Baffinland Iron Mines LP
Mary River Expansion Stage 3

Definitive Study Report

Section 2 – Project History

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2. Project History

2.1 Location

The Mary River mine is located at the northern end of Baffin Island in the Qikiqtaaluk Region of Nunavut, Canada. The site is approximately 550 km north of the Arctic Circle.

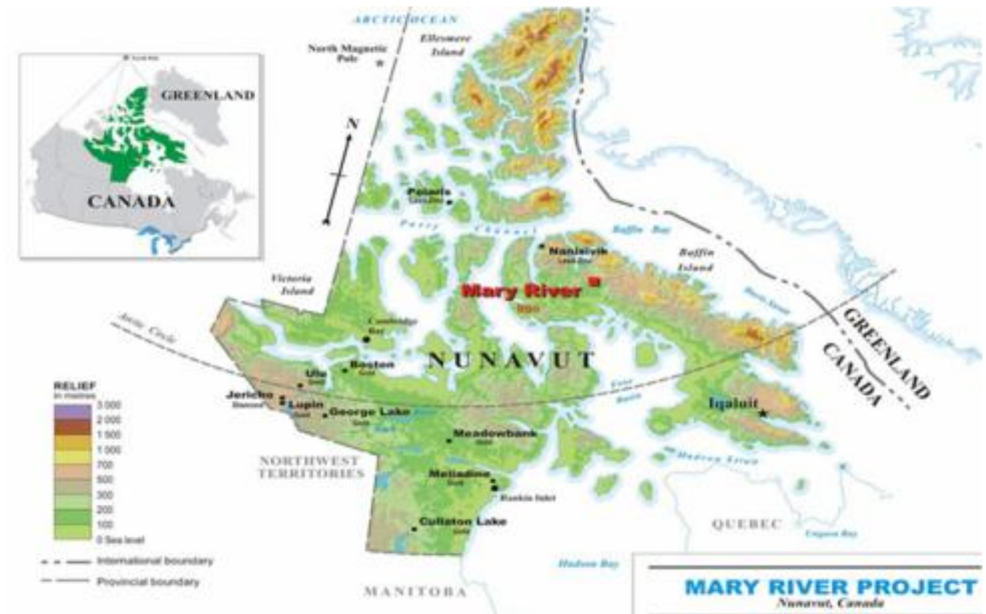

Figure 2-1: Mary River Location Map

Baffin Island presents a unique and challenging environment displaying extreme conditions much of the year. Specific project planning is required to mitigate the associated risks:

- Sub-zero temperatures for at least 9 months of the year, with temperatures reaching as low as -54°C. Requires arctic class winterized equipment, temporary heated shelters, careful work planning and specific scheduling of temperature critical construction activities.
- Conditions during the summer period are relatively mild with an average daily maximum temperature of 10°C. Rainfall, which generally occurs during summer but can extend from April to November, averages approximately 260 mm per year.
- Significant changes in daylight hours during the year, including two months of near total darkness and a two month duration “polar day”. Construction activities scheduled to leverage summer 24-hour sunlight working full “night” shift and to minimize outdoor work during periods of near complete darkness.
- Cold permafrost ground conditions with, in places, significant soil ice content and large ice lenses. Earthworks design and construction to minimize disturbance of existing

permafrost; and activities planned to leverage hard frozen ground conditions during winter including the option to construct ice roads and access over water.

- Ship passage by conventional (non-ice breaking) ships in or out of Milne Port is only possible from late July to mid-October due to ice coverage of the shipping routes. This provides a limited window to ship in supplies and the project must rely solely on air transport for resupply when ships cannot get to Milne Port. Detailed logistics planning, construction and contracting strategy and project scheduling to mitigate impacts on the project schedule.

2.2 Background

Prospector Murray Watts discovered the Mary River iron ore deposit in 1962. The following year Baffinland Iron Mines Ltd. (BIML) was established as a private company to develop the Mary River claims and leases. Over the next three years BIML built a 100 km tote road from Milne Inlet to the Mary River camp; constructed gravel airstrips near the Mary River camp, at Milne Inlet and at Katiktok Lake (near Deposit No. 4); and conducted additional metallurgical tests.

Exclusive rights to the Mary River ore deposits are now held by Baffinland Iron Mines Corporation. Baffinland Iron Mines Corporation's major shareholders include Nunavut Iron Ore and ArcelorMittal.

In 2013 Baffinland Iron Mines (BIM) developed an open-pit iron ore mining operation at Mary River. Mining commenced in August 2014 and BIM shipped its first iron ore to European Markets in July 2015.

Product from the Mary River mine is high grade direct shipping iron ore, both lump (approximately 75% of product) and sinter fines (approximately 25% of product). Crushing and screening of the ore is carried out on site at Mary River, no additional ore processing is required.

2.3 Current Operations

BIM's existing "Early Revenue Phase" operation is approved to mine, crush, stockpile and ship up to 4.2 Mtpa of iron ore lump and fines through Milne Port. Existing equipment and facilities include:

- Open pit mine with associated haul road and waste rock dump at Deposit No. 1.
- Mine equipment fleet based around use of 90t class mine haul trucks (CAT 777's).
- Mobile crushing and screening equipment located at Mary River.
- Ore Haul Trucks (OHT's) for transport of ore from Mary River to Milne Port.
- Lump and fines stockpiles with mobile stacking and reclaim equipment at Milne Port.
- Ore dock with ship loader suitable for loading Panamax vessels.

- Mary River support infrastructure, including mine truck and general mobile maintenance workshops, central warehouse, gravel runway suitable for jet aircraft, accommodation, utility systems, waste management facilities, power generation and fuel storage tank farm.
- Milne Port support infrastructure, including mobile maintenance workshops, warehouse, accommodation, utility systems, waste management facilities, power generation and large capacity fuel tank farm.

Additional support infrastructure includes soft walled (Weatherhaven) camps and established rock quarries at both sites.

2.4 Expansion Project Objectives

The expansion project objective is to increase the volume of iron ore shipped from Milne Port in the defined shipping season each year to 12 million tonnes. Maximize the lump product, while minimizing capital expenditure and operating cost, resulting in a low cost sustainable operation. The proposed expansion project shall:

- Comply with the Nunavut Mine Health & Safety Act and Regulations, requirements defined in BIM's licences and permits, and BIM Safety Standards.
- Be constructed with minimal impact on existing ongoing operations.
- Achieve an annual production rate of 12 Mtpa transported off site during the defined shipping season using available market ice-class and non-ice-class ships up to Cape Size capacity.
- Be designed for operation 24 hours per day, 365 days per year; with the exception of the ship loading operations which are constrained by the available shipping season.
- Produce lump and fines product complying with BIM's specifications, maximizing the proportion of lump product.

2.5 Expansion Study Work Undertaken

2.5.1 High Level Option Study (Q2 2016)

During March and April 2016 Hatch developed a high level option study to determine the optimum project configuration for increasing production from 4.2 Mtpa to 12 Mtpa including rail transport of ore from Mary River to Milne Port. The proposed project configuration included:

- Mine fleet expansion using additional 90t class trucks (CAT 777).
- Primary crushing at the mine site using new and existing equipment.
- Rail transport of ore from the mine to the port. Rail alignment generally following existing Tote Road with specific approved deviations. Rail car loading using front-end-loaders. Rail car unloading using Kiruna Helix system.

- Secondary crushing at the Port using three (3) 1000 hp cone crushers.
- Existing ship loader stockpile expanded to 5.2 Mt. Existing Ship loader utilized without modification.
- New 5.0 Mt lump stockpile with stacker/reclaimer. New ore dock, Panamax size located east of existing dock. Dock constructed from repurposed ship hull with single quadrant ship loader.
- Support infrastructure upgrades necessary for upgrade operations.

2.5.2 Stage II Study (Q3 – Q4 2016)

Based on the results of the High Level Option Study, Hatch was engaged by Baffinland in June 2016 to conduct an updated study to further develop options to increase production to 12 Mtpa, reduce unit operating costs and minimize the associated capital investment.

The Stage II Study was completed in October 2016.

The Stage II Study defined the scope of facilities to be provided to lift the production of iron ore from the Mary River Mine to achieve shipment of 12 Mtpa of iron ore.

The Stage II Project considered:

- Continued mining of Deposit No.1.
- Use of a mining fleet based around 90t class mine haul trucks (CAT 777) augmented with 220t class trucks (CAT 793).
- Conversions of existing crushing and screening plant to be able to produce a primary crushed ore with a nominal top size of 100mm, as averse to production of lump and fines at Mary River.
- Maintaining the Front End Loader (FEL) feeding of Run of Mine (ROM) ore to the crushers.
- Development of ROM stockpiles ahead of the crusher circuit and primary crushed ore stockpiles for reclaim and loading onto trains by FEL.
- Development of a single track, standard gauge rail track with associated locomotives and ore wagons to transport -100 mm ore from Mary River to the port at Milne.
- Unloading trains using an automated rotary car unloaders coupled to a primary crushed ore stockpile at Milne.
- Reclaim of primary crushed ore and feed to a single cone crusher and two multi deck screens to produce separate lump and fines product.
- Conveying lump product to be stacked in new lump ore stockpiles using an automated rail mounted stacker machine.

- Trucking fine ore from the screening plant to be stockpiled within the existing stockpile area with existing stackers being engaged to stack the ore.
- Installation of a single automated bucket wheel reclaimer for lump reclaim
- Installation of a new dock mounted with two radial arm shiploaders capable of loading Cape size and Panamax vessels.
- Use of existing conveyors (reconfigured) and mobile equipment to reclaim fine ore and load onto Panamax sized vessels using the existing ship loader.
- Upgrading Mine and Milne Port infrastructure to provide for additional accommodation units (construction and operations), maintenance facilities (truck shop at Mary River, Rail workshop and Crusher Workshop at Milne), utility, power generation and distribution facilities as well as increases in fuel storage volumes.
- Shipping lump and fines ore from two docks during the defined summer shipping season.
- Recommendations to further define the project using and executions strategy based around;
    - Offsite modular construction for process and bulk materials handling equipment and as many other facilities suited to this construction approach.
    - Use of Design Build (D&B) contracts for development of the rail and the Milne bulk materials handling system.

The Stage II Study defined the capital requirements as shown in Table 2-1.

Table 2-1: Stage II Report Capex Estimate

Production Area	Capital Cost (USD Millions[3])
Mining / Mine site	30.6
Port Site / Bulk Materials Handling	209.9
Railway	276.3
Indirect Costs	247.3
Owners Costs	26.4
Contingency	158.1
Total Estimated Cost	**948.7**
Potential Operating Lease Reduction	(60.0)
Potential Capital Cost Savings (Market Conditions)	(35.0)
Potential Project Capex with Savings	**853.7**

2.6 2016 – 2017 Geotechnical Investigation

In parallel with the Stage II Study, investigations were initiated to generate geotechnical information to confirm Stage II scope, where possible, and to develop a body of data to support rapid progression of Study and detailed design work in subsequent phases of the Project. The programme included:

- 2016 work completed:
  - Boreholes at the Milne Port infrastructure were drilled.
  - Bridge abutment at the existing Tote Road km 17, km 80 and km 97 were drilled.
  - Accessible boreholes on the rail alignment in cut locations between km 0 to km 58 and km 78 to km 108 were drilled.
  - A sample of the Granitic Gneiss was cored near the existing quarry at Milne Port. Samples of the Dolomitic Limestone were cored along the existing Tote Road near km 63.
- 2017 work completed – Marine Study:
  - Offshore investigations related to placement of Dock 2 including:
    - 5 Piezo cone penetration tests.
    - Drilling five locations for the new dock and collection of soil samples for analysis.
    - Seismic surveys at 12 locations within the rail alignment, outside current permit boundaries to allow assessment of bed rock depth.
- 2017 work completed or currently being completed – Rail Study:
  - Boreholes between km 78 and km 70 has been drilled
  - The bridge abutments at km 70 has been drilled.
  - GPR surveys will be completed at km 26 and km 46 where substantial ice formations have been found during the 2016 borehole drilling program.
  - Geophysical investigations will be completed between km 70 and km 58 as this section is not accessible with the borehole drilling equipment.
  - One new boreholes was drilled along a potential alternative alignment to avoid the ice formation at km 26.
  - Additional geotechnical testing is being completed on the ballast samples from the quarries at the mine and port to ensure material properties meet the requirements for railway ballast.

Full details of the geotechnical program and its results are detailed within Section 7 of this report. Further geotechnical work may be required in the execution phase of the project to confirm design baseline data for detailed design purposes.

2.7 Stage III Study Objectives

Minimising capital requirements during the construction period, 2017 to 2020, obtaining a higher level of cost certainty and mitigating risks, relative to the Stage 2 Study result is required for BIM to make a final commitment to project execution.

A number of optimisation elements were recognised in Stage II work requiring further development in Stage III.

2.7.1 Optimization Potential For Subsequent Phases

During the completion phase of the Stage 2 Study a workshop convened between Hatch and BIM identified a number of vectors for improving project cost projections and cost certainty. The major cost and delivery improvement vectors are:

- To reinforce the viability of the project, commissioning and project ramp up planning to ensure production and shipping a total of +12 Mt of DSO in the shipping season of 2020, is required.
- Detailed planning to ensure minimal interruption to existing operations and product shipping during the construction period.
- Detailed planning to ensure a robust operations readiness plan is developed and implemented to ensure smooth transition to new operating methods and a sustained ramp up to 12 Mtpa of DSO shipped.

Specific optimisation targets were identified as:

- Optimisation of rail earthworks design arising from:

  Receipt of a consistent set of Lidar information for the entire alignment length of the railway. Such data became available after completion of cost estimates underpinning the Stage II Study.

  Completion in January 2017 of a field geotechnical program to confirm assumptions about soil and rock conditions used within the Stage II Study. Completion of the geotechnical program will also provide information to confirm and upgrade (where supported by data) assumptions made with respect to the amount of material from rock and other cuts, which may be re-used as construction materials.

  Further optimization of the rail alignment and railway rolling stock requirements arising from completing a software optimization of the rail alignment and operating regime using Trimble optimization software, including:

  - Improving alignment near km 97.
  - Optimization of culvert designs to where possible allow for standard designs.
  - A review of the use of spoil materials as construction material.
  - Optimization of the rolling stock and locomotive requirements.

- Optimisation of project costs;

  Recognizing the depressed global market for equipment and materials supply, there may be the likelihood of commercial competition to secure material, equipment and construction contracts, which may result in reduced pricing relative to the Stage II Study.

  - Sourcing equipment from known low cost countries such as in China.
  - Optimization of mobile equipment costs through competitive bidding in the Stage 3 Definitive Study of contracts for supply, maintenance and operation of mobile equipment on a contract basis. This is approach is applicable to mining equipment and railway maintenance equipment.
  - Optimization of freight costs through packaging freight within major design supply contracts to simplify the freight and logistics train, where this is to the advantage of the project.
  - Optimizing supply and construction cost by packaging work into larger vertically integrated packages on a design, supply and construct basis, to obtain economies of scale and systems integration through provision of complete systems by a single party.
  - Competitive bidding for design during the Stage 3 Definitive Study (using a FIDIC contracting platform), supply and install contracts, may result in vendors offering optimized equipment selections and designs, further driving the cost of the project down. Optimizations expected include:
    - Optimized foundation designs to minimize concrete use and need for site poured contract.
    - Optimized steelwork designs for plant and buildings to minimize project cost.
  - Use of modular concepts to minimize requirement for a site construction workforce and commissioning efforts, through pre-commissioning off site.

An assessment of the risk of delay in placement of contracts, release of permits and mobilisation within shipping windows that may result in shipping windows being missed with consequent risk of substantial project delay is required to balance optimisation concepts.

2.7.2 Stage III Definitive Study – Study and Report Preparation Responsibilities

In October 2016 BIM launched a Stage III Study due for completion in April 2017.

The table below summarises the organisations contributing to the development of this Stage III report.

Table 2-2: Study Report Contributors

Study Report Section	Study Element	Report Contributor
1	Executive Summary	Hatch
2	Project History	Hatch
3	Geology	BIM / Roscoe Postle Associates, Inc (RPA)
4	Mineral Resources	BIM / Roscoe Postle Associates, Inc (RPA)
5	Mining	BIM / Roscoe Postle Associates, Inc (RPA)
6	Process Definition	Hatch
7	Engineering Development	Hatch
8	Project Layout	Hatch
9	Facilities Description	Hatch
10	Business Systems	BIM
11	Project Schedule	Hatch
12	Capital Costs	Hatch
13	Human Resources	BIM
14	Operating Costs	Hatch
15	Market Analysis	BIM
16	Legal and Fiscal	BIM
17	Health Safety, Environment and Community	Hatch
18	Sustainable Development	BIM
19	Financial Analysis and Evaluation	BIM/Hatch
20	Project Risks and Opportunities	Hatch
21	Execution Plan	Hatch
22	Operations Readiness	Hatch