Mary River Project

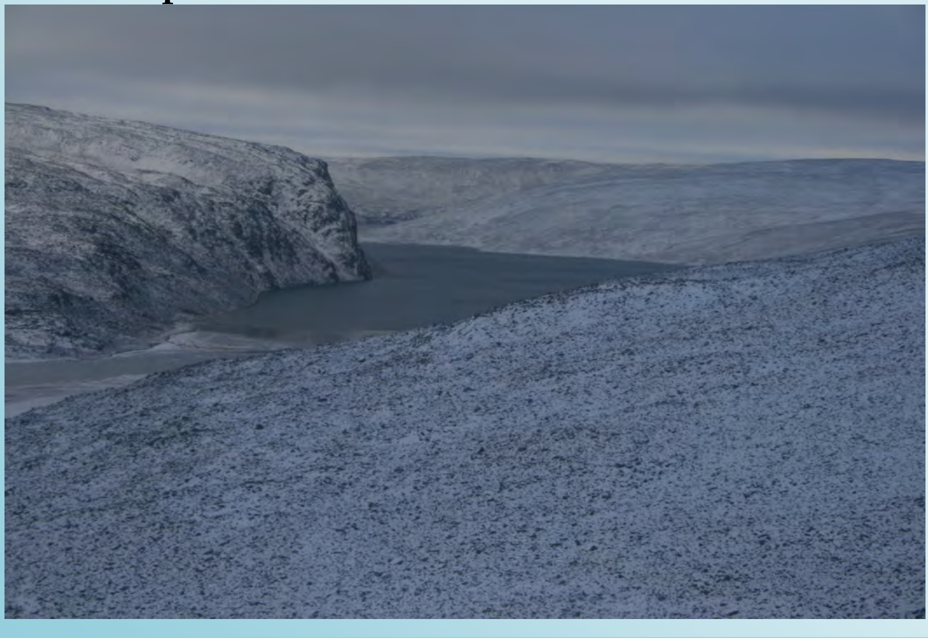
Cockburn Lake – Nuvuit Coastal Rail Link Pre-Feasibility Evaluation Report

prepared for

Qikiqtani Inuit Association

by

HDR Corporation



September 28, 2011

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Executive Summary

HDR Corporation (HDR) and its subsidiary HDR Engineering, Inc. was retained by QIA to review the proposed Cockburn Lake - Nuvuit Coastal Rail Link alignment (Nuvuit extension) and to form a professional opinion on the technical and operational feasibility of constructing a railway along the proposed route based on the project's design criteria and standard practices of heavy haul railroads operating in North America.

The scope of the feasibility evaluation was limited to the currently proposed 116 kilometer extension from Kilometer Post (KP) 131+500 on the original Steensby route to the new proposed Port site at Nuvuit. The study team participated in a project design briefing with Baffinland Iron Mines and its engineer CANARAIL at CANARAIL's Montreal offices. Immediately following the project design briefing the study team conducted a site reconnaissance of the proposed route. Representatives from the communities of Hall Beach and Igloolik participated in the site reconnaissance.

The study was performed by senior railroad engineers and cost estimators experienced in the design, construction, and operations of heavy haul rail lines in North America similar to the Mary River Project. The feasibility analysis included:

- Project briefing and site reconnaissance
- Review of base mapping and assessment of suitability for use in the pre-feasibility study.
- Comparison of project design criteria to standard practices of similar heavy haul rail lines in North America and assessment of their suitability for use on this project.
- Review and evaluation of the proposed alignment and determination of its feasibility
- Review and evaluation of the proposed project cost and opinion of reasonableness
- Review and assessment of required changes to operating plan, fleet size, and staffing and maintenance facilities as compared to the Steensby route.

The study scope did not include an analysis of possible alternative routes or an assessment of the overall economic feasibility of the Mary River Project if the proposed extension to Nuvuit were to be built.

Based upon HDR's review of the available information, site observations, and experience on similar projects, it's our opinion the proposed Nuvuit extension is feasible from a design, construction, operating, and maintenance stand point. The order-of- magnitude cost estimate for the 116 km is reasonable based on the cost data and level of design available. Based on the limited mapping, and absence for hydrological, hydraulic, and geotechnical analyses, there are significant cost risk factors associated with the current alignment. We recommend that cost contingencies, typically in the range of 30 to 50% be added to the cost estimate. Other findings include:

- The mapping data provided is sufficient to develop a corridor and assess the feasibility of a route within the corridor based on the project's design criteria. The mapping is not detailed enough to define an exact alignment of the route within the corridor. Ground elevations could vary by 5m to 10m or more based on accuracy of the mapping provided.

- The design criteria used to develop the alignment is consistent with other heavy haul rail lines in North America. The report noted several areas where the design criteria was more conservative than other rail lines due primarily to concerns about cold weather operations and the remoteness of the line.

- The report noted several locations where the design could potentially be improved. These improvements are minor and would not significantly change the length or cost of the project.

- The operating plan, fleet size, staffing, and maintenance facilities are conservative primarily because of a lack of historical data on cold weather operations and the remoteness of the line. Potential cost savings may be possible in these areas

- Project costs appear reasonable at this stage of the design. It should be noted that project costs could change significantly in either direction as the design is progressed. The report noted the potential for 3.5km of additional tunnels which could significantly increase project costs.

- The longer route (104km) increases risk factors relating to operational reliability and safety due to increased exposure from operating trains over longer distances in a harsh arctic environment. The projects conservative approach to the design and operations of the railway is intended to mitigate these risks to the extent practical.

If it is determined that the proposed extension merits further consideration the following steps are recommended:

1. Obtain additional mapping of the proposed corridor at a minimum scale of 1:5,000 and 3m contour intervals.

2. Refine the proposed alignment and investigate other potential alternative within the corridor.

3. Advance the design, operating plan, and cost estimates to a level equal to the current Steensby route

4. Review design criteria to determine if design variances at specific locations could result in a significant reduction in construction costs.

Introduction

Background

The Qikiqtaaluk Inuit Association (QIA) represents Inuit of the Qikiqtaaluk region of Nunavut. QIA's Department of Lands and is responsible for directing and/or supervising activities that relate to Inuit lands and resources, including, the activities conducted by Baffinland Iron Mines Corporation at the proposed Mary River Project.

HDR Corporation (HDR) and its subsidiary HDR Engineering, Inc. was retained by QIA to review the proposed Cockburn Lake - Nuvuit Coastal rail link alignment and to develop a professional opinion on the technical and operational feasibility of constructing a railway along this route based on standard practices of heavy haul railroads operating in North America.

Analysis focused on defining the technical considerations and constraints related to constructing and operating a railway along a pre-defined route provided to HDR. The objective of the study was to evaluate whether the proposed rail alignment was feasible based on the project's established engineering design criteria and operational parameters. Furthermore, HDR reviewed the level Class-D estimate information provided and performed an independent analysis as to the reasonableness of the costs.

The goal of the study was to provide QIA an independent review and assessment of the pre-feasibility study of the route to allow QIA to provide substantive comments on the pending Mary River Draft Environmental Impacts Statement concerning the potential merits of Nuvuit Coastal routing as compared to the currently preferred Steensby route.

Source Materials

Baffinland Iron Mines Corporation provided the following information to HDR for use in the pre-feasibility evaluation:

- Cockburn Lake – Nuvuit Coastal Rail Link Alignment Pre-Feasibility Design Report, dated September 2011, prepared by CANARAIL for Baffinland Iron Mines Corporation
- Mary River Project December 2010 Railway Plan and Profile Drawings, dated December 2010, prepared by CANARAIL for Baffinland Iron Mines Corporation
- Mary River Project Railway Operating Plan, dated March 2008, prepared by CANARAIL for Baffinland Iron Mines Corporation

Other materials utilized by HDR for this study included:

- American Railway Engineering and Maintenance-of-Way Associations Manual fro Railway Engineering, 2010 edition
- Google Earth Pro Maps

Study Approach

Methodology

This study was conducted by senior railroad engineers and cost estimators with an average of over 30+ years of experience. The team relied heavily on their experiences on similar projects to form an opinion on the feasibility of the proposed rail alignment given the limited data and the short review period. The evaluation of the feasibility of the proposed rail alignment was based on the following:

- Technical review of design criteria based on North America Railway practices including the American Engineering and Maintenance-of-way Associations (AREMA) Manual of Engineering.
- In person meeting with Baffinland Iron Mines' engineers CANARAIL to review the project.
- Site reconnaissance of the proposed rail alignment to verify physical characteristics of the route
- Review of the rail alignment for compliance with project design criteria, and AREMA recommended practices
- Develop a parallel Class D estimate based on the quantities provided and best estimating practices used by HDR's construction subsidiary. Unit price data were supplemented by recent price data from similar cold weather projects in Alaska.

The evaluation was limited to the alignment provided and did not consider other routes previously identified or yet to be identified.

Design Review Meeting

A project review meeting was conducted on Friday, September 16, 2011 at CANARAIL's offices in Montreal, Quebec. In attendance at the meeting were the following:

- Carolyn Fitzpatrick, CANARAIL representing Baffinland Iron Mines
- Stephen Williamson Bathory, Tulaffik, Inc. representing QIA
- Morgan Schauerte, Arktis representing QIA
- Michael Anderson, Baffinland Iron Mines
- Richard Matthews, Baffinland Iron Mines
- Mike Strider, HDR Engineering, Inc. representing QIA

CANARAIL presented an overview of the original proposed rail line (Steensby route) and the proposed 116km Cockburn Lake to Nuvuit Coastal extension. The presentation included discussion of the unique design issues involved in constructing and operating a railroad above the Arctic Circle. Review materials were distributed to QIA including Cockburn Lake – Nuvuit Coastal Rail Link Report, the Steensby route Railway Operating Plan, the Steensby route plan and profile drawings, and cost estimates.

Site Reconnaissance

Immediately following the design review meeting a site visit was conducted by on Sunday September 17-19 2011. Three representatives of the local Qikiqtaaluk communities participated in the aerial helicopter reconnaissance of the rail alignment. Participants included local community representatives Salomon Qanatsiaq (Hall Beach) Abraham Qamaniq (Hall Beach), and Elizabeth Quassa (Igloolik), Baffinland Iron Company representative Dave McCann, along with Stephen Williamson Bathory, Morgan Schauerte, and Mike Strider.

The team flew the Steensby route from the camp at Mary River to the point of beginning of the Nuvuit extension at approximately Kilometer Post (KP) 131.5 and KP 0.0 of the proposed extension. The team inspected the site of bridge numbers 1 & 2 at approximately KP 5.0 from the ground. They performed additional ground inspections at KP 30, KP 40, and at the proposed Nuvuit port site just beyond KP 116. Other areas of interest were documented with photographs taken from the air. See Appendix A for reconnaissance photographs.

A number of general observations were drawn from the site reconnaissance. The Nuvuit extension appeared to be less challenging from a constructability standpoint then the Steensby route, especially in the areas along Cockburn Lake. The majority of the proposed extension route appeared to be rolling hills where the rail line is placed near the toe or benched into the sides of hills. Where the route ran along lakes, the line was located along the shoreline near the base of the adjacent hillside. At KP 40, the team looked at cutting across the river to shorten the proposed route slightly. However, CANARAIL has since indicated that this option would require a longer and higher bridge crossing and potentially increase the grade of the line. The sites of Bridge No. 3 & No. 6 looked as though a culvert could handle the crossing of the stream instead of a larger bridge structure. A potential new bridge structure was identified in an area of fill near KP 35. Near KP 75-76 the line skirts the steep face of a ledge that may require a tunnel as design is progressed.

Figure 1: KP 4.5 Site Reconnaissance

After landing along shore near the Nuvuit port site, the team proceeded along the coast westward to the base camp at the Steensby port site to fuel the helicopters. After leaving the Steensby port site, we flew the Steensby route back to KP 131.5 then cross country to Mary River due to worsening weather conditions. After diner that evening, the team held a debriefing of the reconnaissance trip during which the details of the Nuvuit extension and observations and concerns were discussed. Mike Strider (HDR) explained some of the rail lines design and technical issues with the community representatives at the meeting.

Figure 2: KP 116 Nuvuit Port Site Looking South

Study Evaluation

■ Alignment

Design Criteria and Approach

The proposed Cockburn Lake to Nuvuit coastal rail link utilizes design criteria similar to that of the current Steensby route. The design criteria are consistent with North American heavy haul railroad design criteria for new construction. Because of the remoteness of the line and the severe arctic weather conditions, the criteria developed for the project tend to be on the conservative side. Table 1 Design Criteria Review summarizes the pertinent design criteria applied to the proposed extension and HDR assessment of it.

Table 1 Design Criteria Review

Design Criteria	HDR's Assessment
Axle Loads = 32.4 tonnes	This is the standard axel loading for the North American Railroad network. Many railroads are now using railcars with 35.7 tonne axle loads. Some heavy haul ore operations in Australia have axel loads as high as 40 tonnes. Increasing the allowable axle loads to 35.7 tonnes could decrease ore railcar fleet size by 10%. Axle loads higher than 35.7 tonnes are not recommended for this operation due to alignment grades.
Design Speed = 75 km/hr	The design speed is appropriate to the type of operation and geometric characteristics of the route
Ruling Grade (Loaded Directed) =0.5%	HDR's experience on recent heavy haul lines including the DM&E Power River Basin Expansion Project limits the ruling grade to 0.8%. Good design practice dictates limiting the gradient to the extent possible. HDR would recommend increasing the ruling grade to 0.8% in the loaded direction at select locations where the increased gradient could reduce or eliminate tunneling or otherwise significantly reduce construction costs.
Ruling Grade (Loaded Directed) =1.5%	HDR's experience on similar projects limits the gradient to 1.2% to 1.5%. We recommend the use of railcars equipped with electronically controlled braking (ECB) systems on grades over 1.2%.
Distance between Grade Changes = 1,700m	This requirement seems overly conservative given the proposed ruling grades and should ideally be based on a formula that accounts for the percent of change in grade and operating speed.

	We would recommend the minimum length be one train length or 1,100m.
Desirable Minimum Radius = 500m	In agreement with criteria
Absolute Maximum Radius = 250m	In agreement with criteria

CANARAIL initially used Federal 1:250,000 map series to evaluate two potential rail routes along Rowdy River and Isortoq River to a new port site identified by QIA. These routes were ultimately determined not to be feasible. HDR's scope of services did not include review of these routes. Subsequently an alternative route starting at the southern end of the Steensby route was identified. QIA supplied 1:50,000 scale map tiff image files with 10 m and 20m contour intervals. This data were used to develop the Nuvuit extension that HDR has reviewed.

Ideally more accurate mapping would be desirable for use to develop the proposed alignment. However, the data is sufficient to identify a rail corridor and determine its feasibility. Higher accuracy data may result in significant changes to portions of the proposed alignment if the design of this route progressed.

Alignment

Following is a brief narrative of the proposed alignment and potential design refinements identified during the site reconnaissance. The design refinements are also noted Appendix B: Nuvuit Route Map with Field Notes.

The proposed line leaves the Steensby route at KP 131+500 (Steensby route) with KP 0+000 marking the start of the Nuvuit alignment. For the first ten kilometers the line heads south avoiding the higher elevations (hills) directly to the east. Near KP 5 the study identified two stream crossings listed as Bridges No. 1 and No. 2 on Nuvuit Route map (See Appendix B). It was noted on the site reconnaissance the streams could potentially be realigned to eliminate one of the bridges. Near KP 12 the line turns east and skirts the shorelines of three consecutive lakes. Near KP 18, a tunnel may be required to pass through a steep bluff area alongside the second lake.

A bridge (Bridge No. 3) is proposed near KP 19; however, based on field observations, a culvert might be appropriate since there did not appear to be a well defined stream.

After passing the three lakes, the line continues east and passes through rolling hills where near KP 29+500 (Bridge No. 4) the route crosses a well defined stream.

As the line continues east it approaches the Rowley River Valley and skirts the hillside to the north. Near KP 34+500, a well defined stream was observed that was not shown on the route map indicating a bridge was required. Just before KP 40, the line turns slightly north to wrap around a hill then it crosses the Rowley River, identified as Bridge No. 5. After crossing the Rowley River the route makes a U-turn and heads south in the opposite direction along the hillside adjacent to the Rowley River, and then turns southeast to leave the Rowley River Valley skirting the base of the hillside. Looking at the plan on this area reveals the route could be shortened a few kilometers by crossing the Rowley River further downstream. The profile of the track is near level so the short cut would not affect the grade. Further study is needed to determine whether the shorter track alignment would offset the increased costs to cross a much wider section of the Rowley River Valley.


Figure 3: Bridge No. 5 -Rowley River Crossing

At KP 50, the line loops into a small valley and then returns to the side of the adjacent hillside. Here is another location where the alignment could be straightened.

The line continues south along the east face of a hillside as it approaches Windless Lake. At approximately KP 57, Bridge No. 6 was identified on the route map. At this point, the line is located just off the west shore of Windless Lake. The grade starts to climb at KP 68 while still adjacent to Windless Lake. The route crosses the outlet of Windless Lake approximately KP 69+500, identified as Bridge No. 7. Continuing south and curving west the line skirts the west face of the adjacent hillside and follows the side of the hill until it is adjacent to the bay near KP 75.


Figure 4: Bridge No. 7 –Windless Lake Crossing

The line then turns south and continues to climb in grade to reach the routes high elevation point of 126m near KP 78. At this point the line is located on a terrace above the bluffs adjacent to the bay. Where the line turns south and travels adjacent to the bay, there is a significant cut section required as the line climbs towards its high point. Further study is needed since, from the flight the area appeared to be unstable. Near KP 80, the line skirts around a small lake, then returns to the edge of the bluff next to the bay.

At approximately KP 83, the line continues down in grade turning east away from the bay. At approximately KP 90, a structure (Bridge No. 8) is identified over a well defined stream. At this point, the line turns south and skirts the west face of the adjacent hill.

Just before KP 100, the line switches sides and then runs on the west side of the valley adjacent to the hillside. Continuing south, the line approaches the bay and turns west around the adjacent hillside as the grade continues to come down. The line then skirts the shoreline of the bay near KP 110, and then makes a sharp turn to the north to be routed north of a small lake. From KP 110, the grade is near level to the end of the mapped route at KP 116.

The distance from KP 116 to the area in our flight that was described as the potential Nuvuit port site was only a few kilometers. At this location, there is considerable elevation difference from sea level to where the ore unloading loop would be located, requiring that the ore to be conveyed downhill to the site.

The proposed alignment meets the design criteria discussed previously and appears to be geometrically feasible.

Structures

There are eight major structures identified along this route. The following is a summary of site reconnaissance of the major bridge locations. On inspection there were areas where the need for a bridge structure may not be required, and conversely, some areas that were not listed may require a structure.

Bridge No. 1 and No.2 (KP 4+500): By realigning the stream channel, it could be possible eliminate the need for two bridges at this location.

Bridge No. 3 (KP 18+500): No defined stream section noted at this location. It appears that a culvert can satisfy the drainage requirement.

Bridge No. 4 (KP 29): Bridge appears to be warranted.

New Bridge (KP35): A significant stream exists near KP 35, a new bridge or large culvert may be needed.

Bridge No. 5 (KP 42): An alignment change is recommended to shorten the route by several kilometers. The change crosses the river at a wide flood plain and would likely require a longer bridge. Further study is needed to determine whether a longer bridge would be a more cost effective solution than the longer route.

Bridge No. 6 (KP 57+500): It appeared that a culvert may satisfy the drainage requirement.

Bridge No. 7 (KP 69+500): A bridge appears to be warranted at the outlet of Windless Lake. At this location there is a large fill to the approach of the bridge. An alignment shift closer to the hillside on the north approach could save some embankment work.

Bridge No. 8 (KP 90+5): A bridge appears to be warranted.

Two areas appeared to have potential tunnels sites. One tunnel could be needed to pass through a bluff adjacent to a lake near KP 17. There is also a potential for a second tunnel through an area of a deep cut near KP 75.

HDR noted that the design criteria limit bridge heights to 15m or less for constructability reasons. These criteria should be revisited on a case by case basis to determine whether increasing bridge heights could potentially reduce earthwork costs.

Construction Costs

HDR conducted an independent review of the provided construction cost estimate. The cost estimate for the Nuvuit extension was based on order of magnitude costs derived from the more detailed Steensby construction estimate. Detailed breakdowns of the Steensby unit costs were not provided.

Since time and detailed costing data were limited, our approach was to use the quantities provided in the initial Steensby estimate and run a parallel estimate to verify the order-of-magnitude costs used for the Nuvuit extension. HDR used a best available unit cost approach from available data sources for these items of work. Logic for this pricing is as follows:

- Unit prices for items with definitive work were based on recent estimates HDR has developed for similar work in various areas of the United States, including remote work in Alaska. Some unit costs include subjective factors to compensate for the remoteness of the work.
- Pricing shown is bid level including contractor's Field Overhead, Bond and Profit. These costs do not include administrative, construction engineering, or design engineering.
- All estimates are based on current costs (2011). No escalation factors are included for a future start date or for escalation during the Project duration.
- Prices are in US Dollars and have not been factored to Canadian as the current exchange rate is less than 2%.
- No taxes on materials or value added tax are included.
- Labor wages figured as union with an Alaska scale. No special considerations included for Canadian work rules or other considerations.
- Project is estimated as a camp job with costs included for camp set-up and running for the estimated labor force. No special additional cost for travel for craft workers was included.
- Several items of work were included using the amount of the previous estimate since we had no way of quantifying them to make an analysis. These are for the most part Lump Sum quantity items.

Comments on items of work:

- Mobilization considered in range of 5% of job value.
- Project looks to be a rock borrow job and assumed material would be available adjacent to right-of-way.
- Pricing of excavation and embankment was figured from cut to fill, with hauls in the maximum range of 3 km. Detailed cut to fill analysis-mass haul was not a part of this task.

- Build Access Road was a large cost item provided without details on road sections, drainage or temporary structures. The cost included in HDR is as provided.
- All items to be crushed were considered to be near to the right-of-way and with multiple sites along the corridor to limit haul distances. Specific sites are not identified at this level of estimating.
- All rock excavations and embankments figured to be drill and shoot of good rock. If portions of the alignment are ripable then reduction in earthwork costs would be possible.
- The number of rectangular culverts and their cost were included as provided, since no details were available.
- Abutments and foundations cost from previous estimate were included as provided since no details were available.
- No costs for erosion and sedimentation controls were included, since none were identified in estimate provided. These costs may be a part of the cost of Haul Road Development, but is not known at this time.
- No geotechnical corrections were included, since they were as not quantified in estimate or other information provided.
- Tunnel is estimated as a hard rock tunnel with no geotechnical issues or ventilation requirements. Tunnel also assumed to be unlined.

The Opinion of Probable Construction Cost developed by HDR is $1,080,000,000 USD for the Steensby route. This correlates very closely with the Steensby estimate prepared by CANARAIL.

CANARAIL assumed an average cost of $5.35M/km for the overall construction of the116km of Nuvuit route based on per kilometer costs derived from reach 2 and 3 of the Steensby estimate. These results, in costs of the construction of the railway, are shown in Table 2 below.

Table 2 Estimated Railway Construction Costs for the Complete Mary River - Nuvuit Route

Item	Cost in $M (CAN)	HDR Assessment
Total Mary River – Steensby Railway Construction cost	$1,040M	Total project costs correlate closely with HDR's estimate.
116km Nuvuit Extension	$621M	HDR agrees with per kilometer unit costs
300m Tunnel	$24M	Tunnel quantity is a significant cost risk factor at this level of design
12km of Reach 3 of Steensby (not built)	-$68M	Agree

Siding to ballast quarry (KP 131.5 to KP 133)	$9M	No information provided on side
Total Mary River - Nuvuit Railway	**$1,626M**	
Potential Additional Tunnels (3.5km)	$279M	Additional mapping/design required to potential costs.

This cost evaluation is based on a very high level review of the information provided and any further discussion of cost needs to include a value for contingencies. Examples of such contingencies are item quantities, pricing, schedule and geotechnical. Contingencies at this level of design could range from 30% to 50%.

Operations

HDR reviewed the 2008 DFS Operating Plan as well as the operating changes recommended in Chapter 4 of the pre-feasibility report. Table 3 summarizes our assessment of the proposed operating plan for the Nuvuit extension.

Table 3 Operating Plan Requirements

Criteria	HDR Assessment
Maximum Operating Speed = 60km/hr. (Design allows speeds to be increased to 75m/hr in future).	This appears to be an overly conservative. We are unaware of any North American Railroad that restricts operating speeds solely due to cold weather conditions.
Transit Times (Empty/Loaded) • Mary River/Nuvuit = (5:04/5:34) • Mary River/Steensby = (3:00/3:25)	Increasing train speeds could reduce transit times for both routes
Terminal Times • Mary River/Nuvuit = 2:34 • Mary River/Steensby = 2:21	Agree
Cycle time 15:33 (1.4 round trips per day	Agree based on criteria used.
Train Meets – max. 2 meets per trip	String line graphs indicate that four sidings are required. It should be noted that these locations could shift significantly based on track geometry.
Fuel Requirements	Agree

The operating plan similar to the alignment design takes a conservative approach due to the remoteness of the site and cold operating conditions. The potential exists to reduce cycle times as experience operating the line in arctic conditions is gained.

The 104km increase in the route would increase certain risk factors relating to operational reliability and safety simply due to increased exposure from operating trains over longer distances in a harsh arctic environment. The proposed operating plan allows for 65 out of service days including a five week mid-winter shutdown. Actual operating rules for the line, when developed should identify climate conditions (temperature and wind velocity) where train operations are reduced or stopped.

Rolling Stock and Fleet Size

HDR reviewed the 2008 DFS Operating Plan as well as the recommend fleet size in Chapter 5 of the pre-feasibility report. Table 4 summarizes our assessment of the proposed fleet requirements for the Nuvuit extension. If axle loading is increased to 35.7 tonnes, the number of ore cars could be reduced by 10%.

Table 4 Fleet Size Requirements

Criteria	HDR Assessment
Ore unit trains =4 (one additional)	Agree based on current operating plan.
Additional locomotives =3	This includes an extra locomotive that could be eliminated. The percent of spares is considered high at 27%
Additional Ore cars = 503	Agree, a 10% allowance for spares is standard practice.

Staffing and Maintenance Facilities

The Nuvuit extension report estimates a total of 53 people per shift for the maintenance-of-way (MOW) force. This is a 21 person (66%) increase over the Steensby route number. The report doubled the total staff required based on the assumption that there are two shifts per day. As a comparison the Nuvuit extension route is 73% longer than the Steensby route.

During the winter (frozen months), there should be minimal maintenance activity since most normal maintenance functions cannot be performed when the track is frozen. Routine MOW activities during the winter months include maintenance of switches, snow and slide material removal, routine track inspection, and occasional broken rail or switch point. It is normal in cold climates that MOW duties during the winter months are limited to functions strictly required to keep the track in a safe operating condition and is performed with a skeleton crew. Most trackwork and structure repair/renewals would be done during the summer months. Crews would likely work two-12 hour shifts replacing ties, surfacing track, etc., preparing for the next winter season.

Personnel working in the mine or other locations in the winter time can be trained to perform track related duties in case of emergencies, including derailments and slides. It is likely the track could only be restored to a safe passable condition with permanent repairs deferred until weather conditions permit.

Other MOW positions that may not need to be increased because of the longer route include welder, welder helper, telecom optic and radio technicians, telecom computer network administrator, and signal technician. Other than for rock slide fencing, if there is no wayside signal system to maintain, the workload for the signal department is minimal.

The need for a third or satellite MOW facility should also be revisited. Material caches along the line could reduce need to transport materials for spot repairs. Major maintenance activities would likely be performed by mechanized gangs further reducing the need for a satellite facility.

Conclusions

Findings of Feasibility

HDR relied on the information provided and its team's experiences on similar projects throughout North America to form the following opinions relating to the feasibility of the proposed Cockburn Lake –Nuvuit Coastal Rail Link Alignment Pre-Feasibility Design:

- The mapping data provided is sufficient to develop a corridor and assess the feasibility of a route within the corridor based on the project's design criteria. The mapping is not detailed enough to define an exact alignment of the route within the corridor. Ground elevations could vary by 5m to 10m or more based on accuracy of the mapping provided.

- The design criteria used to develop the alignment is consistent with other heavy haul rail lines in North America. The report noted several areas where the design criteria was more conservative than other rail lines due primarily to concerns about cold weather operations and the remoteness of the line.

- The proposed alignment meets the project's design criteria and appears feasible. The report noted several locations where the design could potentially be improved. These improvements are minor and would not significantly change the length or cost of the project.

- The operating plan, fleet size, staffing, and maintenance facilities are conservative primarily because of a lack of historical data on cold weather operations and the remoteness of the line.

- Project costs appear reasonable at this stage of the design. It should be noted that project costs could change significantly in either direction as the design is progressed. The report noted the potential for 3.5km of additional tunnels which could significantly increase project costs.

- Based on the limited mapping, and absence for hydrological, hydraulic, and geotechnical analyses, there are significant cost risk factors associated with the current alignment. We recommend that cost contingencies, typically in the range of 30 to 50% be added to the cost estimate.

- The longer route (104km) increases risk factors relating to operational reliability and safety due to increased exposure from operating trains over longer distances in a harsh arctic environment. The projects conservative approach to the design and operations of the railway is intended to mitigate these risks to the extent practical.

In summary the proposed Cockburn Lake –Nuvuit Coastal Rail Link Alignment is feasible based on the limited information provided.

HDR scope of services was limited to the review of the single alignment provided and does not include identification of other potential alignments or an assessment of the financial feasibility of the Mary River Project.

Next Steps

If it is determined that the proposed extension merits further consideration the following steps are recommended:

1. Obtain additional mapping of the proposed corridor at a minimum scale of 1:5,000 and 3m contour intervals.

2. Refine the proposed alignment and investigate other potential alternative within the corridor.

3. Advance the design, operating plan, and cost estimates to a level equal to the current Steensby route

4. Review design criteria to determine if design variances at specific locations could result in a significant reduction in construction costs.

APPENDIX A

SITE RECONNAISSANCE PHOTOGRAPHS

APPENDIX B

NUVUIT ROUTE EVALUATION MAP WITH FIELD NOTES