Project has the potential to reduce GHG emissions in some areas and lead to an increase in GHG emissions in others. The delivery of fuel to existing mines (*e.g.*, EKATI and Diavik) via the Project facilities may reduce emissions by replacing part of the current over-land trucking route with ocean transport, which is less emissions intensive. A complete life-cycle analysis of diesel fuel produced for, shipped to and used by the existing mines would be required to quantify the potential reduction in emissions.

Conversely, the development of the Project may facilitate the construction of new mining projects such as Hackett River or Izok Lake. While development of new mines would stimulate the regional economy, such operations would inevitably be associated with considerable GHG emissions.

3.2.6 Significance of Cumulative Effects

Although emissions from the BIPR Project, and from projects facilitated by development of BIPR, contribute to global GHG emissions a limited number of industrial operations within an economy do not contribute sufficient GHGs to be solely responsible for the potential effects of climate change. Therefore, the significance of the cumulative effects on climate was characterized as ***Moderate***.

3.2.7 Confidence Levels of Assessment

The confidence of this assessment is intermediate**,** because even though climate change appears to be ongoing, the relative roles of contributing factors and predictions of its magnitude are associated with considerable uncertainties.

3.2.8 Mitigation, Management and Monitoring

Existing and proposed operations that would make use of the Project facilities will each devise a strategy for minimizing energy use and thereby GHG emissions. Besides environmental considerations, there are considerable financial incentives for incorporating energy efficiency into Project planning and design.

3.3 Air Quality

3.3.1 Residual Effects of the Project

Activities associated with the BIPR Project will result in emissions of NO_2, SO_2, CO, TSP, $PM_{2.5}$ and fugitive dust. The predicted change in TSP concentration was assessed as being of moderate significance; the residual effects for all other measures of air quality were assessed as low.

3.3.2 Spatial Boundary

The spatial boundary for the cumulative effects assessment is the modelling domains defined for the air quality modelling study completed for the Project (Appendix B-4 of the DEIS). The modelling domain used for the port facility covered a 30 by 30 km square centered over the port; the domain for the road was defined as a 20 km wide strip centered on the road and covering its entire length. The sizes of the modelling domain were established such that the majority of air contaminant species would approach background concentrations within the modelling domains. For species with predicted maximum concentrations that were well above background concentrations, areas of potential exceedances of standards and objectives were ascertained to be well within the modelling domains.

3.3.3 Temporal Boundary

Because the majority of air quality effects would be eliminated immediately following closure and reclamation of the Project, the extent of the temporal boundary covers the construction and operation phases of the Project.

3.3.4 Interactions with Other Developments and Activities

The Project will interact with existing mines (*e.g.,* EKATI and Diavik diamond mines) and potential future developments (*e.g.,* Hackett River and Izok Lake), which would use the Bathurst Inlet port facility and road to transport products, goods, supplies and fuel.

3.3.5 Combined Effects of Human Actions

Emissions of air contaminants at the Bathurst Inlet port facility and along the road will be proportional to the air, land and marine traffic volumes. Therefore, the magnitude of potential air quality effects will increase in proportion to increases in traffic volumes. The prospective users of the BIPR road (EKATI, Diavik, Jericho and Snap Lake mines) will require approximately 7,000 truck loads between mid-January and late April; these are the traffic volumes that were assessed in the EA (Appendix B-2 of the DEIS).

Based on estimated hauling requirements for the reasonably foreseeable future mining projects in the region (Izok Lake, Hackett River and Gahcho Kué) approximately 21,000 truck loads could be required each year (see Table 2.3-3). Thus, under the projected future scenario used for the cumulative effects assessment, total annual emissions along the road and at the Bathurst Inlet port facility could increase by a factor of three when compared to the predictions made for the Project EA. Peak hourly and daily emissions are also likely to increase.

3.3.6 Significance of Cumulative Effects

Gaseous and small particulate air contaminants are dispersed and transported over several hundreds to thousands of kilometres and thus contribute to regional or even global background concentrations. However, direct air quality effects from mobile sources or small to moderate sized industrial facilities are typically only significant in areas close to the emission sources. Therefore, cumulative effects are only expected in areas close to the emissions sources at the port facility, near the road and near new mining facilities.

The significance of cumulative air quality effects associated with ambient concentrations of SO_2 and CO as well as dustfall was rated **Low**, while the significance of effects associated with ambient NO_2, TSP and $PM_{2.5}$ concentrations was rated **Moderate**. These ratings reflect the results of the Project air quality modelling study (Appendix B-4), and assuming that total annual emissions will increase by a factor of three as a result reasonably foreseeable future developments. The results indicated that sporadic exceedances of ambient air quality guidelines and objectives for maximum 1-hour or 24-hour NO_2, TSP and $PM_{2.5}$ concentrations could occur in areas close to emission sources when considering the potential increases in traffic volumes. Ambient concentrations of SO_2 and CO are expected to remain well below guideline values or objectives. It should be noted that potential cumulative effects associated with future industrial developments in the region would be greater in the absence of the Bathurst Port and Road Project because of the far greater reliance on emission intensive over-land hauling of equipment, fuel and bulk cargo.

3.3.7 Confidence Levels of Assessment

The confidence associated with the assessment of air quality in terms of ambient concentrations of NO_2, SO_2 and CO is characterized as intermediate. Emission rates of NO_2, SO_2 and CO for sources included in the air quality modelling study for the Project are relatively well characterized. However, the atmospheric dispersion characteristics of the Project site are not well established. Therefore, there is some uncertainty associated with modelling predictions of maximum ambient air contaminant concentrations which the air quality effects assessment was based on.

The confidence associated with the assessment of ambient concentrations of TSP and $PM_{2.5}$ as well as dustfall is low. Emission factors for fugitive dust are highly uncertain and should be thought of as order-of-magnitude estimates.

3.3.8 Mitigation, Management and Monitoring

The air quality mitigation, management and monitoring measures proposed for the Project would apply to cumulative effects associated with increased traffic volumes. New mining projects that are facilitated by the development of the Project would define and implement project-specific measures to mitigate, manage and monitor air quality effects.

3.4 Noise

3.4.1 Residual Effects of the Project

Project activities will generate noise and increase the average daily, hourly and maximum noise levels, as characterized by the equivalent continuous sound level (L_{eq}), near the port facility and along the road. The significance of the residual effects was assessed as low.

3.4.2 Spatial Boundary

The EA for the Snap Lake Project showed that traffic noise at a distance of 10 km from a road will not be audible over the background noise level (De Beers, 2002). Therefore, the assessment area for noise comprises a band of 10 km on either side of the road and a zone with a radius of 10 km around the port site.

3.4.3 Temporal Boundary

Since no noise will be generated after the decommissioning of the Project, the noise effects assessment will be conducted for the construction and operation phase of the road and port.

3.4.4 Interactions with Other Developments and Activities

The anticipated interactions with other developments and activities in the area will be from existing mines (*e.g.*, EKATI and Diavik diamond mines) and future developments (*e.g.*, Hackett River and Izok Lake), which would use the Project facilities to transport products, goods, supplies, and fuel.

3.4.5 Combined Effects of Human Actions

Increased traffic volumes on the road and near the port facility may result in increased 24-hour average and maximum noise levels. Potential future projects may also want to use the road for up to twelve months per year, extending the period of time over which traffic noise will be generated. In addition, new mining projects facilitated by the development of the BIPR Project will produce noise, increasing the total area affected by noise in the region.

The 24-hour L_{eq} is a function of the total number and type of vehicles that pass a particular location over a 24 hour period, in addition to background noise levels. Under the future scenario, the addition of new developments is predicted to result in a three-fold increase in total truck traffic. Background noise levels in the study area are assumed to be 35 dBA (Appendix B-3 of the DEIS), and the Project EA predicted that traffic would raise the daily L_{eq} to 35.8 dBA at a distance of 750 m from the road. Given these results, the daily L_{eq} is expected to remain within the established guideline of 40 dBA even with the projected increase in vehicle traffic.

The maximum noise level (maximum L_{eq}) generated by road traffic is a function of the number and type of vehicles that pass a particular location at the same time. The BIPR road is single-lane and will be operated according to strict safety requirements, limiting the number of trucks that can travel on any given section of the road at the same time. As such, the maximum L_{eq} values at different distances from the road are not expected to differ substantially from those predicted for the Project EA (Appendix B-3 of the DEIS). However, the frequency with which maximum noise levels will occur will increase with greater traffic volumes. Wildlife species are generally more sensitive to intermittent loud noises than to a constant background noise, especially in combination with visual disturbance. Increased incidence of maximum noise levels may result in greater disturbance of wildlife; the cumulative effects on wildlife are discussed in detail in Section 11.

3.4.6 Significance of Cumulative Effects

The predicted changes in hourly and daily noise levels near the port and road are not expected to be significantly different if traffic volumes were to increase due to development of new mining projects in the region. Maximum noise levels are not expected to increase and average daily noise levels are expected to remain with the guideline value of 40 dBA. Although the total area and the period of time each year affected by noise are expected to increase, the total area affected would be small on the regional scale. Therefore, the significance of the cumulative effects on noise was characterized as ***Low.***

3.4.7 Confidence Levels of Assessment

The confidence level of the assessment is intermediate because the noise assessment is based on results from a similar project, not actual modelling of Project conditions. In addition, it is not possible to predict road traffic pattern and season of use for future projects at their current stage of development; therefore, it was not possible to predict future traffic densities.

3.4.8 Mitigation, Management and Monitoring

The noise mitigation, management, and monitoring measures proposed for the Project would apply to cumulative effects associated with increased traffic volumes. New mining projects that are made possible by the development of the Project would define and implement project-specific measures to mitigate, manage, and monitor noise effects.

3.5 Summary of Assessment

A summary of the cumulative effects assessment for climate, air quality, and noise is provided in Table 3.5-1. The significance of cumulative effects on climate, SO_2, CO, dustfall, and TSP are unchanged from the conclusions of Project environmental effects assessment. The significance of residual effects on ambient NO_2 and $PM_{2.5}$ concentrations increases from low to moderate when the cumulative effects of human actions are taken into consideration.

Table 3.5-1
Summary of Cumulative Effects Assessment for Climate, Air Quality and Noise

Description of Effect	Significance	Confidence Level
Climate (CO_2 equivalent emissions)	Moderate	Intermediate
Ambient Air Quality (SO_2, CO and Dustfall)	Low	Intermediate/low
Ambient Air Quality (NO_2, TSP and $PM_{2.5}$)	Moderate	Intermediate/low
Noise Levels (hourly and daily)	Low	Intermediate

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4. SURFACE WATER QUANTITY

4. Surface Water Quantity

4.1 Valued Ecosystem Components and Residual Effects of the Project

The EA considered the effects of the Project on surface water quantity and fluvial erosion (Appendix C-1 of the DEIS). The residual effects were limited to increased fluvial erosion during road construction and decommissioning activities, and the attenuation of peak flows on the upstream side of the road at all stream crossings. With the deployment of best management practices and a monitoring program the significance of these effects was considered negligible.

4.2 Potential for Cumulative Effects

Residual effects of the Project on fluvial erosion are limited to the construction and decommissioning of the road. As such, the changes in road operational periods and traffic volumes that are projected under the cumulative effects assessment future scenario do not alter the conclusions of the original assessment.

During the operation and maintenance period of the road there is the potential for surface water flows to be attenuated on the upstream side of the road at all stream crossings, resulting in potential reductions in peak flow. This effect is limited to the existence of the road and is not affected by the amount of traffic or the operational period of the road each year.

The construction and decommissioning of spur roads that connect the road with other reasonably foreseeable projects, such as Hackett River, may also affect surface water quantity and fluvial erosion. The potential effects of building such connecting roads would be assessed as part of the EA for each new development, and it is not possible to make predictions without detailed route alignments and engineering designs.

4.3 Conclusions

No cumulative effects are expected for surface water quantity or fluvial erosion as a result of extended operational periods and increased traffic volumes along the Bathurst Inlet Road.

Installation of roads that connect future projects with the BIPR road may affect surface water in localized areas.

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5. SURFACE WATER AND SEDIMENT QUALITY

5. Surface Water and Sediment Quality

5.1 Valued Ecosystem Components

The EA for surface water and sediment quality (Appendix C-2 of the DEIS) assessed the potential effects of the Project on the following VECs:

- Surface water quality; and
- Sediment quality.

Negligible and low residual effects were predicted for both VECs, therefore water and sediment quality were considered in the cumulative effects assessment. These two VECs are assessed together in the following sections to minimize redundancy.

5.2 Residual Effects of the Project

The potential for residual effects of BIPR to water and sediment quality included siltation and runoff effects, airborne contaminates, accidental discharge or spills, and metal leaching (ML)/acid rock drainage (ARD) issues. In the case of water and sediment quality most effects occur during the construction phase while some occur during operations.

5.3 Spatial Boundary

The study area boundary considered in the cumulative effects assessment for surface water and sediment quality is the regional study area (RSA) defined for the effects assessment (Appendix C-2 of the DEIS). This includes Contwoyto Lake and all watersheds crossed by the road. This boundary was selected as it serves as an extensive "zone of influence" beyond which residual effects of the Project will diminish to a negligible state. The primary effects will remain localized (*e.g.*, near Project activities).

5.4 Temporal Boundary

The temporal boundary includes the Project's proposed lifetime of 22.5 years, comprised of the construction (2.5 years) and operation phases (19 years) and extending into the closure (1 year) phase. The maximum temporal effects of the Project surface water and sediment quality are anticipated to be medium-term.

5.5 Interactions with Other Developments and Activities

The anticipated interactions with other developments and activities in the area will be from existing developments (*e.g.*, EKATI and Diavik diamond mines) and potential future developments (*e.g.*, Hackett River and Izok Lake) which are expected to use BIPR facilities to transport products, goods, supplies, and fuel. Therefore, with the development of future projects the road would experience increased truck traffic to transport the greater volumes of imported materials/fuel and additional concentrate exports (Section 2.3). In addition it is projected that the road operational period could include operations outside the TCWR haul season, thereby changing the operational conditions of the road.

All significant effects (all phases) predicted from the Project were carried forward to this cumulative effects assessment. Potential effects (including those rated negligible) related to the operations phase of the Project are also considered since interactions may raise the rating of negligible effects up to significant levels. The main issues relating to the interactions between BIPR and other developments are increased traffic which could result in increased effects from dust, potential erosion, and increased probability of accidental spills.

The future development of the Hackett River project has an anticipated construction schedule which overlaps with BIPR construction. The Hackett River development is expected to be accessed via a spur off the BIPR road. Also, expansion of the Project would be necessary to include concentrate storage at the port site, thus potentially extending the construction period at the port with associated effects.

Cumulative effects are not assessed for ML/ARD effects because no additional risk of ML/ARD is created by increased use of the BIPR road. The effects assessment (Appendix C-2 of the DEIS) indicates the water quality monitoring will be in place for areas where concern over ML/ARD exists.

5.6 Combined Effects of Human Actions

5.6.1 Increased Siltation to Streams

Deposition of dust particles generated by road traffic may increase siltation of streams. Traffic may also contribute to erosion of the road surface, generating particles that may enter streams via surface runoff. Existing projects and potential future developments looking to make use of BIPR facilities will increase traffic volumes on the road and at the port. The potential use of the road during the summer months would compound this effect by increasing the potential for erosion of the road and sediments in run-off during precipitation events. Based on projected numbers, the road traffic would increase from 14,098 to 40,950 one-way truck journeys (Section 2.3.5) which suggests that the amount of sediment entering aquatic environment could be almost three times as high. The appropriate road design and maintenance will minimize siltation, however the effects to water quality and sediment quality are expected to increase from negligible to **Low**.

5.6.2 Increased Airborne Contaminants

The additional road traffic will increase the duration, frequency, and amount of dust deposited into nearby streams and lakes in the vicinity of infrastructure, which may increase the severity of the anticipated effects during operations. This may also lead to increased diesel exhaust emissions in the surrounding area. This could result in increased polycyclic aromatic hydrocarbons (PAHs) loading to aquatic environments, but no significant effects to water quality are expected from this activity.

5.6.3 Increased Potential for Spills

Spill risk increases with the number of loaded trucks travelling on the road. A total of up to 8,499 loaded fuel truck loads and 3,039 loaded cargo trucks are projected to use the BIPR road each year. Although not all cargo may pose a risk if spilled, following the precautionary principle it is assumed that all cargos will pose some risk to the freshwater environment if released in an uncontrolled manner. A further 8,937 concentrate truck loads are projected to use the road each year when the Hackett River and Izok Lake projects are operational.

Using data from the Diavik diamond project (Diavik, 1998), a spill rate of 1/ (90,000,000) per truck per kilometre was calculated for travel on northern roads. For loaded fuel, cargo and concentrate loads (total of 20,475), using the road length of 211 km, and a 19-year operational period, a spill rate of:

1/ (90,000,000) x 20,475 loads/year x 211 km x 19 years = 91%

was calculated. This indicates the probable incidence of a fuel, cargo or concentrate spill from truck transport is moderately high: a 91% chance that one truck will spill fuel, cargo or ore concentrate over the 19 years of operations, or a 5% chance of a truck spill happening in any given year. This calculation does not consider the time of year (*i.e.*, summer versus winter) or the location of the spill (*i.e.*, terrestrial versus aquatic habitat), both of which will have a significant impact on the potential effects of a spill. The above calculation is also based on the assumption that drivers are well-trained and adhere to a strict policy of no alcohol or drug consumption while at work.

The spill risk assessment is conservative in that it assumes that there will be 20,475 loaded truck journeys every year of Project operations. It is likely that not all existing and reasonably foreseeable projects will be operating and using BIPR facilities for all 19 years, although it is also possible that other developments that are not included in the future scenario may become operational. To balance this, the assessment does not include empty trucks on the assumption that they pose negligible spill risk. An accident involving an empty truck could, however, still result in some release of cargo residues or fuel from the vehicle fuel tanks.

The effects on the freshwater environment of a spill will vary according to the type and amount of material spilled, the location of the spill (*i.e.*, terrestrial versus aquatic habitat), the timing of the spill (*e.g.*, winter versus summer conditions), and the emergency response to the spill. These are unknown variables that make it difficult to predict the final magnitude. The calculation above indicates the annual probability of a spill is 5%, and it is expected that the annual probability of a spill occurring in the freshwater environment will be even lower (<5%) given the relative proportions of terrestrial versus aquatic habitat along the BIPR road. However, despite the low probability of a spill occurring in the freshwater environment, the significance of this effect has been classified as **Moderate** due to the potential consequences if such a spill occurs. This significance rating is based on the precautionary principle and the undisturbed nature of the existing environment.

Two future mines included in the cumulative effects assessment, specifically Hackett River and Izok Lake, are expected to store ore concentrates at the port site and export them on outbound vessels. Accidental spills of ore concentrate may have toxic effects on water quality. As well, metals could be stored in organic sediment and act as a contaminant source to benthic organisms including invertebrates and fish. However, this type of spill would likely only affect the local area and mitigation efforts would yield a short term effect.

5.7 Significance of Cumulative Effects

After mitigation, the cumulative effect of siltation on water and sediment quality is expected to be **Low**. Particulate loadings remain **Negligible**. Continued vegetation and air quality monitoring will be useful in assessing this risk. Due to the potential consequences of a fuel, cargo or concentrate spill on the aquatic environment, the significance of this potential effect is classified as **Moderate.** However, the likelihood of a major spill occurring and directly affecting the freshwater environment is very low.

5.8 Confidence Levels of Assessment

The assessment of cumulative effects to surface water and sediment quality has been given a high level of confidence for the effect of siltation. This is based on reasonably well understood mitigation strategies that have been in use for decades to minimize impacts on freshwater systems. The level of confidence for the effect of airborne contaminants is low primarily because of the number of assumptions that are required in modelling this effect (Appendix B-2 of the DEIS). The effect of spills was given an intermediate level of confidence because there are various unknowns involved, such as the type and amount of material spilled, the location of the spill, the timing of the spill, and the emergency response to the spill.

5.9 Mitigation, Management and Monitoring

As stated above, the proposed use of air and vegetation monitoring programs on the BIPR Project will aid in managing risk to water quality. Dust suppression during dry times will help to reduce particulate loadings to waterways. Summer road maintenance will become more important due to this increased traffic causing more wear of road substrates which could lead to sedimentation or degradation of stream crossings. Training of haul truck drivers will be important in mitigating effects from increased use of the Project.

5.10 Summary of Assessment

A summary of the cumulative effects assessment for surface water quality and sediment quality is provided in Table 5.4-1.

Table 5.4-1
Summary of Cumulative Effects Assessment for Surface Water and Sediment Quality

Description of Effect	Significance	Confidence Level
Siltation of sediments from truck hauling and summer run-off degrading water and sediment quality	Low	High
Airborne contaminants degrading water quality	Negligible	Low
Fuel, cargo or concentrate spill degrading water and sediment quality	Moderate	Intermediate

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6. FRESHWATER AQUATIC RESOURCES

6. Freshwater Aquatic Resources

6.1 Valued Ecosystem Component

The Freshwater Aquatic Resources Environmental Effects Assessment (Appendix C-3 of the DEIS) assessed the effects on the VEC of freshwater aquatic resources. The effects assessment predicted that there would be some low significance residual effects on this VEC, therefore it was included in the cumulative effects assessment.

6.2 Residual Effects of the Project

The majority of potential effects from the Project were assessed to have negligible significance following mitigation and management. The sources of potential significant effects of the Project to freshwater aquatic resources included sediment entering waterways and fuel or chemical spills along the road. These sources could lead to lethal and/or sublethal effects to both primary and secondary producer communities which make up the biological component of the freshwater aquatic resources in streams and lakes. The significance of sedimentation during construction and during freshet was assessed as low, and the significance of potential fuel spills was also rated as low.

6.3 Spatial Boundary

The study area boundary considered in the cumulative effects assessment for freshwater aquatic resources is the RSA defined for the effects assessment. The road will cross streams in the Burnside and Western river basins as well as smaller basins draining directly into Bathurst Inlet, and will terminate on the east side of Contwoyto Lake. Therefore, the lake and all watersheds crossed by the road and streams downstream of the road make up the spatial boundary for the RSA, and a 200 m buffer zone on either side of the road demarcates the local study area (LSA) for this effects assessment.

The primary effects will remain localized to immediately downstream or localized areas of streams or lakes (*i.e.*, in the vicinity of Project-related activities).

6.4 Temporal Boundary

The temporal boundary includes the roads proposed lifetime of 22.5 years, comprised of the construction (2.5 years) and operation phases (19 years) and extending into the closure (1 year) phase. The effects of the Project are anticipated to be medium term for freshwater aquatic resources.

6.5 Interactions with Other Developments and Activities

The anticipated interactions with other developments and activities in the area will be from existing developments (*e.g.*, EKATI and Diavik diamond mines) and potential future developments (*e.g.*, Hackett River and Izok Lake). These projects are expected to use BIPR facilities to transport products, goods, supplies, and fuel. Therefore, with the development of future projects the road would experience increased truck traffic to transport the greater volumes of imported materials/fuel and additional concentrate exports (see section 2.3). In addition, it is projected that the road operational period could be extended to more than three-and-a-half months per year, thereby changing the operational conditions of the road.

All significant effects (all phases) predicted from the Project were carried forward to this cumulative effects assessment, as well as any potential effects (including those rated negligible) related to the operations phase of the Project. This is because of potential interactions with other developments which could raise the rating of negligible effects (*e.g.*, dust from haul truck traffic affecting periphyton survival in streams) to significant levels due to the increased number of trucks contributing to dust production.

The main issues relating to interaction between the Project and other developments are increased traffic which could result in increased effects from dust release, erosion of roadway and sediment movement from road to adjacent waterways, and potential truck accidents causing spills. Effects assessed for cumulative effects included potential spills and sedimentation.

6.6 Combined Effects of Human Actions

6.6.1 Increased Sedimentation to Streams and Lakes

Existing projects and potential future developments that are expected to use BIPR facilities will increase traffic volumes on the road and at the port. These factors will increase the duration, frequency, and amount of dust deposited into nearby streams and lakes near infrastructure, which may increase the severity of the anticipated effects. Road traffic is projected to increase from 14,098 to 40,950 one-way journeys per year which suggests that the amount of dust deposition could be almost three times as high.

6.6.2 Increased Diesel Exhaust Loadings to Streams and Lakes

The projected increase in road traffic will lead to increased diesel exhaust emissions in the surrounding area. This could result in increased polycyclic aromatic hydrocarbons (PAHs) loading to aquatic environments. However, the airborne transport of PAHs into waterways will not likely contribute significant loadings since the air quality VEC (Appendix B-2 of the DEIS) was shown to potentially experience only low magnitude levels of effects related to particulates (which could carry PAHs). Also, PAH loading would be diffuse throughout the region, therefore only the stream or lake surface would act as an entry point for PAHs into aquatic environments and this would quickly be diluted as the PAHs were mixed downstream or within the lake. No significant effects to freshwater aquatic resources are expected from this activity.

6.6.3 Increased Potential for Effects from Spills

Spill risk increases with the number of loaded trucks travelling on the road. A total of 8,499 loaded fuel truck loads and 3,039 loaded cargo trucks are projected to use the road each year. Although not all cargo may pose a risk if spilled, following the precautionary principle it is assumed that all cargos will pose some risk to the freshwater environment if released in an uncontrolled manner. A further 8,937 concentrate truck loads are projected each year when the Hackett River and Izok Lake projects are operational. Overall, the risk of a truck spill happening over the life of the Project increases, with the risk of a spill occurring in the freshwater environment also increasing. However, given the relative proportions of terrestrial and aquatic habitat along the road, the likelihood of a spill affecting the freshwater environment remains low. Despite this, the significance of this effect is classified as **Moderate** due to the potential consequences of a spill on an undisturbed and sensitive ecosystem.

Because ore concentrate will be stored at the port, away from any freshwater aquatic systems, no cumulative effects on freshwater aquatic resources are related to this activity.

6.7 Significance of Cumulative Effects

Dust loadings to aquatic environments was linked to negligible potential effects from the Project, and a potential tripling in road traffic was not estimated to change ground-based sedimentation rates (due to snow removal, road substrate dispersion, followed by freshet release). Therefore, the significance of sedimentation effects remains **Low**. Also, the vegetation VEC (section 9) did not have an increase in rating for significant effects (remained at low significance) associated with dust loading. Continued vegetation and air quality monitoring will be useful in assessing this risk. Due to the potential consequences of a fuel, cargo or concentrate spill on the aquatic environment, the significance of this potential effect is classified as **Moderate.** However, the likelihood of a major spill occurring and directly affecting the freshwater environment is very low.

6.8 Confidence Levels of Assessment

The process of increased loading of sediment and dust to adjacent waterways is fairly well understood, and mitigation strategies (*e.g.* dust suppression, road maintenance, monitoring) have been developed and used for decades to counter these potential stressors to aquatic systems. Therefore this assessment has been associated with a high level of confidence.

The assessment of PAH loading from diesel engine exhaust is quite complex, based on not only air quality modeling but also air-water transfer, mixing processes, binding to organic matter, and species-specific rates of biological uptake and metabolism. The confidence level associated with this air quality model was low, and potential effects were rated a low magnitude. Therefore this assessment has been assigned a low level of confidence.

The assessment of cumulative effects to freshwater aquatic resources from accidental spills has been assigned an intermediate level of confidence. It is based on assumptions that risk of accidents is similar to that observed on the highway to Yellowknife, although this risk is subjective depending on the driver’s ability, training levels, truck maintenance, and both weather and road conditions in the Arctic. There are also various unknowns that will influence the magnitude of the impact, such as the type and amount of material spilled, the location of the spill, the timing of the spill, and the emergency response to the spill.

6.9 Mitigation, Management and Monitoring

As stated above, the proposed use of air and vegetation monitoring programs on the Project will aid in managing risk to freshwater aquatic resources by quantifying dustfall. Dust suppression will be important in reducing particulate loadings to waterways, considering the potential for a tripling in road traffic through the year. Summer road maintenance will become more important due to this increased traffic causing more wear and movement of road substrates which could lead to sedimentation to adjacent streams or degradation of stream crossings if not properly monitored and managed. Training of haul truck drivers will be important in mitigating the unlikely but high magnitude impact of a fuel or concentrate spill in the vicinity of a stream or lake.

6.10 Summary of Assessment

A summary of the cumulative effects assessment for freshwater aquatic resources is provided in Table 6.10-1.

Table 6.10-1
Summary of Cumulative Effects Assessment for Freshwater Aquatic Resources

Description of Effect	Significance	Confidence Level
Sedimentation (aerial, ground transport) leading to lethal and sublethal effects to benthos and periphyton, reducing productivity	Low	High
PAHs from diesel exhaust causing toxicity to benthos and periphyton, reducing productivity	Negligible	Low
Fuel, cargo or concentrate spill causing lethal or sublethal effects to benthos and periphyton, reducing productivity	Moderate	Intermediate

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7. FRESHWATER FISH AND FISH HABITAT

7. Freshwater Fish and Fish Habitat

7.1 Valued Ecosystem Components

The EA for freshwater fish and fish habitat (Appendix C-4 of the DEIS) assessed the potential effects of the Project on the following VECs:

- Arctic grayling (*Thymallus arcticus*);
- lake trout (*Salvelinus namaycush*);
- Arctic char (*Salvelinus alpinus alpinus*);
- whitefish (general); and
- fish habitat.

No endangered or threatened fish species were identified in the Project area during baseline studies. Residual effects were predicted for fish habitat and Arctic grayling in streams along the road route. These two VECs were assessed together in the cumulative effects assessment to reduce redundancy.

7.2 Residual Effects of the Project

The residual effects of the Project include lethal (*i.e.*, mortality) and sublethal (*e.g.*, behavioural changes, physiological stress) effects from sedimentation and possible spills, as well as habitat loss and disturbance in streams along the road due to construction activities and summer runoff. The significance of all three effects on Arctic grayling and fish habitat was assessed as low. These effects were considered to be most significant during the construction phase of the Project because it will continue through the summer months, while the other Project phases are scheduled to occur only during the winter. However, for the cumulative assessment, the road operational period was considered to include operations outside the TCWR haul season (Section 2.3.6).

7.3 Spatial Boundary

The study area considered in the cumulative effects assessment for fish and fish habitat is the RSA defined for the effects assessment (Appendix C-4 of the DEIS). This boundary was selected as it serves as an extensive “zone of influence” beyond which residual effects of the Project will diminish to a negligible state.

The primary effects will remain localized (*e.g.*, near Project activities); however, increased dust production and sedimentation from the greater traffic volumes anticipated will increase the amount of total suspended solids (TSS) entering streams.

7.4 Temporal Boundary

The temporal boundary includes the Project’s proposed lifetime of 22.5 years, comprising the construction (2.5 years) and operation phases (19 years) and extending into the closure (1 year) phase. Due to the generally fast recovery of fish populations, the maximum temporal effects of the Project on fish and fish habitats are anticipated to occur within the lifetime of the Project.

7.5 Interactions with Other Developments and Activities

The anticipated interactions with other developments and activities in the area will be from existing developments (*e.g.*, EKATI and Diavik diamond mines) and potential future developments (*e.g.*, Hackett River and Izok Lake). These projects would use BIPR facilities to transport goods, supplies, fuel and products. Therefore, the operating conditions of the Project are expected to change to include greater volumes of imports, the addition of concentrate exports, extended road operational periods, and increased volumes of road and shipping traffic.

The proposed Hackett River project has an anticipated construction schedule which overlaps with BIPR construction, and Hackett River is expected to be accessed via a spur from the road. Development of the Hackett River and Izok Lake projects would also require a concentrate storage facility to be built at the BIPR port site, thus potentially extending the construction phase and therefore the effects.

Development of the proposed Izok Lake project may require development of a barge dock at Contwoyto Camp. Barges may be used to transport trucks across Contwoyto Lake during the summer, connecting the road with the proposed all-weather road between Lupin and Izok Lake. Construction of the barge dock has potential to increase sedimentation during construction, and barge operations pose an additional spill risk.

7.6 Combined Effects of Human Actions

7.6.1 Increased Sedimentation

Additional traffic along the road, resulting from new developments connecting to the Project road, is anticipated. Resultant disturbances to fish and fish habitat are likely to be localized at individual stream crossings and minimal in their extent. Use of the road during the summer months would compound this effect by increasing particulates generated from the road and sediments in runoff during precipitation events. However, the effect of increased sedimentation on fish habitat is still expected to be low.

Increases in sediment load would also be expected if a barge dock on Contwoyto Lake is constructed to service the Izok Lake project. However, the effects of construction are expected to be temporary and localized, with the installation of silt booms and adherence to other best management practices, as highlighted for the construction of the BIPR marine port, minimizing the effects of barge dock construction. Further siltation during operation of the barge dock is not expected.

7.6.2 Increased Chance of Spills

The combination of increased road use and its use during the summers of the operations phase increase the chances of equipment or load spills. Using data from the Diavik diamond project (Diavik, 1998), a spill rate of 1/90,000,000 per truck per kilometre was calculated for travel on northern roads. Using an estimate of 7,049 truckloads of fuel and cargo per year, as predicted for the commencement of BIPR operations, a road length of 211 km, and a 19-year operations period, a spill rate of:

1/90,000,000 x 7,049 loads/year x 211 km x 19 years = 31%

was calculated. This indicates the probable incidence of fuel spills from truck transport is low (31% chance that one truck will spill over the 19 years of operations). The assumptions above are based on drivers being well-trained and adhering to a strict policy of no alcohol or drug consumption while at work.

When considering the cumulative effects from other projects, the road traffic estimate increases to 20,475 truckloads of fuel, cargo, and concentrate per year. This level of usage predicts a spill rate of:

1/90,000,000 x 20,475 loads/year x 211 km x 19 years = 91%

Therefore, it is likely, but not certain, that a spill will occur within the lifetime of the Project when considering the cumulative risk of other projects. However, this calculation does not consider the time of year (*i.e.*, summer versus winter) or the location of the spill (*i.e.*, terrestrial versus aquatic habitat), both of which will have a significant impact on the potential effects of a spill. The probability of a major spill is also increased when considering potential barge operations across Contwoyto Lake from Lupin (the terminal end of the Izok Lake all-weather road) to the terminal end of the road.

7.7 Significance of Cumulative Effects

Increased sedimentation in streams along the road can lead to an increased probability of lethal and sublethal effects occurring, as well as habitat loss. Lethal effects of sediments include the smothering of Arctic grayling eggs and larvae in the spring. Sublethal effects can involve behavioural changes in swimming or spawning activities, as well as acute or chronic stress responses to increase levels of TSS. Finally, spawning and rearing habitat can be altered by the siltation of good quality gravels. Despite these potential effects the significance of sedimentation is predicted to remain **Low**. The initial assessment of sedimentation effects during operations was negligible due to the timing of road use; in winter snow and ice limit the amount of sediment entering watercourses. If road operations were to take place during the summer the effects of sedimentation are predicted to be no worse than during the construction phase, when the significance was classified as low. As discussed above, the effects on sediment levels of constructing and operating a barge dock on Contwoyto Lake are also predicted to be **Low**.

In the context of cumulative effects, the significance of residual effects of accidental spills is **Moderate** due to the potential consequences of a spill. The expected increase in road traffic volumes will result in a three-fold increase in the probability of a spill occurring over the life of the Project, thereby also increasing the likelihood that a spill will occur in the freshwater environment. However, given the relative proportions of terrestrial and aquatic habitat along the BIPR road, the likelihood of a spill occurring in the freshwater environment remains low. Barge traffic across Contwoyto Lake also has the potential to have a significant effect on fish and fish habitat in the lake should an accidental spill occur.

The effects of a spill on fish and fish habitat will vary according to the type and amount of material spilled, the location of the spill, the timing of the spill, and the emergency response to the spill. These are unknown variables that make it difficult to predict the final magnitude. However, the undisturbed nature of the existing environment, the sensitivity of Arctic ecosystems, and the importance of the Contwoyto Lake to Inuit as a fishing area (Appendix F-5) and as the headwater to two major rivers, warrant a cautious assessment.

7.8 Confidence Levels of Assessment

It is highly likely that increased use of the road during summer months will cause some sedimentation at stream crossings. The likelihood of a major sedimentation event occurring with mitigation measures in place is low, but stream banks will be less stable during the summer compared with winter conditions. Therefore, the assessment for lethal and sublethal effects, and loss of fish habitat due to sedimentation has been assigned a high level of confidence.

The assessment for lethal and sublethal effects due to contaminants from spills has been assigned an intermediate level of confidence because of the influence that unknown factors, such as the location of the spill and the type and amount of material spilled, will have on the magnitude of the effect.

7.9 Mitigation, Management and Monitoring

In the event of an accidental spill, the Spill Management Plan (see Appendix G-4 of the DEIS) will be deployed to minimize effects. Mitigation and management plans are offered as recommendations and will be refined during the EA process leading to the Final Environmental Impact Statement (FEIS) and Project Certificate. In the event of a spill, it would be worthwhile to periodically monitor the condition of the fish and fish habitat VECs at the spill site to identify effects and develop a site-specific mitigation and recovery program.

7.10 Summary of Assessment

A summary of the cumulative effects assessment for fish and fish habitat is provided in Table 7.10-1. Due to the potential consequences of a fuel, cargo or concentrate spill on the aquatic environment, the significance of this potential effect is classified as **Moderate.** However, the likelihood of a major spill occurring and directly affecting the freshwater environment is very low.

Table 7.10-1
Summary of Cumulative Effects Assessment for Fish and Fish Habitat

Description of Effect	Significance	Confidence Level
Siltation of sediments and particulates from truck hauling and summer runoff increasing TSS and causing lethal effects	Low	High
Siltation of sediments and particulates from truck hauling and summer runoff increasing TSS and causing sublethal effects	Low	High
Siltation of sediments and particulates from truck hauling and summer runoff causing habitat loss	Low	High
Siltation of sediments and particulates from construction and operation of a Contwoyto Lake barge dock	Low	High
Spills from equipment, hauled fuels and cargos, and waste products causing mortality	Moderate	Intermediate
Spills from equipment, hauled fuels and cargos, and waste products causing sublethal effects	Moderate	Intermediate

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8. NAVIGABLE WATERS

8. Navigable Waters

8.1 Residual Effects of the Project

Stream crossings identified along the BIPR road were assessed to identify any that may require approvals under the *Navigable Waters Protection Act*. Of the 104 total stream crossings, 70 contained flowing water, and only 38 were identified as being potentially navigable based on stream size. Transport Canada determined that four of these crossings are in fact navigable (km 2.2 No Name Creek, km 22.9 Amagok Creek, km 128.8 Mara River, and km 181.4 No Name Creek). The remaining crossings were non-navigable due to their small size (width and depth), or presence of barriers (typically boulder fields). Bridges will be installed across the four navigable streams (see Appendix C-5 of the DEIS).

Given the inaccessibility of most of the region around the Project, limited current or historical use of waterways in the region, and the accommodating design of bridge heights over water, the Project is not anticipated to cause adverse residual effects on navigable waters. The predicted increase in traffic volumes and seasonal operating periods of the road will not affect the characteristics of stream crossings, and thus no cumulative effects are expected to occur.

8.2 Mitigation, Management and Monitoring

The following mitigation, management, and monitoring practices should be conducted over the full life-span of the Project, to ensure design of bridges offers sufficient freeboard to ensure crossing does not impede navigability. The height of minimum freeboard at 1:25 year flood levels will be set as follows:

- Mara River, 1.6 m;
- Amagok Creek, 1.8 m; and
- the No Name creeks will each be set at 1.5 m.

Monitoring will require routine maintenance of bridges to ensure crossings do not impede navigability.

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9. ECOSYSTEMS AND VEGETATION

9. Ecosystems and Vegetation

9.1 Valued Ecosystem Components

The EA for ecosystems and vegetation (Appendix D-1 of the DEIS) assessed the potential effects of the Project on the following VECs:

- plant communities and associations (with emphasis on those that are sensitive or serve particular ecological functions);
- rare or significant plant species or species groups; and
- species of ecological importance to the Inuit and wildlife.

No rare plant species were identified in the study areas during baseline studies, and as such they were not assessed further. Residual effects were predicted for plant communities (ecosystems) and associations, and for species of ecological importance. These two VECs were assessed together in the cumulative effects assessment to reduce redundancy.

9.2 Residual Effects of the Project

The residual effects of the Project include the direct disturbance (loss) of plant communities, associations, and plants in the area, as well as an increase in dust deposition and potential establishment of invasive plants. The significance of the loss of plant communities and plant species/groups of ecological concern was assessed as moderate. The significance of degradation of plant communities and plant species/groups due to indirect disturbance (dust deposition, the potential introduction of invasive plant species, and alteration of local hydrology), was rated as low.

9.3 Spatial Boundary

The study area boundary considered in the cumulative effects assessment for plant communities, associations, and plants is the RSA defined for the effects assessment (Appendix D-1 of the DEIS). This boundary was selected as it serves as an extensive “zone of influence” beyond which residual effects of the Project will diminish to a negligible state.

The primary effects will remain localized (*e.g.*, near Project activities); however, increased dust production from the greater traffic volumes anticipated will increase the amount of fine particulate matter in the atmosphere. These finer particulates settle out at much greater distances than those assessed in Appendix D-1.

9.4 Temporal Boundary

The temporal boundary of the cumulative effects assessment begins at the onset of construction of the Project, and ends well beyond 2030 when the Project is scheduled to close. The recovery of Arctic plant communities over the medium-term has been described as occurring between 20-75 years (Forbes *et al.*, 2000). The effects of the Project are anticipated to be long-term; therefore, the temporal boundary has been estimated to be a minimum of 100 years beyond Project closure.

9.5 Interactions with Other Developments and Activities

The anticipated interactions with other developments and activities in the area will be from existing (*e.g.*, EKATI and Diavik diamond mines) and potential future developments (*e.g.*, Hackett River and Izok Lake) looking to use the Project facilities to transport products, goods, supplies, and fuel more economically.

9.6 Combined Effects of Human Actions

9.6.1 Increased Direct Disturbance

The plant communities, associations, and plants identified in the Project RSA are representative of the Arctic. Additional direct disturbance (*e.g.*, building of new infrastructure) resulting from expansion of the Project facilities and from developments looking to connect to the facilities is anticipated; however, it is likely these disturbances will be localized and minimal in their extent. At broader scales, past and existing developments coupled with increased construction from new developments (particularly roads) would contribute to landscape fragmentation (*i.e.*, nibbling loss).

9.6.2 Increased Dust Deposition

Existing projects and potential future developments looking to make use of the Project facilities will increase traffic volumes on the road and at the port. Additionally, there exists the potential to add seasonal operating windows. These factors will increase the duration, frequency, and amount of dust deposited onto plants near infrastructure, which may increase the severity of the potential effects.

9.6.3 Increased Potential to Introduce Invasive Plants

Increased traffic volumes on the road and at the port associated with existing properties and potential future developments will also increase the potential to introduce invasive plants to the area. Vehicles and construction activities provide a dispersal mechanism and habitat for invasive plant establishment.

9.7 Significance of Cumulative Effects

The direct disturbances from developments that could be associated with the Project are anticipated to be localized and limited in their extent but may contribute to increased landscape fragmentation. With time, small, seemingly inconsequential effects could culminate via the "nibbling" effect (Forbes *et al.*, 2000) into larger, more permanent changes on the landscape. Overall, the cumulative effects are expected to result in a long-term decline in condition of the VECs to below baseline conditions, but not to the extent that the VECs become unsustainable. As for the EA, the significance of the loss of plant communities and plant species/groups is rated as **Moderate**.

The amount of dust deposited onto vegetation and the potential to introduce invasive plants to the area is also expected to increase with higher traffic volumes on the road and at the port. The significance of these effects has been characterized as **Low**, largely because only slight declines in the condition of the VECs are anticipated.

9.8 Confidence Levels of Assessment

The assessment for the loss of plant communities and plant species/groups has been assigned a high level of confidence. It is certain that construction of the Project and other developments will cause a long-term loss of some vegetation, and that the effects of individual developments can combine to generate larger, more permanent changes on the landscape

The assessment for increased indirect disturbance has been assigned an intermediate level of confidence, primarily because there is insufficient long-term monitoring data in the Arctic (Dowlatabadi *et al.*, 2003), particularly that describing the resilience of plant communities and vegetation to long-term dust deposition. The general effects of dust deposition on plants and their physiology are well described; however, the recovery of plants or plant communities from such a disturbance is not well documented. Additionally, the threat of invasive plant species establishment is relatively new to the Arctic. .

9.9 Mitigation, Management and Monitoring

It would be beneficial to periodically monitor the condition of the VECs to identify if the predicted effects are more or less severe than originally anticipated. Efforts should also be made to ensure invasive plants are not provided the opportunity to become established, which can threaten native plants and plant communities.

9.10 Summary of Assessment

A summary of the cumulative effects assessment for plant communities, associations, and plants is provided in Table 9.10-1.

Table 9.10-1
Summary of Cumulative Effects Assessment for Ecosystems and Vegetation

Description of Effect	Significance	Confidence Level
Loss of plant communities, associations and plants	Moderate	High
Degradation of plant communities, associations and plants due to increased indirect disturbance (dust deposition and invasive plants)	Low	Intermediate

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10. BEDROCK GEOLOGY, SURFICIAL MATERIAL AND SOILS

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10. Bedrock Geology, Surficial Material and Soils

10.1 Valued Ecosystem Components

The Project effects assessment for bedrock geology, surficial material and soils (Appendix D-2 of the DEIS) examined the potential effects on the following VECs:

- permafrost; and
- soil quality.

Construction and operation of the Project is predicted to have residual effects on these two VECs; therefore, both were carried forward to the cumulative effects assessment.

10.2 Residual Effects of the Project

Construction activities that require excavation of the active layer over permafrost (the layer that thaws during the summer months) or the permanently frozen soils will expose the underlying frozen soils to unusually warm conditions. Melting of permafrost can result in the loss of the soils structural integrity, potentially affecting road and building foundations, and can result in the formation of sinkholes and surface collapse. Permafrost may also be affected by heat migrating from structures and from soil that is side cast during construction and maintenance activities onto the snow during the colder times of the year. The significance of residual effects on permafrost melting was rated moderate (Appendix D-2 of the DEIS).

Construction of Project facilities will result in the long-term loss of approximately 363 ha of soils. The significance of this effect was rated moderate. A further 225 ha of soils are predicted to be degraded as result of contamination of the road bed and edges with lubricants, oils, grease, and metals from trucks deposited as dust or from road runoff. With mitigation, the significance of soil degradation was rated low.

10.3 Spatial Boundary

Spatial boundaries were created based on the anticipated alteration of soils related to cumulative effects. The evaluation of the disturbance to soil quality related to the cumulative effects was conducted at the local level only; the regional level was not applicable.

The spatial boundary includes the Port Site and Contwoyto Camp footprints, the 211 km road extending from the Port Site to Contwoyto Camp, and associated quarries. Total road width will be 23 m, comprising 13 m of road bed and 5 m of road edge on either side. Pullouts will be located on alternate sides every 1 km along the road and will be 4 m wide and 50 m in length. The assessment considers the land corridors that could be used to connect BIPR facilities with potential future projects such as Hackett River and the footprints of those projects.

10.4 Temporal Boundary

The temporal boundary for soil loss and permafrost melting was based on the expected construction, operation, and decommissioning period of the Project, which extends from mid-2009 to 2032. It is assumed that other projects utilizing also will be decommissioned within this time frame.

The temporal boundaries for soil degradation were established based on the predicted times for contaminated soils to return to baseline conditions. The cumulative effects assessment for hydrocarbons considers a time period that extends from the onset of the Project construction for an extended period following closure of the road. Soil remediation can be achieved in cold climates in less time if fertilizers are used and active treatment is carried out (McCarthy *et al.*, 2004). However, natural remediation in this climate is predicted to be much slower, likely taking years instead of weeks.

Metals from vehicles will accumulate with time and may dissipate within 20 to 75 years of road closure. The temporal boundary for soil metal contamination therefore extends to 75 years after road closure. These predictions are based on the time it takes for plant communities to achieve baseline conditions in similar climates (Forbes *et al.*, 2000).

10.5 Interactions with Other Developments and Activities

The projected development of the Izok Lake and Hackett River projects may necessitate expansion of facilities, including a summer barge dock at Contwoyto Lake and the installation of concentrate storage facilities at the port (see section 2.2.4). Spur roads would also be required to connect Izok Lake and Hackett River to the Project facilities. Such induced development would result in additional soil loss and effects on permafrost.

Any additional development or activity that will use the port and/or road will interact with the residual effects of the Project. Potential future developments including Hackett River, Gahcho Kué, and Izok Lake may add substantial volumes of traffic to the road (Section 2.3). Activities such as resource exploration may also add traffic to the road. Increased traffic use along the road may increase the chances of fuel leaks and spills and will contribute to the amount of hydrocarbons and metals that will affect the road bed and edges.

10.6 Combined Effects of Human Actions

10.6.1 Permafrost Melting

Increased traffic volumes are not expected to increase the degree of permafrost melting within the footprint of the Project. However, development of other projects and associated expansion of the Project facilities could increase the area over which permafrost is affected. The effects on any such development are likely to be similar to the effects described in Appendix D-2 of the DEIS and rated as low.

10.6.2 Soil Loss

Development of other projects that connect to the Project and the associated expansion in Project facilities will increase the amount of soil that is lost across the region. The additional area that would be lost cannot be quantified without detailed design information. As for the Project, the effects of additional soil loss would extent into the far future and be of high magnitude, but local in geographical extent.

10.6.3 Soil Degradation

The projected increase in traffic along the road and the potential extension of seasonal road use may result in additional contamination of the road bed and edges with lubricants, oils, grease, fuel, and metals from vehicles deposited as dust or from road runoff. The continuous use of the road may result in a gradual contamination of the soils, which decreases soil quality along the road bed and edges. Contaminated soils contain metals or hydrocarbons in amounts that have adverse effects on the ecosystem, including plant health and potential bioaccumulation in wildlife.

10.7 Significance of Cumulative Effects

The cumulative effects on soil loss are rated as **Moderate**, and as **Low** for permafrost, per the original effects assessment. Although the area affected will increase and there will be a long-term shift away from baseline conditions, the overall sustainability of the VECs is not expected to be threatened.

A **Low** level of significance has been placed on the degradation of soil quality, based on the projected increases in traffic volumes and the expected change in soil quality that may take place. This level of significance indicates that the cumulative effects could result in the decline of soil quality to lower-than-baseline, but stable, levels in the Project area after road closure and into the foreseeable future.

10.8 Confidence Levels of Assessment

An intermediate level of confidence was placed on the conclusions of the assessment because not all cause-effect relationships are fully understood and data for the study area is incomplete. For soil loss and permafrost melting, the exact areas that will be affected by future developments are not known at this time and the long-term effects and soil recovery are difficult to predict accurately. For soil degradation, detailed modelling of the expected level of contaminants that will be deposited on the road bed and road edges has not been carried out.

10.9 Mitigation, Management, and Monitoring

Proposed mitigation for soil loss and permafrost melting for the BIPR Project is described in Appendix D-2 of the DEIS, and it is expected that other developments will employ similar strategies. Little mitigation can be carried out once soil has been degraded by hydrocarbon and metal contamination in this situation. However, good management practices such as ensuring regular maintenance of vehicles and cleaning up spills immediately after they occur should reduce soil contamination.

10.10 Summary of Assessment

The significance of cumulative effects on permafrost melting, soil loss, and soil degradation remains unchanged from the effects assessment described in Appendix D-2 of the DEIS (Table 10.10-1).

Table 10.10-1
Summary of Cumulative Effects Assessment for Bedrock Geology, Surficial Material and Soils

Description of Effect	Significance	Confidence Level
Permafrost melting	Low	Intermediate
Soil loss	Moderate	Intermediate
Soil degradation	Low	Intermediate

11. WILDLIFE AND WILDLIFE HABITAT

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11. Wildlife and Wildlife Habitat

This section evaluates the potential cumulative effects to wildlife of existing and proposed projects in addition to the BIPR Project. The effects assessment evaluated the effects of the Project on a landscape without any other developments. The potential cumulative effects assessment re-evaluates these BIPR effects for a landscape with existing mining projects and with proposed additional mining projects. This re-assessment has one exception. Traffic on the road from existing developments has already been evaluated in the wildlife effects assessment. Hence, the cumulative effects assessment evaluates the possible increase in traffic from proposed developments in addition to the existing developments.

11.1 Valued Ecosystem Components

The Wildlife and Wildlife Habitat Effects Assessment (Appendix D-3 of the DEIS) evaluated the potential effects of the Project on the following species and groups of species:

- caribou (*Rangifer tarandus*): Bathurst Herd, Ahiak Herd, Dolphin and Union Herd, Peary Herd;
- muskox (*Ovibos moshatus*);
- grizzly bear (*Ursus arctos horribilis*);
- wolverine (*Gulo gulo*);
- wolf (*Canis lupus*);
- migratory birds (excluding raptors and waterfowl);
- cliff-nesting raptors (tundra peregrine falcon selected as proxy);
- ground-nesting raptors (short-eared owl selected as proxy); and
- waterfowl (long-tailed duck selected as proxy).

Wildlife VECs that were assessed as being subject to at least one significant residual effect (*i.e.*, non-negligible residual effect) were carried forward into the cumulative effects assessment. All VECs with the exception of ground-nesting raptors (short-eared owl) were carried forward to the cumulative effects assessment. There were no significant effects predicted for short-eared owl in the Effects Assessment. Also, there were no potential effects that are expected to become significant as a result of cumulative effects.

11.2 Methodology

Cumulative effects are investigated on a Valued Ecosystem Component (VEC) basis, focusing on those effects previously rated as significant (low, moderate, or high) due to the Project alone. Effects which were rated as negligible in the Project effects assessment were also considered in an initial scoping stage, and those with the potential to increase to a significant residual effect in the cumulative effects assessment are discussed in this report. Table 11.2-1 summarises the significant residual effects of the Project on each VEC, as evaluated in the effects assessment

(Appendix D-3 of the DEIS). Each potential effect listed in Table 11.2-1 is discussed in this cumulative effects assessment. All other effects are expected to remain negligible when taking into account the combined effects of human actions.

Table 11.2-1
Summary of Significant Residual Effects of the Project on Wildlife and Wildlife Habitat from the Effects Assessment

VEC	Habitat Loss	Disturbance	Disruption of Movements	Features Acting as Attractants	Direct Mortality	Indirect Mortality	Reduction in Reproductive Productivity	Carried Forward
Caribou (Bathurst herd)	Low	Low	Low	Negligible [1]		Negligible [1]	Low	Yes
Caribou (Ahiak herd)		Low	Low	Negligible [1]		Negligible [1]	Low	Yes
Caribou (Dolphin and Union)			Low			Negligible [1]		Yes
Caribou (Peary)			Moderate					Yes
Muskox	Low	Low	Negligible [1]			Negligible [1]	Low	Yes
Grizzly Bear			Negligible [1]	Low		Negligible [1]	Low	Yes
Wolverine		Negligible [1]	Negligible [1]	Low	Low	Negligible [1]	Low	Yes
Wolf			Negligible [1]	Negligible [1]		Negligible [1]	Negligible [1]	Yes
Migratory Birds				Negligible [1]	Negligible [1]		Negligible [1]	Yes
Short-eared Owl								No
Peregrine Falcon	Negligible [1]			Negligible [1]			Negligible [1]	Yes
Long-tailed Duck	Negligible [1]	Negligible [1]	Negligible [1]	Negligible [1]				Yes

1: Effects rated negligible in the BIPR effects assessment but that are re-assessed in the cumulative assessment are listed in the table.

The methodology for this cumulative effects assessment follows that for the effects assessment (Appendix D-3 of the DEIS, Section 3). This assessment provides a qualitative assessment for each effect based on quantitative data, where applicable, and species traits. A qualitative assessment is provided because the number and diversity of potential project impacts to wildlife reduce the confidence with which quantitative predictions can be made. For example, mortality of an individual may or may not have consequences for the population depending on whether mortality is compensatory or additive. In other cases, quantitative data are lacking for more complex assessments (Dowlatabadi *et al.*, 2003).

11.3 Spatial Boundaries for all VECs

Spatial boundaries are defined on a VEC by VEC basis from knowledge of their movement patterns and range sizes and whether these would overlap the Project study area and the area affected by other projects. Spatial boundaries are defined as:

- **LSA:** a 500 m buffer around the port, camp, and road;
- **RSA:** a 30 km buffer around Project infrastructure; and
- **beyond the RSA:** defined by the range size of the species in question and discussed in more detail within the relevant section for each VEC.

11.4 Temporal Boundaries for all VECs

The temporal boundaries of this cumulative effects assessment for all VECs will include all projects and activities that coincide with the construction phase (2.5 years), 19 year operations phase, closure in 2031, and beyond closure into the far future. For VECs such as caribou that display large seasonal migration patterns the cumulative effects are also considered for particular seasons when these VECs occur in the Project area. For example, additional projects are considered to have a greater effect if they will interact with a species during a sensitive life-history phase.

11.5 Caribou

11.5.1 Residual Effects of the Project

The effects assessment evaluated six residual effects for caribou; habitat loss, disturbance, disruption of movement, features acting as an attractant, indirect mortality and reduction in reproductive productivity (Table 11.2-1).

11.5.2 Spatial Boundary

The spatial boundaries are based on the seasonal ranges of each caribou herd (see Section 2.4.1 of Appendix D-3 of the DEIS). Effects of any other projects or anthropogenic activities that occur within each of the annual ranges for each caribou herd (Bathurst, Ahiak, Dolphin and Union and Peary herds) are used when considering the cumulative effects on each herd (Figures 11.5-1 to 11.5-4).

11.5.3 Interactions with Other Project Developments

The annual ranges and seasonal movements for each caribou herd are superimposed onto existing and potential future projects in the region in Figures 11.5-1 to 11.5-4. Each project will contribute to traffic on the road and may also directly affect caribou herds in the area. Existing projects include EKATI, Diavik, Jericho, Snap Lake and the TCWR. Reasonably foreseeable future projects include Gahcho Kué, High Lake, Hackett River, Izok Lake, and Yellowknife Gold. The effects of other projects on caribou are considered for each herd in the following sections.

11.5.4 Combined Effects of Human Activities

11.5.4.1 Habitat Loss

The effects assessment rated habitat loss from the BIPR Project a Low residual significance for the Bathurst herd and this herd is carried forward to the cumulative effects assessment. Habitat loss was rated as Negligible for the Ahiak, Dolphin and Union, and Peary caribou and was not carried forward.

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FIGURE 11.5-1

the Bathurst Inlet Port and Road Project

Other Projects Potentially Contributing to Cumulative Effects on Bathurst Caribou

Rescan

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the Bathurst Inlet Port and Road Project

FIGURE 11.5-2

Other Projects Potentially Contributing to Cumulative Effects on Ahiak Caribou

Rescan

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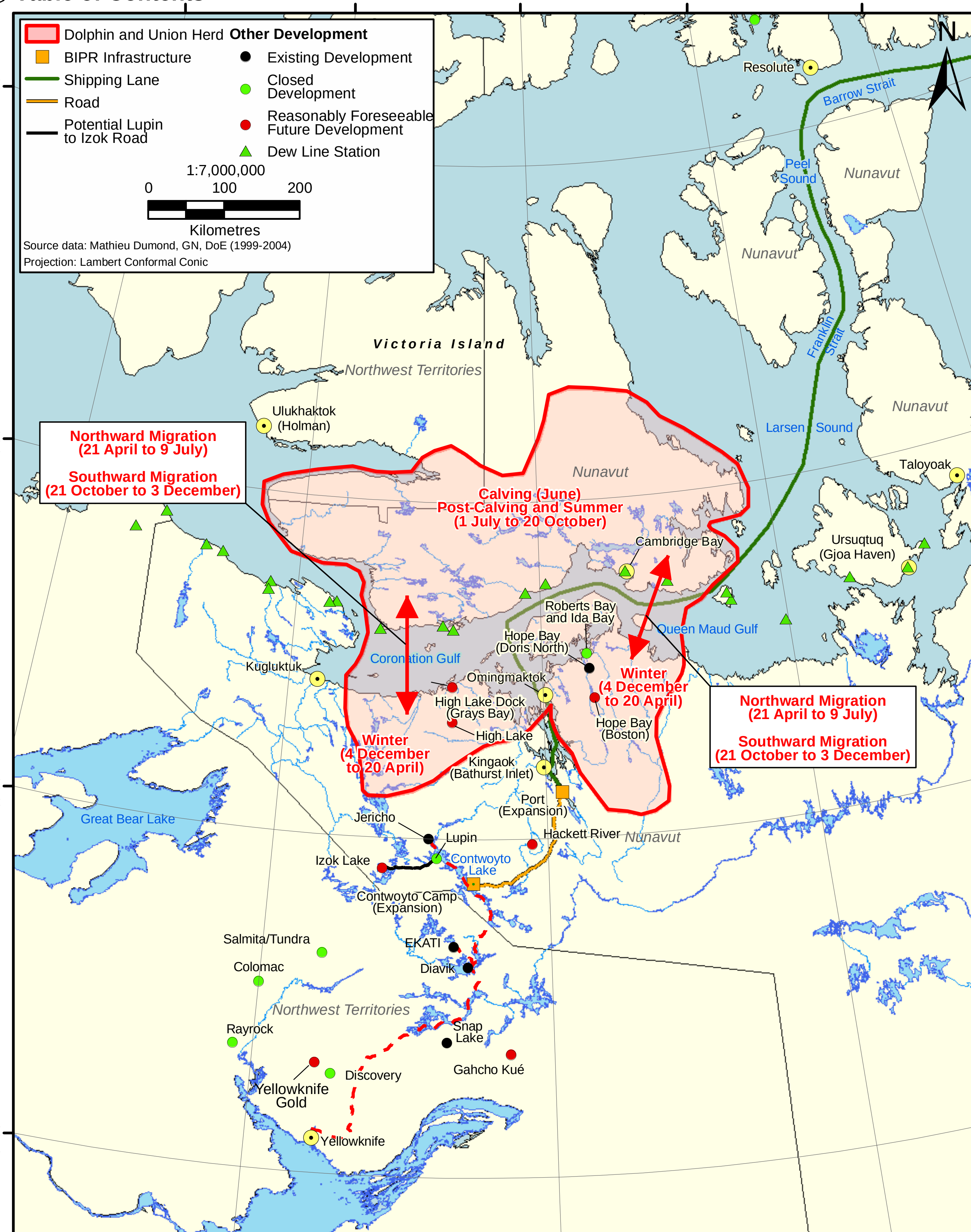

FIGURE 11.5-3

Other Projects Potentially Contributing to Cumulative Effects on Dolphin and Union Caribou

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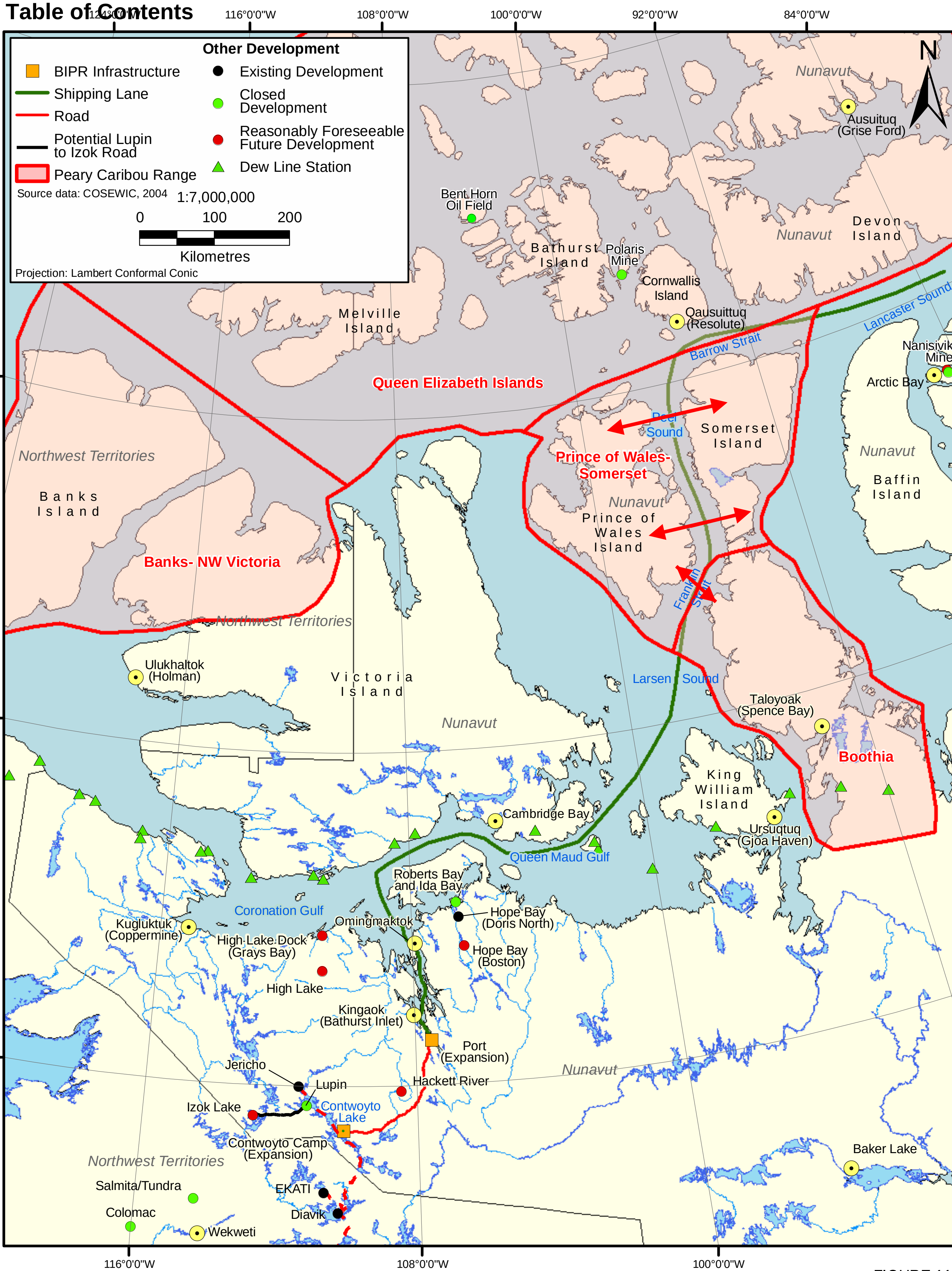

FIGURE 11.5-4

Other Projects Potentially Contributing to Cumulative Effects on Peary Caribou

the Bathurst Inlet Port and Road Project
Rescan

Bathurst Herd

Habitat selection by caribou is mainly dictated by their nutritional requirements and the distribution and availability of forage (Calef, 1981; Russel, 1998), so projects that will remove forage during periods of high forage demand, such as calving and post-calving seasons, may contribute more strongly to the cumulative effects. The proposed Hackett River project also has the potential to overlap with the calving area for this herd. Other existing developments, such as EKATI, Diavik and Snap Lake mines overlap with the summer, and fall migration ranges of the Bathurst herd, which further decreases available habitat or habitat quality for developing calves directly and indirectly (*e.g.*, due to dust fall-out, disturbance, *etc.*).

Other projects that may occur in the foreseeable future, including Gahcho Kué and Yellowknife Gold, would also overlap with the fall and winter ranges of the Bathurst caribou herd. The direct habitat loss resulting from these additional projects in combination with indirect habitat loss due to avoidance of disturbed areas are predicted to increase the effects of habitat loss on Bathurst caribou due to the Project.

11.5.4.2 Disturbance

Disturbance was rated as Low for the Bathurst and Ahiak herds by the BIPR effects assessment.

Bathurst Herd

Existing projects, including Jericho, EKATI, Diavik and Snap Lake, and the proposed projects Gahcho Kué, Yellowknife Gold, Izok Lake and Hackett River mines, all fall within the range of this herd (Figure 11.5-1). These projects may cause additional disturbances to caribou including noise and visual stimuli. Of particular importance will be the existing Jericho mine and the proposed Hackett River and Izok Lake developments, which are in proximity to the to the calving and post-calving areas for the Bathurst herd. Approval of the Hackett River and Izok Lake projects may result in additional periods of road use such that hauling may be proposed in the calving and post-calving periods. The Hackett River development would also include building a haul road that runs west to east connecting the mine to BIPR road. This would create a potential barrier, depending on traffic volumes, to the movements of cows and calves from the calving grounds northwest of the Hackett River project to post-calving range. Since Bathurst caribou calve north of the road in mid June and then move south across the road with their calves to their summering area (by July 21), increased disturbance to cows and calves due to visual and auditory stimuli from trucks could be experienced.

Cumulative effects due to disturbance from other projects, particularly the influence of Jericho, Hackett River, Izok Lake, and the additional road use periods, are predicted to increase the effects of disturbance on Bathurst caribou. Relative to the other projects in the area, the Project as currently proposed (a three-and-a-half month operational window and with the traffic volumes predicted at the onset of operations) will contribute to a relatively low proportion of disturbance.

Ahiak Herd

The Ahiak herd is predicted to experience a low residual effect due to disturbance from the Project alone. A number of additional projects have the potential to overlap with the range of this herd, and may add to the level of disturbance (Figure 11.5-2). Of particular importance to this herd will be the proposed development of the Hope Bay deposits which are in proximity to the calving and post-calving areas for this herd and will have the largest disturbance effects. The operating Diavik and Snap Lake projects and the proposed BIPR, Gahcho Kué, and Hackett River developments are on the western margin of the Ahiak range. The majority of the Ahiak range occurs in an area of relatively few current or proposed developments. Therefore, cumulative impacts on disturbance of Ahiak caribou are predicted to be low.

The Project is predicted to account for a proportionally large portion of the cumulative disturbance, especially if traffic volumes increase and the hauling seasons include summer truck traffic.

11.5.4.3 Disruption of Movement

The disruption of movement is often the largest single effect of linear developments on wildlife. The disruption of movement for caribou was rated as Low for the Bathurst, Ahiak, and Dolphin and Union herds, and as Moderate for Peary caribou, by the effects assessment for BIPR. The main cumulative effects on movement for caribou will result from:

1. increasing traffic volumes, since high traffic levels are known to deflect movement of caribou (Murphy, 1988; Rescan, 2007); and
2. potential addition to the BIPR road use to greater than three-and-a-half months per year.

The truck traffic on the BIPR road from existing mines is predicted to be 14,098 one-way truck journeys per year, equivalent to approximately 140 one-way truck journeys per day over the winter haul season (mid-January to April). Truck traffic will increase to approximately 40,950 one-way truck journeys per year if the proposed developments are added (see section 2.3.5).

To determine potential cumulative effects, the road operational period is assumed to be extended beyond three-and-a-half months per year if the proposed projects are developed (see Section 2.3.6).

Bathurst Herd

The Bathurst herd is predicted to experience a Low residual effect on movement due to the Project as described in the effects assessment. The road will account for the majority of this effect, while the port and camp will not likely act as a significant barrier to movement.

If the hauling season for the road is not extended and remains restricted to mid-January to April, the cumulative effects on movement of caribou are expected to be low; although a very high traffic volume would be compressed into that three-and-a-half month window, very few if any Bathurst caribou are predicted to be in the vicinity of the road during the mid-January to April winter haul season.

If the road hauling season includes summer hauling, trucks could be travelling on the BIPR road while adults and calves are in the area and are moving across the road from calving to summering areas. If the use of the road during the caribou calving and post-calving season (May 15 to July 15) were to be restricted in accordance with Conformity Requirement 3.1 (Interim

Protection of Caribou) of the Draft West Kitikmeot Regional Land Use Plan (NPC, 2005), the potential cumulative effects would be reduced.

Ahiak Herd

The Ahiak herd is predicted to experience a Low residual effect on their normal movement patterns due to the Project as described in the effects assessment. The effects of increasing traffic volume will present a similarly elevated barrier to movement as outlined for Bathurst caribou. However, the Ahiak herd is only present in the RSA between approximately November 1 and June 5, and predominantly adults are expected to enter the RSA because calving occurs east of Bathurst Inlet and the road.

Dolphin and Union Herd

The Dolphin and Union herd is predicted to experience a Low residual effect on movement patterns due to the Project shipping requirements as described in the effects assessment. Additional projects will increase shipping traffic through Dease Strait and the Queen Maud Gulf, which the Dolphin and Union caribou cross on the ice during spring and fall migration. It is projected that between 42 and 66 one-way movements of vessels will be required each year (see Sections 2.3.3).

Increased ice-tolerant ship traffic in the fall (in October especially) may delay ice formation across Bathurst Inlet and Dease Strait or result in thin, unstable ice during freeze up. This could result in altered timing of migrations or the number of caribou breaking through ice may increase. Shipping is planned for the normal open water season, as outlined in the Draft West Kitikmeot Regional Land Use Plan (NPC, 2005).

Peary Caribou

Peary caribou are predicted to experience a Moderate residual effect on movement patterns due to the Project as described in the effects assessment. Additional projects will increase shipping traffic through Franklin Strait and Peel Sound, which Peary caribou cross during spring and fall migration. Increased ship traffic in the fall could break up the ice bridge, or delay ice formation across Franklin Strait and Peel Sound, which may delay when Peary caribou cross the ice bridge.

Delayed freeze-up or crushed ice in the shipping route could alter the timing of migration or result in caribou breaking through the ice, and has been identified as a threat to this endangered herd (COSEWIC, 2004). Significant ice forms in Franklin Strait and Peel Sound by early October (Section 2, Figure 2.4.29 and 2.4.30 in Appendix D-3 of the DEIS) which suggests that the timing of migration may overlap with the proposed shipping period. Shipping is planned for the normal open-water season as defined in the Draft West Kitikmeot regional Land-Use Plan (NPC, 2005). However, the “open water” season can support considerable ice and the exact timing of fall migration of Peary caribou across the ice is not known, while the period of ice-formation varies each year. There are also very few of this endangered group remaining (estimate of 60) and there is high potential for Peary caribou movements to be disrupted due to shipping (COSEWIC, 2004).

11.5.4.4 Features Acting as Attractants

Bathurst and Ahiak caribou are predicted to experience a Negligible residual effect of features acting as an attractant due to the Project alone. Caribou may use the road as a travel corridor and be exposed to vehicle collisions. Additional mining projects and traffic are unlikely to measurably increase this effect and the cumulative effect is not thought to increase in magnitude.

11.5.4.5 Indirect Mortality

Indirect mortality due to immigration and increased hunting in the area was rated as Low for the Bathurst, Ahiak, and Dolphin and Union Herds in the Project effects assessment (Appendix D-3 of the DEIS). No immigration is expected due to the Project along the northern portion of the shipping route leading to a Negligible rating for Peary caribou.

One source of indirect mortality may result if immigration occurs into the area and increased hunting occurs around settlements and as a consequence of increased access due to the road. Increased hunting is unlikely because the resident population in the area is very low, the area is already accessible by snowmobile during the winter and the road will be difficult to access during the summer since both ends of the road require water access and transportation of a vehicle to the road.

Indirect mortality to caribou may also occur if predators use the road as a travel corridor, increased stress levels in animals, and increased dusting and metals uptake through food sources.

Bathurst Herd

Several proposed projects will overlap with the range of this herd and may lead to increased indirect mortality (Figure 11.5-1). Frequent disturbances may lead to chronic elevations in stress hormones which can lead to decreased survival and reproductive output. Predators may use the road for travel and hunt caribou along the road. However, increased traffic volumes will likely lead to greater deterrence of predators, which may eliminate this concern.

Developments may also cause indirect mortality via toxicological effects. Many existing and proposed mines fall within the range of Bathurst caribou, including EKATI, Diavik, Hackett River, Izok Lake, Jericho, High Lake and Gahcho Kué. These projects may result in increased dusting and release of metal contaminants which can be taken-up by plants and consumed by caribou. Several closed projects may also increase the metals and contaminants in the surrounding areas, including Colomac, Rayrock, Discovery and Salmita/Tundra mines.

Cumulative effects due to decreased health and contaminant burdens are expected to be low. The relative contribution of the Project alone is small relative to the potential impact of combined projects in the area.

Ahiak Herd

The range of this herd contains several developments (BIPR, Hope Bay, EKATI, Diavik, Snap Lake and Gahcho Kué), which may yield increased stress and contaminant effects.

Dolphin and Union Herd

The range of this herd contains fewer developments (BIPR, Hope Bay, and High Lake), yielding a lower cumulative rating for increased stress and contaminant effects than for the Bathurst herd.

11.5.4.6 Reduction of Reproductive Productivity

Reduction in productivity as a result of interactions between other effects was rated as Low for the Bathurst and Ahiak caribou in the Project effects assessment. Reduction in productivity for Dolphin and Union, and Peary caribou, were rated as Negligible because these herds were exposed to fewer other effects which could interact and produce a reduction in productivity.

Bathurst Herd

Disturbances and displacement of caribou during sensitive periods such as calving and post-calving may alter the stress and nutritional status of females and cause a decreased reproductive success. Several proposed projects may occur near the calving and post-calving ranges of this herd, including Hackett River and High Lake projects (Figure 11.5-1).

Multiple existing and potential projects also overlap with the fall mating/rutting areas (*e.g.*, Snap Lake, Yellowknife Gold and Gahcho Kué). All of the other impacts discussed for Bathurst caribou, including disturbance, habitat loss, indirect mortality and disruption of movements may all synergistically act to decrease the reproductive success of Bathurst caribou.

The effects on reduced reproduction are expected to result mainly from other projects, with a relatively small influence of the Project alone. Those projects that occur near the calving and rutting areas, or any projects that extend the seasonal use of the road, will likely have the largest influence on this herd.

Ahiak Herd

Several projects will overlap with the range of the Ahiak caribou, including the Hope Bay deposits and Hackett River (Figure 11.5-2). Development of proposed projects such as Hackett River may add to the seasonal use of the BIPR road. Other projects such as Snap Lake, Gahcho Kué and Diavik have the potential to overlap with the Ahiak caribou as they move from their wintering grounds northward to their calving grounds.

These projects are on the western edge of the range of this herd and may interact with a small proportion of Ahiak caribou population, and most will interact with caribou prior to calving.

11.5.5 Significant Cumulative Effects

The potential cumulative effects of development projects, including BIPR, on the Bathurst caribou are expected to be ***Moderate***. With the development of other projects, the road may be used past the projected 20 year lifetime, and some effects, such as increased access, will not dissipate when the road is closed. This rating reflects the combined effects of habitat loss (***Low***), disturbance (***Low***), disruption of movements (***Moderate***), features acting as attractants (***Low***), indirect mortality (***Low***), and reduction in reproduction (***Moderate***). This assessment indicates that careful monitoring and management of Bathurst caribou will be required to maintain the population at a sustainable level.

Ahiak caribou are rated as having a combined potential cumulative effects rating of ***Low***. This rating is reflects the combined effects of disturbance (***Low***), disruption of movements (***Low***), features acting as attractants (***Low***), indirect mortality (***Low***), and reduction in reproduction (***Low***). Dolphin and Union caribou are also rated as ***Low*** due to the potential for disruption in movements across Dolphin and Union Strait (***Low***) and indirect mortality (***Low***).

Peary caribou are given a potential cumulative effect rating of Moderate due to a small population size, the potential for disruption of movements (***Moderate***) and low level of confidence in the exact timing of fall migration of Peary caribou across sea ice.

11.5.6 Mitigation, Management and Monitoring

The proposed mitigation and management plan developed for the Project, can be found in Appendix D-3 (Wildlife and Wildlife Habitat Effects Assessment) of the DEIS. Elements of the plan include:

- Caribou (Section 5.2);
- Roads (Section 5.4);
- Wastes (Section 5.5); and
- Employee Education (Section 5.7).

Monitoring programs were developed to compare the observed effects against the predicted effects in the Wildlife Effects Assessment, thus enabling an ongoing assessment of Project environmental performance relative to wildlife and habitat protection goals (Section 6, Appendix D-3 of the DEIS), and include:

- Caribou Monitoring Program (Section 6.2);
- Road and Wildlife Monitoring Program (Section 6.4); and
- Employee Wildlife Education Monitoring Program (Section 6.7).

Mitigation, management and monitoring plans are offered as recommendations and will be refined during the EA process leading to the Final Environmental Impact Statement (FEIS) and Project Certificate. The cumulative assessment also indicates that monitoring and management of caribou populations on a regional scale, outside the scope of any single project, may be required.

11.6 Muskox

11.6.1 Residual Effects of the Project

The Project effects assessment (Appendix D-3) rated four residual effects as significant for muskox; habitat loss, disturbance, indirect mortality and reduction in reproductive productivity (Table 11.2-1). One effect, disruption of movement, was assessed as negligible in the effects assessment, but is also re-assessed here.

11.6.2 Spatial Boundary

Muskox are present in the RSA throughout the year (Appendix D-7) and have relatively small home ranges; the average home range size is 70 km^2 (Reynolds, 1998). Based on this average home range size, muskox with home ranges approximately 50 km from the road could still enter the 30 km RSA on either side. Cumulative effects boundaries for muskox were thus defined as 50 km on either side of Project facilities (Figure 11.6-1). Muskox are a resident species in the RSA and thus have potential to interact with projects in this area year round.

11.6.3 Interactions with Other Project Developments

Figures 11.6-1 shows all other active, proposed and closed developments that could interact with muskox that could enter the BIPR RSA. The proposed Hackett River mine is the only project within the muskox RSA for BIPR. Existing developments including EKATI, Diavik, Jericho and Snap Lake, and potential future projects including Izok Lake, Gahcho Kué and Hackett River are expected to use the BIPR road, which would contribute to road traffic experienced by muskox. Therefore, traffic contributions of these projects to the BIPR road are also considered in this assessment.

11.6.4 Combined Effects of Human Activities

11.6.4.1 Habitat Loss

Habitat loss due to the addition of the Hackett River project will include the direct footprint of the mine, camp, support facilities and quarries as well as the haul road that will be built to connect the Hackett River project to the BIPR road. Indirect habitat loss due to degradation of vegetation surrounding the mine site may also occur. The area of habitat expected to be removed due to the combination of the BIPR and Hackett River projects is small in comparison to the area of the muskox RSA.

11.6.4.2 Disturbance

The Hackett River development and spur road to connect with the BIPR road may increase disturbances to feeding and breeding behaviours. Disturbances include helicopter support, hauling and blasting. Muskox may avoid disturbed areas, resulting in indirect habitat loss.

Disturbance can also cause muskox to alter their regular behavioural patterns, which can impact the ability of muskox to breed successfully (thus reducing their reproductive productivity) or may cause changes in their behaviour (*e.g.*, more startle responses and therefore less time spent feeding) (Macarthur *et al.*, 1982; Moen *et al.*, 1982; McLaren and Green, 1985). Disturbances are especially detrimental to muskox during late winter/early spring (April to June) and rutting/autumn (August to September) when animals are calving and developing fat reserves critical for reproduction and survival.

The development of future projects would also increase haul traffic on the BIPR road, and periods of road operations may be added, increasing the time period over which muskox are exposed to disturbances.

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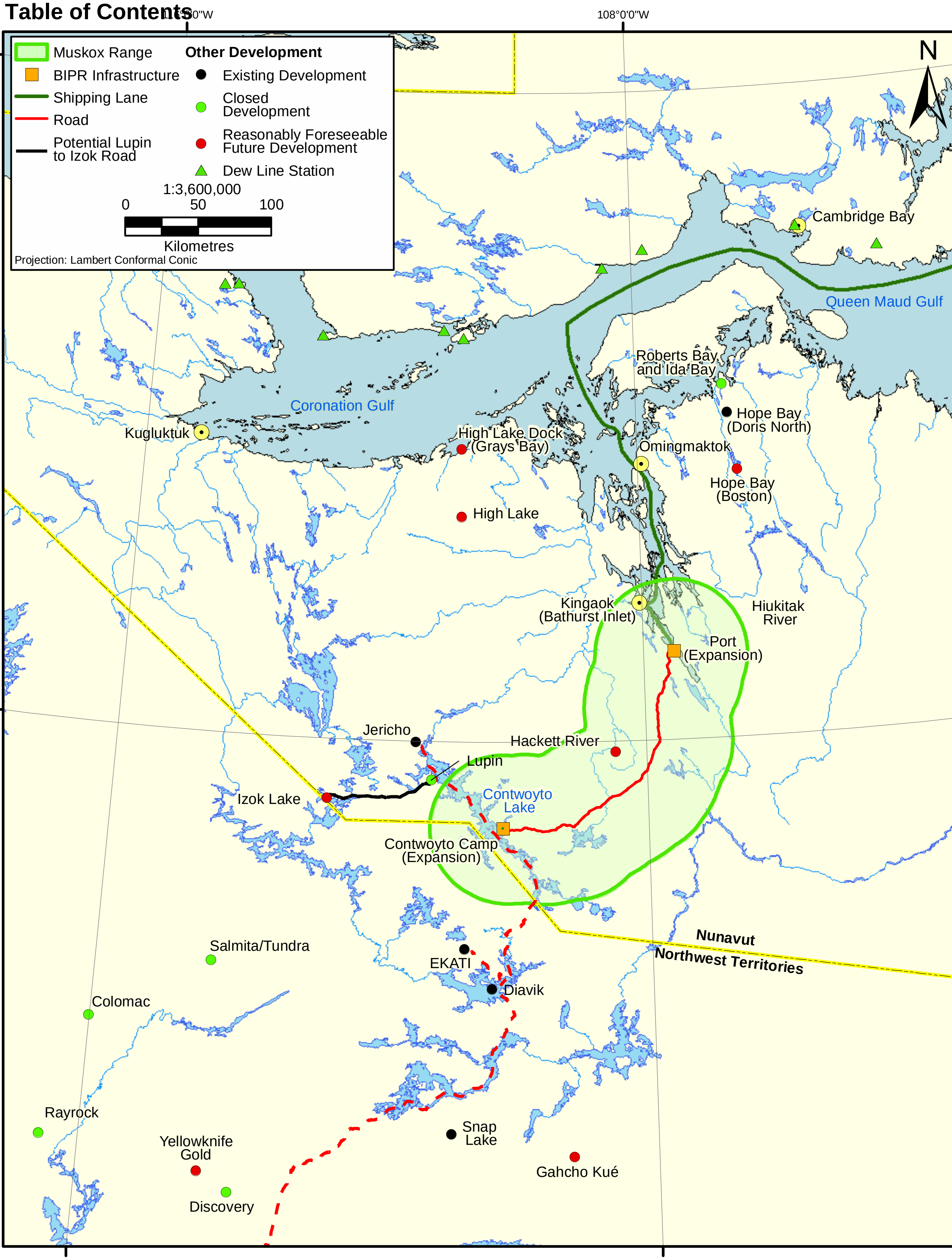

FIGURE 11.6-1

Projects Potentially Contributing to Cumulative Effects on Muskox

the Bathurst Inlet Port and Road Project

Rescan

11.6.4.3 Disruption of Movement

The Hackett River project will create an additional east-west road between this project and the BIPR road. This road may act as a barrier to movements of muskox. Additional projects would also increase the volume of traffic on the BIPR road (see Section 2.3.6). Few data exist on the interactions between muskox and roads, but the permeability of road to crossing by other ungulates decreases with increased traffic. As muskox are present year round, those with home ranges that include the BIPR road, or the Hackett River mine site or connecting road, may experience alterations to their movement patterns. Muskox have high fidelity to their home ranges and major shifts to new home ranges are rare (Reynolds, 1998).

11.6.4.4 Indirect Mortality

Potential shifts in population due to developments in the area and increased access along the road may increase the hunting rate of Muskox in the RSA; either increasing the total hunting rate or redistributing hunting pressure to this areas.

11.6.4.5 Reduction of Reproductive Productivity

The muskox population in the RSA is currently declining and reproductive rates are low (Dumond, 2006, 2007); therefore, an increase in projects in this area may be detrimental for this population. The combined influence of the Hackett River project and the increasing traffic along the BIPR road due to other proposed projects have the potential to reduce muskox reproductive productivity.

Muskox herds often break and stampede when approached by people on foot, by snowmobiles or other vehicle (Gray, 1973; Russell, 1975). Calves can be left behind when muskox herds stampede as a result of disturbances, leading to death of calves (Gunn and Adamczewski, 2003). Potential future projects that contribute to traffic volume and that may extend the seasonal use of the road are predicted to play a potential role in reducing reproductive rates.

11.6.5 Significant Cumulative Effects

The potential cumulative residual effects of BIPR and the other projects in the area are rated ***Low*** for Muskox, with habitat loss (***Low***), disturbance (***Low***) and disruption of movements (***Low***) during the winter season, indirect mortality (***Low***) and reduction in reproductive productivity (***Low***) as drivers for this rating..

11.6.6 Mitigation, Management and Monitoring

The applicable section of the proposed mitigation and management plan are reviewed in Section 11.5.6 and the plan can be found in Appendix D-3 of the DEIS.

11.7 Grizzly Bear

11.7.1 Residual Effects of the Project

The BIPR effects assessment rated two effects as significant for grizzly bears; features acting as attractants and reduction in reproductive productivity (Table 11.2-1). Two other effects were rated as negligible in the effects assessment, but are reviewed here: disruption in movements and indirect mortality.

11.7.2 Spatial Boundary

Grizzly bear female and male adults can range over 2,000 to 7,000 km^2, and sub-adult male grizzly bears can range over 40,000 km^2 (McLoughlin *et al.*, 2002). The spatial boundaries for grizzly bears include the area within which a sub-adult male may travel and interact with existing and proposed developments and extends 200 km from the BIPR road port and camp (Figure 11.7-1).

11.7.3 Interactions with Other Project Developments

Figures 1.4-1 displays all of the active, proposed and closed developments that could interact with grizzly bears in the BIPR RSA. Effects are assessed for April to November when grizzly bears are active. While in hibernation, bears are still susceptible to effects that occur in close proximity to den sites, such as construction. Although most of the assessment will be discussed in relation to summer habitat, effects relating to winter dens will be addressed where applicable.

11.7.4 Combined Effects of Human Activities

11.7.4.1 Disruption of Movement

Other developments in the RSA are unlikely to impede the movement of grizzly bears. However, the additional summer traffic produced by these projects that would use BIPR facilities may disrupt seasonal or foraging movements of bears across the BIPR road. Future projects including Izok Lake, Gahcho Kué and Hackett River, will all contribute to vehicular traffic along the BIPR road. Roads with high density traffic can act as a barrier to grizzly bear movements (McLellan and Shackleton, 1989; Mace *et al.*, 1996; Gibeau and Herrero, 1998; Benn and Herrero, 2002; Wielgus *et al.*, 2002; Waller and Servheen, 2005). These studies report that avoidance depended on traffic levels. Females are particularly sensitive and avoid crossing large roads in some parts of their range (Ross, 2002; Waller and Servheen, 2005). However, in some cases, grizzly bears will continue to use habitats adjacent to developments (*e.g.*, a collared female was resident at EKATI before construction and this individual continued to use the same habitat areas after construction).

Effects of traffic will not be important for grizzly bears if a three-and-a-half month haul period is maintained. However, if summer road operating periods are added, traffic is expected to coincide with the period when grizzly bears are active and accumulating their fat reserves for winter hibernation. Vehicular traffic rather than the physical structure of the road itself is expected to contribute the greatest to impeding grizzly bear movement

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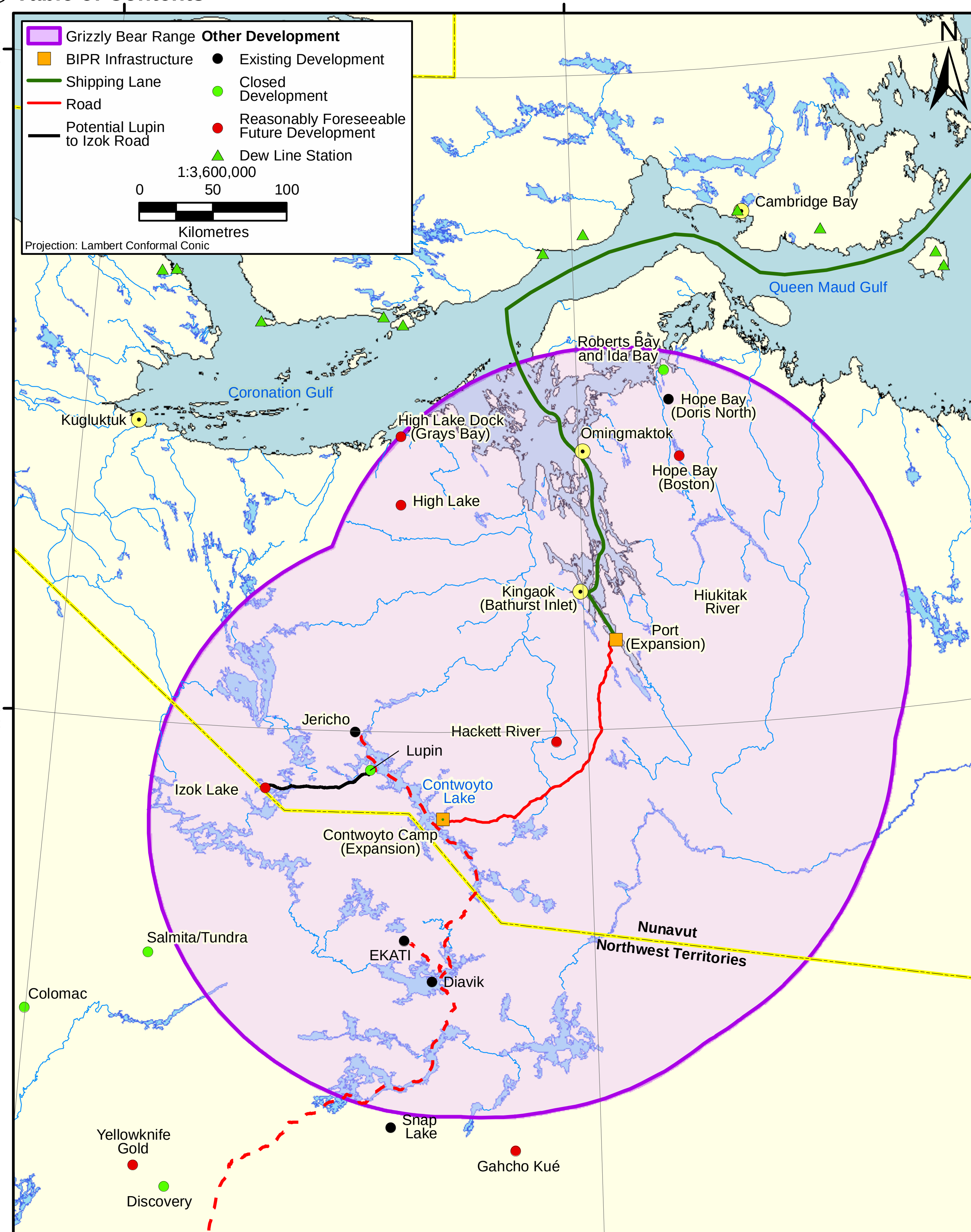

FIGURE 11.7-1

Projects Potentially Contributing to Cumulative Effects on Grizzly Bears

the Bathurst Inlet Port and Road Project
Rescan™

11.7.4.2 Features Acting as Attractants

Grizzly bears are often attracted from long distances to a human settlement in search of food. Additional camps associated with the construction and operation of the eight developments that occur in the area assessed for cumulative impacts on grizzly bears will increase the probability of attraction of bears. The more areas where bears are attracted to scents of foods and wastes, or where they will potentially receive a reward, the greater the chance of producing habituated bears. A crucial consideration for cumulative effects on attraction of grizzly bears is that one poorly managed camp has the potential to attract and create habituated bears that can then move into many other areas of human use; thus the probability of creating and interacting with habituated bears increases exponentially with the number of new developments in an area. Issues of human safety can result from habituated bears, whereby destruction of the animal may be a last resort.

11.7.4.3 Indirect Mortality

As grizzly bears are present at low densities in the Arctic tundra, have large range size, a late age of maturity, and a naturally low reproductive rate (Appendix D-3 of the DEIS), they have low ecological resiliency (capacity to absorb disturbance or stress and recover to a similar state before the stress was imposed) and are sensitive to human activity or elevated causes of mortality (McLellan, 1990; Weaver *et al.*, 1996; Ross, 2002). In addition, grizzly bears may also be susceptible to starvation if their main prey item, caribou, decline in the area. However, grizzly bears are not entirely dependent on caribou, and can rely on other sources of forage (*e.g.* berries, small mammals).

The main potential source of indirect mortality identified for grizzly bears was an increase in hunting pressure from greater human accessibility to the area. The Kitikmeot communities surrounding the Project may grow in size as a result of the creation of BIPR and other projects. Some studies indicate that indirect mortality of grizzly bears as a result of roads and increased hunting pressure is of far greater concern than direct morality (McLellan and Shackleton, 1988; Titus and Beier, 1991; Ross, 2002). The Bathurst Inlet grizzly bear population have a total annual harvest (TAH) rate of six bears (including problem kills), recommended by the Nunavut Department of Environment (2005). Grizzly bears may be harvested in a ratio of two males to one female, but harvest is not recommended for females accompanied by cubs given poor survival rates of orphaned cubs (GN DOE, 2005). Since hunting of grizzly bears is regulated by the Government of Nunavut, increased hunting pressures caused by growing populations will likely not increase the residual effects.

11.7.4.4 Reduction of Reproductive Productivity

The potential for a reduction in reproductive productivity in grizzly bears depends on the magnitude of disturbances they experience. Disturbance leading to displacement of female grizzly bears with young to lower quality habitats adjacent to the development, separation of females and young as a result of traffic presence or disturbance along the road, or mortality of females or young, either direct or indirect, along the road would likely lead to the greatest effects on local grizzly bear populations.

11.7.5 Significant Cumulative Effects

The potential cumulative effects on grizzly bear are rated as ***Low***, with features acting as attractants (***Low***) and reduction in reproduction (***Low***) being the drivers for this assessment.

11.7.6 Mitigation, Management and Monitoring

The applicable section of the proposed mitigation and management plan are reviewed in Section 11.5.6 and the plan can be found in Appendix D-3 of the DEIS.

11.8 Wolverine

11.8.1 Residual Effects of the Project

The BIPR effects assessment rated six residual effects for wolverine: disturbance, disruption of movements, features acting as attractants, direct and indirect mortality, and reduction in reproductive productivity (Table 11.2-1).

11.8.2 Spatial Boundary

Studies conducted in Nunavut estimated that the home range of male wolverines average 400 km^2, and that females range over significantly smaller areas (126 km^2). These same studies also found that juveniles range over larger areas than mature animals (Lee, 1997; Mulders, 2000). Based on the average home ranges of wolverine, individuals with home ranges approximately 50 km from the road could still enter the 30 km RSA. Cumulative effects boundaries for wolverine were thus defined as 50 km on either side of the road, port and camp facilities – the same RSA as muskox (Figure 11.6-1). Wolverines are year-round residents of the study area and are active during all seasons. Therefore, they will likely be exposed during all aspects of developments that occur within this area.

11.8.3 Interactions with Other Project Developments

Wolverines in the BIPR RSA could directly interact with the proposed Hackett River project (Figure 11.6-1). Other existing developments including EKATI, Diavik, Jericho and Snap Lake and future projects including Izok Lake, Gahcho Kué and Hackett River, will all contribute to vehicular traffic along the BIPR road. Therefore, traffic contributions of these projects to the BIPR road are also considered in this assessment.

11.8.4 Combined Effects of Human Activities

11.8.4.1 Disturbance

Disturbances to wolverine in the RSA include noise from construction and operations of the proposed Hackett River project and increased traffic along the road and at the port. Proposed developments will increase traffic along BIPR road and the level of disturbance. Wolverines avoid areas of human activity and hide during aircraft overflights (AXYS Environmental Consulting Ltd. and Penner and Associates Ltd., 1998; AMEC Americas Limited, 2005), resulting in reduced feeding, greater vigilance, and/or increased metabolic stress levels. Disturbance events near the den that occur during the late winter denning period may result den abandonment (Magoun and Copeland, 1998; Heinemeyer *et al.*, 2001).

The BIPR effects assessment evaluated the effects of wolverine avoiding the road as Negligible. Once wolverine have avoided the road, it is unlikely that greater traffic volumes will increase this zone of avoidance. Additional habitat areas will be lost due to disturbance from the Hackett River project and spur road.

11.8.4.2 Disruption of Movement

Wolverines prefer large, untouched areas, yet their home ranges can overlap active traplines, busy logging roads and the edges of communities (COSEWIC, 2003). In British Columbia, wolverines avoided areas within 100 m of the Trans Canada Highway and preferred areas more than 1,100 m away (Austin, 1998), and avoided areas with developments (Krebs *et al.*, 2004; Lofroth and Krebs, 2007). As with other wildlife, wolverine avoidance of roads and hence the effects of the road as a barrier to movement is likely dependant on the level of traffic.

The traffic expected during the winter haul season is expected to disrupt wolverine movements to some degree. Proposed projects and the potential addition of summer haul seasons will likely increase this effect. However, wolverine do not conduct seasonal migrations and there is evidence that they will cross roads with moderate traffic densities (Austin, 1998; Krebs *et al.*, 2004; Lofroth and Krebs, 2007).

11.8.4.3 Features Acting as Attractants

Wolverine are attracted to human settlements and are a problem animal at mining developments in Nunavut and Northwest Territories. Improperly disposed-of wastes and food smells attract wolverines which can interact with hazardous substances (*e.g.*, plastics and oils) or become problem animals. The Project contributes only two camps to the RSA and is a relatively small portion of this cumulative effect.

11.8.4.4 Direct Mortality

Wolverines, being scavengers, can be attracted to roads by carrion from road-killed wildlife. Also, wolverines are known to use snowmobile and ski paths as travel routes, so the road may also be used by wolverines (unpublished reports referenced in Jalkotzy *et al.*, (1997)). Wolverines may be adversely affected due to the increased traffic on the BIPR road, construction of the Hackett River spur road that will connect to the BIPR road, as well as the potential seasonal extension of the road use to twelve months, which includes seasons when wolverine are actively moving long distances and following prey. With mitigation, including speed controls, cumulative impacts on direct mortality to wolverine are predicted to be low (Krebs *et al.*, 2004; Lofroth and Krebs, 2007).

11.8.4.5 Indirect Mortality

Increased population and access to the area may lead to increased hunting and trapping of wolverine (COSEWIC, 2003). Wolverines are highly valued for their pelts and hunting of this species is not regulated by the Government of Nunavut. .

11.8.4.6 Reduction of Reproductive Productivity

Wolverines have low population densities and reproductive rates, making their populations particularly susceptible to alterations in reproductive productivity. The loss of a few individuals as a result of increased road traffic or extension of the road haul season could have important consequences for the greater population. Changes to dispersal and feeding behaviours may also increase stress levels, decrease physical condition and thus decrease reproductive success of wolverines.

11.8.5 Significant Cumulative Effects

The cumulative effects on wolverine are rated as ***Low***, with disturbance (***Low***), disruption of movements (***Low***), features acting as an attractants (***Low***), direct mortality (***Low***), indirect mortality (***Low***), and reduction in reproduction (***Low***) being the drivers for this assessment.

11.8.6 Mitigation, Management and Monitoring

The applicable section of the proposed mitigation and management plan are reviewed in Section 11.5.6 and the plan can be found in Appendix D-3 of the DEIS.

11.9 Wolf

11.9.1 Residual Effects of the Project

The BIPR effects assessment rated one residual effect as significant for wolves: features acting as an attractant. Three other effects were rated as negligible in the effects assessment and are re-evaluated here: disruption of movement, indirect mortality, and reduction in reproductive productivity.

11.9.2 Spatial Boundary

A study in the central Canadian Arctic estimated annual range sizes for wolves of approximately 63,000 km^2 for males, and approximately 45,000 km^2 for females (Walton *et al.*, 2001). The cumulative effects RSA for the spring and summer, when wolves are in the area, extends 280 km from the port, road and camp, the approximate range of a male wolf (Figure 11.9-1). During the winter, wolves follow the caribou south and out of the BIPR wolf RSA.

11.9.3 Interactions with Other Project Developments

Several active, proposed and closed developments occur in the wolf RSA including: High Lake, Hope Bay, Gahcho Kué, and Lupin (Figure 11.9-1). Proposed projects such as Izok Lake, Gahcho Kué and Hackett River are all expected to contribute to vehicular traffic along the BIPR road. Therefore, traffic contributions of these projects to the BIPR road are also considered in this assessment.

11.9.3.1 Disruption of Movement

Multiple other projects will fall within the range of wolves that could enter the BIPR RSA. While wolves may avoid project footprints and surrounding disturbed areas, the developments themselves are not predicted to have a significant effect on the movements of wolves. Wolves do not have an aversion to roads and readily travel on roadways if traffic levels are low (Gehring, 1995), however they do avoid roads with high traffic volumes (Thurber *et al.*, 1994; Frair, 1999). Several studies have reported that wolves do not persist where road density exceeds 0.6 km/km^2 (Thiel, 1985; Jensen *et al.*, 1986; Mech *et al.*, 1988). Increased traffic and the potential extension of the haul season may impede normal long distance movements of wolves, which follow caribou for seven months of the year.

11.9.3.2 Features Acting as Attractants

In some cases, wolves are attracted to human settlements at developments in Nunavut and Northwest Territories. Improperly disposed-of wastes and food smells attract wolves which can interact with hazardous substances (*e.g.*, plastics and oils).

11.9.3.3 Direct Mortality

Direct mortality for wolves may occur due to vehicle collisions along the road. Collisions of vehicles with wolves are a minor source of wolf mortality in North America (Frame, 2005) and although wolves can learn to avoid high-traffic routes, they do not avoid all roads (Gehring, 1995). Mech (1989) concluded that relatively small areas of high road densities can sustain wolves so long as suitable roadless areas are nearby. However, projected traffic volumes for the road are expected to be relatively high, especially north of Hackett River. If the haul period includes June and July when wolves are resident in the area, wolves would have to navigate crossing the road at least once during their movements.

11.9.3.4 Indirect Mortality

Increased population and access to the RSA may result in increased trapping and hunting. Wolves are hunted for their pelts and hunting of this species is not regulated by the Government of Nunavut.

11.9.3.5 Reduction of Reproductive Productivity

Reproductive success in wolves is strongly related to prey availability (Fuller, 1989; Frame, 2005). In the central Arctic, prey availability is a function of caribou migration patterns (Frame, 2005). Scarce prey will influence reproductive success, so the availability and health of barren-ground caribou in the region are vital to the reproductive success of the wolf population. Given that the majority of pup mortality occurs within the first six months of life (Harrington and Mech, 1982), females and pups are especially vulnerable to the effects of disturbance around their den sites. Disturbances that affect den site selection and activity around the den will affect reproductive success of the pack.

Developments that alter the distribution or timing of caribou migration may have profound effects on reproductive success of wolves (Walton *et al.*, 2001). As multiple developments will interact with the range of wolves entering the BIPR RSA, and since cumulative effects of these projects on caribou are predicted to be low, cumulative effects on reproduction of wolves are also expected to be low.

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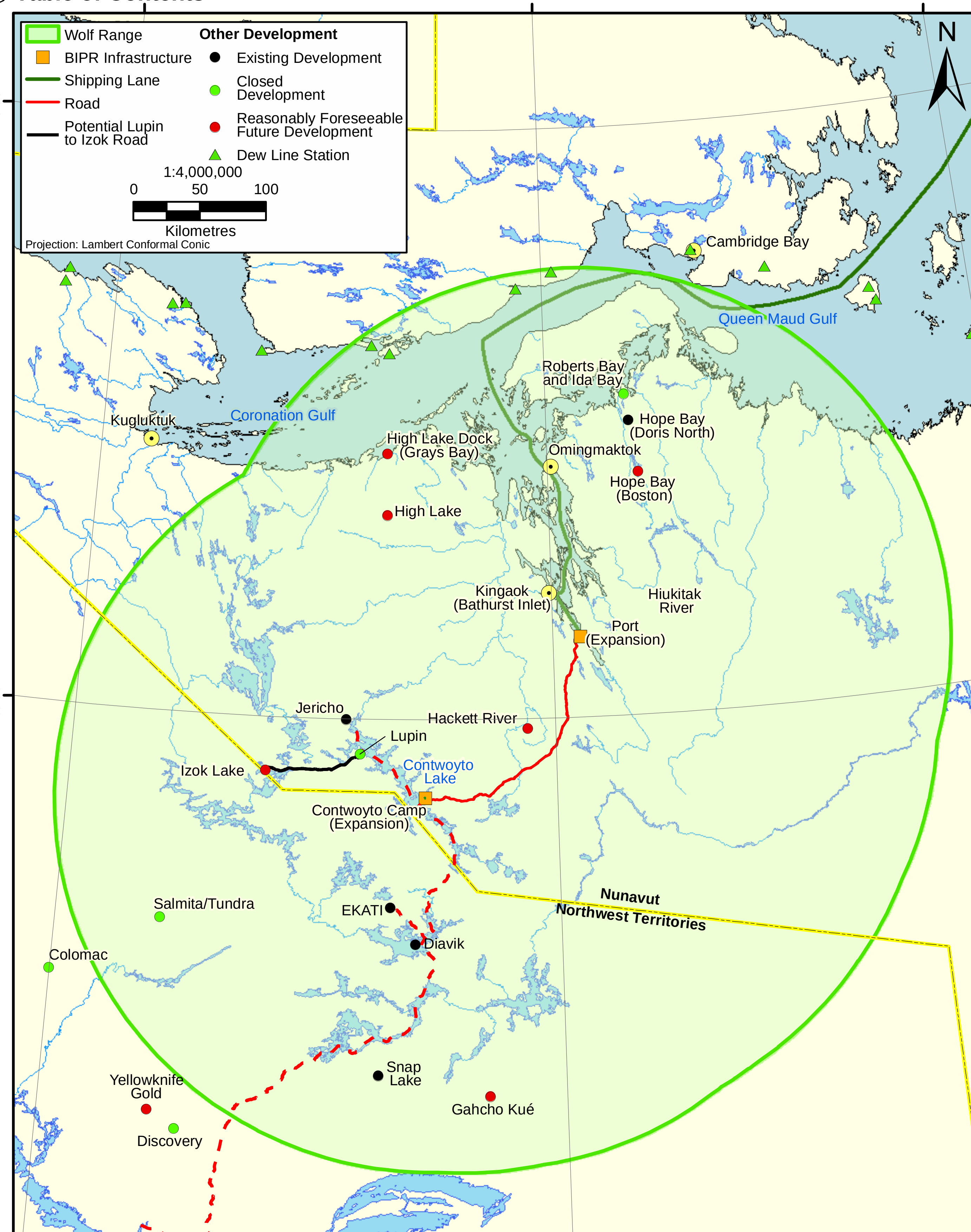

FIGURE 11.9-1

the BATHURST INLET PORT AND ROAD PROJECT

Projects Potentially Contributing to Cumulative Effects on Wolves

Rescan

11.9.4 Significant Cumulative Effects

The cumulative effects on wolf are rated as ***Low***, with indirect mortality (***Low***) and reduction in reproduction (***Low***) being the drivers for this assessment..

11.9.5 Mitigation, Management and Monitoring

The applicable section of the proposed mitigation and management plan are reviewed in Section 11.5.6 and the plan can be found in Appendix D-3 of the DEIS.

11.10 Migratory Birds

11.10.1 Residual Effects of the Project

The BIPR effects assessment did not rate any residual effects on migratory birds as significant. However, three effects which were rated as negligible are re-assessed here; features acting as an attractant, direct mortality, and reduction in reproductive productivity (Table 11.2-1).

11.10.2 Spatial Boundary

Migratory birds in the central Arctic comprise a diverse number of species that migrate from all over the world in order to breed. The BIPR effects assessment examined the direct disturbance and mortality effects to birds within 1.5 km of the port, road and camp since birds in breeding territories can be affected by projects over this spatial scale (Reijnen *et al.*, 1996). The cumulative effects assessment combines the potential local effects of projects on birds to examine the potential effects to the migratory bird population in Nunavut and the Northwest Territories.

11.10.3 Interactions with Other Project Developments

This cumulative effects assessment evaluates the addition of the Project to a landscape with existing projects such as EKATI, Diavik, Jericho and Snap Lake, each of which could have detrimental effects on the population of migratory birds in Nunavut. Future projects, including Izok Lake, Gahcho Kué and Hackett River, are expected to contribute to vehicular traffic along the BIPR road. Therefore, traffic contributions of these projects to the BIPR road are also considered in this assessment.

11.10.4 Combined Effects of Human Activities

11.10.4.1 Features Acting as Attractants

In many areas, lighting appears to be primary negative effect on birds (Kerlinger, 2000; Manville II, 2000; Erickson *et al.*, 2005). Lighting during the migration period for night-migrating species can disorient birds in fog (Ogden, 1996), resulting in collisions and interference with migration routes (Squires and Hanson, 1918; Wiese *et al.*, 2001; Longcore and Rich, 2004). These effects are typically significant only when lights are at a high density and are not likely to be a significant effect in Nunavut despite an increased number of projects.

11.10.4.2 Direct Mortality

Some direct mortality to birds is expected due to vehicle strikes along the BIPR and adjoining haul roads. In the Canadian Rockies, small birds comprise 20-65% of small vertebrate roadkills (Clevenger *et al.*, 2003) with a peak during the breeding/fledging season (summer) and dispersal season (autumn). Birds in the Arctic tundra tend to fly just above ground level because there is minimal vegetation which makes birds there more susceptible to vehicle strikes. However, the low vehicle density and haul speeds result in this effect being insignificant along the BIPR road.

11.10.4.3 Reduction of Reproductive Productivity

Vegetation clearance and disturbance to birds during the breeding season could affect reproductive productivity in the area. Disturbed birds may abandon nests, causing egg mortality due to exposure when adults flush from the next, or increased predation from predators using the road as a travel corridor (Reijnen and Foppen, 1994; Reijnen *et al.*, 1995). These effects may be reversible if birds habituate to disturbances (Bears *et al.*, 2003) or relocate to new breeding sites

Relocating to new breeding habitats may occur if the habitat is not saturated for the species in question. The degree of saturation is unknown for most species. A conservative estimate of the cumulative impact is that areas removed and disturbed are lost as habitat and the resident birds are lost from the population.

11.10.5 Significant Cumulative Effects

The cumulative effects on migratory birds are rated as ***Low***, with reduction reproduction (***Low***) being the drivers for this assessment..

11.10.6 Mitigation, Management and Monitoring

The applicable section of the proposed mitigation and management plan are reviewed in Section 11.5.6 and the plan can be found in Appendix D-3 of the DEIS.

11.11 Peregrine Falcon

11.11.1 Residual Effects of the Project

The BIPR effects assessment did not rate any residual effects as significant for Peregrine Falcon. Three effect which were rated as negligible are re-assessed here; habitat loss, features acting as attractants, and reduction in reproductive productivity (Table 11.2-1).

11.11.2 Spatial Boundary

Peregrine falcon home ranges overlap their nesting range and can cover 27 km^2 (Government of the Northwest Territories, 2007). The peregrine falcon RSA is defined as 35 km from the Project. This boundary includes the 30 km boundary that was used for baseline monitoring studies, plus an additional 5 km that represents approximately one dimension of the range size, *i.e.*, the maximum distance that a bird would be likely to fly to reach the reach the edge of the baseline monitoring study area.

Raptors nest from April through August in the Arctic (Poole and Bromley, 1988). The availability of suitable cliffs for nesting is a critical for breeding and the same cliffs can be used for decades (Sinclair *et al.*, 2003). The cliffs within the RSA have not been mapped, and their locations are not all known; however, it is assumed that mining projects falling within this region have the potential to impact cliff nesting habitat (Figure 11.11-1).

11.11.3 Interactions with Other Project Developments

The Hackett River Project occurs within the peregrine falcon RSA (Figure 11.11-1). Proposed projects, including Izok Lake and Hackett River will contribute to vehicular traffic along the BIPR road. Therefore, traffic contributions of these projects to the BIPR road are considered in this assessment as well.

11.11.4 Combined Effects of Human Activities

11.11.4.1 Habitat Loss

Habitat for peregrine falcons is composed of a nesting area on a cliff and foraging areas. Raptors nest from April to August in the Arctic (Poole and Bromley, 1988). There, the peregrine falcon nests predominately on south facing cliffs, which can be used for decades, near waterbodies where this species forages for waterfowl and shorebirds (Sinclair *et al.*, 2003). Peregrine falcon nests are concentrated along Bathurst Inlet and overlap the proposed port and road (COSEWIC, 2007). Nest sites were also identified from Inuit Traditional Knowledge on the margins of Contwoyto Lake and near Bathurst Inlet (Appendix F-5 of the DEIS) and at Raptor Lake (H. Bears, Senior Wildlife Biologist, Rescan, *Pers. Obs*). Both cliff areas and lakes will be avoided for the Project due to engineering considerations. Other projects will likely also avoid these areas.

11.11.4.2 Features Acting as Attractants

Peregrine falcons hunt and scavenge road kill along roads (H. Bear, Senior Wildlife Biologist, Rescan, *Pers. Obs*), an effect rated by the BIPR effects assessment as **Negligible** since haul traffic is planned for the winter, when peregrine falcons are not present. Proposed developments will increase traffic and may include a summer haul season. However, at this time vehicle traffic will be very low, reducing the potential for vehicle-falcon interactions.

11.11.4.3 Reduction of Reproductive Productivity

The addition of other projects will increase traffic on the road and disturbance, and may increase the haul period which could then overlap with the peregrine falcon nesting period and result in increased disturbance to birds.

11.11.5 Significant Cumulative Effects

The cumulative effects on peregrine falcon are rated as **Low,** due to the potential for a reduction in reproductive productivity (**Low**).

11.11.6 Mitigation, Management and Monitoring

The applicable section of the proposed mitigation and management plan are reviewed in Section 11.5.6 and the plan can be found in Appendix D-3 of the DEIS.

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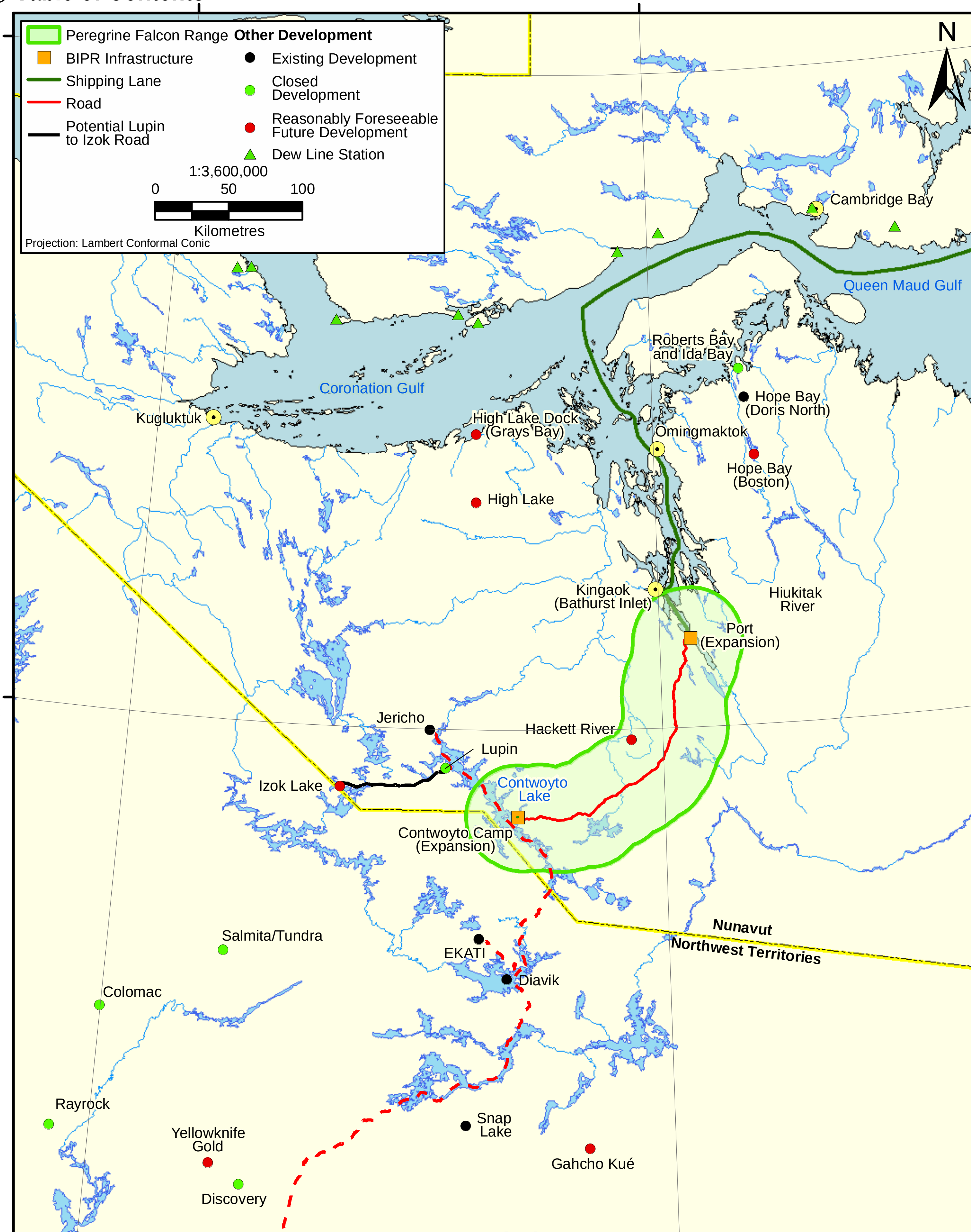

FIGURE 11.11-1

the Bathurst Inlet Port and Road Project

Projects Potentially Contributing to Cumulative Effects on Peregrine Falcon

Rescan™

11.12 Long-tailed Duck

11.12.1 Residual Effects of the Project

The BIPR effects assessment did not rate any residual effects as significant for long-tailed duck (Table 11.2-1). However, four effects which were rated as negligible are re-assessed here because of the potential for cumulative effects to be significant; habitat loss, disturbance, disruption of movements and features acting as attractants.

11.12.2 Spatial Boundary

The long-tailed duck nests along the Arctic coast, such as in Bathurst Inlet, and on inland tundra on dry ground close to water. As long-tailed ducks breed over vast ranges and are found at low densities, all habitat occurring around Bathurst Inlet and within the same area designated as the grizzly bear cumulative effects assessment area is considered as having a potential effect on the overall population of long-tailed ducks in the region. This area encompasses most projects that could affect watersheds associated with the BIPR RSA (Figure 11.7-1).

11.12.3 Interactions with Other Project Developments

Several active, proposed and closed developments are present within the long-tailed duck RSA. Additional proposed developments will increase the area of habitat removed and traffic on the BIPR road. Additional developments are also expected to increase the volumes of shipping traffic and barge traffic using BIPR port, and this marine traffic will also interact with long-tailed duck using Bathurst Inlet.

11.12.4 Combined Effects of Human Activities

11.12.4.1 Habitat Loss

Habitat for this species has been lost at existing mine sites and will be further lost through the Project and other proposed developments. Some habitat may also be degraded where these facilities border long-tailed duck habitat such as ponds, streams and wetlands.

11.12.4.2 Disturbance

Visual and auditory disturbances from existing projects, BIPR, and other potential projects can alter feeding, breeding and nesting behaviours of waterfowl and result in indirect habitat loss where projects are adjacent to long-tailed duck habitat. Noise from traffic has been shown to be the most critical factor in causing reduced bird densities close to roads (Reijnen *et al.*, 1995; Conomy *et al.*, 1998a; Conomy *et al.*, 1998b). Increased traffic volumes on the road and near the port facility are expected to result in small increases in the 24-hour average noise level, but are not expected to increase the maximum noise levels (Section 3.4). .

11.12.4.3 Disruption of Movements

Increasing traffic along the BIPR road or extension of the seasonal use of the road is not expected to significantly affect movements of long-tailed duck. Long-tailed ducks fly at significantly higher elevations than low flying migratory songbirds, and would not regularly fly over the road during foraging or other movements within their breeding season.

11.12.4.4 Features Acting as Attractants

Long tailed duck may be affected by lighting at the port facility and other developments, although the density of these lights on the landscape results in a negligible rating (Section 11.10.4.1)..

11.12.5 Significant Cumulative Effects

The cumulative effects on long-tailed duck are rated as ***Low*** due to habitat loss (***Low***) and disturbance (***Low***).

11.12.6 Mitigation, Management and Monitoring

The applicable section of the proposed mitigation and management plan are reviewed in Section 11.5.6 and the plan can be found in Appendix D-3 of the DEIS.

11.13 Summary of Assessment

Cumulative effects that were significant (low, moderate, or high) for each VEC and the confidence level of the assessment (low, intermediate, or high) are presented in Table 11.13-1. The combined effects of human actions are predicted to have moderate significance effects on Bathurst and Peary caribou), and low effects on muskox, grizzly bear, wolverine, wolf, migratory birds, peregrine falcon, and long tailed duck.

An important contributor to the potentially significant cumulative effects is the predicted change in road operating conditions, including increased traffic volumes and the potential extension of the road haul season. This could result in increased disturbance and disruption to movements, especially during sensitive life-stages. The projected increase in shipping traffic may also disrupt movements of the Peary caribou herd.

The effects of existing and reasonably foreseeable future developments cannot be assessed with a high degree of certainty without knowing their finalized project descriptions, construction and operations schedules, mitigation strategies, or locations and frequency of disturbances (*e.g.*, helicopter traffic for construction, blasting sites). Further, if a large scale shift in spatial movements of any of VEC occurs, cumulative effects may be diminished or elevated beyond expectations in this report.

Table 11.13-1
Summary of Significant Cumulative Effects and Confidence Levels for Wildlife and Wildlife Habitat

	Habitat Loss		Disturbance		Disruption of Movements		Features Acting as Attractants		Direct Mortality		Indirect Mortality		Reduction in Reproductive Productivity	
VEC	**Sig.**[1]	**Conf.**[2]	**Sig.**	**Conf.**	**Sig.**	**Conf.**	**Sig.**	**Conf.**	**Sig.**	**Conf.**	**Sig.**	**Conf.**	**Sig.**	**Conf.**
Caribou (Bathurst Herd)	Low	Intermediate	Low	Intermediate	Moderate	High	Low	Intermediate			Low	Intermediate	Moderate	Intermediate
Caribou (Ahiak Herd)			Low	Intermediate	Low	Low	Low	Intermediate			Low	Intermediate	Low	Low
Caribou (Dolphin and Union Herd)					Low	Intermediate					Low	Intermediate		
Caribou (Peary)					Moderate	Low								
Muskox	Low	Intermediate	Low	High	Low	Low					Low	Intermediate	Low	Intermediate
Grizzly Bear							Low	Intermediate					Low	Intermediate
Wolverine			Low	Intermediate	Low	Intermediate	Low	Intermediate	Low	Intermediate	Low	Intermediate	Low	Low
Wolf											Low	Intermediate	Low	Low
Migratory Birds													Low	Low
Peregrine Falcon													Low	Intermediate
Long-tailed Duck	Low	Intermediate	Low	High										

[1] Significance of Cumulative Effect
[2] Confidence Level of Assessment
Blank cells indicate effects which will remain negligible

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12. MARINE WATER AND SEDIMENT QUALITY

12. Marine Water and Sediment Quality

12.1 Valued Ecosystem Components

The EA for surface water and sediment quality (Appendix E-1) assessed the potential effects of the Project on the following VECs:

- Marine water quality; and
- Sediment quality.

Residual effects were predicted for both VECs, therefore marine water and sediment quality were considered in the cumulative effects assessment. These two VECs are assessed together in the following sections to minimize redundancy.

12.2 Residual Effects of the Project

The residual effects of BIPR to marine water and sediment quality included siltation and runoff effects, accidental discharge or spills, and ML/ARD issues. The significance of these effects was assessed as being low, except for accidental spills, which was negligible but may increase in significance with the additional port traffic. Siltation and runoff are primarily construction and decommissioning effects, while spills and ML/ARD issues occur during all Project phases.

12.3 Spatial Boundary

The study area boundary considered in the cumulative effects assessment for marine water and sediment quality is the RSA defined for the effects assessment (Appendix E-1). This includes the waters, sediment and shoreline adjacent to the port and the ocean waters and sediment of the shipping lane. The significant effects will remain localized (*i.e.* near Project activities).

12.4 Temporal Boundary

The temporal boundary includes the Project's proposed lifetime of 22.5 years, comprised of the construction (2.5 years) and operation phases (19 years) and extending into the closure (1 year) phase. The maximum temporal effects of the Project marine water and sediment quality are anticipated to be medium-term.

12.5 Interactions with Other Developments and Activities

The anticipated interactions with other developments and activities in the area will be from existing developments (*e.g.*, EKATI and Diavik diamond mines) and potential future developments (*e.g.*, Hackett River and Izok Lake) which are expected to use BIPR facilities to transport products, goods, supplies, and fuel. Therefore, with the development of future projects the port and shipping lanes would experience increased shipping traffic to transport the greater volumes of imported materials/fuel and additional concentrate exports. Development of the Hackett River and Izok Lake projects may also require concentrate storage facilities to be built at the port site.

Significant effects (all phases) predicted from the Project were carried forward to this cumulative effects assessment. Potential effects (including those rated negligible) related to the operations phase of the Project are also considered since interactions may raise the rating of negligible effects up to significant levels. This would increase the probability of accidental spills.

Cumulative effects are not assessed for ML/ARD effects since no additional risk of ML/ARD is created by increased use of BIPR facilities. The effects assessment (Appendix E-1) indicates the water quality monitoring will be in place for areas where concern over ML/ARD exists.

12.6 Combined Effects of Human Actions

12.6.1 Increased Siltation and Runoff

The effect of siltation and runoff during the construction phase was assessed as low (Appendix E-1 of the DEIS). With appropriate construction management, the potential addition of concentrate storage facilities is not expected to add to this effect, which remains **Low**. Existing projects and potential future developments looking to make use of the Project facilities will increase traffic volumes at the port. The increased activities at the port may increase the potential for erosion and sediments in run-off during precipitation events. However, during operations the significance of these effects is expected to remain **Negligible**.

12.6.2 Increased Potential for Spills

Spill risk (*i.e.* fuel and ore concentrates) increases with unloading (ships) and loading (trucks) at the port. A total of 8,499 fuel truck loads are projected taking into account existing and reasonably foreseeable future projects. A total of 8,937 concentrate truck loads are projected to be generated by future mines (Hackett River and Izok Lake).

The proposed Hackett River and Izok Lake projects are expected to store metal concentrates at the port site and export them on outbound vessels. Accidental spills of concentrate may have adverse effects on water quality. As well, metals could be stored in organic sediment and act as a contaminant source to benthic organisms including invertebrates and fish. Since this type of spill would likely be of low volume it was considered negligible in the effects assessment (Appendix E-1 of the DEIS). However, the projected increase in activities at the port increases the significance of this effect *to **Low***.

12.7 Significance of Cumulative Effects

After mitigation, the cumulative effect of siltation on marine water and sediment quality during operations is expected to remain **Negligible**. The projected increase in truck traffic increases the probability of an accidental spill happening over the life of the Project to **Low**.

12.8 Confidence Levels of Assessment

The process of increased loading of sediment and dust to adjacent waterways is fairly well understood, and mitigation strategies (*e.g.* dust suppression, silt curtains, maintenance, monitoring) have been developed and used for decades to counter these potential stressors to aquatic systems. Therefore this assessment has been associated with a high level of confidence.

The assessment of cumulative effects from accidental spills has been assigned an intermediate level of confidence. This risk is somewhat dependent on unknown factors such as sea conditions, ship crew experience, and ship maintenance.

12.9 Mitigation, Management and Monitoring

Mitigation, management and monitoring plans are offered as recommendations and will be refined during the EA process leading to the Final Environmental Impact Statement (FEIS) and Project Certificate. Annual water quality and bi-annual sediment quality monitoring programs at the BIPR Project will help to manage risk to all marine VECs. Samples will be collected from indicated port sites (Appendix E-1 of the DEIS), reference sites as well as from quarry pits and sedimentation ponds when ML/ARD is a concern.

12.10 Summary of Assessment

A summary of the cumulative effects assessment for marine water quality and sediment quality is provided in Table 12.10-1

Table 12.10-1
Summary of Cumulative Effects Assessment for Marine Water and Sediment Quality

Description of Effect	Significance	Confidence Levels
Siltation and run-off degrading marine water and sediment quality (construction phase)	Low	High
Siltation and run-off degrading marine water and sediment quality (operations phase)	Negligible	High
Fuel or Concentrate spill degrading marine water and sediment quality	Low	Intermediate

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13. MARINE AQUATIC RESOURCES

13. Marine Aquatic Resources

13.1 Valued Ecosystem Component

The Marine Aquatic Resources Environmental Effects Assessment (Appendix E-2) assessed the effects on the VEC of marine aquatic resources. The effects assessment predicted that there would be some low significance residual effects on this VEC, therefore it was included in the cumulative effects assessment.

13.2 Residual Effects of the Project

The majority of potential effects from the Project were assessed to have negligible significance following mitigation and management. The sources of potential significant effects of the Project to marine aquatic resources included sedimentation to the local marine area around the port (during construction phase), and fuel or chemical spills during loading and unloading of fuel and supplies from ships and barges (during operations). These sources could lead to lethal and/or sublethal effects to both primary and secondary producer communities, which make up the biological component of the marine aquatic resources. The significance of sedimentation during construction was assessed as low, and the significance of potential spills was also rated as low.

13.3 Spatial Boundary

The spatial boundary for the marine aquatic resources effects assessment includes both a local and regional boundary.

The LSA was defined as the footprint of the dock and barge landing sites and immediate surrounding area, including marine waters, seabed, and shorelines. The spatial boundary for the LSA was set at 2 km from the port given that all baseline studies conducted in 2001 on marine aquatic resources were located within 2 km of the port site. It also includes the footprint (width of the ship) of the shipping lane. The potential impact of shipping activities and port activities were limited to these boundaries.

The regional boundary for the marine aquatic resources effects assessment includes the shipping lane from Lancaster Sound to the Bathurst Inlet port site including all waters and shorelines bordering the shipping lane.

13.4 Temporal Boundary

The temporal boundary includes the roads proposed lifetime of 22.5 years, comprised of the construction (2.5 years) and operation phases (19 years) and extending into the closure (1 year) phase. The effects of the Project are anticipated to be short to medium term for marine aquatic resources.

13.5 Interactions with Other Developments and Activities

The anticipated interactions with other developments and activities in the area will be from existing developments (*e.g.*, EKATI and Diavik diamond mines) and potential future developments (*e.g.*, Hackett River and Izok Lake). These projects are expected to use the Project facilities to import goods, supplies and fuel and to export products. With the development of future projects the port will be required to handle approximately five times more material each year, and the volumes of shipping traffic are expected to be between two and three times higher (assuming that vessels importing fuel and cargo ships will backhaul concentrate). If the Hope Bay (Boston) deposit is developed, the number of barge journeys to supply the Hope Bay site and Nunavut communities and is expected to increase from seven sailings to 26 sailings (52 one-way journeys) each year (section 2.3.4).

All significant effects (all phases) predicted from the Project were carried forward to this cumulative effects assessment, as well as any potential effects (including those rated negligible) related to the operations phase of the Project. This is because of potential interactions with other developments which could raise the rating of negligible effects (*e.g.*, loading and unloading cargo and fuel from ships leading to a potential spill) up to significant levels due to the increased ship traffic involved in support of various projects.

13.6 Combined Effects of Human Actions

13.6.1 Increased Sedimentation

The main issues relating to interaction between the Project and other developments are increased ship traffic and port activity relating to the handling and storage of cargos. No additional marine construction activity would be required at the port, therefore the sedimentation effects identified in the Marine Aquatic Resources Effects Assessment will not change ratings of significance (*i.e.*, they will remain **Low**). Increased vehicle traffic along the road leading to the port may result in very small increases dust loadings into the local area of Bathurst Inlet, with negligible effects to biota.

13.6.2 Increased Potential for Effects from Spills

Spill risk increases with the number of loaded ships and barges used to support the various developments that will use the Project. Fuel and cargo will be brought into port, and concentrate is expected be shipped from the port. Fuel and cargo/concentrate storage will be designed away from waterways and the marine environment, to mitigate effects from container leaks. However, loading and unloading from ships, and ship accidents, present a risk related to the release of deleterious substances to the marine aquatic resources.

Under the future scenario a total of 406,230 tonnes of fuel and 147,055 tonnes of cargo are projected to be imported via the BIPR port each year. This represents a doubling of fuel imports and near-doubling (180%) of cargo imports. An additional 804,330 tonnes/year of concentrates are also projected to be exported from the port. Using these projections, ship loads would increase by 478%. This means the likelihood of a spill approximately increases five times due to the greater volumes of material being handled and increased shipping traffic. The probability of a spill is likely still low. The significance rating for effects of a spill remain **Low**.

An evaluation of the potential effects of an accidental oil spill in the marine environment is presented in Appendix E-6 of the DEIS.

13.7 Significance of Cumulative Effects

The consideration of potential cumulative effects from BIPR and other developments indicated that no additional significant effects would be expected.

Low level effects of sedimentation are possible during construction of the rock jetty, road terminus at the port, and dock and terrestrial erosion and runoff.

Although the risk of accidental spills increases approximately five-fold, this value was still quite low considering the rarity of ship spills. Potential lethal and sublethal effects to marine aquatic resources from spills were assigned a **Low** level of significance.

13.8 Confidence Levels of Assessment

The process of increased loading of sediment and dust to adjacent waterways is fairly well understood, and mitigation strategies (*e.g.* dust suppression, silt curtains, maintenance, monitoring) have been developed and used for decades to counter these potential stressors to aquatic systems. Therefore this assessment has been associated with a high level of confidence.

The assessment of cumulative effects to marine aquatic resources from accidental spills has been assigned an intermediate level of confidence. This risk is subjective depending on the weather and sea conditions, ship traffic and communication between land and sea crews, ship crew experience, and ship maintenance.

13.9 Mitigation, Management and Monitoring

Mitigation, management and monitoring plans are offered as recommendations and will be refined during the EA process leading to the Final Environmental Impact Statement (FEIS) and Project Certificate.

Annual water quality monitoring will be conducted at selected sites based on the previous baseline study designs. Sediment quality monitoring will be conducted every two years at selected sites. Together, this monitoring will provide indications of any changes occurring in the marine habitat that may affect the local biota.

Proper design and regular inspections of the dock and jetty will serve to mitigate structural failures or erosion effects that could lead to effects to marine aquatic resources. Erosion control measures will be used during construction and decommissioning to contain sediment during installation and removal of structures at the port site, and to divert and contain any potential terrestrial runoff into diversion channels leading to sediment control ponds.

Effective communication and training of all land and sea-based crews will be essential in safely and efficiently conducting cargo and fuel loading and unloading. Proper maintenance and engineering of ships and transport vehicles associated with port activities will be important in avoiding potential spills.

13.10 Summary of Assessment

A summary of the cumulative effects assessment for marine aquatic resources is provided in Table 13.10-1.

Table 13.10-1
Summary of Cumulative Effects Assessment for Marine Aquatic Resources

Description of Effect	Significance	Confidence Level
Sedimentation (aerial, ground transport) leading to lethal and sublethal effects to benthos and periphyton, reducing productivity	Low	High
Fuel, cargo or concentrate spill causing lethal or sublethal effects to benthos and periphyton, reducing productivity	Low	Intermediate

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14. MARINE FISH AND FISH HABITAT

14. Marine Fish and Fish Habitat

14.1 Valued Ecosystem Components

The EA for marine fish and fish habitat (Appendix E-3) assessed the potential effects of the Project on the following VECs:

- Arctic char (*Salvelinus alpinus*);
- Bering wolffish (*Anarhichas orientalis*);
- Fourhorn sculpin (*Triglopsis quadricornis*); and
- Marine fish habitat.

No endangered or threatened fish species were identified in the Project area during baseline studies. Although not listed under the *Species at Risk Act* (SARA), Bering wolffish is a species of concern for the region. The limited knowledge of the species distribution, biology and life history adds extreme uncertainty as to its presence in the port area and also to effects assessments. The Project was predicted to have residual effects on the three fish species as well as fish habitat and as such they were all selected for inclusion in the cumulative effects assessment.

14.2 Residual Effects of the Project

The majority of potential effects from the Project were assessed to have negligible significance following mitigation and management. The source of potential significant effects of the Project is the alteration, disruption or destruction of fish habitat. The significance of this effect was assessed as low.

14.3 Spatial Boundary

The study area boundary considered in the cumulative effects assessment for marine fish and fish habitat is the RSA defined for the effects assessment for the marine fish community and fish habitat (Appendix E-3 of the DEIS). This boundary was selected as it serves as an extensive "zone of influence" beyond which residual effects of the Project will diminish to a negligible state.

The primary effects will remain localized (*e.g.*, near Project activities); however, increased traffic along the shipping route may affect fish to a greater extent than that described in Appendix E-3 of the DEIS.

14.4 Temporal Boundary

The temporal boundary of the cumulative effects assessment begins at the onset of construction of the Project, and ends past the scheduled 2030 closure date. The recovery of the marine fish community and fish habitat over the medium-term is expected to be moderately fast. Therefore, the temporal boundary has been estimated to be a minimum of 10 years post-closure. Within this time span, the productive capacity of the marine fish community and fish habitat will return to pre-Project conditions.

14.5 Interactions with Other Developments and Activities

The anticipated interactions with other developments and activities in the area will be from existing (*e.g.*, EKATI and Diavik diamond mines) and potential future developments (*e.g.*, Hackett River and Izok Lake). These projects are expected to use the Project facilities to transport products, supplies and fuel. The anticipated future developments would change the operational phase of the Project by increasing the volume of imports, adding the export of ore concentrates which would require a concentrate storage facility at the port, and increasing shipping traffic.

All significant effects predicted from the Project were carried forward to this cumulative effects assessment. In addition, any potential effects (including those having negligible significance) related to the operations phase of the Project was carried forward to this cumulative effects assessment. This is because an effect that may have a negligible rating could change to a significant level with the potential interactions from other developments. For example, the negligible rating of a potential spill from the loading and unloading of cargo and fuel may move to a significant level due to increased ship traffic involved in support of more projects.

14.6 Combined Effects of Human Actions

14.6.1 Increased Potential for Accidental Spills

It is predicted that the volumes of fuel and cargo imports handled at the port will approximately double with the development of new projects, increasing the potential for accidental spills. In addition, two potential future mines included in the cumulative effects assessment (Hackett River and Izok Lake) are expected to store concentrates at the port site and export them on outbound vessels. Accidental spills of metal concentrate may have toxic effects on benthic invertebrates and fish. As well, metals could be stored in organic sediment and act as a contaminant source to benthic organisms including invertebrates and fish. While the magnitude of an accidental spill of hazardous substances may range from low to high depending on the size of the spill, the likelihood of a major spill occurring at the port site is considered to be low. In addition, if concentrates were to spill, the product would likely settle to the substrate, limiting the area of habitat affected.

14.6.2 Increased Coastal Traffic

Existing projects and potential future developments that are expected to use BIPR facilities will increase barge and ship traffic in the Bathurst Inlet area and along the shipping route; however, these disturbances will be localized and minimal in their extent. Wave action resulting from increased shipping is not predicted to affect shoreline habitat any more than natural wave action.

Potential future developments will increase the amount of fuel that is transported to the BIPR port along the shipping lane. An evaluation of the potential effects of an accidental oil spill in the marine environment is presented in Appendix E-6 of the DEIS.

14.6.3 Increased Water Turbidity and Sedimentation

Once the port is constructed, no additional marine construction activity would be required at the port site; therefore, all sedimentation effects identified for marine fish habitat in the Marine Fish and Fish Habitat Effects Assessment will remain unchanged (*i.e.*, they will remain **Low**).

14.7 Significance of Cumulative Effects

The direct and indirect disturbances from future developments that could be associated with the Project are anticipated to be localized and limited in their extent. While there is a higher potential for an accidental spill to occur, implementation of mitigation measures will minimize the possibility. The significance of this effect has been characterized as **Negligible**.

Increased traffic in the Bathurst Inlet area and along the shipping route has the potential to cause behavioural changes in fish; they may either elicit a pattern of avoidance (Vabø *et al.* 2002; Skaret *et al.*, 2006) or attraction (Handegard and Tjøstheim, 2005; Røstad *et al*,. 2006). With repeated exposure to this effect, fish may even become habituated to vessel traffic (Skaret *et al.*, 2006). As for the EA, the significance of increased coastal traffic is rated as **Negligible**.

Increased water turbidity and sedimentation will remain a **Low** level effect for marine fish habitat as no additional significant effects would be expected when the potential cumulative effects from BIPR and other developments are considered.

14.8 Confidence Levels of Assessment

The assessment for increased potential of accidental spills has been assigned a high level of confidence. The general effect of a spill, if it were to occur, would be localized. Although tidal currents could potential distribute the deleterious substance a greater distance, dilution would minimize its effect.

Increased coastal traffic in the Bathurst Inlet area and along the shipping route has been assigned an intermediate level of confidence, primarily because research on this effect is limited.

Increased turbidity and sedimentation has been assigned a high level of confidence as no additional significant effects are expected.

Given the lack of data on Bering wolffish, a low level of confidence has been assigned to the assessment of how accidental spills, increased coastal traffic and increased turbidity and sedimentation will affect this species.

14.9 Mitigation, Management and Monitoring

Mitigation, management and monitoring of marine fish and fish habitat should follow the plans proposed in Appendix E-3, Section 5.0, of the DEIS for marine fish and fish habitat.

14.10 Summary of Assessment

A summary of the cumulative effects assessment marine fish communities and fish habitat provided in Table 14.10-1.

Table 14.10-1
Summary of Cumulative Effects Assessment
for Marine Fish Communities and Fish Habitat

Description of Effect	Significance	Confidence Level
Accidental spills from equipment, hauled fuels and cargos, storage of ore concentrate and release of untreated waste products on Arctic char, fourhorn sculpin and marine fish habitat	Negligible	High
Increased traffic from barges supplying local communities and vessels importing and exporting products, supplies, and fuel on Arctic char and fourhorn sculpin	Negligible	Intermediate
Increased turbidity and sedimentation on marine fish habitat	Low	High
Effects of accidental spills and increased coastal traffic on Bering wolffish	Negligible	Low

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15. POLAR BEAR AND SEABIRDS

15. Polar Bear and Seabirds

15.1 Valued Ecosystem Components

The EA for polar bear and seabirds (Appendix E-4 of the DEIS) assessed the potential effects of the Project on the following VECs:

- Polar Bear (*Ursus maritimus*)
- King Eider (*Somateria spectabilis*)
- Thick-billed Murre (*Uria lomvia*)

The Project was predicted to have residual effects on the three species and as such they were all selected for inclusion in the cumulative effects assessment.

15.2 Residual Effects of the Project

The residual effects of the Project for all VECs are summarized in Table 15.5-1. The magnitude of potential effects is poorly understood necessitating a cautious approach. Hence, effects that were not rated in the effects assessment (Appendix E-4 of the DEIS), such as habitat loss, or those that were assessed as negligible are re-evaluated in this report.

Table 15.5-1
Summary of Residual Effects of the Project on Polar Bear and Seabirds

VEC	Habitat Loss[1]	Disruption of Movements[2]	Disturbance	Features Acting as Attractants	Direct Mortality	Indirect Mortality	Reduction in Reproductive Productivity
Polar bear	*unrated*	Negligible	Negligible	*unrated*	Negligible	Negligible	Negligible
King eider	*unrated*	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Thick-billed murre	*unrated*	Low	Negligible	Negligible	Low	Negligible	Low-Negligible

1: Habitat loss was not identified as an effect for polar bears, king eiders or thick-billed murres in the Effects Assessment (Appendix E-4 of the DEIS).

15.3 Methodology

The methodology for this cumulative effects assessment follows that for the effects assessment (Appendix E-4 of the DEIS, Section 4.0). This assessment provides a qualitative evaluation of each effect based on quantitative data, where applicable, and species traits. A qualitative assessment is provided because the number and diversity of potential Project impacts to wildlife reduce the confidence with which quantitative predictions can be made. For example, mortality of an individual may or may not have consequences for a population depending on whether mortality is compensatory or additive. In other cases, quantitative data are lacking for more complex assessments (Dowlatabadi *et al.*, 2003).

15.4 Spatial Boundary for All VECs

The spatial boundaries identified for the Seabirds and Polar Bear Effects Assessment (Section 3.2.1, Appendix E-4 of the DEIS) applies for all shipping route VECs and are reiterated here. The spatial boundaries include the gulfs and straits that encompass the shipping route as presented in the Marine Mammal Baseline (Figure 2 in Appendix E-8 of the DEIS), including: Bathurst Inlet, Dease Strait, Queen Maud Gulf, Victoria Strait, Franklin Strait, Peel Sound, Franklin Strait and Barrow Strait. Lancaster Sound was not surveyed but is included in the spatial boundaries.

15.5 Temporal Boundary for All VECs

The temporal boundaries of this cumulative effects assessment for all VECs will include all projects and activities that coincide with the construction phase (2.5 years), 19 year operations phase extending to January 2031, and beyond closure into the far future (100 years).

15.6 Interactions with Other Project Developments

For the marine shipping route, the outcome of future projects interacting with the Project could result in more shipping traffic through the Northwest Passage, as well as increased ocean barge traffic to supply the Hope Bay (Boston) Project. Figure 15.6-1 illustrates all projects that could contribute to cumulative effects of shipping on VEC species identified in the Seabirds and Polar Bear Effects Assessment (Appendix E-4 of the DEIS).

The following sections evaluate the combined effects of human actions on each VEC. The projected increase in shipping traffic is not predicted to affect direct habitat loss or direct mortality for any of the species; these effects remain unrated or negligible for all VECs and are not considered further in the cumulative effects assessment.

15.7 Polar Bears

15.7.1 Disruption of Movement

Polar bears are predicted to experience a negligible residual effect on their normal movement patterns due to the Project (*i.e.*, the shipping route). The main cumulative effect on movement to be considered for polar bears will involve an approximate three-fold increase in industrial ship traffic volumes along the shipping route (see Section 2.3). The projected ship traffic in the future scenario is 27 (30,000 DWT) or 17 (50,000 DWT) movements (round trips) of Type B to CAC 2 class vessels (assuming that vessels that bring in imports will ship out concentrate). The High Lake project is expected increase the number of shipping movements by between four and six round trips of Type B vessels if this project uses the eastern shipping route option. The Nanisivik naval station could also increase air and sea traffic in that portion of the shipping route, in addition to occasional cruise traffic in the northern shipping route.

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FIGURE 15.6-1

Projects Potentially Contributing to Cumulative Effects along the Shipping Route

The effects of shipping causing increased ice break-up or altering movement corridors for polar bears is poorly understood, therefore a cautionary approach was undertaken in assessing this effect. More frequent shipping traffic may cause larger and longer open water channels and disrupt previous movement corridors for polar bears. However, this assessment assumes that shipping traffic is limited to the normal open-water season from July 1 to October 15, as defined in the draft WKRLUP (NPC, 2005). The cumulative effect on polar bear movement is predicted to be **Low**.

15.7.2 Disturbance

Disturbance of feeding was identified as a negligible effect for polar bears in the Effects Assessment (Appendix E-4 of the DEIS). However, this effect is expected to increase due to the projected increased frequency of shipping traffic with the addition of future projects. Habitat avoidance (indirect habitat loss) is the main issue identified which may be caused by more frequent shipping, due to increased presence and associated noise of passing ships. These facts increase the magnitude of this cumulative effect, yielding an expected rating of **Low** significance.

15.7.3 Features Acting as Attractants

Shipping traffic is not expected to act as an attractant for polar bears; this potential effect was not considered in the Effects Assessment (Appendix E-4 of the DEIS) and is therefore not considered for the cumulative effects assessment.

15.7.4 Indirect Mortality

Increased shipping traffic could alter prey distribution and abundance, thus affecting foraging success of polar bears. Polar bears are highly dependent of ringed seals for sustenance. Ringed seal are generally found more in open water areas during the summer months where they may come in contact with ships. Disturbance of seals is not expected to result from shipping associated with the Project (Appendix E-5 of the DEIS) or on the cumulative scale (Section 16). Hence there is a low potential to affect prey distribution which could lead to reduced body conditions for polar bears. The magnitude of this effect is rated as **Negligible**.

15.7.5 Reduction of Reproductive Productivity

The potential for a reduction in reproductive productivity in polar bears depends on the degree of disturbances experienced. Increased shipping volumes may cause more disturbances leading to displacement of polar bears from hunting habitat adjacent to the shipping route. If increased shipping also affects the quality or distribution of ice cover or alters sea ice edges, polar bears, especially females with dependent young, would be at risk of declines in body conditions due to higher energy expenditures (females with cubs) and lower body fat reserves for when prey abundance is lower (all polar bears). With the increase in shipping traffic, the overall synergistic cumulative effects from all of the projects potentially encountered by polar bears will likely be **Low**.

15.7.6 Significance of Cumulative Effects and Confidence Levels

The projected increase in shipping traffic is expected to result in **Low** effects on disruption of movement, disturbance and reduction in reproductive productivity. Indirect mortality is expected to remain **Negligible.**

The confidence levels of the assessment are low because effects of shipping traffic causing increased ice break-up or altering movement corridors for polar bears is poorly understood.

15.7.7 Mitigation, Management and Monitoring

Mitigation, management and monitoring plans are offered as recommendations and will be refined during the EA process leading to the Final Environmental Impact Statement (FEIS) and Project Certificate. Mitigation measures developed for the Project focus on minimizing potential sensory disturbance to polar bears along the shipping route. Monitoring activities will focus on assessing the management strategies outlined in the Seabirds and Polar Bear Management Plan (Appendix E-4 of the DEIS), as well as addressing ways to reduce knowledge gaps which have reduced the confidence levels in assessing effects.

15.8 King Eider

15.8.1 Disruption of Movement

Shipping traffic is not expected to disrupt the movement of king eiders; this potential effect was not considered in the Effects Assessment (Appendix E-4 of the DEIS) and is therefore not considered for the cumulative effects assessment.

15.8.2 Disturbance

With the projected addition of other mines and developments that will use the port and all-weather road, ships carrying in supplies and exporting concentrate will increase (see section 2.3). In addition, sea lift operations re-supplying the Kitikmeot communities of Gjoa Haven, Cambridge bay, Kugluktuk, Taloyoak and the Hope Bay deposits will originate from the port. These sea lifts will use existing routes for ocean tug and barge re-supplies. It is projected that there will be a total of 22 barge sailings of fuel and 4 barge sailings of cargo (a total of 52 one-way barge journeys) servicing the Hope Bay deposits and Kitikmeot communities (section 2.3.4).

King eiders are known to be sensitive to disturbance and become more alert or flush (flee the area) in response to aircraft overflights and boat approach (Frimer, 1994). Increasing ship traffic and sea lift operations therefore may potentially disturb feeding king eiders, especially tug and barge traffic which may be coming closer to shore than larger fuel and cargo vessels. However, the degree to which king eiders will be disturbed from feeding is unknown, and the cumulative impacts of shipping and barge traffic on disturbance of king eiders is expected to remain **Negligible**.

15.8.3 Features Acting as Attractants

Industrial lighting can cause night-migrating birds to become disoriented, especially in fog (Ginter and Desmond, 2004), however these effects are dependent on the density of lighting. Given the very low density of lights from ships and port facilities this effect is expected to be **Negligible**.

15.8.4 Indirect Mortality

Disturbance of king eiders in coastal areas used for migration staging may cause birds to be more alert. Increasing ship traffic and sea lift operations therefore have the potential to disturb feeding and migration staging in shoreline areas, especially tug and barge traffic which may be coming closer to shore than larger fuel and cargo vessels. This type of persistent disturbance could lead to higher stress levels and reduce individual eider body condition. Hence, the cumulative impacts of shipping and barge traffic will increase the magnitude of the residual effect from negligible to **Low**.

15.8.5 Reduction of Reproductive Productivity

Persistent noise disturbance is known to have multiple population level effects on birds, such as habitat avoidance and reduced reproductive output of males (Van Der Zande and Vos, 1984; Foppen and Reijnen, 1994; Reijnen *et al.*, 1995). Increases in ship and ocean barge traffic could potentially cause habitat avoidance, disrupting feeding in king eiders using shoreline areas during migration staging. Moulting requires significant body resources to complete (Lindström *et al.*, 1993; Schieltz and Murphy, 1995), therefore noise and physical disturbance emanating from ships and barges transiting the BIPR shipping route and sea lift route could lower individual fitness thus lowering reproductive success. Hence, the cumulative impacts of shipping and barge trafficking may increase the effect of reduction in productivity of king eiders to **Low**.

15.8.6 Significance of Cumulative Effects and Confidence Levels

The projected increase in shipping traffic is expected to result in residual effects on indirect mortality and reduction in reproductive productivity. There is no expected increase in the potential effects of lighting on king or common eiders or disturbance of king eiders.

The confidence levels of the assessment are low for disturbance, indirect mortality and reduction in reproductive productivity because the effects of increased disturbance from shipping traffic are not fully understood for king eiders.

15.8.7 Mitigation, Management and Monitoring

Mitigation, management, and monitoring plans are offered as recommendations and will be refined during the EA process leading to the FEIS and Project Certificate. Mitigation measures developed for BIPR focus on minimizing potential sensory disturbance to king eiders along the shipping route, especially in migration staging areas. Monitoring activities will focus on assessing the management strategies outlined in the Seabirds and Polar Bear management Plan (Appendix E-4 of the DEIS), as well as addressing ways to reduce knowledge gaps which have reduced the confidence levels in assessing effects.

15.9 Thick-billed Murre

15.9.1 Disruption of Movement

Thick-billed murres are predicted to experience a low residual effect on movement (fall migration) due to the predicted amount of shipping traffic at the commencement of operations. With the projected additional developments using the port, shipping traffic would increase to between 27 (30,000 tonne capacity) and 17 (50,000 tonne capacity) round trips per season. The number of ships passing through the shipping route could increase further if the potential High Lake project uses the Northwest Passage as their shipping route, as well as cruise traffic and sea traffic from Nanisivik naval station.

During the late summer (August), thick-billed murres undergo a lengthy sea-borne migration with the young of the year, when they swim through Lancaster Sound into Baffin Bay. This migration takes place during the expected shipping season (July to October). The increased frequency of shipping will result in greater potential for migrating groups of murres to encounter ships. Therefore, the cumulative effects on potential disruption to movements of migrating thick-billed murres are predicted to increase from negligible to **Low.**

15.9.2 Disturbance

Noise emanating from ships, such as horns and cavitations from ship propellers, and physical presence of ships is predicted to have a negligible residual effect on feeding and nesting of thick-billed murres. Increasing ship traffic has the potential to alter foraging patterns in adult thick-billed murres. Any alterations of ice cover and break-up caused by shipping activities could affect foraging and breeding success of thick-billed murres, as the distribution of sea ice and open water areas (polynyas) are vitally important to migratory species (Stirling, 1980). However, shipping traffic is expected to be restricted to the normal open-water season from July 1 to October 15 (Section 2.3.3.4), thus minimizing the likelihood of this potential effect. Cumulatively, the effects of disturbance of feeding, nesting or breeding on thick-billed murres are expected to be **Negligible**.

15.9.3 Features Acting as Attractants

As mentioned in section 1.4.1.6, ship lighting could potentially alter migration movements in birds. However, specific attraction by migrating thick-billed murres to light sources has not been documented, necessitating the low confidence level in the original assessment. Thick-billed murres are expected to have high resilience to adapting to this effect, therefore, cumulatively, the effects of features acting as attractants to migrating thick-billed murres is expected to remain **Negligible.**

15.9.4 Mortality (Direct and Indirect)

Young murres (hatch year) are essentially altricial (requiring parental care after hatching) and are unable to sustain long dives like adults. Therefore they are more vulnerable than adult murrres, and during the fall migration may be at risk from physical strikes and of separation from parent murres (most often males will travel with the chick (Gaston and Hipfner, 2000)). More frequent shipping increases the potential of ships to encounter murres during migration and events of disruption and separation. Thus, on a cumulative scale, the magnitude of effect of indirect mortality has increased from negligible to **Low**, and direct mortality on thick-billed murres will remain **Low**.

15.9.5 Reduction of Reproductive Productivity

As mentioned in section 15.8.2, population level effects have been observed in songbirds in response to noise disturbance, and migration and moulting are energetically expensive activities. Thick-billed murres forage at varying distances from their nesting colonies (Gaston and Hipfner, 2000) and are sensitive to noise and physical disturbance near nesting colonies (Chardine and Mendenhall, 1998). As well, adult thick-billed murres moult during the fall migration (Gaston and Hipfner, 2000). Since nesting colonies (cliffs) are adjacent to open water, shipping traffic has the potential to influence both the daily (foraging) and annual (migration) movements of thick-billed murres. The effect of reduced reproductive productivity results from the synergy of the effects on disruption of movement and disturbance of feeding, nesting or breeding. Cumulatively, increased shipping traffic will not increase the reduction in productivity of thick-billed murres, and the effect will likely remain **Low**.

15.9.6 Significance of Cumulative Effects and Confidence Levels

The projected increase in shipping traffic is expected to result in **Low** residual effects on disruption of movement, disturbance, indirect mortality, and reduction in reproductive productivity. Lighting attracting thick-billed murres is not expected to increase.

The confidence levels of the assessment are low for disruption of movement, disturbance, indirect mortality, and reduction in reproductive productivity because the effects of increased disturbance from shipping traffic are not fully understood for thick-billed murres.

15.9.7 Mitigation, Management and Monitoring

Mitigation, management, and monitoring plans are offered as recommendations and will be refined during the EA process leading to the Final Environmental Impact Statement (FEIS) and Project Certificate. Mitigation measures developed for the Project focus on minimizing potential sensory disturbance to thick-billed murres along the shipping route, especially around key marine areas and breeding colonies for this species. Monitoring activities will focus on assessing the management strategies outlined in the Seabirds and Polar Bear Management Plan (Appendix E-4 of the DEIS), as well as addressing ways to reduce knowledge gaps which have reduced the confidence levels in assessing effects.

15.10 Summary of Assessment

The final cumulative effects ratings for polar bear and seabirds are presented Table 15.10-1. The addition of future developments is projected to cause a three-fold increase in shipping traffic (section 2.3.3) and a four-fold increase in barge traffic (section 2.3.4). This is expected to increase disturbance, disruption of movement and indirect mortality. The combination of these factors is expected to result in a greater reduction in reproductive productivity for all VECs when compared to the results of the Effects Assessment (Appendix E-4 of the DEIS). For all VECs, the significance of cumulative effects on reproductive productivity is rated **Negligible** to **Low**.

Table 15.10-1
Summary of Cumulative Effects Assessment for
Polar Bear and Seabirds

Effect	Polar Bear		King Eider		Thick-billed Murre	
	Significance	Confidence Level	Significance	Confidence Level	Significance	Confidence Level
Disruption to Movements	Low	Low	Negligible	Low	Low	Low
Disturbance	Low	Low	Negligible	Low	Negligible	Low
Features Acting as Attractants	N/A	N/A	Negligible	Intermediate	Negligible	Intermediate
Mortality (Direct and Indirect)	Negligible	Low	Low	Low	Low	Low
Reduction in Reproductive Productivity	Low	Low	Low	Low	Low	Low

The effects of reasonably foreseeable future developments projects cannot be assessed with a high degree of certainty without knowing their finalized project descriptions, including their locations, construction and operation schedules, frequency of disturbances (*e.g.*, shipping and potential air traffic) or mitigation strategies. The effects of increased disturbance on the VECS are also not fully understood, resulting in a general low level of confidence in the assessment. Further, if a large-scale shift in spatial movements of any of the VECs occurs, cumulative effects may be diminished or elevated beyond the expectations described in this report.

16. MARINE MAMMALS

16. Marine Mammals

16.1 Valued Ecosystem Components

The Marine Mammals Effects Assessment (Appendix E-5 of the DEIS) considered the potential effects on the following mammal VECs:

- bowhead whale (*Balaena mysticetus*);
- beluga (*Delphinapterus leucas*);
- narwhal (*Monodon monoceros*);
- walrus (*Odobenus rosmarus*); and
- ringed seal (*Pusa hispida*).

The rationale for the choice of these VECs is provided in Section 3.1 of Appendix E-5 of the DEIS. It is expected that shipping and barge traffic will increase substantially with the development of other projects that are likely to use Project facilities, warranting a re-examination of the potential effects on all marine mammals. Marine mammal VECs are considered together in this cumulative effects assessment to avoid redundancy.

16.2 Residual Effects of the Project

It was concluded in Section 4 of Appendix E-5 of the DEIS that residual effects of the Project could include the following:

- alteration of movement patterns and distributions and ringed seal pup mortality near the port resulting from disturbance caused by pile-driving noise during port construction;
- alteration of movement patterns and distributions and ringed seal pup mortality near the port resulting from disturbance caused by aircraft overflights during port construction and operations;
- alteration of movement patterns and distributions along the shipping route resulting from disturbance caused by vessel noise during operations;
- injury or mortality from collisions with vessels on the shipping route during operations;
- increased potential for exposure to contaminants at the port, possibly leading to injury or mortality, resulting from a small spill during operations; and
- increased potential for exposure to contaminants on the shipping route, possibly leading to injury or mortality, resulting from a large, accidental spill during operations.

Residual effects of all of the above aspects of the Project were predicted to be of negligible significance.

16.3 Spatial Boundary

The only possible cumulative effects are related to vessel traffic on the shipping route. In keeping with the final EIS guidelines for this Project (NIRB, 2004), only the shipping route from

Lancaster Sound to the proposed port location, which has not been used previously for the regular shipping of fuel, is included in this assessment.

The spatial boundary is the same as that for the effects assessment of vessel traffic on the shipping route (*i.e.*, the area within 5 km to either side of the shipping route from Bathurst Inlet to Lancaster Sound).

Many, if not all, marine mammals will hear sounds from vessel traffic on the shipping route far beyond 5 km, but disturbance effects are not likely to extend much (if any) beyond 5 km in open water. There will be some masking of low-frequency sounds out to greater distances, so some masking effects on baleen whales are theoretically possible beyond 5 km from the shipping route. However, this would be transient and not very severe at $\geq$5 km.

16.4 Temporal Boundary

The temporal boundary is the same as that for operations in the effects assessment, *i.e.*, an estimated 20 years.

16.5 Interactions with Other Developments and Activities

16.5.1 Links with other Developments and Activities

The potential links between the Project and existing and reasonably foreseeable future projects and activities are summarized in Table 16.5-1. There were no linkages between closed developments or other land-use activities because these do not generate shipping traffic.

16.5.2 Projected Shipping Traffic

16.5.2.1 BIPR Project

Assuming that vessels delivering fuel and bulk materials will also be used to backhaul concentrate, the number of ship movements is determined by the amount of concentrate that needs to be exported. The Project port is designed to receive vessels with a capacity up to of 50,000 DWT, meaning that at a minimum 17 ship loads will be required each year to export 804,330 tonnes of concentrate. Depending on vessel availability, it may be necessary to use vessels with smaller capacities for some movements. As a worst-case scenario, if vessels have an average capacity of 30,000 DWT, 27 ship loads would be required. Overall, use of the BIPR port is predicted to generate between 34 and 54 one-way shipping movements along the shipping lane each year.

16.5.2.2 High Lake Project

During operations approximately 140,000 tonnes per year of concentrate will be exported from the Grays Bay dock (Wolfden, 2006). The concentrate will be collected by between four and six vessels each with a capacity of between 30,000 and 50,000 tonnes, generating between eight and twelve one-way shipping movements. These vessels will also deliver supplies to the Project. Ships will either follow a route from the west through Bering Strait to the Coronation Gulf, or from the east through Davis Strait to the Coronation Gulf (Wolfden, 2006).

Table 16.5-1
Summary of Links between the Project and Other Human Actions for Marine Mammals

Development	Linkage with Effects of Project
Existing Developments:	
EKATI Diamond Mine	Shipping to import fuel and supplies via the Project
Diavik Diamond Mine	Shipping to import fuel and supplies via the Project
Jericho Diamond Mine	Shipping to import fuel and supplies via the Project
Snap Lake Diamond Mine	Shipping to import fuel and supplies via the Project
Hope Bay (Doris North) Gold Mine	Shipping to import fuel and supplies via the Project
Reasonably Foreseeable Future Developments:	
Gahcho Kué Diamond Mine and Spur Road	Shipping to import fuel and supplies via the Project
Hope Bay (Boston) Gold Mine	Shipping to import fuel and supplies via the Project
Nanisivik Naval Station	Shipping related to the proposed Canadian naval station beginning in 2010
Hackett River Base Metal Mine And Spur Road	Shipping to import fuel and supplies and export concentrate via the Project
Expansion Of Bathurst Inlet Port	None (no shipping)
Izok Base Metal Mine and All-weather Road to Lupin	Shipping to import fuel and supplies and export concentrate via the Project
Expansion of Contwoyto Camp (Barge Dock)	None (no shipping)
High Lake Base Metal Mine	Shipping to import fuel and supplies and export concentrate (Grays Bay dock)
Yellowknife Gold Project	None (no shipping)

16.5.2.3 Total Shipping Traffic

The High Lake project eastern shipping route option is the same as the Project shipping route. Therefore, under this cumulative effects assessment future scenario there is potential for between 42 and 66 one-way cargo vessel movements along this route each shipping season. In addition, cruise ships travel the Northwest Passage once or twice per year and often stop at Cambridge Bay and Kugluktuk (NPC, 2005). Additional ship movements may derive from operations at the Nanisivik naval base. Overall, there is potential for in excess of 70 one-way shipping movements along some or all of the Project shipping lane (beyond Bathurst Inlet) each arctic shipping season.

16.6 Combined Effects of Vessel Traffic on Marine Mammals

16.6.1 Likelihood of Interactions between Marine Mammals and Vessel Traffic

Most of the marine mammals in the study area likely would not come into close contact with vessels on the shipping route, regardless of the number of vessels, because of their distribution or preferred habitats (Sections 2 and 4.3.1 of Appendix E-5 of the DEIS). The shipping route is located well offshore or in mid-channel except in Bathurst Inlet itself, whereas many of the marine mammals are coastal and some are found only in low numbers along the shipping routes.

The relatively few times and locations when marine mammals could occur near the shipping route during the shipping season are as follows:

- A few bowheads occur in the Peel Sound/Franklin Strait area and in Barrow Strait during August and September.
- Belugas occur in deep-water area offshore in Peel Sound called the Franklin Trench from mid August to early to mid September.
- Narwhal occur only in small numbers in Barrow Strait and Peel Sound during August and September. During fall migration back to Baffin Bay via Lancaster Sound, narwhals are dispersed in open water and remain there as long as open water permits.
- Very few walruses use the offshore waters and south shores of Barrow Strait, the west shores of Prince Regent Inlet and the Gulf of Boothia, or Peel Sound.

16.6.2 Disturbance by Vessel Traffic

The literature on disturbance effects on the marine mammal VECs by vessel traffic and icebreaking is reviewed in Section 4.3.3 of Appendix E-5 of the DEIS and summarized below.

16.6.2.1 Bowhead Whales

In general, bowhead whales react strongly to approaching vessels, interrupting their normal activities and swimming rapidly away, although they have been observed to return to feeding locations within a day after being displaced. Bowheads are more tolerant of vessels moving slowly or in directions other than toward the whales, and bowheads actively engaged in social interactions or mating may be less responsive to boats. The only effect that could occur at distances greater than 5 km from the shipping route would be transient masking effects of low-frequency sounds on bowhead whales.

16.6.2.2 Belugas

In most situations, belugas are quite tolerant of vessels, *e.g.*, those travelling in consistent directions in summering areas. Noise from large vessels is predominantly low frequency (<1 kHz), where beluga hearing is poor. Belugas are known to be sensitive in two situations. When approached by fast, erratically moving small boats, as is typical during the subsistence hunt, belugas flee towards shore. Belugas are also sensitive when exposed to noise from ships and icebreakers in deep channels of the Canadian High Arctic in spring. In studies carried out at ice edges in Lancaster Sound and Admiralty Inlet, belugas made “alarm” calls when an approaching ship was over 80 km away. At distances of 30 to 50 km, they formed into herds with a loss of pod integrity, and moved rapidly along ice edges away from approaching ships, only stopping when they reached shore.

16.6.2.3 Narwhals

In the same study as that discussed immediately above for belugas, narwhals did not form large herds, their movements were slow or they were motionless near the ice edge, and they huddled together in pods. They ceased vocalizing temporarily, and dispersed slowly along the ice edge or offshore as the ships approached. Narwhals returned to disturbance areas much faster than did belugas, and showed little or no change in vocal activity or surface behaviour. Similar behaviour has been observed during subsistence hunting; their immediate response to a perceived threat was to lie motionless below the surface of the water, and when they did flee, they fled toward deeper water.

16.6.2.4 Ringed Seals

Seals do not appear to respond as strongly to vessels and, in some areas, are commonly observed close to vessels. Some seals are likely to avoid approaching vessels by a few metres to tens of metres, whereas some curious seals are likely to swim toward vessels.

16.6.2.5 Effects of Disturbance

Increased vessel traffic would increase the number of times that marine mammals were disturbed by noise, possibly or probably leading to evasive movements depending on species. The reactions would be temporary, so would not result in displacement from critical habitats. Energy would be expended for those species that evade vessels, by the energy cost likely would not have a significant effect on individuals, let alone populations. Habituation or increased habituation to vessel traffic may result from increased traffic, which would reduce energy expended in evasive actions.

Given the distribution of marine mammals along the shipping route, the transitory disturbance that would be the only likely effect of any encounter, and the mitigation measures described in Section 5.2 of Appendix E-5, which would apply to all vessels, the residual cumulative effects of vessel traffic along shipping routes are predicted to be of **Negligible** significance because they would have or be:

- low probability of occurrence for bowheads and walrus or moderate probability of occurrence for beluga, narwhal, and ringed seals;
- of negligible or low magnitude;
- of landscape spatial extent (<5 km or, for masking in bowhead whales, <10 km);
- short term (<1 day) and sporadic (between 45 and 70 times per open-water season); and
- reversible in the short term.

16.6.3 Injury or Mortality from Collisions with Vessels

The probability of collisions between vessels and marine mammals is very low, but on infrequent occasions whales and ships do collide resulting in injury or death to the whale. The probability would increase with the projected increase in the number of vessels using the shipping route, and could also increase if the animals become habituated to the vessel traffic.[1] However, the probability would still be very low.

[1] Behavioural habituation refers to the gradual waning of responses when a repeated or ongoing stimulus lacks any significant consequences for the animal (Thorpe, 1963).

Most of the marine mammals near the shipping route are relatively small and agile, and likely would avoid vessels. The bowhead whale and other baleen whales are large, slow-moving baleen whales and are more susceptible to collisions. There are no records, to our knowledge, of mortality from collisions involving bowhead whales, which is probably attributable at least in part to their avoidance reactions. Examination of 236 subsistence-harvested bowhead whales between 1976 and 1992 for scarring indicated that the incidence of ship collisions with bowheads was quite low (~1%). It was suggested that the low level was probably largely attributable to the comparatively small amount of vessel traffic, but also to the possibility that many do not survive the collision. However, the number of animals succumbing to such injuries is likely very low, based on the rarity of beach-cast animals bearing such injuries. Very few (if any) bowheads would occur on the shipping route, and only between Franklin Strait and Lancaster Sound.

After considering the mitigation measures presented in Section 5.2 of Appendix E-5, the residual cumulative effects on marine mammal populations from collisions with vessels on the shipping route are predicted to be of ***Negligible*** significance because they would have or be:

- low probability of occurrence;
- of negligible or low magnitude;
- of local spatial extent;
- short term and sporadic, if at all; and
- reversible in the short term.

16.6.4 Exposure to Contaminants from Accidental Oil Spills

The most serious accident that could occur would be one that released a large amount of oil into the marine environment (*e.g.*, a hull breach). There will be no cargoes of crude oil, only diesel fuel, much of which evaporates or is dispersed in the water. Increased vessel traffic would result in increased probability of such an accident. An evaluation of the potential effects of an accidental oil spill in the marine environment is presented in Appendix E-6.

Marine mammals that rely on fur rather than a layer of blubber for insulation are most vulnerable to effects of oil spills. The only marine mammal VECs in the study area that do so are newborn seal pups less than 3 to 4 weeks old, which are born in April, mostly on landfast ice. There will be no vessel traffic at that time of year.

Effects of spilled oil on marine mammals that do not rely on fur for insulation are reviewed in Section 4.3.4 of Appendix E-5 of the DEIS. Contact with oil on the external surfaces can cause increased stress and can irritate the eyes, but these effects seem to be temporary and reversible. Marine mammals can ingest oil if their food is contaminated, and oil can also be absorbed through the respiratory tract and can cause toxic effects, including minor kidney, liver, and brain lesions. When returned to clean water, contaminated animals can depurate this internal oil; marine mammals extensively metabolize aromatic compounds in their livers and metabolites are excreted. Whales or seals exposed to an oil spill are unlikely to ingest enough oil to cause serious internal damage. In baleen whales, oil could coat the baleen and reduce filtration efficiency, but light diesel oil is not likely to cause much reduction in efficiency and effects can be reversible within a few days.

There is no clear evidence that implicates oil spills, including the much-studied *Santa Barbara* and *Exxon Valdez* spills, with mortality of cetaceans. Reports of the effects of oil spills and blowouts have shown that some mortality of hair seals may have occurred as a result of oil fouling; however, large-scale mortality has never been observed. Studies of both captive and wild cetaceans indicate that they can detect oil spills. It is possible that cetaceans swim through oil because of an overriding behavioural motivation (for example, feeding). Some evidence exists that indicates dolphins attempt to minimize contact with surface oil by decreasing their respiration rate and increasing dive duration.

With the exception of ringed seals, marine mammals likely would not be encountered along approximately half of the eastern shipping route, from Bathurst Inlet to Franklin Strait. An oil spill along the rest of the route likely would have only minor and transient effects on cetaceans unless the spill occurred near whale concentrations, especially in confined situations. A number of ringed, bearded, and harp seals could become oiled with consequent mortality, but evidence from other spills indicates that numbers would be small.

Increased vessel traffic would increase the probability of an oil spill, but that would still be very small, given the light traffic compared with busy shipping routes elsewhere in the world, the lack of icebergs, and the water depth and distance from shore along the entire shipping route except in Bathurst Inlet itself. Given the mitigation measures described in Section 5.2 of Appendix E-5 of the DEIS, which would apply to all vessels, effects of a large oil spill on the shipping route are predicted to of **Negligible** or **Low** significance because they would:

- have a low probability of occurrence;
- be of negligible or low magnitude;
- be of landscape spatial extent (<5 km);
- be short term (<1 year) and sporadic (if at all); and
- be reversible in the short term.

16.7 Significance of Cumulative Effects

The significance of cumulative effects on marine mammals were assessed as **Negligible** for disturbance and mortality from collisions, and **Negligible** to **Low** for exposure to contaminants (Table 16.7-1).

16.8 Confidence Levels of Assessment

The cause-effect relationships are not fully understood; thus, there is an intermediate degree of confidence that the conclusions of the assessment are accurate.

Table 16.7-1
Summary of Cumulative Effects Assessment for Marine Mammals

Description of Effect	Significance	Confidence Levels
Alteration of movement patterns and distributions along the shipping route resulting from disturbance caused vessel noise during operations	Negligible	Intermediate
Injury or mortality from collisions with vessels on the shipping route during operations	Negligible	Intermediate
Increased potential for exposure to contaminants on the shipping route, possibly leading to injury or mortality, resulting from a large, accidental spill during operations	Negligible / Low	Intermediate

16.9 Mitigation, Management and Monitoring

The cumulative effects assessment assumes that the mitigation measures presented in Section 5.2 of Appendix E-5 of the DEIS are being carried out by all vessels. No additional mitigation measures are required.

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17. ARCHAEOLOGY AND HERITAGE RESOURCES

17. Archaeology and Heritage Resources

17.1 Valued Socio-economic Components

For the purpose of this analysis, all heritage resources are combined into a single VSEC. Heritage resource sites were identified within the proposed boundaries of the Project. Of the 71 sites identified, 14 will be directly impacted by construction of the port facility (Appendix F-1 of the DEIS). An additional nine sites are located in the immediate area of the Port and will likely be indirectly disturbed during the operational phase as a result of increased human presence. Although the remaining sites identified along the road alignment will be avoided, increased human presence in the area resulting from provision of access into previously inaccessible areas may also have adverse effects on heritage resources.

17.2 Residual Effects of the Project

A positive residual effect of the Project is the formal inventory of heritage sites through the archaeological permitting system, increasing the existing database and providing information on site location, type, content, context and associations. After mitigation, the archaeological information contained in the 14 sites will have been conserved through mapping, excavation and recording. However, these sites will be destroyed and will no longer be available to meet the present and future needs of the local communities regarding appreciation of history and education. Because heritage resources are non-renewable, the residual effect on heritage resources at the Port facility is moderate. Sites along the road have been avoided by the route. Therefore, there will be no direct effects and no residual effects from Project construction on the road component of the Project.

17.3 Spatial Boundary

The current inventory of heritage resources on file was accumulated primarily through academic research and impact assessments in which the geographic areas investigated were based on either academic interest or development parameters. Although no archaeological work has been done in much of the interior barren lands, it is expected that many archaeological sites occur over the landscape. Because the Project spans a considerable geographic area and because comprehensive data on heritage sites is unavailable at both the local or regional levels, it is difficult to evaluate cumulative effects other than in a very general way.

To provide some measure of cumulative effects, the spatial boundary for heritage resources focuses on the 1:250,000 NTS map sheets through which the Project passes. These map sheets are 76J, 76G, 76F, and 76E. Given the variable nature and scope of past field inventory programs and the generally limited amount of inventory conducted in the interior, the selected study area is best suited to evaluation of generic cumulative effects. However, comments regarding effects relative to the Project Cumulative Effects Assessment area are provided.

17.4 Temporal Boundary

The temporal boundary for heritage resources cumulative effects extends into the far future as these sites are non-renewable. As such, effects are treated as moderate and high in the following analyses.

17.5 Interactions with Other Developments and Activities

Effects on heritage resources from past developments in the selected study area are confined to the Contwoyto Lake map sheet (76E) and are associated with the Lupin Mine, operating between 1982 and 2005. There is no information available indicating that a heritage resources impact assessment was completed relative to the Lupin Mine. Relative to the Project Cumulative Effects Assessment Area (Figure 2.2-1), it should be noted that heritage resources impact assessments are currently being undertaken as part of the remediation programs at some of these facilities (Table 17.5-1).

Existing developments in the selected study area for heritage resources consist of the Jericho Project in the Willingham area of the Contwoyto Lake map sheet. Heritage resource studies identified archaeological sites and appropriate mitigative measures were implemented. Further, overview archaeological studies associated with potential development of facilities between Jericho and Lupin resulted in the identification of ten sites of which one had been previously recorded. The existing developments in the Project Cumulative Effects Assessment Area (Figure 2.2-1), were all assessed for heritage resources and appropriate mitigation completed, thereby minimizing adverse effects. At the Diavik diamond mine, for example, facilities were relocated and redesigned to avoid archaeological sites, ensuring no direct adverse effects occurred. These studies produced positive effects as current knowledge about archaeological site distribution increased.

All future developments within the Project Cumulative Effects Assessment Area (Figure 2.2-1), and the heritage resource study area require heritage resources impact assessments. Many of these studies have been either completed or are under way. As such, positive effects will accrue in enhancing current knowledge of past human use of the landscape and negative effects of development will be minimized by appropriate mitigation. Because many of these developments are localized and relatively far removed from each other, direct effects are greatest within the footprint areas with little cumulative consequence.

17.6 Combined Effects of Human Actions

17.6.1 Expansion of Bathurst Inlet Port

Heritage resource sites located within the proposed Port facility will be lost as a result of construction. Recording completed to date and proposed mitigation will conserve the information in these sites but they will not be available for present and future needs of the local communities relative to appreciation of history and education. Given the number of sites recorded on the peninsula and the distribution of sites in the RSA, additional sites are very likely to be present in the area. Should the Port facility be expanded in the future, it can be anticipated that more intensive land use activities will be associated with operations. These activities and footprint expansion could result in disturbance (nibbling loss and growth-inducing potential) of additional heritage resource sites.

Table 17.5-1
Summary of Links between the Project and Other Human Actions for Heritage Resources

Development	Linkage with Effects of BIPR Project
Past (Closed) Developments	
Lupin mine	Unknown
Nanisivik mine	Archaeological Studies
Polaris mine	Archaeological Studies
Colomac mine	Archaeological Studies
Bent Horn oil well	Unknown
Tundra mine	Unknown
Salmita mine	Unknown
Roberts Bay and Ida Bay mine	Remediation Heritage Resources Impact Assessment
Discovery mine	Unknown
Rayrock mine	Unknown
DEW Line radar stations (some now NWS stations)	Remediation Heritage Resources Impact Assessment
Existing Developments	
EKATI diamond mine	Heritage Resources Impact Assessment and Mitigation
Diavik diamond mine	Heritage Resources Impact Assessment and Mitigation
Jericho diamond mine	Heritage Resources Impact Assessment and Mitigation
Snap Lake diamond mine	Heritage Resources Impact Assessment and Mitigation
Hope Bay (Doris North) gold mine	Heritage Resources Impact Assessment and Mitigation
Reasonably Foreseeable Future Developments	
Gahcho Kué diamond mine and spur road	Heritage Resources Impact Assessment; Nibbling loss; Growth-inducing potential
Hope Bay (Boston) gold mine	Heritage Resources Impact Assessment; Nibbling loss; Growth-inducing potential
Nanisivik naval station	Nibbling loss; Growth-inducing potential
Hackett River base metal mine and spur road	Heritage Resources Impact Assessment; Nibbling loss; Growth-inducing potential
Expansion of Bathurst Inlet Port	Nibbling loss; Growth-inducing potential
Izok base metal mine and road to Lupin	Heritage Resources Impact Assessment; Nibbling loss; Growth-inducing potential
Expansion of Contwoyto Camp (barge dock)	Nibbling loss; Growth-inducing potential
High Lake base metal mine	Heritage Resources Impact Assessment; Nibbling loss; Growth-inducing potential
Yellowknife Gold Project	Heritage Resources Impact Assessment; Nibbling loss; Growth-inducing potential
Other Human Activities	
Subsistence harvest (fish and wildlife)	Nibbling loss from disturbance
Commercial harvest (fish and wildlife)	Nibbling loss from disturbance
Sports hunting, including guide-outfitting	Nibbling loss from disturbance
Eco-tourism	Nibbling loss from disturbance; Growth-inducing potential
Mineral and diamond exploration	Growth-inducing potential

17.6.2 Expansion of Contwoyto Camp

The current footprint of the Contwoyto Camp is not in conflict with any heritage resources. However, a number of sites were identified in the vicinity and expansion of this camp could result in potential nibbling loss and growth-inducing interactions with heritage resource sites in the area.

17.6.3 Other Human Activities

Other human activities such as hunting and fishing, camp set up, ecotourism and mineral and diamond exploration could disturb archaeological materials. Extensive surveys for heritage sites have not been conducted in large portions of the barren grounds. There is no heritage resource data available to manage the effect of these activities on these sites; consequently, growth-inducing and nibbling loss interactions could occur. Further, mineral and diamond exploration is associated with nibbling loss as positive finds lead to full-scale development.

Residual effects resulting from increased human presence (*e.g.*, hunting, fishing, ecotourism, exploration) are difficult to predict as there is a lack of both heritage resource inventory beyond the limits of the field work completed in association with the Project and specific data on nature and extent of disturbance from these activities on heritage resource sites.

17.7 Significance of Cumulative Effects

Because heritage resources are non-renewable, adverse cumulative effects could ultimately be highly significant. Of particular concern are localities of high heritage resources potential in which human activities are not regulated. However, with the appropriate research, assessment and monitoring, these effects could be effectively managed and beneficial effects would accrue from site discovery, recording and inclusion in public programs. With the implementation of such programs the significance of residual effects is reduced to **Moderate**.

17.8 Confidence Levels of Assessment

The potential for cumulative effects and the predicted significance of cumulative effects is based on perceived heritage resource potential and likely activities. Because of the lack of comprehensive regional inventories, confidence levels are intermediate.

17.9 Mitigation, Management and Monitoring

Management of cumulative effects can be achieved by meeting the requirements of the Archaeological and Palaeontological Regulations at the effects assessment and mitigation stages. Implementation of monitoring programs designed to provide data on construction and operational effects on heritage resources associated with individual projects would ensure that unregulated effects are identified and mitigated as necessary.

17.10 Summary of Assessment

The predicted expansion of the BIPR port facility is expected to result in the loss of additional heritage resource sites. Recording completed to date and proposed mitigation will conserve the information in these sites and increase our knowledge about heritage resources, but the sites themselves will not be available for present and future needs of the local communities relative to appreciation of history and education. BIPR may facilitate the development of other projects and increase human presence in the area, resulting in further disturbance and nibbling loss of heritage sites. Heritage Resources Impact Assessments and mitigation measures will reduce the significance of effects to **Moderate** (Table 17.10-1).

Table 17.10-1
Summary of Cumulative Effects Assessment for Heritage Resources

Description of Effect	Significance	Confidence Level
Increased knowledge of archaeological site distribution and enhanced knowledge of past human use of the landscape	Moderate	Intermediate
Loss of heritage sites and context	Moderate	Intermediate

18. SOCIO-ECONOMICS

18. Socio-economics

18.1 Introduction

This section describes the analysis of potential cumulative effects that could result in Nunavut and the NWT from the BIPR Project in combination with other developments projects that have been identified in the region. Cumulative effects of the BIPR Project are considered important as the Project will improve access and related infrastructure to the Slave Geological Province for mineral exploration and development, and other projects that may otherwise remain undeveloped.

18.2 Area of Influence

The cumulative effects assessment area of influence was established to include the limit of potential effects from all identified existing projects, plus the limit of potential effects from future projects (Figure 18.2-1).

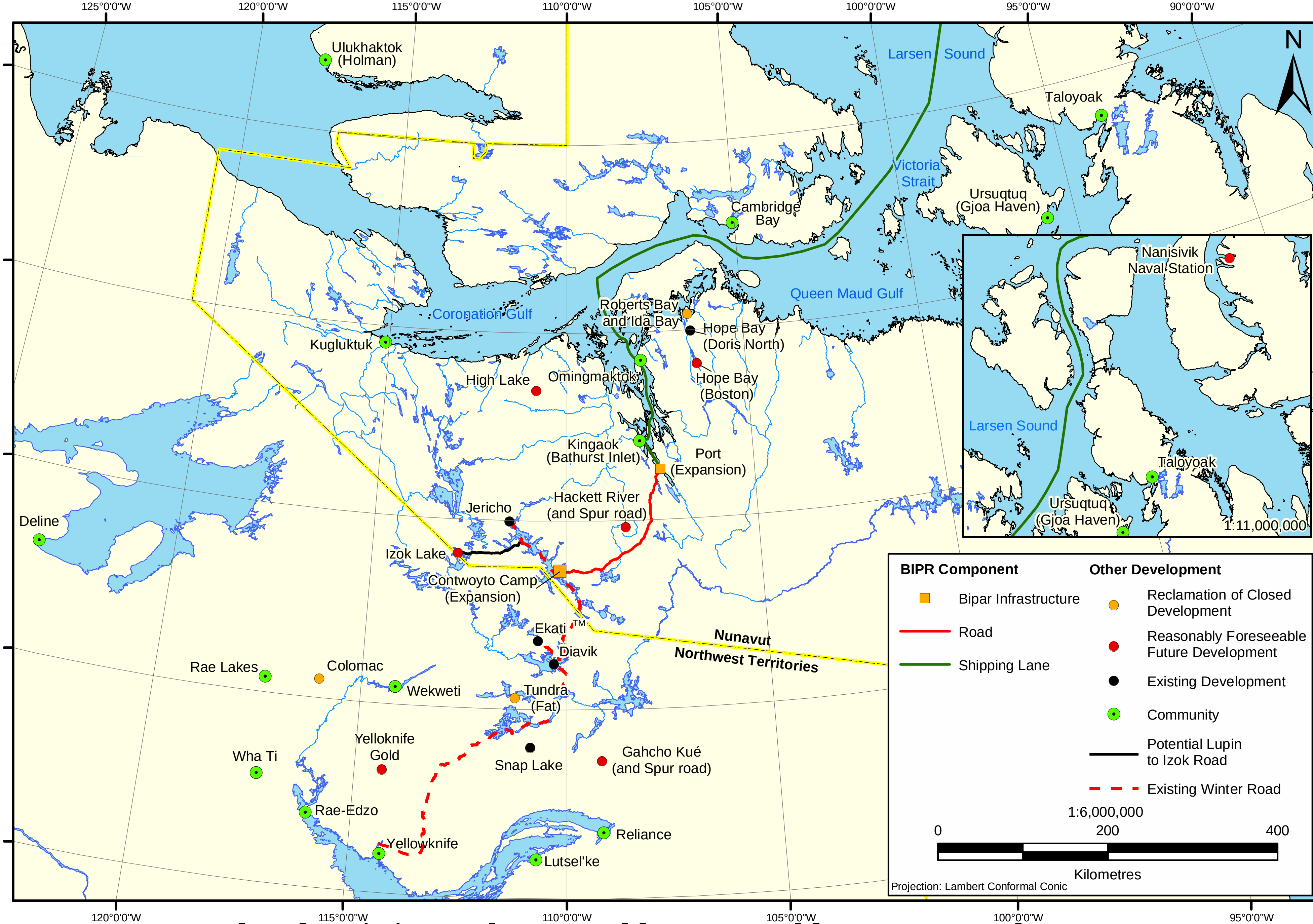
Only existing and future projects enumerated by NIRB located within Kitikmeot region of Nunavut and the Akaitcho, Tlicho and Sahtu Regions of NWT, were included in the cumulative effects assessment. The area of influence includes areas within Nunavut and the NWT to capture trans-boundary effects to features such as caribou.

Projects included in the cumulative effects assessment are described in Table 18.2-1 (existing projects) and Table 18-2-2 (reasonably foreseeable future projects). In addition to “reasonably foreseeable” developments (see Section 2.2.4), there may be other projects whose feasibility is improved by commissioning the Project, for example the Back River Project (George Lake and Goose Lake)

Table 18.2-1
Existing Developments in the
Cumulative Effects Assessment Area of Influence

Project	Company	Project Status	Operating Period [1]
Nunavut			
Jericho Diamond Mine	Tahera Diamond Corp.	Operating	2006-2014
Hope Bay (Doris North) Gold Mine	Miramar Mining Corp.	Development	2009-2010
NWT			
EKATI Diamond Mine	BHP Billiton	Operating	1998-2020
Diavik Diamond Mine	RTZ Rio Tinto	Operating	2003-2025
Snap Lake Diamond Mine	De Beers	Operating	2007-2030

Sources: De Beers Canada Mining Inc. (2005); Miramar (2005); MVEIRB (2006); Sabina Silver Corporation(2007); Wolfden (2006); Zinifex Limited (2007); Tyhee Development Corp. (2005); Tyhee Development Corp. (2007b).
[1] The operation periods for each mine/project are not finalized.



the Bathurst Inlet Port and Road Project

Closed, Existing and Reasonably Foreseeable Future Developments in the Cumulative Effects Assessment Area of Influence

Figure 18.2-1

Rescan

Table 18.2-2
Reasonably Foreseeable Future Developments in the Cumulative Effects Assessment Area of Influence

Projects	Company	Project Status	Projected Operating Period
Nunavut			
Hope Bay (Boston) Gold Mine	Miramar Mining Corporation	Potential Development	Information unavailable
Hackett River Silver-Zinc Mine (and Spur Road)	Sabina Silver Corporation	Potential Development	2013 to 2026
Izok Lake Zinc-Copper-Lead-Silver Mine (and all-weather Road to Lupin)	Zinifex Ltd.	Potential Development	2014-2025
High Lake Gold-Silver-Zinc-Copper Mine	Zinifex Ltd.	Potential Development	2016-2027
NWT			
Gahcho Kué Diamond Mine (and Spur Road)	De Beers	Potential Development	2011-2026
Yellowknife Gold Project	Tyhee Development Corp.	Potential Development	Information unavailable

Sources: De Beers Canada Mining Inc. (2005); Miramar (2005); MVEIRB (2006); Sabina Silver Corporation(2007); Wolfden (2006); Zinifex Limited (2007); Tyhee Development Corp. (2005); Tyhee Development Corp. (2007b).

18.3 Temporal Boundary

The temporal boundary for the cumulative effects assessment has been determined to be 22.5 years, based on the projected Project life including construction, operation, and closure.

18.4 Valued Socio-economic Components

A definition of Valued Social and Economic Components (VSECs) is provided in Appendix F-2 (Socio-Economic Effects Assessment). The VSECs considered in the cumulative effects assessment are:

- Health and Wellness;
- Economic Development; and
- Aboriginal Culture.

18.5 Health and Wellness

18.5.1 Community Health and Security

Increased incidence of drug use and alcoholism, and associated problems such as increased rates of sexually transmitted diseases (STDs) and HIV/AIDS and/or increased acts of family violence and sexual assaults can adversely affect community health and security. Drug and alcohol use, and associated social pressures, is already common in Nunavut and the NWT communities (as it is throughout all of Canada); however, with the opening of various projects in the North, access to, and use of, drugs and alcohol could magnify. Increased access to, and prevalence of, drugs and alcohol is anticipated as there are new markets (mining camps). With a greater movement of southern and community workers throughout the area of influence, drugs and alcohol can be more rapidly transferred from camp to camp or from camp to community. Criminal offences are expected to increase as a result. The SEIA Project Team recognizes the association between increased wages, narcotics use, sexual promiscuity, and criminal activity and considered this in the aforementioned assessment.

It cannot be predicted whether additional projects will provide onsite support for victims of addiction or assault, making it difficult to determine whether these effects can be regulated or minimized. The purpose of this assessment is to identify the potential impacts and communicate them to additional project proponents, appropriate authorities, and leaders in the affected communities.

18.5.2 Community Cohesion

The cumulated effect of multiple pressures on community health and wellness, such as increased use of drugs and alcohol, can indirectly perpetuate continual or accelerated rates of STDs and HIV/AIDS and acts of family violence or sexual abuse, thereby disrupting community cohesion. Community cohesion is defined as the functioning of a community; the way in which a community relates and interrelates with other community members or families. These actions create the social fabric by which a community functions. As stated previously, drug and alcohol use is already common within Nunavut and the NWT communities (as it is throughout all of Canada); however, with the opening of various projects in the North, access to and use of drugs and alcohol could magnify. The aggregation of pressures on traditional communities can potentially encourage community members to relocate or migrate to surrounding communities.

It cannot be predicted whether additional projects will provide onsite support for victims of addiction or assault, making it difficult to determine whether these impacts can be regulated or minimized. It is the purpose of this assessment to identify the potential impacts and communicate them to additional project proponents, appropriate authorities, and leaders in the affected communities.

18.6 Economic Development

18.6.1 Employment and Labour

The combined effect of the Project with additional developments in the cumulative effects assessment area of influence will generate a positive effect on the wage labour force within Nunavut and the NWT. The employment opportunities that will be generated from currently operating and reasonably foreseeable future developments will benefit the communities within the cumulative effects assessment. Noteworthy potential users of the Project are the operational EKATI, Diavik, Snap Lake, and Jericho mines, which could utilize the road for most of the duration of the life of the Project.

The aggregation of average annual revenue that operational mines will generate for the cumulative effects assessment area of influence is estimated at CAD $1.5 billion for the Nunavut and NWT region over the 19 year operational life of BIPR. The EKATI mine will generate CAD $400 to $500 million in revenue a year on average, the Diavik mine will generate CAD $420 million a year on average and the Jericho mine will potentially generate CAD $76 million in revenue a year.

According to the report *Bathurst Inlet Port and Road: Economic Benefits for Nunavut and Canada* (Appendix F-10 of the DEIS), the Project in combination with other existing mines will increase employment in Nunavut by 754 persons-years measured on a labour force basis; of which 445 (about 59%) will go to non-aboriginal employment while 311 (41%) will go to aboriginal employment.

Potential future developments will also bring about employment opportunities over the course of the Project life, but it was difficult to estimate to revenues or employment rates. According to the economic benefits analysis (Appendix F-10 of the DEIS), the predicted effect that the BIPR Project and additional mineral projects would have on Nunavut would be significantly favourable:

> *Total employment in Nunavut will rise by 2,928 person years through 2027 in Case I and by 11,767 person years in Case II. Although the majority of jobs in both cases go to Non-aboriginal peoples, Aboriginal employment rises by 1,221 in Case I and 4,914 in case II.*

Case I refers to the economic effect that the BIPR Project and the EKATI, Diavik, Gahcho Kué and Jericho mineral projects will have on Nunavut. Case II refers to the aforementioned mines coupled with the economic effects of Hackett River and Izok Lake. It can be argued that the opportunities created by the Project will be experienced not only by Nunavummiut but also by communities in the NWT.

A potential adverse cumulative effect of job creation within the area of influence could be the levelling off of employment opportunities when mines close and with the closure of the BIPR Project. The Project is expected to be operational for 19 years, and although it is possible that demand for Project facilities will extend beyond 19 years, this cannot be guaranteed.

18.6.2 Business Opportunities

The cumulative effect of the Project and additional developments within the cumulative effects assessment area of influence will generate a positive effect by induced or indirect spin-off employment opportunities for local businesses.

The operations of various projects within the area of influence could foster new business developments, specifically along the road or at the port site, if the anticipated port and road users do utilize the Project. Similarly, additional business opportunities can be generated in Kitikmeot communities. It can be expected that services from Bathurst Inlet or Omingmaktok could be established to serve the users of the Project. This could also assist in the strengthening of local economies within each region by specializing/diversifying the type of entrepreneurial or professional skills that Project users require. Once communities within the area of influence have attained a self-sustaining economy due to job creation and higher wages to offset already high cost of living, communities can invest locally to further diversify their economies, such as in the tourism industry. Expansion of the local tourism industry in Nunavut is among each community's economic development goals (Appendix F-7 of the DEIS, Socio-Economic Studies).

There may be potential adverse effects to the development of local businesses as some may not be able to compete with the higher wages offered by the mining sector or alternative businesses that offer similar services to the same clientele. Even though the development of the mining industry may increase the demand for various services, there is a possibility of business closures as an overabundance of the same business may be created.

18.6.3 Education and Training

The cumulative effect of the Project and additional developments within the cumulative effects assessment area of influence will generate a positive effect on the development of education and training opportunities. The demand for skilled labourers will require a trade certificate and a secondary school diploma. This will encourage young people (future labourers/workforce) to continue their studies and graduate, and possibly specialize within a specific industry/occupation. As the standard of living rises due to an increase in wage employment, the quality of education is also expected to improve as wealth is being created and remaining in the region.

18.7 Aboriginal Culture

18.7.1 Traditional Economic Pursuits

People leaving traditional economic activities to pursue wage employment opportunities may have limited time to pursue traditional skills. It is generally the youth who leave the communities in search of economic prosperity, such as in mineral development projects. This usually occurs when the youth are at the most important point of their education with the elders, and is further complicated by the rotational work schedule often in place at mines (*e.g.*, two to three weeks on and a week off). This departure represents an interruption in the traditional teaching methods of aboriginal societies where traditional skills and knowledge are passed on from elders to youth. The youth will have a difficult time refreshing their skills and learning new traditional skills when they have limited access to the elder's teachings or within their home environment.

18.7.2 Traditional Skills and Knowledge

The addition of mineral projects in the region of the Project will increase the potential for reduced participation in traditional pursuits. During the construction phase of new mining projects the highest numbers of unskilled positions are available, and will draw employees from across Nunavut and the NWT. It is generally the youth who are drawn to the labour intensive positions, forgoing teaching from the elders of their communities.

There is an opportunity to change this potentially adverse effect into a positive effect. If elders are employed at the sites for mentoring and teaching the youth, those youth who would not normally be exposed to traditional skills and knowledge can benefit from their teaching. Also, by having cultural awareness courses for the construction employees, non- aboriginal peoples will be exposed to the culture and traditions of the aboriginal involved, helping to break down barriers between cultures.

18.7.3 Language

Within the area of influence, the percentage of adults who stressed the importance of keeping, learning, or re-learning an Aboriginal language in 2001 ranged from 92.0% to 100.0% (Appendix F-7 of the DEIS). However, new industrial developments and technological advancements in the Arctic challenge community elders and family efforts to preserve the traditional language (orally handed down) amongst youth. The combined effects of mineral development projects that follow the Project could potentially endanger language preservation amongst Aboriginal population engaged in the projects. Cultural Awareness Programs (CAP) can be introduced at the job site and continue throughout the rotational Project work schedule. The CAPs' objective would be centered on capacity building and would encourage the fostering of relationships between aboriginal and non-aboriginal employees. The CAP would also aim to build collective understanding and respect for all parties in the workplace despite their community/city/territory of origin and to provide a social environment in which Nunavummiut are able to participate in the formal wage economy while maintaining their traditional heritage and lifestyle.

18.7.4 Traditional Land Use Patterns

Increased mineral development in the West Kitikmeot region of Nunavut facilitated by the Project will limit the traditional land use of the aboriginal groups within the cumulative effects assessment area of influence. Although individual mines have a small footprint the combined mines would incorporate a large area of the traditional lands of the aboriginal peoples. Cumulative effects must take into consideration not only the mines that are in current operation or development but also those that are in the exploration phase. Although the Project does not itself encroach on land used by the Aboriginal populations, future mineral developments will create a much larger footprint that may encompass traditional lands. There will also be an increase in the risk to water and air quality. ARD from proposed mine sites and sedimentation of aquatic ecosystems has potential to become a major concern for the Aboriginal populations who use the region for traditional economic pursuits such as hunting, fishing and berry-picking. Dust could become a problem for vegetation, and consequently, for the wildlife and human populations that rely on the vegetation and wildlife for medicine and subsistence.

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19. SUMMARY AND CONCLUSIONS

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19. Summary and Conclusions

The cumulative effects assessment evaluated the combined effects of the Project and other human actions on VECs and VSECs. The assessment of cumulative effects was based on a hypothetical but realistic future scenario, which was developed using the best available data about closed, existing, and reasonably foreseeable future developments in the Project area. The key features of the future scenario were:

- development of five new mines that are proposed in the Project area (Gahcho Kué, Hope Bay Boston Deposit, Hackett River, Izok Lake and High Lake) in addition to existing developments (it is predicted that all these developments will connect to and/or utilize Project facilities to varying degrees);
- projected five-fold increase in the volume of material moved through Project facilities each year, including the addition of concentrate exports generated by the Hackett River and Izok Lake projects;
- expansions of facilities to include concentrate storage facilities at the port site and a summer barge dock at Contwoyto Lake Camp;
- projected three-fold increase in shipping traffic (assuming backhaul of concentrate exports);
- projected four-fold increase in barge traffic, mostly to supply the proposed Hope Bay (Boston) project;
- projected three-fold increase in truck traffic on the road;
- potential addition to road operational period to include hauling between the port and Contwoyto Camp from mid-July to mid-October for the Izok Lake Project; and
- potential addition to road operational period for the Hackett River Project, with trucks hauling between the port and the Hackett River site.

The cumulative effects that were assessed as having moderate significance are summarized in Table 19-1. All other effects were rated as negligible or low. The moderate significance effects predominantly result from the projected increase in road traffic, and potential addition of road operational periods.

Table 19-1
Summary of Moderate Significance Cumulative Effects

VEC/VSEC	Cumulative Effect
Atmospheric Components:	
Climate	GHG (CO_2 equivalent) emissions
Ambient Air Quality	Atmospheric concentrations of NO_2, TSP and $PM_{2.5}$
Freshwater Components:	
Water and Sediment Quality	Accidental spill of fuel or cargo along the road or from barges crossing Contwoyto Lake
Aquatic Resources	Accidental spill of fuel or cargo along the road or from barges crossing Contwoyto Lake
Fish and Fish Habitat	Accidental spill of fuel or cargo along the road or from barges crossing Contwoyto Lake
Terrestrial Components:	
Ecosystems and Vegetation	Loss of plant communities, associations and plants
Soil Quality	Soil loss
Caribou (Bathurst Herd)	Disturbance and disruption to movements
Caribou (Peary)	Disruption of movements
Socio-Economic and Archaeology:	
Heritage Resources	Increased knowledge of archaeological site distribution and enhanced knowledge of past human use of the landscape
Heritage Resources	Loss of heritage sites and context

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An explanation of the acronyms used throughout this reference list can be found in the *Acronyms and Abbreviations* section.

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Appendix G-6
Closure and Reclamation

Author: **Rescan Environmental Services Ltd.**
Date: **December 2007**

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Bathurst Inlet Port and Road Closure and Reclamation

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ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations

BIPR	Bathurst Inlet Port and Road
DEIS	Draft Environmental Impact Statement
NIRB	Nunavut Impact Review Board
the Project	the Bathurst Inlet Port and Road Project
the Proponent	Bathurst Inlet Port and Road Project Joint Venture Ltd.

CLOSURE AND RECLAMATION

Closure and Reclamation

1. Introduction

The Bathurst Inlet Port and Road (BIPR) Project (the Project) involves the construction of a port on Bathurst Inlet, Contwoyto Camp, and an all-weather road between the port and Contwoyto Lake. It is expected that the Project will be in use for many generations in the future; nevertheless, Bathurst Inlet Port and Road Project Joint Venture Ltd. (the proponent) acknowledges that non-renewable resources are finite and that some day the road and associated facilities may no longer be required. This chapter describes how the Project facilities will be closed, decommissioned, and reclaimed to minimize long-term effects on the biophysical environment and to meet specified land use objectives following the cessation of Project.

2. Regulatory Framework and Requirements

Planning for reclamation and closure is mandated by the Nunavut Impact Review Board (NIRB) (NIRB, 2006) as part of receiving a permit to construct the Project. Therefore, the closure plan must be sufficient to provide confidence to the government that closure, decommissioning, and reclamation will be successful. The abandonment and reclamation activities described here present practices and treatments that are available to achieve appropriate abandonment goals and objectives. All reclamation activities will be done in accordance with the final closure plan as approved by all land use authorities and will be subject to terms and conditions including those required by land owners (KIA and INAC) and the Nunavut Water Board. The Proponent will undertake to post sufficient security to cover the costs of remediation on termination of the Project.

3. Reclamation and Closure Objectives

The closure and reclamation approaches outlined in this report are designed to meet several objectives:

- to protect the environment through sound reclamation practices;
- to restore the land to its original state as closely as possible;
- to restore land uses (*e.g.*, creating wildlife habitat and/or promote habitat recovery);
- to minimize effects to aquatic habitat and water quality with proper engineering; and
- to ensure that reclaimed and abandoned areas are safe and do not pose health and safety risks.

To achieve this, detailed studies have been carried out which have then been used to establish the post-closure land use objectives. The goal of the closure, decommissioning, and reclamation plan is to carefully plan the development of the Project facilities such that the lands they occupy can be reclaimed with minimum residual effect on the environment. To do this, construction and operation/maintenance of the components of the Project will incorporate techniques to minimize surficial disturbance and to progressively reclaim areas affected during the construction and operation phases. Progressive reclamation is critical for minimizing the effects on the environment. Stabilizing and rehabilitating surfaces reduces the potential for degradation of the resources due to extended exposure to climatic factors. Careful planning before beginning Project construction will allow for the successful closure and reclamation of the Project.

The environmental management and monitoring systems developed for the Project will ensure terrestrial, aquatic, heritage, and archaeological resources are sufficiently protected on an on-going basis during Project construction, operations, and post-closure.

4. Reclamation Planning/Soil Handling

The Project will involve the construction of the facilities at the port, at Contwoyto Camp, and the road. Reclamation planning will require the salvage and storage of soils suitable for reclamation and the design of all earth structures, cuts, fills, and stream embankments, as near as possible, to closure condition. This will include contouring all erosion prone surfaces and slopes, excavations, and embankments (except when in solid rock), to a stable slope.

Surficial materials in the Project area have been described (Appendix D-4 of the DEIS) and include glaciomarine deposits, which generally occur at the port site, morainal materials, organic soils, lacustrine, and fluvial and glaciofluvial deposits. Where construction requires that the soils will be directly disturbed for installation of the facilities, the soils suited for reclamation will be salvaged and stockpiled in an area where they will not be disturbed until required for reclamation. For example, approximately 3 m of ice rich soil capped with between 30 and 50 cm of organic material occurs at the Contwoyto Lake Camp (SNC Lavalin, 2007). Some of this material can be salvaged for later reclamation. Roughly 1.5 m of the soil will be excavated to provide a foundation area that will be backfilled with granular material, providing a base for the camp facilities. This material will be stockpiled.

Stockpiled soils are susceptible to water erosion and wind erosion when dry. Therefore, the stockpiled soils will be seeded with a certified weed free native seed mix that has been found to be successful in this climate and region (Martens, 2007):

- alpine bluegrass (*Poa alpina*): 40%;
- tufted hairgrass (*Deschampsia ceaspitosa*): 40%; and
- spike trisetum (*Trisetum spicatum*): 20%.

The seed mix will be Canada No. 1 grade to minimize the potential of introducing unwanted plants. The seed will be applied at a rate of between 8 to 10 kg/ha with fertilizer (16-16-16 NPK) at approximately 50 kg/ha (Martens, 2007) on the stockpiles. A chemical analysis will be carried out to assess the appropriate fertilizer rate.

Where the soils to be salvaged have a thick organic cover, such as at Contwoyto Lake Camp and the fuel tank farm, it will be mixed with the underlying soils during the salvage operation as this material has a tendency to become desiccated and hydrophobic if stored separately. It is also subject to wind erosion when dry. The incorporation of this material with the subsoil will support the soil structure, be a source of nutrients, and improve the moisture and nutrient holding capacities of less suitable soils.

Effort will be made to not salvage the soils when they are excessively wet. They can be salvaged when they are frozen. Topsoil will be salvaged and stockpiled separately from the underlying soils, if possible. Topsoil is nutrient rich and therefore this material, when used as a cover, will result in more successful revegetation. Salvage will also include the vegetation growing on the soils. The plant material will provide maintenance of the soil structure due to the benefits of roots and the incorporation of plant material. Further, the incorporated plant material will include native seeds and plants as well as microorganisms which will accelerate the establishment of native vegetation when used as a cover.

5. Closure and Reclamation Plan

5.1 Introduction

Many revegetation and closure practices will be common throughout the Project and many parts of the Project will require a closure plan tailored to the facility. For example, over the whole Project area, efforts will be made to treat (through bioremediation) and/or remove and dispose of all contaminated soils, in accordance with land use regulations, as expeditiously as possible and on an on-going basis to minimize the accumulation of such materials on-site. Areas not used for the operation phase will be progressively reclaimed as time and equipment permits. Revegetation of disturbed sites as soon as possible will reduce the potential for environmental degradation as it will minimize the amount of surface disturbed and exposed to erosion.

5.2 Revegetation

Native seed will be used for revegetation purposes throughout the Project area. The use of native seed on reclaimed areas will provide a preliminary vegetative cover which will likely infill naturally with native plants from adjacent areas resulting in a more complex vegetative community with time. This will expedite the return of wildlife habitat rather than delaying the process until closure of the Project.

The invasion of native plants, with time, will vary according to site conditions. In a climate characterized by light summer rains and significant evapotranspiration, soil moisture is key to revegetation. Invasion of native species may occur relatively quickly on wet sites. Such sites are generally depressional and have a substrate that contains appreciable soil fines (*i.e.*, sand, silt, or clay particles). Cotton grass (*Eriophorum* spp.), sedges (*Carex* spp.), and a variety of grasses, herbs and shrubs are expected to invade wet to moist sites (Martens 2007).

On mesic sites, colonization will likely be slower and expected groundcover less abundant, because of lower soil moisture. Native grasses (such as *Calamagrostis canadensis*), sedges, herbs (such as *Oxytropis* spp. and *Astragalus* spp.), dwarf birch (*Betula glandulosa*) and willow (*Salix* spp.) are expected on mesic sites, with time (Martens 2007).

Xeric sites, such as road and pad surfaces, will be rapidly draining presenting inhospitable conditions for revegetation. Ripping (scarifying) surfaces will improve conditions for plant reestablishment by relieving soil compaction and creating a furrowed surface to collect and concentrate moisture (arriving as snow or rain), and soil fines. Xeric sites are likely to support a scattered cover of drought tolerant grasses, xeric mosses, lichens, and in depressional areas, clumps of dwarf birch mixed with grasses and the occasional willow with time.

Side slopes of rock quarries are not expected to support plant growth, other than lichens and xeric mosses. Floors of quarries will revegetate in depressional areas where soil fines and moisture collect and where salvaged overburden is replaced.

5.3 Port Site

The port area is approximately 159 ha and will include a wharf, a 200-person camp with services, a 200+ million litre fuel tank farm, a diesel power plant, ammonium nitrate storage, two sedimentation ponds, a truck and trailer maintenance shop, a sewage treatment plant, a fuel disposal area, a heliport, an airstrip, a landfill/soil stockpile, and two quarries. The airstrip will be approximately 1,200 m in length and 70 m wide. One quarry will be located between the camp at the port and the landfill/soil stockpile site. The second quarry is at the wharf site. The landfill will be located off the main road, approximately 600 m from No Name Creek.

Final closure activities will include the following:

- removal of all buildings and structures;
- commence and enhance revegetation on parts of the land disturbed or altered as expediently as possible;
- complete all clean-up and removal activities;
- contour all surfaces to reduce the potential for erosion, and slope the sides of excavation (*e.g.*, the quarry) and embankments to permanent stable conditions;
- apply soil cover where available on level or gently sloping surfaces;
- apply seed and fertilizer;
- treat and/or remove and dispose of all contaminated soils; and
- implement abandonment monitoring program.

5.3.1 Quarries

Quarries will be contoured and designed to prevent entrapment of wildlife and if possible, benched. The quarry floor will be designed to reduce the potential for water accumulation. Soil salvaged prior to construction will be spread on the benches, if available. The soil on the benches will then be planted with native seed and fertilized, if required. Soil fertility analysis will be carried out prior to reclamation.

5.3.2 Fuel Storage

The tanks and all piping will be drained and cleaned. These will then be dismantled. The tank and piping will be shipped off site. The liner within the tank enclosures will be removed and the area re-graded to blend in with the local topography. The liner will be transported off-site to be disposed of in a permitted landfill.

The gravel surface which formed the foundation of the fuel storage area will be ripped to 30 cm to improve drainage. As there are approximately 2 to 3 m of soil in this area including 30 cm of organic material (SNC Lavalin, 2007), some will likely have been salvaged and stockpiled prior to construction. Areas that will be reclaimed will require a soil cover of not less than 15 cm. Care will be taken not to spread the soil when it is excessively wet or frozen. The area will be planted with native seed and fertilized.

5.3.3 Fuel Dispensing and Loading Area

All equipment will be drained, cleaned, and then dismantled. All steel will be shipped out. Subject to obtaining the necessary permits, all combustible materials including wood will be burned. Inert material will be shipped off site for disposal in a permitted landfill or in the on-site landfill, if permitted. Fuel-contaminated soil will be cleaned by bioremediation, if demonstrated to be an effective tool in this location, or by other cost-effective techniques.

The gravel surface which formed the foundation of the fuel dispensing and loading areas, will be ripped to approximately 30 cm to improve drainage. If soil salvage can be carried out, the soils will be stockpiled and spread on the gravel surface at closure. Areas that will be reclaimed will require a soil cover of not less than 15 cm. Care will be taken not to spread the soil when it is excessively wet or frozen. The area will be planted with native seed and fertilized.

5.3.4 Buildings and Camp

All modular units, generators, buildings, and equipment will be cleaned, dismantled, and removed from the site and shipped out. Any wood or combustible materials from the camp will be burned. Inert material will be disposed of off-site in a permitted disposal facility or placed in the on-site landfill, if possible. The gravel surfaces which form the foundations of the various structures will be ripped to approximately 30 cm to improve drainage. If salvaged soil is available, it will be spread on the surface. Areas to be reclaimed should have not less that 15 cm of soil spread on the surface. Care will be taken not to spread the soil when it is excessively wet or frozen. The area will be planted with native seed and fertilized based.

5.3.5 Wharf

The wharf may serve further purpose and thus will not be removed. All steel from the sheet pile cells will remain in place. The rock approach fill and the causeway will also remain as is.

5.3.6 Airstrip, Helipad, and Port Area Road

The airstrip, helipad, and road will be graded so they blend with the local topography. Efforts will be made to minimize covering undisturbed tundra during the re-grading process. The road and airstrip will be breached to restore natural drainage in areas that contain drainage courses that have intermittent water flow.

These areas will be highly compacted and, therefore, will be ripped to approximately 30 cm. Reclaimed areas will require at least 15 cm of soil Native seed can be used and with time other native plants from the adjacent areas will likely invade these areas such that the diversity of the plant community will increase with time.

5.3.7 Maintenance Truck Shop/Administration and Dry/Sediment Ponds

All structures, equipment, and related infrastructure related to the truck shop and administration and dry will be dismantled and removed. The concrete slabs will be broken down to fragments less than 50 cm and disposed of in the sediment ponds. This material will be covered with salvaged soil and broadcast seeded with native seed. The soil will be roughly placed on the broken concrete as it will be difficult to obtain a smooth surface on this material. This will likely result in small pockets of soil occurring amongst the fragments, similar to parts of the Project area characterized by boulder fields and rocky outcrops.

5.3.8 Landfill/Soil Stockpile

At closure, the landfill will be leveled. Some foundation gravel from the other facilities may be placed in the landfill to bring it to grade. This will then be covered with soils previously salvaged from the site prior to construction of the landfill. The soils will be seeded with the native mix and fertilized. The soil stockpile will be located adjacent to the landfill.

5.4 Road/Quarry Access Roads

The road between the Port and Contwoyto Camp will be approximately 211 km long. The road width will total 13 m. Pullouts will be located along the road every 1 km on alternate sides. Pullouts will be 4 m wide and 50 m in length. Approximately 40 quarries will be constructed along the route to provide road bed material. The southern end of the road will terminate at Contwoyto Camp.

The road will likely be constructed by end dumping onto the tundra. Therefore, there will likely be little opportunity to salvage soil for final reclamation. However, if soils are salvaged they will be stockpiled for reclamation use.

Closure activities on the road will include the following:

- treat and/or remove and dispose of all contaminated soils;
- remove all bridges and culverts from roads;
- rip road bed surface to approximately 30 cm in areas that will be reclaimed;
- apply not less than 15 cm of soil cover material;
- revegetate with native seed; and
- implement the environmental monitoring program.

5.4.1 Quarries

Quarries will be closed as soon as they are no longer required and reclaimed as soon as possible. Quarries required for the maintenance of the road during operations will be reclaimed at closure.

The quarries will be contoured and benched, if possible. They will also be designed to prevent entrapment of wildlife. Those with a highwall will be bermed with large sized rock material at the high edge to discourage wildlife from falling into the quarries. The large rocks will represent a physical barrier as well as be inhospitable to vegetation establishment, thus reducing the potential for browse. A wildlife specialist or other qualified personnel will work with the contractors in the installation of berms and escape terrain.

Not less than 15 cm of soils will be spread on the benches where such material is available. The soil will then be planted with a native seed mix (described in Section 4) and fertilized. At no time during the construction or operations of the Project, will active erosion of any terrain be allowed to proceed unchecked.

Quarries on eskers will be re-sloped to no more that 30% to accommodate wildlife needs. A wildlife specialist will be on-site to ensure that the excavated slopes of the eskers are appropriately designed.

5.4.2 Contwoyto Camp

All modular units, generators, buildings, and equipment will be cleaned and dismantled and removed from the site. Any wood or combustible materials from the camp will be burned, and inert material will be transported off site and disposed of in a permitted landfill. Any hydrocarbon soils will be remediated on-site using microorganisms suited to the climate and standard practices. Contaminated soils which cannot be remediated on-site will be disposed off-site at a permitted facility.

The submersible pump and pipes located in Contwoyto Lake as well as the sewage outfall pipes will be removed and disposed of off site. Areas that are severely compacted, such as the parking area, will be ripped to approximately 30 cm depth. The stockpiled soil will be spread over the gravel pad. The soils will not be spread when they are excessively wet or frozen. Care will be taken not to compact the soil cover. The cover will be planted to a native seed mix. With time, the vegetation community will likely increase in diversity due to the invasion of surrounding native plants.

6. Implementation and Site Supervision

The reclamation and closure of the various facilities will be carried out under the direction of the proponent. An environmental monitor will meet with the Project manager to review details of the closure activities to determine precautionary measures during the closure phase. The environmental monitor will make regular site visits to inspect conditions during closure activities.

7. Monitoring and Reporting

Post closure monitoring will be conducted along the road, at stream crossings, quarry sites, the port area and Contwoyo Camp to ensure closure and associated reclamation efforts remain effective in the longer term. Post-Closure monitoring will include:

- soil erosion monitoring;
- revegetation success;
- terrestrial habitat use;
- water quality and stream flow in water courses downstream of decommissioning and reclamation activity, according to parameters and guidelines agreed by NIRB and the Nunavut Water Board; and
- water quality from areas exhibiting metal leaching/acid rock drainage after closure.

The reporting process is critical to providing a record of the closure program for use by the proponent and NIRB. Monitoring and reporting will be performed as required in the Closure and Abandonment Plan as approved by NIRB and the Nunavut Water Board.

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Appendix G-7
Summary of Commitments

Author: **Rescan Environmental Services Ltd.**
Date: **December 2007**

Bathurst Inlet Port and Road
Summary of Commitments

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Summary of Commitments

1. Introduction

Throughout all phases of the Bathurst Inlet Port and Road (BIPR) Project (the Project), BIPR Joint Venture Ltd. (the proponent) is committed to the underlying principles of integrated environmental management and sustainable development. This includes the need to find the right balance between biophysical and socio-economic impacts, and ensuring that current operations do not limit or diminish the opportunities for future generations.

Throughout the Draft Environmental Impact Statement (DEIS) document, the proponent has proposed mitigation measures to decrease possible negative effects or enhance possible positive effects of activities for environmental and socio-economic components of the Project. As well, the proponent has proposed monitoring and management plans for most of these components to ensure sustainable development of the Project. This section provides a summary of corporate commitments which includes these proposed mitigation measures and monitoring plans. These overall commitments to mitigation and monitoring are summarized in Table 4-1 at the end of this report.

2. Community Relations, Consultation, and Involvement

The proponent is committed to building long-term relationships with the communities in which it operates, in recognition and respect of cultural and regional diversity. The Inuit and other community inputs are critical to the success of the Project. Results of community input have contributed to identifying issues examined in the DEIS, developing mitigation measures and impact predictions, and optimizing project design with regard to environmental and socio-economic impacts.

The proponent is committed to continuing the process of consultation and community involvement through the life of the project. They are also committed to hiring as many Inuit and local workers (as possible) as a first priority, and to help them become prepared and trained for a career. The Nunavut Land Claims Agreement requires that the proponent negotiate an Inuit Impact Benefit Agreement (IIBA) with the Kitikmeot Inuit Association (KIA). Table 4-1 includes elements that could be included in an IIBA.

3. Environment

The proponent is dedicated to the concept of sustainable development, which requires balancing good environmental stewardship with economic growth. The proponent will continue to examine areas where the project can be improved. This includes a commitment to using an adaptive management approach in developing the project’s final closure plans. Table 4-1 summarizes these commitments.

4. Summary of Commitments

The proponent is committed to sustainable development, which requires balancing good environmental stewardship with economic growth, and will ensure that all phases of the project are carried out in compliance with the following objectives:

- responsible and effective environmental management planning is carried out for all aspects of this project;
- all regulatory environmental requirements are met or exceeded;
- Inuit Traditional Knowledge is incorporated into the Project;
- an integrated approach is followed through all phases of the project, including planning, design, construction, operations and decommissioning/reclamation;
- Project activities are monitored through all phases for environmental compliance and follow-up occurs in a timely and effective manner;
- strategies for efficient use of energy, resources and materials through all project phases and activities are implemented/enforced;
- environmental performance is improved through monitoring and evaluation;
- project activities are identified, assessed and managed to reduce environmental risks;
- emergency preparedness plans are developed, maintained, and tested to ensure protection of the environment, workers;
- contractors and consultants are required to comply with corporate environmental requirements and monitor their environmental performance;
- appropriate training is provided to all staff, contractors and consultants, to ensure understanding for risk to the environmental and related community concerns; and
- mutual aid agreements with mining companies are developed, including Coast Guard, Government of Nunavut, Government of Northwest Territories, and other agencies, in the case of a serious spill that requires more capacity than the proponent has instantly available.

The proponent understands that the final mitigation measures and monitoring plans will be dependent upon the results of the environmental assessment and regulatory review process. In the end, they will reflect the requirements of the Nunavut Impact Review Board, various regulator recommendations, and the permits, authorizations, and licences issued for the Project. Table 4-1 summarizes the commitments made by the proponent.

Table 4-1
Summary of the Proponent's Commitments to Mitigation Measures and Monitoring Plans for the Project

Component	Proposed Mitigation	Proposed Monitoring Plan
Meteorology and Climate	• The proponent is committed to the application of best industry practices and techniques to project operations. These commitments extend to energy consumption and GHG emissions. • The proponent will implement design features and practices that will minimize CO_2 emissions.	• Maintenance of the meteorological station and analysis of collected data will continue throughout the life of the Project.
Air Quality	• The proponent has committed to minimizing the concentrations of NO_2 around the port during both construction and operation. • A number of best management practices will be employed independent of weather conditions to minimize emission of NO_2 and other air contaminants. • The proponent has committed to minimizing the fugitive dust emissions during construction and operation of the port and road.	• Dustfall Monitoring Plan (dustfall will be assessed by analyzing snow cores collected after the end of the winter operation period).
Noise	• The proponent will control noise within the Project area in consideration of wildlife and workers.	• Monitoring of noise (worker's environment) around the Project site is planned.
Surface Water Quantity	• Mitigation for fluvial erosion and surface water quantity effects will be achieved by using best management practices while working in and around stream environments. • A regular management program will be established to ensure crossing structures are free of ice, snow, or debris to convey flow through the systems.	• No monitoring planned for water quantity. • Fluvial geomorphology and erosion in stream environments will not have a specific monitoring program but will be assessed in conjunction with watercourse crossing infrastructure and soil erosion monitoring program.
Surface Water and Sediment Quality	• Best management practices will be implemented as the basis for all work undertaken, particularly when working in or around water. • Mitigation measures to prevent the contamination of water and sediment quality will begin with detailed road design and include the construction, operation, decommissioning and post-closure phases. These measures will largely focus on the reduction of downstream sediment loadings to minimize effects on water and sediment quality.	• Environmental Monitors will monitor water quality during construction of fish bearing stream crossings in open water season. • Water quality will be monitored in the receiving environment of quarries that were identified as potentially acid generating and in proximity to a waterbody.

(continued)

Table 4-1
Summary of the Proponent's Commitments to Mitigation Measures and Monitoring Plans for the Project (continued)

Component	Proposed Mitigation	Proposed Monitoring Plan
Freshwater Aquatic Resources	• The proponent will maintain all roads to prevent or correct stream bank failures, sinkholes, or blockage of culverts at crossings. • ML/ARD potential will be assessed at quarries prior to construction. • Treated sewage effluent piped from the lake camp into Contwoyto Lake will undergo tertiary treatment to remove solids, nutrients and organics, and to control turbidity, bacteria, and pH such that it does not alter the physical, chemical, or biological properties of the lake.	• Monitoring and evaluation includes construction monitoring, surveying the road for structural issues, sampling downstream of quarries for ML/ARD issues (if problematic), and monitoring treated effluent discharge to Contwoyto Lake.
Freshwater Fish and Fish Habitat	• The proponent will ensure that freshwater fish communities and their habitat are not affected by activities of the Project, or if affected will compensate for it by developing a Fish Habitat Compensation Plan. • The proper application of specific fisheries measures will be used for each fish bearing stream crossing to prevent significant impacts to the aquatic and riparian habitat and fish populations. • Qualified and experienced environmental monitors will be employed to monitor the impact avoidance and environmental protection procedures during work at fish bearing streams in open water season.	• Water quality monitoring (see above) • Surveys of culverts and bridges for any blockages • Monitoring compensation projects
Navigable Waters	• The proponent will ensure that the design of bridges will offer sufficient freeboard to ensure crossing does not impede navigability.	• Monitoring will require routine maintenance of bridges to ensure crossings do not impede navigability.
Ecosystems and Vegetation	• The proponent will limit the effects of Project development on ecosystems and vegetation by minimizing the amount of overall disturbance, (*e.g.*, total footprint size), restricting Project operations to areas that have already been disturbed, and implementing the various management plans. • The assessment of re-vegetated areas will be carried out in conjunction with surveys identified in the soil management plans and the closure and reclamation plan. • The proponent will monitor disturbed areas for invasive plant colonization.	• Assessment of re-vegetated areas • Surveys of invasive plant colonization • Plant tissue metals analysis

(continued)

Table 4-1
Summary of the Proponent's Commitments to Mitigation Measures and Monitoring Plans for the Project (continued)

Component	Proposed Mitigation	Proposed Monitoring Plan
Bedrock Geology, Surficial Material, and Soils	• The proponent will follow management plans to reduce adverse effects on soils, permafrost, and ARD/ML within the Project area. Where an effect is unavoidable the proponent will minimize the magnitude of any effect over the short and long term. • Monitoring programs will be carried out to assess the progress of the mitigation plans designed to reduce the effects of the Project.	• Monitoring areas exhibiting soil erosion • Monitoring fuel and vehicle storage areas for soil contamination • Monitoring soil stockpiled areas • Monitoring of permafrost where disturbed • Monitoring water quality for ML/ARD potential issues (see above)
Wildlife and Wildlife Habitat	• The proponent will maintain wildlife habitats and populations in areas influenced by Project development, while taking into account operational requirements and the safety of Project employees.	• Wildlife Monitoring Program
Marine Water and Sediment	• The proponent will implement best management practices as the basis for all work undertaken, particularly when working in or around water. • Mitigation measures will be put in place to minimize or reduce the spatial extent, magnitude, duration, and frequency of increased contaminant loading.	• Monitoring of water quality during open water construction • Monitoring water quality as part of the Spill Response Plan • Monitoring water and sediment during operation
Marine Aquatic Resources	• The proponent will adhere to all mitigation measures, as well as all federal and territorial acts and guidelines relevant to the Project (*i.e.* operation of tankers and barges in Canadian Arctic waters). This will help reduce the increase in suspended material, minimize the risk and adverse effects associated with accidental spill or inadvertent release of deleterious substances into marine waters.	• Water and sediment monitoring (see above) • Monitoring of aquatic resources if a spill occurs and if effects detected with water and sediment.
Marine Fish and Fish Habitat	• The proponent will implement and adhere to a variety of mitigation and management measures to protect marine fish and fish habitat at the port site and along the shipping lane. • Qualified and experienced environmental monitors will be employed to provide quality assurance that project environmental management commitments are being achieved during construction in the open water season.	• Water and sediment monitoring (see above) • Monitoring of substrate and bathymetry • Noise monitoring during pile driving • Monitoring of compensated habitat
Polar Bears and Seabirds	• The proponent will reduce the impacts of the Project on identified wildlife issues by maintaining wildlife habitat and populations in areas influenced by shipping traffic, while taking into account operational requirements and safety of Project employees. • Management strategies will be reviewed periodically due to the changing nature of the Project over time, and will be adapted based on the outcome of initial management practices.	• Monitoring of ice conditions • Watchstanders on vessels would record presence of seabirds and polar bears

(continued)

Table 4-1
Summary of the Proponent's Commitments to Mitigation Measures and Monitoring Plans for the Project (continued)

Component	Proposed Mitigation	Proposed Monitoring Plan
Marine Mammals	• The proponent will integrate mitigative measures to navigate well clear of concentrations of marine mammals and to minimize the number of marine mammals exposed to spilled oil.	• Watchstanders on vessels would look for marine mammals
Marine Oil Spill	• The proponent will develop an up-to-date Oil Spill Response Plan including: descriptions of the spills likely to occur from the operation; actions to be taken in cleaning up these spills; decision trees and checklists used to implement the response; and comprehensive lists of contacts and resources needed to conduct cleanup and monitoring programs. • Trained personnel designated to fulfil spill response functions.	• Oil Spill Response Plan
Heritage Resource	• All monitoring activities would be undertaken under archaeological permit by a qualified archaeologist on behalf of the proponent, ensuring appropriate reporting procedures and required mitigation responses. • The permit report will be reviewed prior to issuance of heritage resource clearance for the Project construction to proceed.	• The presence of archaeological monitors • Monitoring under archaeological permit at recommended sites (*e.g.*, port)
Climate Change	• Ground Temperature: Design infrastructure to incorporate warming trend • Water Volume: Design infrastructure with sufficient buffer to account for potential increased peak discharge events • Sea Ice Cover: No mitigation to a positive effect on the project	• Weather forecasts will be monitored for advanced warnings of potential events that may affect the project infrastructure or personnel. • A meteorology station will be used for monitoring climate change trends.
Environmental Management Plan	• The proponent will create a detailed Environmental Management Plan upon project approval. • The proponent will develop comprehensive and detailed Road, Port, and Camp Management Plans to ensure safe operating conditions along the Project infrastructure and reduce the risk of accidents and/or environmental incidents. • The proponent will develop a detailed emergency response and contingency plan prior to undertaking any activities pertaining to the site development, construction or operation of the port and camp facilities. • The proponent is committed to a prevention strategy of ongoing maintenance, inventory control, staff training, and vigilance of all aspects of the work.	• Road, Port, and Camp Management Plan (which will include spill response and training plans, and an accident/incident management plans). • Risk Assessment and Emergency Response Plan (which will include a spill response and training plan, and a fire prevention and training plan). • Oil Spill Response Plan

(continued)

Table 4-1
Summary of the Proponent's Commitments to Mitigation Measures and Monitoring Plans for the Project (completed)

Component	Proposed Mitigation	Proposed Monitoring Plan
Socio-economic	• The proposed work rotation of 2 weeks in and 2 week out may help to stabilize the community during the life of the project. • Male and female workers will be assigned to segregated accommodations within the camps. • The proponent will implement a "Zero Tolerance Policy" towards drugs and alcohol, and a "Code of Conduct" which outlines the expected behaviour and performance standards in the workplace. • Counselling services and workshops regarding sexual health, including safe sex methods will be made available to all workers at the project site. • Partnerships between BIPR and the social services departments of Cambridge Bay, Kugluktuk, Taloyoak and Gjoa Haven will be created for the purposes of providing substance abuse counselling to workers and community members. • Counsellors will visit camps and workshops will be conducted at camp and in communities on drug and alcohol abuse. • The proponent will make available appropriate facilities/services where victims of sexual assault or related offences will feel safe to report a crime or speak with a professional regarding the aftermath/shock of an assault. • Partnerships to deliver workshops on parenting and money management. • Hire a community liaison officer to work and communicate directly with the local RCMP units regarding increased criminal activity at the Project sites or within the communities. • Training and education programs. • Mitigation measures will include controlled access to the road and continuous monitoring of tourist use of the road and their intended activities upon arrival in Nunavut. The government can also hire additional Wildlife Officers to patrol Inuit Owned Land (IOL) areas during prime hunting seasons. • Mitigation measures will include the implementation of a Cultural Awareness Program (CAP) and the implementation of a favourable rotational work schedule. The objective of the cultural awareness program will be to build collective understanding and respect among all parties in the workplace for Inuit culture and tradition and to provide a social environment in which Nunavummiut people are able to participate in the formal wage economy while maintaining their traditional heritage and lifestyle. Sub-programs will include traditional language use in the workplace; serving country food and celebrating Inuit events, and the encouragement of developing Inuit arts and crafts within the work camps. Elders will be invited into the BIPR Project Site to assist in educating young Inuit about their own culture, their language and their traditions. • The BIPR will support traditional forms of economic activity. Through the implementation of a favourable work rotation schedule of 2 weeks in and 2 week out, Inuit will be encouraged to return to the land on a regular basis. If needed, BIPR is prepared to implement cultural awareness programs in the communities and in the work camps, providing traditional economic pursuit training, plus Inuit cultural activities such as story-telling, serving country food and celebrating Inuit events thorough the work schedule.	• Occupational Health and Safety information Data Collection • Community Health and Traditional / Cultural Activities Programs • Education and Development Programs • Project Level-Worker Information Data Collection

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Appendix G-8
List of Consultants for the Bathurst Inlet Port and Road Project

Author: Rescan Environmental Services Ltd.
Date: November 2007

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List of Consultants for the Bathurst Inlet Port and Road Project

Consultant	Location	Contribution
Primary Consultants		
Rescan Environmental Services Ltd.	Vancouver, BC	• baseline environmental studies • consultation with federal and territorial agencies • coordination of third party consultants • community consultation • draft Environmental Impact Statement
SNC Lavalin	Vancouver, BC	• abridged feasibility study • socio–economic analysis • community consultation • technical input into DEIS
Nishi Khon/SNC Lavalin	Vancouver, BC	• feasibility study, engineering field work
Tony Keen, P.Eng.	Vancouver, BC	• Project manager for proponent (2001 to 2007)
Ben Hubert (Hubert and Associates Ltd.)	Calgary, AB	• coordination and review of baseline studies and DEIS for proponent
Other Consultants		
Angonaitit Niovigvia Ltd.	Kugluktuk, NU	• provided field assistants
Chris Anderson	Vancouver, BC	• shipping lane assessment
Dr. Eric Howe	Saskatoon, SK	• economic analysis
EBA Engineering Consultants	Yellowknife, NT	• geotechnical sample testing
FMA Heritage Resources Consultants Inc.	Calgary, AB	• archaeology
Geographic Air Survey Ltd	Edmonton, AB	• aerial photography
Geowest Environmental Consultants Ltd.	Edmonton, AB	• surficial geology, soils, and ecosystem mapping
Harvey Martens	Calgary, AB	• reclamation and closure
Hemmera Environmental Service Consultants	Vancouver, BC	• socio–economic analysis and community consultation
Ian Ross (Arc Wildlife Services Ltd.)	Calgary, AB	• wildlife baseline studies (raptor survey)
Kitikmeot Geosciences	Vancouver, BC	• contributed to project description
LGL Ltd.	Vancouver, BC	• marine mammals effects assessment and baseline studies
Mark Fraker (Terramar Environmental Research Ltd.)	Sydney, BC	• wildlife baseline studies
McElhanney	Vancouver, BC	• ground control survey and mapping
Mollard & Associates	Regina, SK	• aerial terrain analysis, road route selection
New Economy Development Group Inc.	Ottawa, ON	• socio-economic baseline studies
Page Burt (Outcrop)	Vancouver, BC	• ecosystem and vegetation baseline studies
PricewaterhouseCoopers LLP	Vancouver, BC	• financial analysis
SL Ross Environmental Research Ltd.	Ottawa, ON	• marine oil spill, fate & behaviour and effects assessment
SNC Lavalin Capital	Vancouver, BC; Montréal, QC	• financial analysis
Vivian Banci (Banci Consulting Services)	Maple Ridge, BC	• Traditional Knowledge