Baffinland

TECHNICAL SUPPORTING DOCUMENT

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

TSD 01

Alternatives Analysis

TSD 01: Alternative Analysis
Mary River Project Phase 2 Proposal

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

Date: August 2018

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ABBREVIATIONS

the Project	Mary River Project
AIRSS	Arctic Ice Regime Shipping System
Baffinland	Baffinland Iron Mines Corporation
BWM Convention	Ballast Water Management Convention
EIS	Environmental Impact Statement
ERP	Early Revenue Phase
FEIS	Final Environmental Impact Statement
GHG	Greenhouse Gas
IMO	International Maritime Organization
MHTO	Mittimatalik Hunters and Trappers Organization
Mtpa	Million tonnes per annum
NBRLUP	North Baffin Regional Land Use Plan
NM	Nautical miles
QEC	Qulliq Energy Corporation
ROI	Return On Investment
TC	Transport Canada
TSD	Technical Supporting Document

1 APPROACH TO ASSESSING ALTERNATIVES

Core to the environmental assessment process is a detailed assessment of alternatives to a project and alternative means of carrying out a project. Baffinland Iron Mines Corporation (Baffinland) has carefully considered the need to increase production and the alternatives to doing so. Additionally, within the Phase 2 Proposal as suggested within the Amended EIS Guidelines (NIRB 2015), Baffinland has considered a range of alternative means of carrying out the Phase 2 Proposal to achieve increased delivery of ore to market based on the current Mary River Project (the Project). Alternative means of carrying out the project have been organized according to two tiers:

- Tier 1 - Major alternatives shaping the overall approach to, and the viability of the Project
- Tier 2 - Minor alternatives relating to the specific Project components

Viable alternatives have been evaluated according to the following performance criteria:

- **Technical Feasibility -** The appropriateness of an alternative from an engineering or operational perspective. The technical feasibility of an alternative includes known and expected performance and reliability of the alternative in a remote arctic setting.
- **Cost-effectiveness -** The relative cost of the alternatives. The cost-effectiveness of Tier 1 alternatives each have the potential to affect the economic viability of the Project. Generally, cost is only a consideration and not a determining factor for Tier 2 alternatives. Cost-effectiveness considers the ability of the alternative to facilitate the Project achieving sufficient future cash flows to pay back the capital invested, pay the ongoing operating expenses, and cover the closure and reclamation costs while generating the necessary return on investment for shareholders to attract the required upfront capital investment.
- **Environmental Acceptability -** The performance of an alternative with respect to potential residual effects on the natural and/or socio-economic environment. The expected severity of negative residual environmental and/or socio-economic effects may be compared from one alternative to another. In certain instances, positive effects may accrue from one or more alternatives.
- **Community Acceptability -** Community acceptability or preferences of the community(s) potentially affected by the Project are considered in the decision-making process. Input on alternatives, particularly Tier 1 alternatives, was derived from community engagement activities such as public meetings and workshops (TSD No. 12). This criterion is by nature subjective, in terms of the community perspectives that have been expressed and the interpretation and weighing of those perspectives. In some instances, communities have varying views on a specific alternative. Baffinland attempted to address concerns by undertaking supplemental studies and developing further processes to facilitate community engagement.

The performance criteria for each alternative can be qualitatively evaluated, followed by an overall evaluation as a culmination of the individual performance criteria. Rankings are assigned to alternatives based on professional judgement, engineering cost estimates (for cost-effectiveness), previous experience with similar projects or situations, and feedback recorded in community consultation. Where applicable, options are rated as preferred, acceptable, or unacceptable for each performance criteria. In instances where no options are unacceptable, a relative scale of acceptability has been applied (i.e., high, medium, and low).

It is necessary that a given alternative is technically feasible; alternatives that are not technically feasible are not considered further. Since Tier 1 alternatives have the potential to affect the economic viability of the Project, Tier 1 alternatives that are currently not economically viable given recent ore prices are also ranked as unacceptable overall. Options that are technically feasible and do not affect the economic viability of the Project are evaluated further.

Table 1.1 provides a summary of the assessed alternatives and identifies the preferred alternatives.

Table 1.1 Assessed Alternatives

Alternatives	Technical Feasibility	Cost Effectiveness	Environmental Acceptability	Community Acceptability	Decision
Production Rate/Alternatives for Phase 2 Proposal					
Phase 2 Proposal	Acceptable	Most cost effective	Acceptable Improved	Acceptable or Preferred - The current Phase 2 Proposal addresses previously-expressed concerns about shipping in March to June	Retained for Phase 2
Maintain Production (current No-Go Option)	Acceptable	Less cost effective - Marginal return on investment (ROI); possible negative ROI at lower iron ore prices	Acceptable	Preferred - This Project was previously approved by NIRB with community support	Rejected
Cease Production	Acceptable	Least cost effective - A negative return on investment	Acceptable	Unacceptable - Employment and other benefits would cease	Rejected
Implement the approved 18 Mtpa South Railway and Steensby Port	Acceptable	Not economically feasible in the short-term	Acceptable (Previously Approved)	Acceptable (Previously Approved)	Retained for future development
Shipping Season – Northern Shipping					
Open Water Shipping	Acceptable	Less cost effective as it limits number of shipment and tonnage shipped	Acceptable	Acceptable	Acceptable
Extended Shipping Season with Support Vessels (July 1-November 15)	Preferred - Provides best trade-off between length of season and ease	More cost effective as it extends the shipping period	Acceptable	Acceptable - Though concerns were expressed regarding ice breaking through Pond Inlet, using this route during open water and the shoulder season was acceptable.	Preferred
Eight-and-a-half-Month Shipping Season – Direct Shipping	Acceptable - Increased technical challenges with shipping in ice	More cost effective as it significant extends the shipping period	Acceptable	Acceptable - Though concerns were expressed regarding ice breaking through Pond Inlet, using this route during open water and the shoulder season was acceptable.	Desirable but Rejected for Phase 2
Eight-and-a-half-Month Shipping Season with Trans-shipping from Eclipse Sound	Acceptable - Increased technical challenges with shipping in ice	Less cost effective due to trans-shipping operation	Acceptable	Acceptable - Though concerns were expressed regarding ice breaking through Pond Inlet, using this route during open water and the shoulder season was acceptable.	Rejected for Phase 2
Shipping Route					
Navy Board Inlet	Acceptable - Longer route with challenging ice conditions including multi-year ice.	Acceptable - Shipping costs are higher due to 130 NM of additional distance.	Acceptable	Preferred - Community expressed a preference for Navy Board Inlet when shipping in ice.	Retained as a back up alternative
Pond Inlet	Preferred - Most direct route with preferable ice conditions	Preferred - Most direct and therefore cost-effective route	Acceptable - This option was approved for the Early Revenue Phase	Acceptable	Retained for Phase 2
Transportation of Ore from Mine Site to Milne Port					
Trucking of Ore on Tote Road	Acceptable - There are limits to the tonnage that can be hauled by trucks over a two-lane road. Operational risks with trucking higher tonnages of ore over the Tote Road. Would require significant upgrade to Tote Road.	Lowest capital cost option with high operating costs. Not economic at low iron prices.	Acceptable - Increased dust	Acceptable - However, community members have expressed concern with the volume of traffic and amount of dust fall generated	Rejected on basis of high operational risks
North Railway (from Mine Site to Milne Port)	Acceptable – most economical mode of transportation for bulk commodities	Acceptable - Higher capital cost and lower operating cost. Most economical mode of transportation for bulk commodities with lowest operational risks.	Acceptable- Fewer rail transits (compared to trucks) will result in reduced dust and sensory disturbance to wildlife	Acceptable	Retained for Phase 2

Table 1.1 Assessed Alternatives

Alternatives	Technical Feasibility	Cost Effectiveness	Environmental Acceptability	Community Acceptability	Decision
North Railway - Rail Route					
Option A - Adjacent the Tote Road	Acceptable - Presents advantages with site access; ground conditions are acceptable.	Acceptable cost-effectiveness	Acceptable - Habitat loss and sensory disturbance to wildlife and land users is minimized by sharing a common transportation corridor with the Tote Road.	Acceptable - Reduced terrestrial footprint and disturbance to land users and wildlife.	Retained for Phase 2
Option B - Alignment of railway north of Tote Road	Acceptable - Expected to be technical feasible based on available information.	Acceptable cost-effectiveness	Acceptable - avoids more watercourses but increased terrestrial footprint.	Acceptable - Baffinland believes the community preference is Option A, but Option B would likely be acceptable if Option A was not a viable option.	Rejected
Location of Second Ore Dock					
Option A - West of Existing Ore Dock	Acceptable - The location is close to stockpiles and rail terminal but results in congestion at the port.	Acceptable – lower cost-effectiveness due to increased cost	Acceptable	Acceptable	Second best alternative for dock location
Option B - Ore Dock Location	Acceptable –Location is closer to the ore stockpiles and rail load out.	Acceptable - Minimize capital investment and reconfiguration of ore reclaim and loading systems	Acceptable	Acceptable	Retained for Phase 2
Option C - East of Proposed Ore Dock	Acceptable - Technically challenging due to distance from rail and ore stockpiles, with limited option to re-locate the stockpiles. Longer conveyors. Requires the relocation of freight dock.	Acceptable - Least cost effective - Would require additional conveyors or significant modification to the site layout	Acceptable	Acceptable - Would likely affect community use of the east side of the Milne beach area	Rejected based on cost and operational complexity
Renewable Energy Sources					
Solar	Acceptable - Although low amount of solar energy and a concentration during the summer are barriers	Least cost effective - Given the cost of solar and the limited solar energy	Acceptable	Acceptable	Rejected
Wind	Acceptable – Proposed for other mining operations and employed by other mines	More cost effective - Although Baffinland will need to conduct own study to determine cost effectiveness	Acceptable	Acceptable	Acceptable
Hydroelectric	Not Acceptable- No viable hydroelectric sites have been identified between the Mine Site and Milne Port.	Not applicable	Not applicable	Not applicable	Rejected

2 ALTERNATIVES TO THE PROJECT

2.1 Cease, Maintain or Increase Production

The Early Revenue Phase (ERP) operation is marginally profitable at current iron ore prices, and not profitable at lower ore prices as experienced in 2015-2016. While operation of the ERP has provided Baffinland with valuable operational experience, there is no business case for continuing to operate the ERP indefinitely.

In addition to the four performance criteria outlined in Section 1 (Technical Feasibility, Cost-effectiveness, Environmental Acceptability, and Community Acceptance), there are commercial factors that influence Baffinland's decision-making with respect to its production rate. The ERP operation has been effective in raising customers' interest in Baffinland's iron ore product. Larger tonnage, the reliability of supply, and consistency of delivery remain three major hurdles in securing long-term contracts. Baffinland needs to achieve better economies of scale to compete with other international producers. Major international iron ore operations produce in the range of 30 Mtpa to 300 Mtpa (BHP, Rio Tinto, Vale). The Project will need to increase its production to 30 Mtpa or greater in the future to be competitive on world markets.

The following alternatives have been identified with respect to production rate:

- Continue operating the ERP at up to 4.2 Mtpa
- Cease production and transition to care and maintenance until iron ore prices recover further
- Implement the approved 18 Mtpa South Railway and Steensby Port
- Implement the Phase 2 Proposal

For the Project to remain attractive to investors, an acceptable rate of return must be maintained. With the current ERP production rate, and especially at a reduced production rate, the Project is vulnerable to iron ore prices fluctuations. At recent lows in iron ore prices and a production rate less than 3 Mtpa the Project had provided a negative return on investment. Hence, the option of maintaining or reducing the current ERP production rate to extend the mine life is not a viable alternative. Expansion of the Project is necessary for Baffinland to continue to operate and provide benefits to its shareholders, its Inuit partners, governments, and stakeholders.

Ceasing operations until iron ore prices recover and putting the Project on care and maintenance is a technically viable option that does not generate revenue but minimizes the risk of financial loss. While ceasing production is possible, this alternative would have a negative ROI and would result in negative commercial implications with Baffinland's customers. It would also result in a loss of significant benefits otherwise accruing to local communities and the Nunavut economy. For these reasons, this alternative is rejected.

Implementation of the 18 Mtpa South Railway and Steensby Port as authorized under Project Certificate No. 005 is not economically feasible in the short-term, due to its high capital cost, exceeding $4.1 billion in initial CAPEX (compared to $1 billion for the 12 Mtpa north rail). Under current market conditions, it is challenging to obtain financing for the 18 Mtpa Project. However, the South Railway and Steensby Port remains an important part of Baffinland's long-term development plan for the Project, as Baffinland seeks to expand to 30 Mtpa to be competitive in the world's iron ore market. Implementation of this Project is largely dependent on timing and market conditions in order to secure financing. For these reasons, Baffinland wishes to retain all authorizations granted under Project Certificate No. 005 which would enable the company to gradually implement the South Railway and Steensby Port.

Implementing the Phase 2 Proposal is Baffinland's preferred alternative. This option is superior for several reasons. It allows the company to move to railway transportation with a lower capital expenditure and gain valuable operational experience with a railway under Arctic conditions and at a higher production rate. The Phase 2 proposal builds on Baffinland's experience with open water shipping and introduces limited ice management during the shoulder season. With a capital expenditure of approximately $1 billion, the operation will be profitable at current iron ore prices. Furthermore, the operation will generate additional cash flow which could finance part of the expenditure for the South Railway and Steensby Port. Advancing the Phase 2 Proposal will allow Baffinland to increase production and achieve profitability in a shorter time, while working incrementally towards the longer-term goal of reaching a production rate of 30 Mtpa. The environmental impacts are assessed within this environmental impact statement without any significant residual effects. The incremental expansion is also expected to incrementally bring greater benefits to local communities and Nunavut over time. Community concerns with shipping are also alleviated with the limited amount of ice management that may be required during periods of ice formation and ice break-up (July 1-November 15)). The Phase 2 Proposal is the preferred development alternative.

3 TIER 1 – ALTERNATIVES TO CARRYING OUT THE PROJECT

3.1 Shipping Season

In support of the Phase 2 Proposal, Baffinland commissioned Enfotec (the ice navigation division of Fednav Limited) to undertake an updated study of ice conditions and shipping season alternatives for shipping ore from Milne Port (Enfotec 2016). The study, presented as TSD 16, identified four shipping window alternatives:

- Open water season – August 5 to October 15 (71 days)
- Extended season - July 25 to October 31 (98 days)
- Extended season with support vessels – July 1 to November 15 (123 days)
- Eight-and-a-half-month season - June 20 to March 10 (263 days)

The open water season, extended season with support vessels, and eight-and-a-half-month season are described briefly below, with additional details provided in TSD 16.

3.1.1 Open Water Shipping – August 5 to October 15 (71 days)

Baffinland has considered shipping iron ore during the open water season exclusively. August 5 to October 15 is defined as the average open water season with an average of 71 days. However, variability to the open water season exists. Over the 20 years of data, open water dates have been as early as July 23 (2015) and as late as August 18 (1999; 2012) and freeze up dates have been as early as September 29 (2003) and as late as October 20 (2006); the shortest season being 54 days and the longest 87 days.

This alternative has demonstrated community support but seriously limits the economic viability of the Project. The annual variability in the duration of the open water season presents a meaningful likelihood that the required tonnage may not be delivered to market in certain years, which has implications on cost-effectiveness as well as commercial impacts regarding reliability of supply. To ship within the limited open water season, Baffinland is required to build a second ore dock capable of berthing capesize vessels.

Another consideration is the lack of availability of market ore carriers to transport the required tonnage of ore during a shorter shipping window. For these reasons, Baffinland needs to extend the shipping season.

The open water shipping alternative is acceptable, although brings a lack of certainty in meeting delivery targets to customers on an annual basis (inability to meet contractual obligations on tonnage of ore delivered). This in turns brings additional risks for Baffinland to maintain its customer base and overall economic viability of the Project.

3.1.2 Extended Season with Support Vessels - July 15 to November 15 (123 days)

Baffinland has assessed an extended shipping season from July 15 to November 15. The extended shipping season is roughly equivalent to the shoulder shipping season suggested by the Mittimatalik Hunters and Trappers Organization (MHTO) in Pond Inlet. The start and end to the shipping season will vary based on ice conditions and based on consultation with residents of

Pond Inlet and the MHTO in Pond Inlet. Inuit communities and stakeholders have indicated that shipping in ice is acceptable when it does not overlap with Inuit use of the landfast ice.

> *"The best time to come in with a ship is after the floe edge is closed. If shipping will happen in Eclipse Sound, there will need to be adjustments to the timing of the shipping schedule." (Workshop #3 Participant, October 26-27, 2015, Pond Inlet).*

Adding shipping during the shoulder seasons expands the shipping season to approximately 123 days. Shipping at the end and beginning of the season will require the use of polar class ore carriers capable of shipping through ice (1A class vessels). Polar Class 3 ice management vessels will be required at the beginning and end of the season for escort. This option is technically feasibly, since ice breaking will only be required for a short amount of time and fewer high ice class vessels to transport ore will be needed compared to year-round shipping. Open water shipping and shoulder season shipping is cost effective because Baffinland will be able to deliver on their customer orders and meet their commercial commitments with customers. Furthermore, it is cost effective in that the need for expensive ice-breaking vessels is reduced compared with longer shipping season alternatives (although some ice class is required, with ice breaker support). This option involves the construction of a second dock at Milne Port to accommodate capesize vessels.

With respect to potential environmental effects, this alternative is outside of the seal birthing and pupping period in March and April, and the floe edge season (April to June). This option makes best use of the shipping season while reducing potential impacts on Inuit use of the landfast ice, and, is therefore preferred in terms of community acceptability. There are no mitigation measures required to address public safety concerns associated with crossing a ship track during winter. Communities have accepted the alternative as a viable shipping option for Baffinland that increases Baffinland's ability to get ore to market, while reducing adverse impacts.

With the extension of the shipping season by approximately 52 days and the minimal requirement for ice breaking, while considering technical, economical, environmental, and social considerations, this is Baffinland's preferred alternative.

It is important to note that although the extended shipping season running from July 15 to November 15 is Baffinland's preferred alternative, Baffinland intends to ship predominately in the open water season and as a contingency, following consultation with Pond Inlet and the MHTO in Pond Inlet, will ship in the periods of ice formation and ice break-up as required (July 1-November 15) to meet production targets.

> *"Regarding the proposed shipping route during the open water season – The people of Pond Inlet already approved the route for summer shipping. We have no objection to that route." (Workshop #3 Participant, October 26-27, 2015, Pond Inlet).*

3.1.3 Eight-and-a-Half-Month Season - June 20 to March 10 (263 days)

Baffinland previously envisioned an extended shipping season in its original Phase 2 Proposal (Baffinland 2014). The extended shipping season consisted of shipping for eight-and-a-half months from June to March with the use of Polar Class Post Panamax sized vessels (Baffinland 2014). This roughly corresponds to the June 20 to March 10 shipping season evaluated by Enfotec (2016). To ship in ice while making best use of market vessels (and hence reducing the investment in purpose-built ice-breaking ore carriers by Baffinland), trans-shipping was proposed as part of the original Phase 2 Proposal. In addition to direct loading of ore carriers at Milne Port, Post Panamax self-discharging vessels would transit to Greenland starting in June

until the open water season and again from mid-October into March. During the open water season, trans-shipping would also occur in Eclipse Sound.

The self-discharging ore carrier utilizes a conveyor system rather than grab un-loaders, allowing loading directly into the market capesize vessels either in Eclipse Sound or in Greenland (Baffinland, 2014). Potentially-affected communities have expressed concern regarding winter shipping and ice-breaking siting concerns to wildlife and land use activities:

> *"I am a hunter, and this is my livelihood and I will lose money if Baffinland ships chaise away the marine life. Pond Inlet feels like they are being left out. If the ship is traveling through here in the winter, we will not be able to travel to Button Point and Bylot Island to get food and supplies. Would Baffinland consider providing bridges for the broken ice? People are precious, life is precious, but our cultures are different, so we need to take this issue into careful consideration." (James Atagootak, Hamlet of Pond Inlet, February 18, 2015).*

Baffinland decided to not pursue this alternative at this time considering public concern. In addition, there are greater technical challenges related to ice breaking and ice management, trans-shipping activities and facilities, and required seasonal fuel storage at sea.

3.2 Shipping Route

As part of the updated ice study conducted by Enfotec (2016; TSD 16), two ship routing options from Baffin Bay were analyzed and assessed for the Phase 2 Proposal:

- Navy Board Inlet
- Pond Inlet

Shipping from Milne Inlet via Lancaster Sound and Navy Board Inlet results in an additional 130 nautical miles (NM) of steaming when compared to shipping via Pond Inlet. Navy Board Inlet tends to freeze-up earlier compared to Pond Inlet and is more likely to have old ice present throughout the entire channel, where as Pond Inlet old ice is limited to a short area at the junction of Baffin Bay and Eclipse Sound. Challenges to vessels transiting through Navy Board Inlet are generally more pronounced compared to Pond Inlet during winter shipping. Ice conditions detailed in TSD 16 were verified by workshop participants in Pond Inlet, where it was stated that shipping through Pond Inlet and Eclipse Sound was safer than through Navy Board Inlet, as the ice in Navy Board Inlet is considerably rougher. Despite this, community members noted they would prefer the use of Navy Board Inlet for winter shipping compared to Eclipse Sound due to their harvesting activities. Although Baffinland is not proposing winter shipping, given the lengthier transit, earlier freeze up, and poorer overall ice conditions in Navy Board Inlet, shipping through Pond Inlet is the preferred alternative.

Although Pond Inlet will remain the primary transit corridor, subject to prevailing ice conditions and Arctic Ice Regime Shipping System (AIRSS) calculations, Baffinland may advise relevant Ice Class Ore Carriers to proceed to Milne Inlet via Navy Board Inlet. Transit via Navy Board would be regulated in the same manner as Pond Inlet, meaning speed restrictions would be imposed and way points would be adhered to during transit, irrespective of whether a vessel is transiting to or from Milne Inlet via Navy Board.

3.3 Trans-Shipping

Trans-shipping was an integral part of Baffinland's initial conception of the Phase 2 Proposal (Baffinland 2014). This included trans-shipment within Eclipse Sound or Milne Inlet, as well as trans-shipment off the coast of Greenland. Trans-shipment was a necessary part of Baffinland's previous plans to ship extensively during the ice-covered period in terms of reducing the need for ice breakers that would need to be custom built for the Project.

With the Phase 2 Proposal, Baffinland has been able to avoid shipping in ice when it would interfere with Inuit use of the landfast ice. This has been accomplished by proposing to construct a larger second ore dock that is capable of berthing larger (capesize) ore carriers. Since the current plans do not include a project-built ice-breaking ore carrier, there is no longer a need to trans-ship. The trans-shipping proposal has been abandoned.

3.4 Transportation of Ore to Milne Port

The Phase 2 Proposal involves a switch from the current truck haulage of ore on the Milne Inlet Tote Road to the Port to a railway to support the targeted 12 Mtpa production rate.

3.4.1 Ore Transportation by Trucks

Recent experience with trucking along the Tote Road has demonstrated that trucking is a challenging method of transporting high volumes of ore due to weather issues and maintenance requirements to maintain the road with a high volume of trucks. It is considered feasible to increase trucking from 4.2 Mtpa to 6 Mtpa along the Tote Road.

The extant Tote Road is not wide enough to accommodate two-way truck traffic at the levels required for the Phase 2 operation. Additional improvements to the Tote Road would be required to support the necessary amount of truck traffic (realignment, reduce grade, widening of bridges and culverts). Furthermore, community members expressed their concerns in continuing to use the Tote Road for increased production rates as it relates to land use activities, safety, and dust.

Given the challenges demonstrated by trucking high tonnages of ore on the Tote Road during the ERP, the larger environmental footprint due to dust, an inadequate ROI, and through community feedback expressing concern over high volumes of road traffic that would be needed to support the Phase 2 Proposal, the railway alternative is preferable. However, trucking of ore remains a viable alternative should difficulties arise with the development and operation of the North Railway.

3.4.2 Railway Transportation of Ore

Rail transportation is better-suited for hauling large quantities of ore as proposed in the Phase 2 Proposal, has a better ROI, and a reduced environmental footprint due to reduced sensory disturbance and dust generation. Further, due to reduced fuel consumption, greenhouse gas (GHG) emissions generated by the operation are also reduced (TSD 06 Climate Change Assessment, provides a discussion on GHG emissions during the Phase 2 Proposal). The railway will also reduce the amount of interaction the Project has with wildlife and land users along the transportation corridor and is perceived to be preferred by communities over an increase in road haulage.

3.4.3 Selection of a Previously Rejected Alternative

The Phase 2 Proposal involves construction of a railway to Milne Port and shipping of ore via the Northern Shipping Route. This alternative was considered during the 2012 FEIS (Baffinland 2012) review and was assessed not to be technically and economically feasible at the time. The primary reason for rejecting this alternative was that year-round shipping from Milne Port was considered "high operational risk" for reliability of delivery of iron ore to customers. This in turn could jeopardize the expected customer base and revenue streams for the Project, impacting economic viability of an investment exceeding $4 billion.

The following considerations led to the previous dismissal of this alternative:

- Customers would require a constant (year-round, or nearly year-round) supply of iron ore, and options for stockpiling iron ore at Rotterdam (the obvious port to ship iron ore to considering travel distances and shipping costs) were almost non-existent; the need to deliver ore to Baffinland's customers year-round or nearly year-round.
- Insufficient market vessels would be available to transport large amounts (10+ Mt) of ore over the short open-water season. A dedicated fleet of ice-breaking ore carriers would be required.
- Based on community feedback received in the 2006 to 2008 timeframe, the Pond Inlet community had expressed concerns with shipping year-round from Milne Inlet.
- A group of major shipping companies who visited the Project in 2007 indicated that year-round shipping of the quantity of iron ore thought to be required to make the Project economic (±18 Mtpa) would be too technically challenging given the more severe ice conditions in Baffin Bay and the limited area to maneuver capesize ice-breaking ore carriers within Milne Inlet and the Milne Port area.
- Ice studies have indicated that ice conditions to Milne Port are challenging. In addition to thicker ice requiring higher ice class vessels (compared to those required to ship to Steensby Port), there is ice ridging and shear zones that occur at the entrance to Pond Inlet from Baffin Bay.
- Based on available geotechnical information at the time, it was thought that a railway to Milne Inlet would be substantially located on ice-rich glaciofluvial soils, such that the cost of a railway within this corridor would be more expensive on a per kilometre basis than the railway to Steensby Port.

The decision to move forward with the 18 Mtpa South Railway and Steensby Port Operation presented in the 2012 FEIS and approved under Project Certificate No. 005 was deemed the most viable scenario for the development of the Mary River deposits due to lower operational risks.

The ERP has provided Baffinland with operating experience in the Arctic, a customer base, and operating relationships with shipping companies that contribute to attenuate the perceived operational risks associated with year-round shipping via Milne Port.

3.5 Railway Route

Two routing alternatives for the North Railway were considered at a high level (Figure 3.1):

- Option A - The proposed route, which generally parallels the Tote Road
- Option B - Railway alignment north of the Tote Road

Option A has been the focus of recent study, as it is located within an existing transportation corridor established under the North Baffin Regional Land Use Plan (NBRLUP; Nunavut Planning Commission 2000), amended by the Nunavut Planning Commission (NPC) in 2014 to allow for the transport of ore over the existing Tote Road. Transportation corridors located within the North Baffin Planning Region must be approved through a plan amendment, preceded by a comprehensive review by the NPC and either the NIRB or a federal review panel (NPC 2000).

Land use planning often aims to concentrate development activities within a common linear corridor to reduce environmental effects. Given that the Tote Road is an approved transportation corridor under the NBRLUP, it is incumbent upon Baffinland to first investigate a railway alignment that is adjacent to the Tote Road to the extent possible. Baffinland's geotechnical investigations over the past two years have identified considerable near-surface bedrock along Option A, and feasibility studies have verified that a railway along this alignment is technically feasible and economically viable.

Option B is an alignment that was briefly considered at a reconnaissance level only during pre-feasibility studies, prior to Baffinland's decision to construct the South Railway to Steensby Port. Option B was discussed as a railway route alternative in the Draft Environmental Impact Statement (DEIS Volume 3, Section 6.5.3.6, and Figure 3-6.2; Baffinland 2010). At the time and based on limited geotechnical information, this alignment was thought to be superior to an alignment that followed the Tote Road within the Philip's Creek valley for several technical and environmental reasons. Being outside of the river valley, ground conditions were thought to be better (i.e., more bedrock) and the number and size of watercourses crossing the railway would be reduced. Being more often at the height of land, it was thought that less snow would accumulate next to the embankment, which represents an operational issue and can also be a geotechnical concern if large snow drifts are late to melt and thermally insulate the ground or create water-ponding issues. While Option B has some possible technical and environmental advantages, it is distant from the Tote Road in terms of sharing a common corridor and would require more extensive construction access roads and trails.

Both railway routing alternatives are technically feasible and cost-effective.

Option A was selected as the preferred railway route for the following reasons:

- The alignment is located within the existing transportation corridor, consistent with both land use planning principles and with the amended NBRLUP
- The existing road is available to support construction, which significantly reduces construction cost
- Losses of wildlife habitat, sensory disturbance effects to wildlife, and impacts to Inuit land use are minimized
- Archaeological surveys have established that while archaeological sites do exist within the corridor, no culturally significant sites have been identified in the vicinity of Option A

Minor changes to the routing of Option A have been incorporated into the engineering design as geotechnical investigations have progressed, and further minor changes can be expected up to and during construction. One variation of the alignment of Option A is notable in the context of assessing alternatives. From approximately km 57 to km 84.5 along the proposed rail alignment, it is necessary for the railway to deviate from the Tote Road alignment, travelling west of the road to circumvent a localized height of land to maintain acceptable grades for the railway. The only alternative to circling this hill would be to undertake a massive excavation, which would be both costly and create a large disturbance on the landscape. The maximum distance between the rail alignment and the tote road is 7 km.

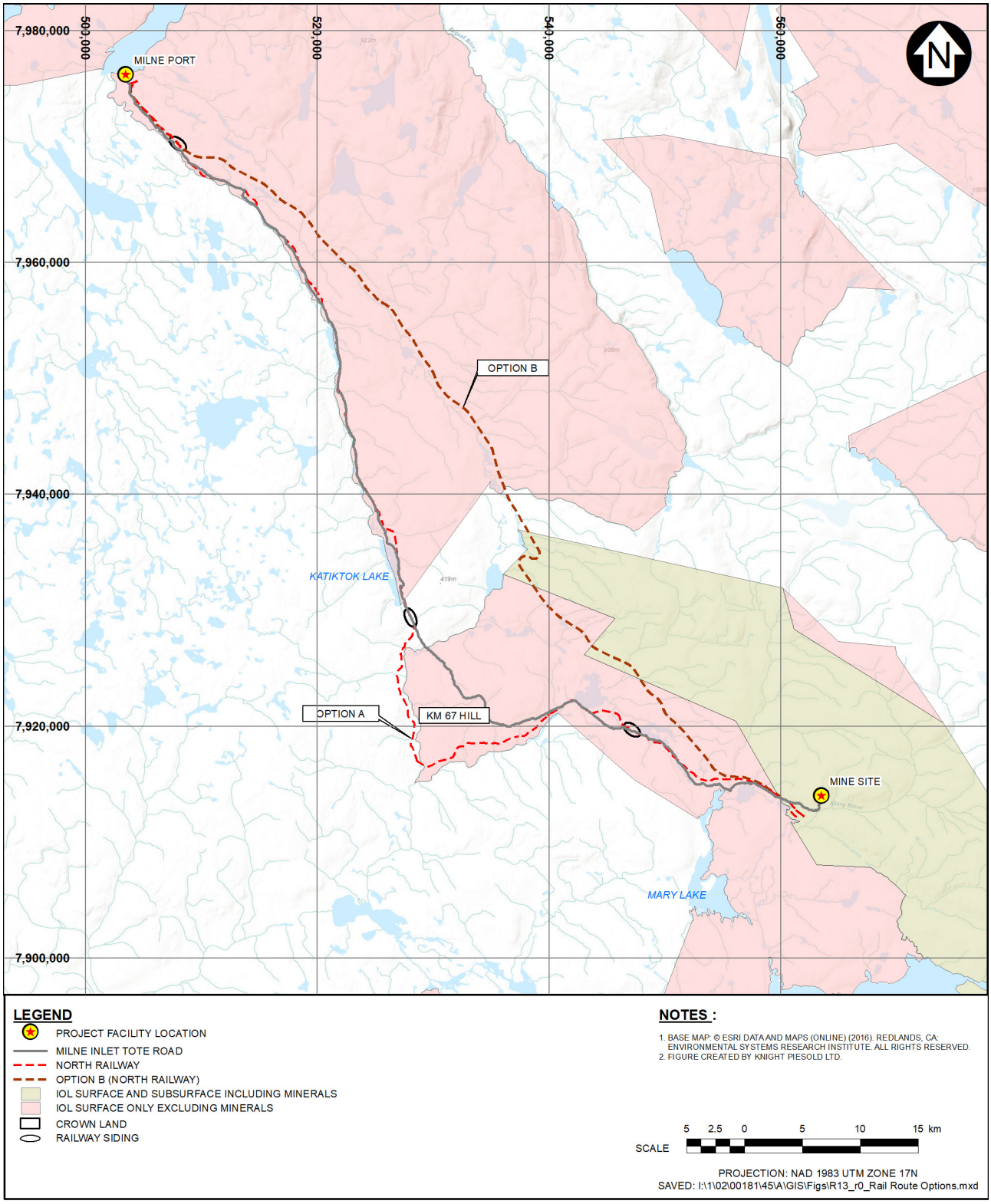

Figure 3.1 Rail Route Options

4 TIER 2 ALTERNATIVES TO CARRYING OUT THE PROJECT

4.1 Location of Second Ore Dock

A second ore dock will be constructed at Milne Port. The dock design will be consistent with the design of the current dock but will be sized larger so that capesize vessels can berth. The use of capesize ore carriers is critical to being able to ship 12 Mtpa during the open water and shoulder shipping seasons. TSD 02 Detailed Project Description provides details regarding the construction of the new capesize dock. In selecting the site of the ore dock, considerations were given to bathymetric conditions, potential needs for dredging and underwater blasting, and ore carrier movements.

Baffinland considered three potential dock locations for the new ore dock (Figure 4.1). The considered ore dock locations included:

- **Option A - West of existing dock** – the new ore dock will need to be larger to accommodate larger vessels. The location is close to the stockpile and the rail load out area but may result in congestion at the port. The area west of the existing dock is too constraining and would make berthing of vessels challenging. The dock would be located close to the mouth of Phillips Creek, resulting in a more dynamic shoreline that may have technical implications in terms of dock stability.
- **Option B - Proposed dock location** – the proposed location for the ore dock has suitable ground conditions with no visible ice in the seabed. Therefore, it would not pose geotechnical challenges for its construction. The location provides ample space to construct the larger ore dock and allow vessels to berth safely. It is located close to the stockpiles and near the terminus of the railway, which would not require movement of stockpiles or major reconfigurations of the existing Milne Port site layout.
- **Option C - East of proposed dock** – this location is within an area that would require the excavation and mitigation of cultural heritage features dated to be from the Arctic Small Tool Tradition. This option would likely affect community use of the east side of the Milne beach area. The location is technically challenging due to the distance from rail and ore stockpiles, with limited option to re-locate the stockpiles. This option would require additional conveyors or significant modification to site layout (high capital expenditure).

Based on a desktop review of the potential location for the new capesize ore dock, considering technical and economic acceptability, Option B was retained as the preferred dock location. Option B also reduces the need for a largely expanded PDA, improving environmental and social acceptability, and does not require underwater blasting or dredging for construction of the dock.

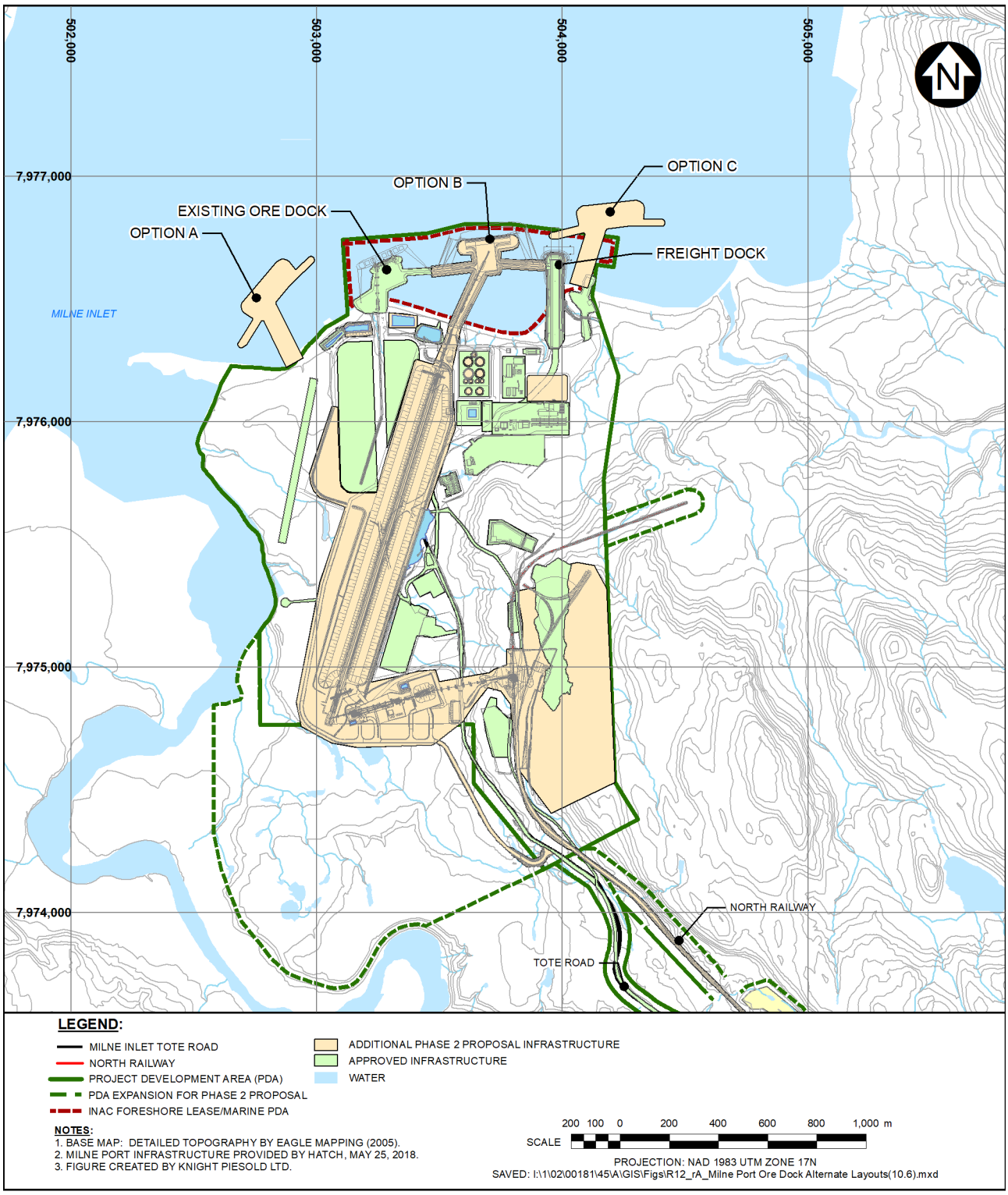

Figure 4.1 Second Dock Location Alternatives

4.2 Renewable Energy Sources

Alternative energy sources were evaluated previously in FEIS Volume 3, Section 6.7.5. As stated in the FEIS, diesel remains the preferred alternative because it can meet the project's power generation requirements on a continuous basis year-round at an acceptable capital cost, with an acceptable timeframe for implementation.

Renewable energy alternatives include solar, wind and hydroelectric power. Geothermal energy is not feasible due to the depth of permafrost. Solar energy potential varies throughout the territory with greatest potential being exhibited in southern Nunavut. North Baffin has the lowest amount of solar energy reaching the ground in Canada, with solar energy being concentrated in the summer months and lacking in the winter months (Qulliq Energy Corporation n.d.a). These factors act as barriers to Baffinland to meaningfully investigate solar energy for the Project. Solar energy is currently under study or demonstration at various Arctic locations, including Clyde River.

In 2006, Baffinland undertook a pre-feasibility level renewable energy study that identified a promising hydroelectric project at Separation Lake, located approximately 35 km southeast of Steensby Port. No viable hydroelectric sites were identified within a reasonable distance of the Mine Site or Milne Port. With further study, hydroelectric energy may be a possibility; potential development of this hydroelectric project will be considered once Steensby Port is developed.

The viability of wind turbines has been recently demonstrated at several northern mine sites, including the Raglan Mine in northern Quebec and the Diavik Diamond Mine in the Northwest Territories. Qulliq Energy Corporation (QEC) had commissioned a study of wind power potential in all Nunavut communities, demonstrating the territories desire to harness wind power in Nunavut (QEC n.d.b). The study ranked communities on the economic viability of wind power generation and rate of return (ROE) (Pinard 2016). Baffinland's 2006 renewable energy study also identified a potentially promising wind resource, and in 2007 Baffinland installed a test wind tower. The wind tower collapsed the subsequent winter due to an excessive build-up of hoarfrost. NRCan is currently studying the accumulation of ice on wind turbine blades resulting in reduced power output and increased rotor loads (reference: https://www.nrcan.gc.ca/energy/renewable-electricity/wind/7321).

Mindful of recent successes operating wind turbines in other arctic locations, the company initiated further study in 2017 to assess the local wind resource at the Project. Although wind power sources cannot completely replace diesel power, recent success in Arctic conditions have demonstrated the technical viability of wind turbines. Baffinland is considering the installation of wind turbines at Milne Port and the Mine Site as part of the Phase 2 Proposal. A preliminary study (TSD 02, Appendix E) identifies suitable areas where the wind turbines could be installed. More engineering studies are required in order to finalize the locations of these turbine. The operation of wind turbines will complement and reduce fuel consumption by diesel generation.

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