



NISHI-KHON/SNC♦LAVALIN

November 14, 2007

BY EMAIL

Kivalliq Inuit Association
P.O. Box 340
Rankin Inlet, NU
X0C 0G0

016259-30RA

Attention: Melodie Sammurtok, Project Manager

Dear Ms. Sammurtok:

Re: Nunavut-Manitoba Route Selection Study: Final Report

We are pleased to submit the final documentation of the Nunavut-Manitoba Route Selection Study as a concluding deliverable of this two-year multi-disciplinary study. An electronic copy of the Final Report is submitted initially via email. One hard-copy report will be subsequently provided to each member of the Project Working Group, along with a CD containing the electronic copies of the Final and Milestone Reports, along with all the associated Appendices.

On behalf of the Nishi-Khon/SNC-Lavalin Consultant Team, we would like to thank you, members of the Project Working Group and the Project Steering Committee, for your guidance and valuable contributions to this study. It has been our pleasure to work with KIA, Nunavut, Manitoba and Transport Canada on this challenging project. We look forward to continuing working with you over the next few years on the business case development, more detailed engineering and environmental studies necessary to bring this important project to fruition.

Yours truly,

SNC♦LAVALIN INC.

Tim Stevens, P. Eng.
Project Manager

Enclosures

DISTRIBUTION LIST

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 NISHI-KHON/SNC♦LAVALIN	FINAL REPORT	Date: November 14, 2007
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CLIENT: KIVALLIQ INUIT ASSOCIATION

PROJECT: NUNAVUT-MANITOBA ROUTE SELECTION STUDY

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NUNAVUT-MANITOBA ROUTE SELECTION STUDY

FINAL REPORT

COVERLETTER

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1.0 INTRODUCTION

1.1 Background

The Kivalliq Inuit Association (KIA), together with the governments of Nunavut (NU) and Manitoba (MB), retained Nishi-Khon/SNC-Lavalin (NKSL) to carry out a two-year multidisciplinary study to determine the best location for a road route linking the community of Rankin Inlet to the Port of Churchill and the existing all-weather road transportation network in Manitoba, and thence to the National Highway System. This study was commissioned under the auspices of the Nunavut-Manitoba Transportation Memorandum of Understanding (MoU), signed in December 2001 between the two jurisdictions, of which a key objective was collaboration on the road initiative. Throughout 1999 and 2000, a “Manitoba Nunavut Transportation Assessment”¹ was undertaken jointly by the Governments of Canada, Nunavut and Manitoba. This study established that a road connection between Manitoba and Nunavut is a critical requirement to providing communities in the Kivalliq Region of Nunavut with access to Manitoba and the rest of North America. In 2001, the Nunavut Transportation Strategy further identified the need for a road between Manitoba and the Kivalliq region. The current study is undertaken to identify a preferred route for this road link. There are three possible locations within Manitoba for the southern terminus of the new route: Lynn Lake, Thompson and Gillam.

The development strategy for the new route, including the link to Churchill, is based on initial staging as a winter road, followed in time by possible construction of a single-lane, all-weather road, then finally, construction of a two-lane, all-weather road. The respective governments see implementation of the new road as a means of supporting the objectives of healthy communities, simplicity and unity, self-reliance and continued learning². Furthermore, it has been determined that the road should enhance opportunities for resource development such as eco-tourism and mining; benefit employment, small business development and standard of living; and increase capital investment by reducing the cost of transporting people and goods between the Kivalliq Region and urban centres in Manitoba.

As specified in the Proposal for this Route Selection Study, this study was carried out under four task headings:

- Task A: Initial public consultations³, social, economic, transportation and environmental analysis of corridors, and preparation of road development standards
- Task B: Route selection
- Task C: Refinement of preferred route
- Task D Final reporting

¹ “Manitoba-Nunavut Transportation Assessment Report” (Prolog, 2000) and “Manitoba-Nunavut Transportation Assessment: Road Corridor Sub-Study Report” (DS-Lea Consultants, 2000).

² These are priorities specified in the Bathurst Mandate, on which the Nunavut Transportation Strategy 2001 is based.

³ In this study, the term “consultation” is used to refer to the communication sessions and meetings conducted by the Consultant Team and the Project Working Group with the project stakeholders and the general public for providing project information and receiving feedback for the selection of the preferred route. The term should not be confused with the formal consultation process with the First Nations involving a vote from members of the communities.



Since this study has extended over two years to accommodate public consultation windows, it was felt advantageous to prepare reports at the end of each major milestone in addition to the required Final Report. Two Milestone Reports have been issued documenting the work completed to date:

- Milestone Report A: First draft submitted on December 20, 2006 to summarize the work completed under Task A (Input stage and generation of alternative routes).
- Milestone Report B: First draft submitted on March 23, 2007 to summarize the work completed under Tasks B and C (Selection and refinement of the preferred route).

This Final Report concludes the work undertaken during this two-year study, consolidates and summarizes the key findings from Milestone Reports A and B, and documents the outstanding issues not previously addressed, including:

- mining interests and activities in the study area
- hydro-electric and utilities development along the preferred route
- work staging and preliminary implementation strategy
- business case and project funding opportunities
- next phases of road development project.

1.2 Notice to Readers

This document contains an expression of the professional opinion of NKSL as to the matters set out herein, using its professional judgment and reasonable care. It is to be read in the context of the agreement (the “Agreement”) between NKSL and KIA (the “Client”) on behalf of the Project Working Group, the methodology, procedures and techniques used, NKSL’s assumptions, and the circumstances and constraints under which its mandate was performed. This document is written solely for the purpose stated in the Agreement, and for the sole and exclusive benefit of the Client, whose remedies are limited to those set out in the Agreement. This document is meant to be read as a whole, including content of Milestone Reports A and B, thus sections or parts thereof should not be read or relied upon out of context.

NKSL has, in preparing cost estimates, followed methodology and procedures, and exercised due care consistent with the intended level of accuracy, using its professional judgment and reasonable care. NKSL is thus of the opinion that there is a high probability that actual costs will fall within the specified error margin. However, no warranty should be implied as to the accuracy of estimates. Unless expressly stated otherwise, assumptions, data and information supplied by, or gathered from other sources (including the Client, other consultants, testing laboratories and equipment suppliers, etc.), upon which NKSL’s opinion as set out herein is based, has not been verified by NKSL, NKSL makes no representation as to its accuracy and disclaims all liability with respect thereto.



1.3 Study Goals

The primary goal of the current Nunavut-Manitoba Route Selection Study has been to answer the following questions:

- Is it feasible to link Rankin Inlet, NU and Churchill, MB by an all-weather road to the National Highway System in MB?
- What is the likely scope of the social and economic benefits and impacts of an all-weather road on northern communities?
- What are the potential natural environment impacts associated with an all-weather road?
- What is the range of construction and maintenance costs for such a road?
- Can an all-weather road be staged initially as a winter road?
- Where is the best route for an all-weather road, taking into account engineering, the natural and social environment, the regional economy and national interests?
- How strong is the business case for a new road?

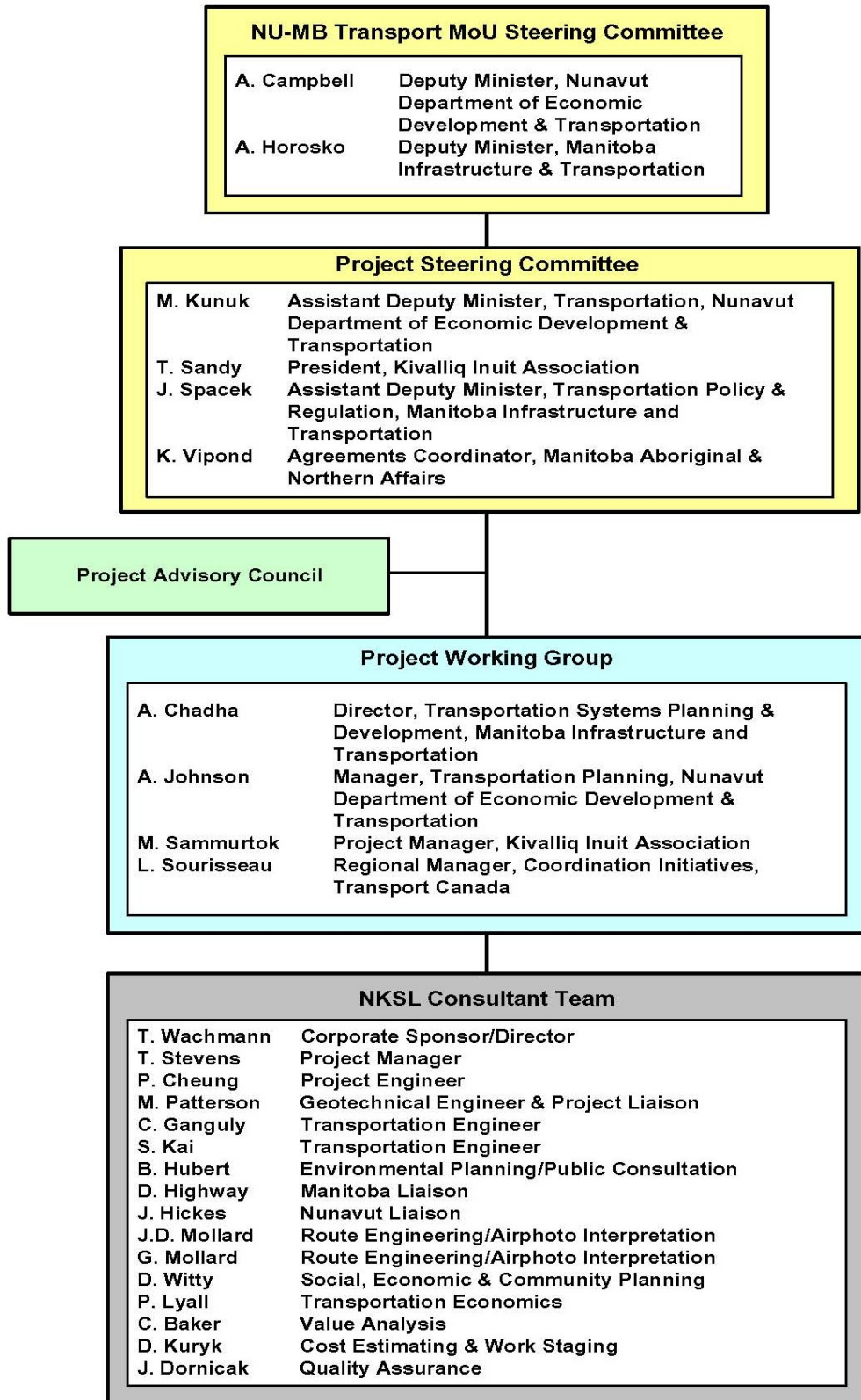
1.4 Study Organization

The study was carried out by a multi-disciplinary team managed by the NKSL Consultant Team. As illustrated in the Study Organization Chart (Figure 1-1), the Project Steering Committee and Project Working Group represented the interests of the Nunavut, Manitoba and Canadian governments who were co-sponsors of this study. The Project Advisory Council was made up of representatives from municipalities, First Nations and other major stakeholders with an interest in the location of the Nunavut-Manitoba road link. The Project Working Group consisted of representatives from the respective governments and provided technical and administrative advice to the Consultant Team.

The methodology used for this study was intended to provide the respective governments with a route selection that will support the realization of the wants and desires of those who live and work in this region, while at the same time minimizing detrimental impacts on the natural environment. The study processes were broken into two main streams – Technical Process and Consultation Process. The former refers generally to the technical work of the consultant team which, in conjunction with the Project Working Group, collected and synthesized topographic, physiographic, geological, social, economic and natural environmental data; generated and evaluated route options from a context-sensitive transportation engineering perspective; made capital and operating cost estimates; and prepared technical analysis for the recommendation of a preferred route for the Nunavut-Manitoba road. The Consultation Process refers to meetings with the Project Advisory Council, the general public and other government/non-government and First Nations organizations. Newsletters, along with the project website, informed the stakeholders and the public of the results of the technical deliberations, and also the ongoing information being gained by the public consultation process. Two newsletters have been issued (one in December 2005 and one in February 2007), both including a questionnaire for public feedback and input. The public consultation for this study ends with the issuance of a final newsletter to communicate the results of the study, including the refinement of the preferred route.



Figure 1-1: Study Organization Chart





2.0 INPUT STAGE

2.1 Development of Route Alternatives

The proposed all-weather road will, when completed, provide the sole overland fixed link between Nunavut and the rest of Canada, and will therefore likely qualify for National Highway status (similar to the status of PTH6, which connects Thompson to the Trans-Canada Highway at Winnipeg). Assuming that the Nunavut-Manitoba road route will become part of Canada's National Highway System (NHS), the ultimate design standard for this road will conform to NHS standards (i.e. RAD 90-100). For the Route Selection Study, an arterial road classification (RAU 80-100) is proposed for initial capital budgeting and to tie in to Manitoba's existing all-weather road system in the north (i.e. PR 290, 280 and 391 from Sundance near Gillam to Thompson, and PR 394 east of Kinoosao, then PR 391 from Lynn Lake to Thompson). To allow for the future NHS design standard, design and construction will be staged such that the corridor footprint will be established and protected for the ultimate standard. Initial construction of the all-weather road will be based on a pioneer arterial classification with allowance for future upgrades to NHS standard later.

Geometric criteria are proposed for the new all-weather road assuming a gravelled top width of 8 m (26 ft), an average embankment height in the range of 1 to 1.5 m (3-5 ft), and 4.3 m (14 ft) wide single-lane bridge structures (see Section 3.1 of Milestone Report A). In considering route location options, it was decided to select the best alternative all-weather road route from Rankin Inlet to the Port of Churchill (the Northern Common Route), then select the best alternative all-weather routes to the three destinations on the existing Manitoba highway system; and subsequently address the issue of winter road travel. The design approach for the winter roads is to route them overland along the eventual all-weather route. This enables permanent bridges to be built over critical streams and rivers during the winter road phase. It can help overcome the problem of early break-up of ice bridges over lakes and fast flowing rivers and streams, thus enabling longer operation of the winter road, reducing the risk of vehicles breaking through the ice, endangering the life of the vehicle operator and releasing pollutants into fishery-sensitive waters. Furthermore, placing the winter road overland on the ultimate all-weather alignment where possible, can reduce the need for future disturbances and environmental impacts outside an established right of way.

The following criteria were used to generate and locate feasible route alternatives for the proposed all-weather road within the previously referenced northern, western, central and eastern corridors:

- Selecting a direct route between communities, to the extent possible and practical;
- Selecting a smooth, firm and thaw-stable road foundation;
- Avoiding wildlife concerns to the extent possible;
- Selection a route accessible to road construction materials;
- Selecting gentle terrain to the extent possible (i.e. avoid rolling and rugged terrain if possible);
- Minimizing construction and maintenance costs;
- Minimizing length of river crossings; avoid rapids; consider future hydro-electric power generation potential;



- Avoiding protected areas where feasible.

Using the above criteria for terrain analysis and route location, a significant number of route alternatives was generated by the consultant team in the route engineering and analysis process. In order to facilitate the subsequent evaluation of route alternatives, it was beneficial to break the routes to be studied and evaluated into a number of groups providing an all-weather connection between Rankin Inlet and the all-weather system in Manitoba, together with a cross link to Churchill. We felt this grouping of the routes would reduce the overall analysis workload, and also be an aid to simplifying the public consultation requirements. The groups consisted of western route alternatives (WRA), central route alternatives (CRA) and eastern route alternatives (ERA). Each of the route alternatives (WRA, CRA and ERA) within Manitoba were interconnected with route alternatives between northern Manitoba and Kivalliq to provide a continuous link from Rankin Inlet to Churchill and Manitoba’s all-weather road system. These route alternatives were presented to the project stakeholders and the general public in the first round of public consultation starting in early 2006 (see Appendix 8 of Milestone Report A for a description of these alternatives and the associated exhibits).

2.2 First public consultation

Three groups of all-weather route alternatives (western, central and eastern corridors, all including a northern corridor from Rankin Inlet to the south⁴) were initially generated in the route engineering, socio-economic and environmental scoping analysis. These groups of alternatives were shown to the Project Advisory Council and the communities in Northern Manitoba and the Kivalliq Region of Nunavut during the first round of public consultations and information sessions in 2006⁵ (See Table 2-1 for the first public consultation communities and schedule). Consultations were also held with First Nations, government/regulatory agencies and other non-government organizations to understand and discuss the issues and opportunities associated with each group of route alternatives identified for further studies.

Table 2-1: First Public Consultation Meetings and Schedule

<i>A. Project Advisory Council</i>	
First Meeting: Rankin Inlet, NU	November 1, 2005
Second Meeting: Thompson, MB	November 3, 2005
<i>B. Communities in Nunavut and Manitoba:</i>	
Tadoule Lake, MB	January 31, 2006
Lac Brochet, MB	February 2, 2006
Brochet, MB	February 3, 2006
Lynn Lake, MB	February 6, 2006
South Indian Lake, MB	February 7, 2006
Thompson, MB	February 8, 2006
Nelson House, MB	February 9, 2006

⁴ The northern corridor refers to the corridor encompassing route alternatives in the Kivalliq portion of the project study area and connecting into Manitoba in the vicinity of Caribou River Provincial Park.

⁵ See Note 3 on page 1.



Split Lake, MB	February 10, 2006
Gillam/Fox Lake/Bird, MB	February 11, 2006
Baker Lake, NU	February 27, 2006
Rankin Inlet, NU	March 1, 2006
Arviat, NU	March 3, 2006
Churchill, MB	March 4, 2006
Chesterfield Inlet, NU	April 10, 2006
Whale Cove, NU	October 18, 2006
<i>C. Government/Non-Government Organizations and First Nations:</i>	
Nunavut Day	Winnipeg, MB, April 27, 2005
Hudson Bay Neighbours Regional Round Table (HBNRRT)	Rankin Inlet, NU, May 18, 2005; Gillam, MB, October 5, 2005
Beverly and Qamanirjuaq Caribou Management Board (BQCMB)	Rankin Inlet, NU, May 27, 2005; Winnipeg, MB, Nov 24, 2005 and Nov 7, 2006
NorMan Regional Development Corporation (NMRDC)	Flin Flon, MB, September 9, 2005; Winnipeg, MB, November 24, 2005; Snow Lake, MB, February 24, 2006
MB Conservation	Thompson, MB, November 3, 2005; Winnipeg, MB, November 4, 2005
Thompson Unlimited	Thompson, MB, February 8, 2006
Keewatin Tribal Council	The Pas, MB, February 14, 2006
Kivalliq Chamber of Commerce	Rankin Inlet, NU, March 28, 2006

The results and feedback from the stakeholders and general public during the first public consultations are summarized below.

A. Project Advisory Council

Members of the Project Advisory Council indicated that the overall study process should be clear and transparent, and that public consultation is very important in the regulatory approval phase of the project. Major issues related to the route selection raised at these meetings included: caribou protection, current land claims in the region, environmental impacts, regional land use, connection to communities, resource extraction, cost of goods/standard of living in remote communities, construction costs and project funding. Some of the First Nations representatives expressed the need for resources to participate in the study and undertook to write a letter to Indian and Northern Affairs Canada (INAC) regarding funding for Dene participation with the study group.

B. Community Consultations

After meeting with the Project Advisory Council, the NKSL consultant team scheduled and conducted consultations in the previously referenced 15 communities within the study area. In the Kivalliq region, community liaison officers were used as a resource to arrange the consultation meetings and to provide advice with respect to local customs, meeting venues and appropriate community officials to be consulted. Members of the NKSL consultant team facilitated the consultation process with the help of local interpreters as required to ensure that



the presentation materials were understood by uni-lingual residents. Consultation with the First Nations and community elders was conducted with sensitivity, to elicit Traditional Knowledge, and to flag cultural and environmental issues at the initial round of the consultation process.

As documented in the Social and Economic Scoping Findings Report (see Appendix 6 of Milestone Report A), a review of the community feedback during the first round of public consultation indicated that the communities had identified a number of positive and negative effects resulting from a fixed link connection to the Manitoba road network. Overall, there appeared to be a neutral to positive view by community members of the Nunavut-Manitoba route proposal. There is widespread agreement that a fixed link would bring economic benefits, but there were some concerns about the social issues (principally an expected increase in drugs and alcohol use) that might arise. Community concerns about the environment were generally negative (impacts on caribou and increasing hunting), resulting in a negative impression of the fixed link upon the environment.

The Social and Economic Scoping Study confirmed that the majority of communities supported a fixed link connection, but that the greatest support existed in five communities: Arviat, Churchill, Gillam/Bird, Lynn Lake, and Rankin Inlet. Potential for increased drug and alcohol use and detrimental effects upon caribou were common concerns in most communities. Tadoule Lake expressed particular vulnerability to issues around social and environmental considerations. The communities of Brochet and Lac Brochet expressed cautious support for a fixed link. In all communities, there was considerable recognition that a fixed link would reduce cost of goods and provide greater flexibility for construction of houses and other buildings. The findings of this work were key to the evaluation of the route alternatives within the overall Route Selection Study.

Regarding the location of route alternatives, the responses from the general public could be summarized as follows:

- Nunavut communities were looking for the most direct route to the south, to Churchill and to Manitoba's all-weather road system. They did not express a preference as to whether the road should be closer or further away from the coast in situations where such sub-options were shown.
- Manitoba communities in the northwest stated a preference for the routes in the western corridor; people who attended the public meetings in Tadoule Lake, Lac Brochet and Brochet indicated their primary interest was in a direct route to the south. Communities in northeast Manitoba preferred routes in the eastern corridor. However, the public who attended the community meetings in Manitoba did not express a preference for one sub-option over another within the western or eastern corridors.

C. Government/Non-Government Organizations and First Nations

The NKSL consultant team received several invitations to attend meetings of government/non-government organizations (NGOs) and First Nations organizations to brief them on the status of the study. During these meetings, exhibits on the proposed route alternatives were provided and a powerpoint presentation was made to the meeting attendees. The presentations made to these organizations were similar to those made to the communities to ensure that all consultations were based on the same information about the study. The presentations were generally well received and generated a high level of interest among all meeting participants. Many participants were in favour of the new road and would like it to service their communities.



The issues raised at these meetings were largely similar to those at the Project Advisory Council and Community Consultation meetings. Specific questions were asked about the decision-making process for the route selection, as well as the scope, funding and timing of the road construction.

A resolution letter was received from the Keewatin Tribal Council Chiefs giving support for an all-weather and permanent road through the northwest region of Manitoba to Nunavut (a western route alternative) to service the Barren Land, Northlands and Sayisi Dene First Nations. We also note that prior to the Project Advisory Council held in Thompson on November 3, 2005, the Consultant Team received a letter from the Sayisi Dene expressing their interest in a swath of territory between the boundary of Manitoba and Saskatchewan and the west shore of Hudson Bay. This area of interest also extended into southern Nunavut. Since all route alternatives connecting Rankin Inlet to Churchill and Manitoba's all-weather road system passed through this area of interest, we did not feel that it was a factor in favouring one route alternative over another.

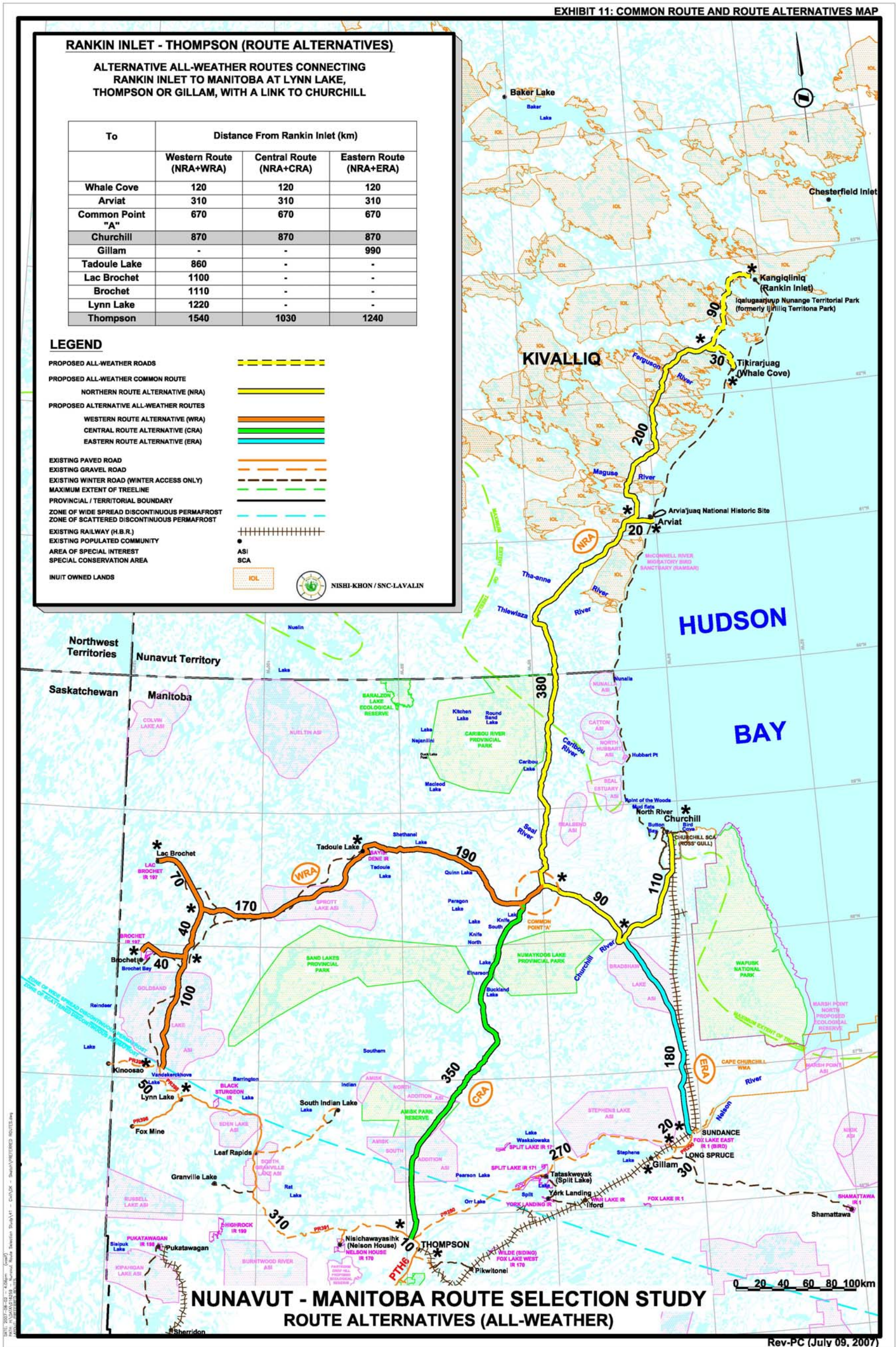
The study team also asked to meet with Manitoba Conservation and did so in Thompson on November 3, 2005, with regional staff, and in Winnipeg on November 4, 2005 with head office staff. Manitoba Conservation followed up with a letter on February 17, 2006. Their main concern was to avoid all provincial parks, reserves and areas of special interest. They indicated a preference for an eastern route alternative as long as it could bypass the Bradshaw Lake Area of Special Interest. The Beverly and Qamanirjuaq Caribou Management Board (BQCMB) had concerns with the impacts of a new road and asked for a rail option to be studied. Their concerns are documented in a letter dated November 14, 2006. The written responses from these stakeholders are provided in Appendices 11 to 13 of Milestone Report A.

The feedback from these consultations enabled us to eliminate all route sub-options in the western, central, eastern and northern corridors (see Figure 2-1), and focus on the best route in each corridor in terms of its engineering feasibility; the directness of its connectivity to population centres; and its avoidance, where possible, of parks and environmentally sensitive areas. For the Kivalliq portion of the corridor, it was evident that an important objective for the road was to provide the shortest and most direct route between the communities of Rankin Inlet, Whale Cove, Arviat and the Port of Churchill. The preferred location for the northern corridor was therefore considered to be the route to the east of the Caribou River Provincial Park and this northern route alternative (NRA) is identified to be the Common Route for all route alternatives. For the Manitoba portion of the proposed road south of the Common Route, three alternatives were identified to be the most feasible of all the sub-options developed earlier in the study. These alternatives (WRA, CRA and ERA) would connect to Manitoba's all-weather road system at Lynn Lake, Thompson and Sundance/PR290 near Gillam respectively. Together with the Northern Route Alternative or Common Route, the three alternatives short-listed for the Multiple Account Evaluation were defined as follows:

- Western Alternative (NRA+WRA)
- Central Alternative (NRA+CRA)
- Eastern Alternative (NRA+ERA)



Figure 2-1: Common Route (NRA) and Route Alternatives (WRA, CRA and ERA) Map





3.0 ROUTE SELECTION

3.1 Evaluation and Selection of Preferred Route

For the selection of the preferred route, a Multiple Account Evaluation (MAE) framework was developed to evaluate the three route alternatives for an all-weather Nunavut-Manitoba road. Each of the route alternatives were evaluated under five accounts:

I) Financial Account

- This is the present value of the capital, maintenance and rehabilitation costs and salvage values over a 25-year project life at a discount rate of 6% for each route alternative.

II) Transportation Benefits Account

- This includes project benefits (in time and vehicle operating costs) in passenger travel and freight transport, as well as safety benefits calculated as a present value over a 25-year project life for each option.

III) Social/Community Account

- This documents the external effects of the proposed Nunavut-Manitoba road on the communities and their social values as perceived by the communities. Evaluation criteria include the impacts of the all-weather road access to communities (positive and negative); impacts in terms of employment, costs of living, quality of life, health care, education and land use; and impacts on water quality and wildlife;⁶ and the protection of archaeological and cultural artifacts.

IV) Natural Environment Account

- This account is intended to provide an overview assessment of the project impacts on the natural environment. Criteria under this account include habitat protection, wildlife populations, watershed values, fish populations, heritage values and protected areas.

V) Economy/National Interest Account

- This is intended to evaluate the route alternatives in meeting the strategic functions of the proposed Nunavut-Manitoba road. Criteria under this account include regional economy/resource use, sovereignty and security, staging, regional network (population served), reliability, Port of Churchill and enhanced inter-jurisdictional trade.

The general approach of the MAE was to establish weights for each account and scores for each route alternative. The sum of weighted scores for each alternative was used to rank the alternatives such that a preferred route could be identified. An MAE workshop was held on October 11-12, 2006, with representatives from the Project Working Group and the Consultant Team, to conduct the MAE of these alternatives for the selection of a preferred route. Based on the technical analysis and consultation findings of the route alternatives, the Working Group and Consultant Team agreed on the definition and relative weights for each account and criteria within each account, and scored each route alternative against the defined criteria in terms of how each

⁶ It is noted that typically with aboriginal populations, there is considerable overlap between social, economic and natural environment issues, since the livelihood of a considerable portion of the population directly depends on harvesting wildlife and fisheries resources.



alternative met the project goals (see Section 2.0 of Milestone Report B for a fuller account of the MAE of the three route alternatives).

The results of the MAE are shown in Table 3-1a and described qualitatively in Table 3-1b in the following pages. Based on the overall ranking of the three route alternatives, the Eastern Alternative (NRA+ERA) is considered the preferred route for the proposed Nunavut-Manitoba road. Although the overall benefits of the Eastern Alternative at \$367.8 million are 6% less than those for the Central Alternative (NRA+CRA) at \$392.7 million (due to the shortest route from Rankin Inlet to Thompson), and 4% less than those for the Western Alternative (NRA+WRA) at \$381.9 million (because the Western Alternative also serves the northwestern communities in Manitoba), it has the highest benefit to cost ratio (0.33, as compared to 0.30 and 0.26 for the Central and Western Alternatives respectively) due to the lowest construction cost and the shortest length of new road construction. It is the most favourable from a social/community perspective due to the strong support from the affected communities (weighted score of 0.20, as compared to 0.18 and 0.14 for the Central and Western Alternatives respectively). In terms of potential impacts on the natural environment, it is ranked second (weighted score of -0.25) after the Western Alternative (weighted score of -0.24), but more favourable than the Central Alternative (weighted score of -0.28). From the economy/national interest perspective, it is ranked significantly higher than the other two alternatives (weighted score of 0.33, as compared to 0.15 and 0.17 for the Central and Western Alternatives respectively). In terms of the overall ranking, the Eastern Alternative comes out at 0.42, well ahead of the Central and Western Alternatives at 0.18 and 0.17 respectively.

The rationale for selecting the Eastern Alternative (NRA+ERA) as the preferred route can be summarized as follows:

- Most effective, safe and reliable route from Rankin Inlet, Whale Cove and Arviat to Churchill and Thompson in light of its length, the terrain, the lowest construction and maintenance costs and ease of staging
- Strong support from directly affected communities along the route
- Moderate environmental impact due to shortest length of new road construction and avoidance of all protected areas except the Bradshaw Lake ASI (the width of the Great Beach on which the route is located through this protected area appears to be sufficient to allow for adequate mitigation of impacts along this feature).
- Greatest potential for early extension of the National Highway System to Churchill and Nunavut and in so doing, to address inter-jurisdictional trade opportunities, national sovereignty and security needs.





















Table 3-1a: Multiple Account Evaluation – Nunavut-Manitoba Route Selection Study

Weights		ACCOUNT	NRA+WRA	NRA+CRA	NRA+ERA
A	B	Winnipeg to Rankin Inlet (km)	2,278	1,768	1,978
Account	Sub-Account	FINANCIAL (\$millions)	Quantitative Accounts		
		Construction + Engr.	\$1,619	\$1,390	\$1,180
		Property	\$10	\$10	\$10
		Maintenance	\$80	\$81	\$70
		Salvage	(\$212)	(\$182)	(\$154)
		<i>Total Costs (\$millions)</i>	\$1,498	\$1,300	\$1,106
		TRANSPORTATION BENEFIT (\$millions)			
		Kivalliq Freight	\$328.9	\$365.1	\$346.8
		Manitoba Freight	\$37.8	\$0.0	\$0.0
		Kivalliq Passenger	\$8.0	\$28.5	\$15.7
		Manitoba Passenger	\$7.5	\$1.0	\$1.0
		Accident Cost Savings	(\$6.7)	(\$5.9)	(\$5.9)
		<i>Total Benefit (\$millions)</i>	\$375.4	\$388.7	\$357.6
40%		Benefit/Cost Ratio	0.25	0.30	0.32
		A x Benefit Cost Ratio	0.10	0.12	0.13
20%		SOCIAL/COMMUNITY	Qualitative Accounts		
	15%	Tadoule Lake, MB	0	0	0
	15%	Lac Brochet, MB	0	0	0
	6%	Brochet, MB	1	0	0
	4%	Lynn Lake	2	0	0
	0%	Thompson, MB	1	1	1
	4%	Gillam/Bird, MB	0	0	2
	11%	Churchill, MB	2	2	2
	15%	Arviat, NU	1	2	2
	10%	Whale Cove, NU	0	0	0
	20%	Rankin Inlet/Chesterfield/Baker, NU	1	2	2
		Sum (A x B x Score)	0.14	0.18	0.20
20%		NATURAL ENVIRONMENT			
	20%	Habitat Protection	-2	-2	-2
	20%	Wildlife Populations	-1	-1	-1
	15%	Watershed Values	-2	-1	-1
	10%	Fish Populations	-1	-1	-1
	10%	Heritage Values	-1	-1	-1
	20%	Protected Areas	0	-2	-1
	5%	Emmissions	-2	-1	-2
		Sum (A x B x Score)	-0.24	-0.28	-0.25
20%		ECONOMY/NATIONAL INTEREST			
	20%	Regional Economy/Resource Use	1.0	0.8	0.8
	10%	Sovereignty and Security	1	2	1
	10%	Staging	1	0	2
	20%	Regional Network (population served)	2	0	2
	5%	Reliability	1	1	2
	15%	Churchill	0	1	2
	20%	Enhanced Interjurisdictional Trade (Nat'l Hwy System Connection)	0	1	2
		Sum (A x B x Score)	0.17	0.15	0.33
100%		OVERALL RANKING	0.17	0.18	0.41

Where: +2 = Significantly better; +1 = better; 0 = neutral; -1 = worse and -2 = significantly worse.



Table 3-1b: MAE – Account Description and Route Evaluation

Evaluation Account	Evaluation Criteria	Western Alignment (NRA/WRA)	Central Alignment (NRA/CRA)	Eastern Alignment (NRA/ERA)
Financial Cost	<ul style="list-style-type: none"> Life-cycle costs over 25 years of road construction (including structures), maintenance, rehabilitation and salvage values 	 Longest construction length and rugged terrain for new road west of Common Point A (i.e. WRA); highest cost	 Shorter construction length, rugged terrain for new road south of Common Point A (i.e. CRA); higher cost than ERA	 Shortest construction length, gentle terrain south of Common Point A (i.e. ERA); lowest cost
Transportation Savings	<ul style="list-style-type: none"> Savings in freight and passenger transport costs to affected communities Travel benefits to the road users 	 WRA serves 3 communities that now have only winter road land access, but is longest route from Rankin Inlet to Winnipeg	 Shortest distance between Rankin Inlet and Winnipeg but rugged terrain will reduce travel speed	 Less communities served than WRA but shorter distance from Rankin Inlet to Winnipeg
Social/Community	<ul style="list-style-type: none"> External effects of the new road on the communities', culture and social values including livelihoods, standard of living, education, use of drugs and/or alcohol 	 Mixed reaction to all-weather road from 3 MB communities that now have only winter road land access	 Least number of communities connected by new road	 Significant support from affected communities
Natural Environment	<ul style="list-style-type: none"> Nature, degree and mitigation of the impacts to the natural environment (e.g. habitat protection, wildlife populations, watershed/fish values and protected areas) 	 In same corridor as winter road in MB, but crosses 2 ASIs; concern with impacts on wildlife habitat, especially caribou	 Impacts on park, park reserves and 2 ASIs	 Subject to acceptable mitigation through Bradshaw Lake ASI, modest environmental impact due to shortest length of new road construction
Economy/National Interest	<ul style="list-style-type: none"> Strategic interests served by the new road (e.g. national connectivity; benefits to resource use and inter-jurisdictional trade, Port of Churchill, and sovereignty/security issues) 	 Indirect connection (1070 km) between Churchill and NHS at Thompson; indirect connection (1530 km) between Rankin Inlet and Thompson	 Direct connection (560 km) between Churchill and NHS at Thompson but terrain is rugged; direct connection (1020 km) between Rankin Inlet and Thompson	 Direct connection (590 km) between Churchill and NHS at Thompson, gentle terrain; fairly direct connection (1230 km) between Rankin Inlet and Thompson; direct access to north from Nelson River hydro stations; completes reliable multi-modal surface access (road and rail) to Churchill at least cost of all options; shortest length (290 km) of construction from Churchill to Manitoba's all-weather road system
Overall				

Legend:  = More Favourable;  = Favourable;  = Less Favourable

ASI = Area of Special Interest; NHS = National Highway System



3.2 Second Public Consultation

The second and final round of public consultation for this study was conducted in February 2007 to present the results of the MAE and the selection of the preferred all-weather route to the affected stakeholders and communities of the study area. The goals of this round of consultation were to find out if there was concurrence with the preferred route; to find out if the Consultant Team had overlooked any crucial information; to ascertain whether any refinements to the preferred route were needed; and to learn of any other northern transportation issues that needed to be brought to the attention of the governments. Consultation meetings and information sessions were held by the NKSL Consultant Team, members of the Project Working Group and Project Steering Committee, with the Project Advisory Council, communities in Rankin Inlet, Whale Cove, Arviat, Churchill, and Thompson (with attendance by members of the public from Northern Manitoba communities); as well as other government/non-government stakeholder groups. The consultation meetings and schedules for the second public consultation are summarized in Table 3-2 below.

Table 3-2: Second Public Consultation Meetings and Schedule

<i>A. Project Advisory Council</i>	
First Meeting: Thompson, MB	February 8, 2007
Second Meeting: Rankin Inlet, NU	February 15, 2007
<i>B. Communities in Nunavut and Manitoba:</i>	
Thompson, MB	February 9, 2007
Rankin Inlet, NU	February 15, 2007
Whale Cove, NU	February 19, 2007
Churchill, MB	February 20, 2007
Arviat, NU	February 21, 2007
<i>C. Government/Non-Government Organizations</i>	
MB Conservation	Winnipeg, MB, February 7, 2007
Nunavut/Kivalliq/Manitoba Infrastructure Development Forum	Winnipeg, MB, February 12, 2007
Nunavut Mining Investment Pre-Conference	Winnipeg, MB, February 12, 2007
MB Hydro	Winnipeg, MB, February 13, 2007
Nunavut Water Board	Rankin Inlet, NU (teleconference), February 15, 2007
Nunavut Impact Review Board	Rankin Inlet, NU (teleconference), February 15, 2007
Nunavut Planning Commission	Arviat, NU, Feb 21, 2007

Feedback and discussion among members of the Project Advisory Council were largely focused on the selection of the preferred route. Representatives from First Nations stated that the First Nations communities have come to recognize the need for an all-weather road and would adapt to changes associated with the new road. They preferred to have the route go through the remote communities in northwestern Manitoba, providing a direct connection to the Port of Churchill from Tadoule Lake, and promoting partnership opportunities between the federal government and the First Nations. Furthermore, they would like to be better informed of the route selection decisions via a formal consultation process involving a vote from members of the communities.



Compared to the first round of public consultation in the communities, it was evident that there was much stronger support for the proposed Nunavut-Manitoba road and that the public recognized the social and economic benefits associated with the new road. There were concerns that the three remote communities in northwestern Manitoba (i.e. Brochet, Lac Brochet and Tadoule Lake) would not be connected by an all-weather road. It was suggested that the need for an all-weather road by the western communities (in addition to an all-weather connection from Nunavut and Churchill to Gillam) be documented even though it might not be a mandate of the Nunavut-Manitoba Route Selection Study.

In the Kivalliq communities, the public was pleased with the study progress and was very supportive of the new road as it was considered essential to public service. Some participants commented that small population should not be an issue for the new road as Canada's national rail and road system were built to low-populated areas initially. Most of the meeting participants were eager to see the road being constructed soon and expressed that inter-community connectivity and access to Churchill and the south were their primary concerns. Overall, the Kivalliq communities accepted the Eastern Alternative (NRA+ERA) as the preferred route and suggested to proceed to the implementation phase of the road project. In Churchill, the public showed strong support for the proposed road and expected it to provide significant economic benefits to the port. Regarding the existing rail operations in Churchill, it was expected that the road to Churchill would stimulate additional north-south imports and exports through the port, while grain and ore would still be best transported by rail.

Stakeholder feedback and inputs were received from a number of government/non-government organizations regarding the potential issues and opportunities associated with the preferred route in their respective jurisdictions. Manitoba Conservation discussed two "rare enduring features" along the great beach within the Bradshaw Lake ASI, but recognized that depending on the actual location of environmentally sensitive features within the beaches, there appeared to be sufficient flexibility to select a route that can avoid impacting unique features within the ASI. It was suggested that a detailed environmental impact assessment be conducted in the next phase of the project to further address these concerns. On July 6, 2007, an email was received from a Wildlife Manager with Manitoba Conservation in Thompson expressing the concern that "the entire migration of caribou may be along the road to Nunavut in certain years" and that "this is a real concern to the BQCMB".

Manitoba Hydro discussed their current plans in the study area in relation to the proposed Nunavut-Manitoba road. Even though Manitoba Hydro indicated no plans to extend transmission lines into Nunavut (any such plans would be the responsibility of Qulliq Energy, formerly Nunavut Power Corporation), they stated that there might be benefits locating the road route between Churchill and Kivalliq in close proximity to hydro-electric generation sites and transmission line corridors. Discussion was also held with representatives from the mining industry regarding the proposed road and there was general agreement that the proposed road would support exploration activities and that mining would address the under employment of the Kivalliq region. There was also strong support that the government and industry should work together in the development of the proposed road.

The Nunavut Impact Review Board (NIRB), Nunavut Water Board (NWB) and Nunavut Planning Commission (NPC) were consulted regarding the regulatory and permitting processes of the proposed road. The NIRB representative stated that the proposed road issues would likely include impacts on caribou and wildlife, access to communities, fishery characteristics, river crossings,



global climate change, and impacts on Traditional Knowledge, and suggested that an eco-system study be conducted in the Environmental Impact Assessment phase of the project. Regarding land use regulations, the proposed road would provide impetus for land use changes which would need to be amended in the Regional Land Use Plan. The new road would benefit from the application of land use policy and associated access control within the preferred route corridor in order to preserve the functional integrity of the road as a component of the National Highway System. It was identified that the Kivalliq Inuit Association would be the proponent for the Environmental Impact Assessment process and that the affected communities be involved in the process.

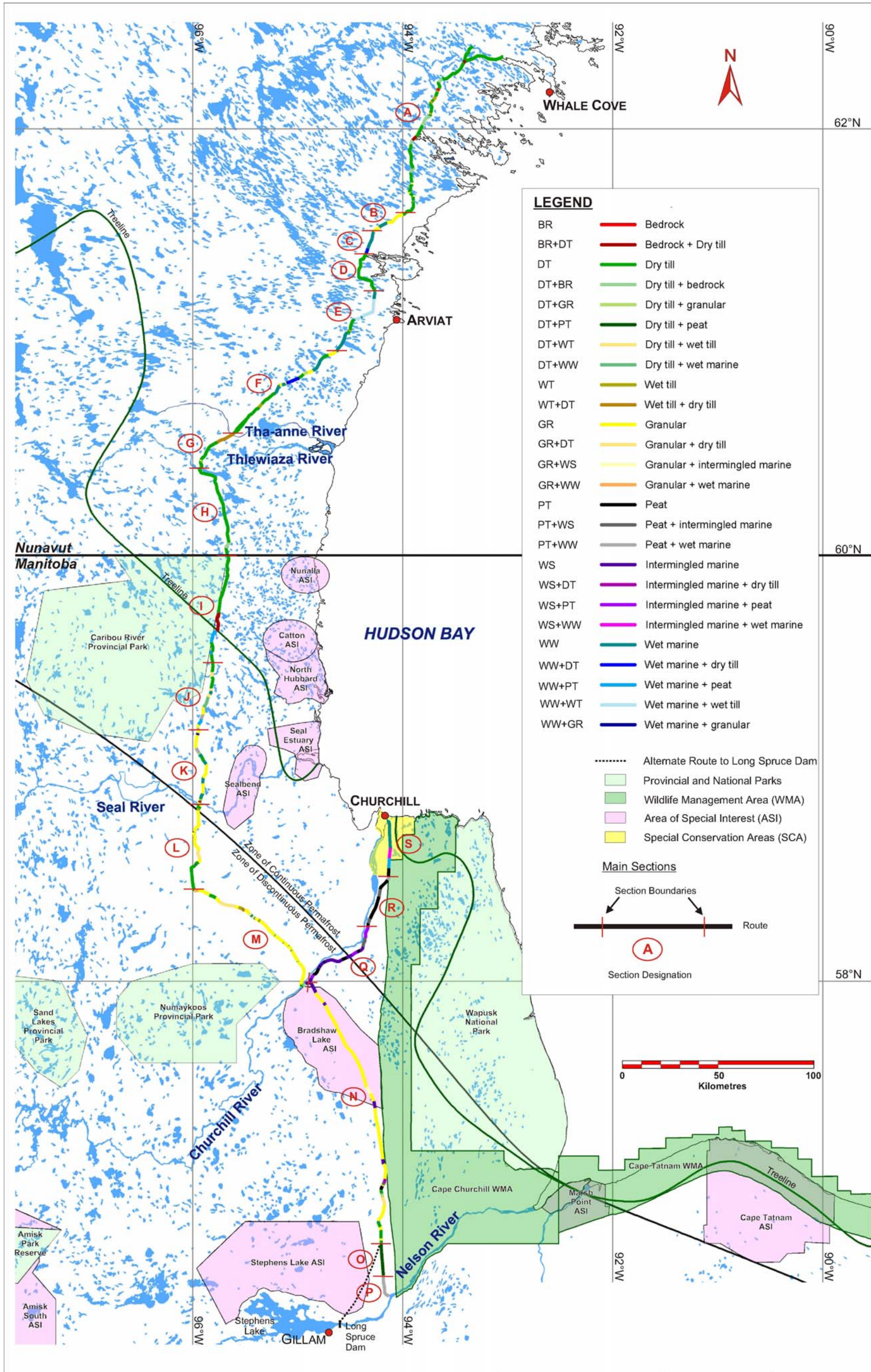
4.0 REFINEMENT OF PREFERRED ROUTE

4.1 Terrain Classification and Capital Costs

Prior to and following the selection of the preferred route (NRA+ERA), a number of studies were conducted to confirm and refine the location of the proposed road. A variety of maps and airphotos were examined and interpreted such that the terrain along the road location could be described, classified and mapped to a level where roadbed conditions could be evaluated with some confidence and construction costs estimated. Right-of-way identification is critical because there are many long stretches of route location where moving the alignment laterally as little as 50 to 100 m would result in very different and significantly increased road construction and maintenance costs. As shown in Figure 4-1, most of the preferred route between Whale Cove and the Caribou River in northern Manitoba consists of long segments of relatively dry, smoothly rolling, bouldery sand-rich till, with a thin, seasonably saturated and active layer above continuous permafrost, separated by short, depressional segments of wet till or marine silt where the surface organic layer is thicker. South of the Caribou and Kirk River confluence to the north of the Sundance-Gillam area, the route follows intermittent, wave-reworked, granular deposits in esker ridges and the Great Beach ridge. Between Churchill River and the Port of Churchill and between the southern terminal of the Great Beach and the Sundance-Gillam area, the dominant terrain features are ice-lensed bog peat overlying marine silt and sand where thaw settlements and erosion problems, particularly those associated with global climate changes, need to be monitored more carefully.



Figure 4-1: Generalized Terrain Types of Preferred Route: Whale Cove to PR290 (Nelson River)





To determine the capital costs⁷ of the preferred route from Rankin Inlet to Sundance/PR290, the road is classified into six homogeneous sections based on terrain analysis, soil conditions, embankment and material estimates (see Appendix 2 of Milestone Report B for a more detailed discussion of the project cost estimates). The location, length and cost estimates for these six segments are shown in Table 4-1 below.

Table 4-1: Capital Costs of Preferred Route (NRA+ERA) by Section
(\$ Million in 2006 Dollars)

Location	Section 1 Sundance to Churchill River	Section 2 Churchill River to Common Point (including spur to Churchill)	Section 3 Common Point to Caribou River	Section 4 Caribou River to 60th Parallel	Section 5 60th Parallel to Arviat Jct. (including Arviat spur)	Section 6 Arviat Jct. to Rankin Inlet (including Whale Cove spur)	Total
Length (Km)	180	200	120	70	210	320	1,100
Mobilization & Road Clearing	18.2	20.2	12.1	7.1	21.2	32.3	111
Embankment & Materials	82.3	134.3	62.7	69.3	173.9	241.6	764
Bridges	2.1	30.1	34.6	1.8	37.8	44.4	151
Extra Work	1.5	1.7	1.0	0.6	1.7	2.6	9
Engineering	11.9	13.2	7.9	4.6	13.8	21.1	72
Contingency	11.9	13.2	7.9	4.6	13.8	21.1	72
Total Capital Cost (\$ million)	127.8	212.6	126.3	87.9	262.2	363.2	1,180
Unit Cost (\$ million/km)	0.71	1.06	1.05	1.26	1.25	1.13	1.073

4.2 Traffic Volumes on Preferred Route

With the proposed all-weather road from Rankin Inlet to Churchill and northern Manitoba, a portion of the existing freight from Winnipeg to the Kivalliq communities will be diverted to road transport by trucks. It is estimated that over half of the existing road/rail/barge and air freight will be diverted to trucks via the all-weather road. By 2031, it is estimated that 27,800 Tonnes of Kivalliq freight will be diverted to the all-weather road along the preferred route (NRA+ERA) per year. This is equivalent to 1,390 trucks one-way, or 2,780 trips per year (7.6 trips per day) assuming a carrying capacity of 20 Tonnes per truck one-way. For long distance passenger travel between Rankin Inlet and Winnipeg, it is assumed that 75% of the existing air travel is non-business⁸ and that over half of this traffic will be diverted to the all-weather road along the preferred route, equivalent to an annual one-way traffic of 455 vehicles or 910 trips per year (2.5 trips per day). The long distance traffic volumes along the preferred route are shown in Table 4.2 below. Details in calculations and assumptions are documented in the Traffic Report in Appendix 3 of Milestone Report B.

⁷ Capital cost estimates include engineering, mobilization, construction (roads and bridges) and contingency, excluding property acquisition, in 2006 Dollars.

⁸ “Manitoba-Nunavut Transportation Assessment Report” (Prolog, 2000).



Table 4-2: Forecast Freight and Passenger Long Distance Travel Demand (NRA+ERA) - 2031

Modes	Long Distance Traffic on All-Weather Road		
	Freight (Tonnes/Yr)	Trucks/Yr	Passenger Veh/Yr
Annual Traffic Volume	27,800	2,780	910
AADT	-	7.6	2.5

Note: Assume 20 Tonne/Truck one-way for freight movements between Rankin Inlet and Winnipeg.

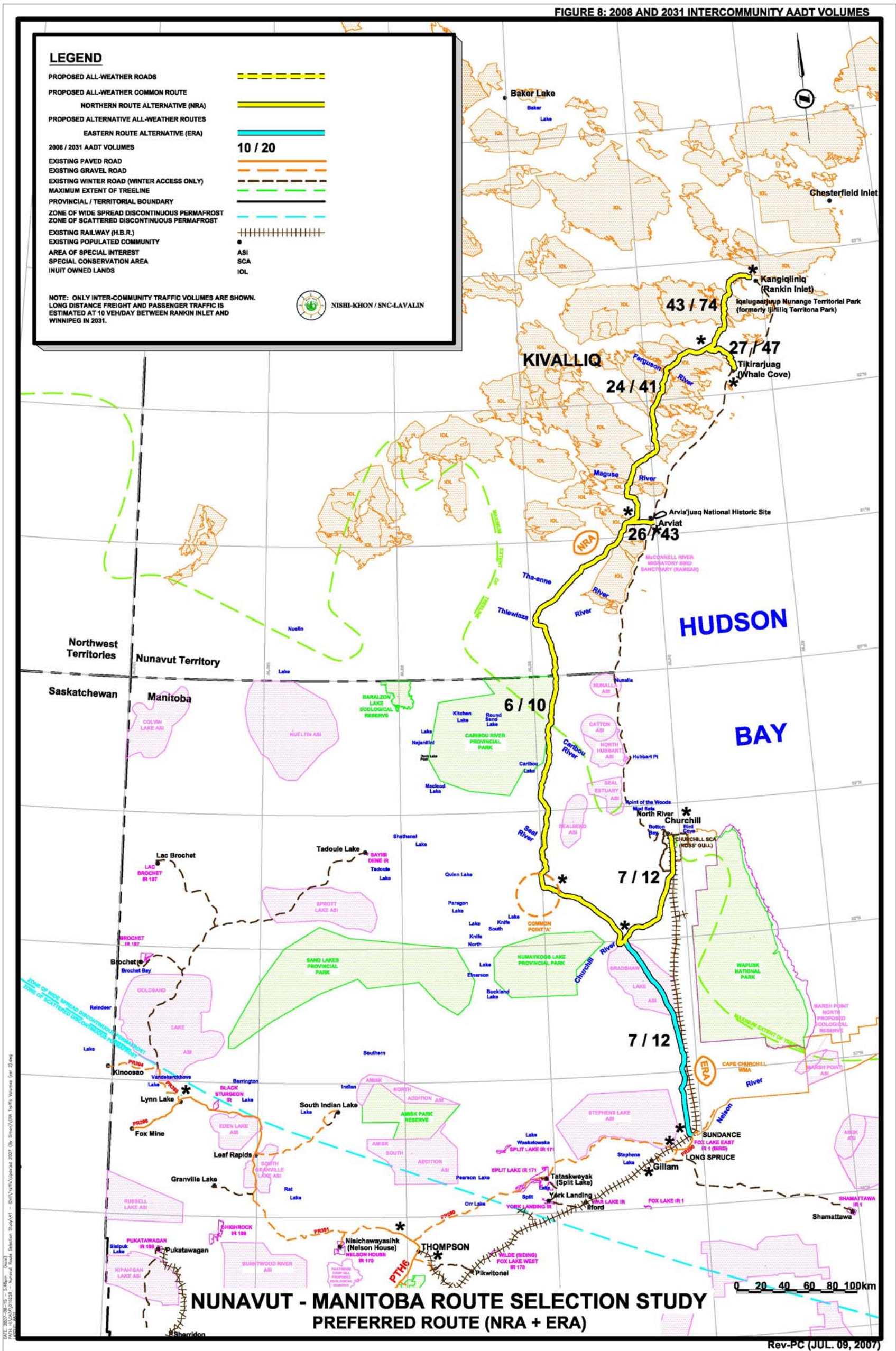
To estimate the local traffic between the communities along the preferred route, a gravity model was developed based on the Average Annual Daily Traffic (AADT) in the northern Manitoba communities provided by Manitoba Infrastructure and Transportation. The model was applied to estimate the 2008 (assumed Opening Year of NU-MB road) and 2031 AADT volumes within the communities along the preferred route. The highest inter-community traffic demand is estimated to occur between Rankin Inlet and Whale Cove, the two closest communities along the proposed road, with an estimated 40 daily trips in 2031. The next highest demand is estimated to occur between Rankin Inlet and Arviat with an estimated 30 daily trips in 2031. Table 4-3 and Figure 4-2 summarizes the inter-community traffic volumes between each community in 2008 and 2031.

Table 4-3: Inter-community AADT Traffic Volumes on NRA + ERA - 2008 and 2031

Community	2008 AADT Volume				
	Community				
	Rankin Inlet	Whale Cove	Arviat	Churchill	Total
Whale Cove	23				23
Arviat	18	4			22
Churchill	1	0	2		3
Gillam	1	0	2	4	7
Total	43	4	4	4	55
Community	2031 AADT Volumes				
	Community				
	Rankin Inlet	Whale Cove	Arviat	Churchill	Total
Whale Cove	40				40
Arviat	30	7			37
Churchill	2	0	3		5
Gillam	2	0	3	7	12
Total	74	7	6	7	94



Figure 4-2: Inter-community Traffic AADT Volumes: 2008 and 2031 (NRA+ERA)





4.3 Major Bridge Crossings

In selecting the river crossing sites (after appreciating terrain conditions in the entire study area), the constraints influencing the selection of a fairly narrow route corridor dictated a fairly narrow reach of river within which a preferred bridge site needed to be chosen. Foundation conditions, borrow availability, directness (length) of crossing, and various environmental constraints all resulted in a limited number of locations available for river crossings. Individual crossing-site selection was aided by the interpretation of surface and bedrock geology maps, topographic maps, stereoscopic examination and interpretation of small-scale (1:50,000 to 1:60,000) airphotos. Some major factors considered in selecting bridge sites were the width of river channel and width of valley crossing, possible use of islands in a river to reduce span length, and consideration of the type (i.e., characteristics) of river channel based on several controls.

In addition to the above controls, river-ice effects were considered, such as ice scraping of river banks, and rapids that create ice dams in northern rivers. The ice dams can cause potentially significant rises in water levels upstream of rapids and eroded (deepened and widened) riverbeds immediately downstream. Information on the stability of river bank and river bed materials were also assessed in choosing bridge-crossing sites. Another constraint on some rivers was environmental concerns, such as the heritage sections of rivers. As well, the prospect of future hydro development was taken into consideration in a few locations. The potential negative effects of permafrost degradation resulting from summer thawing was also another consideration.

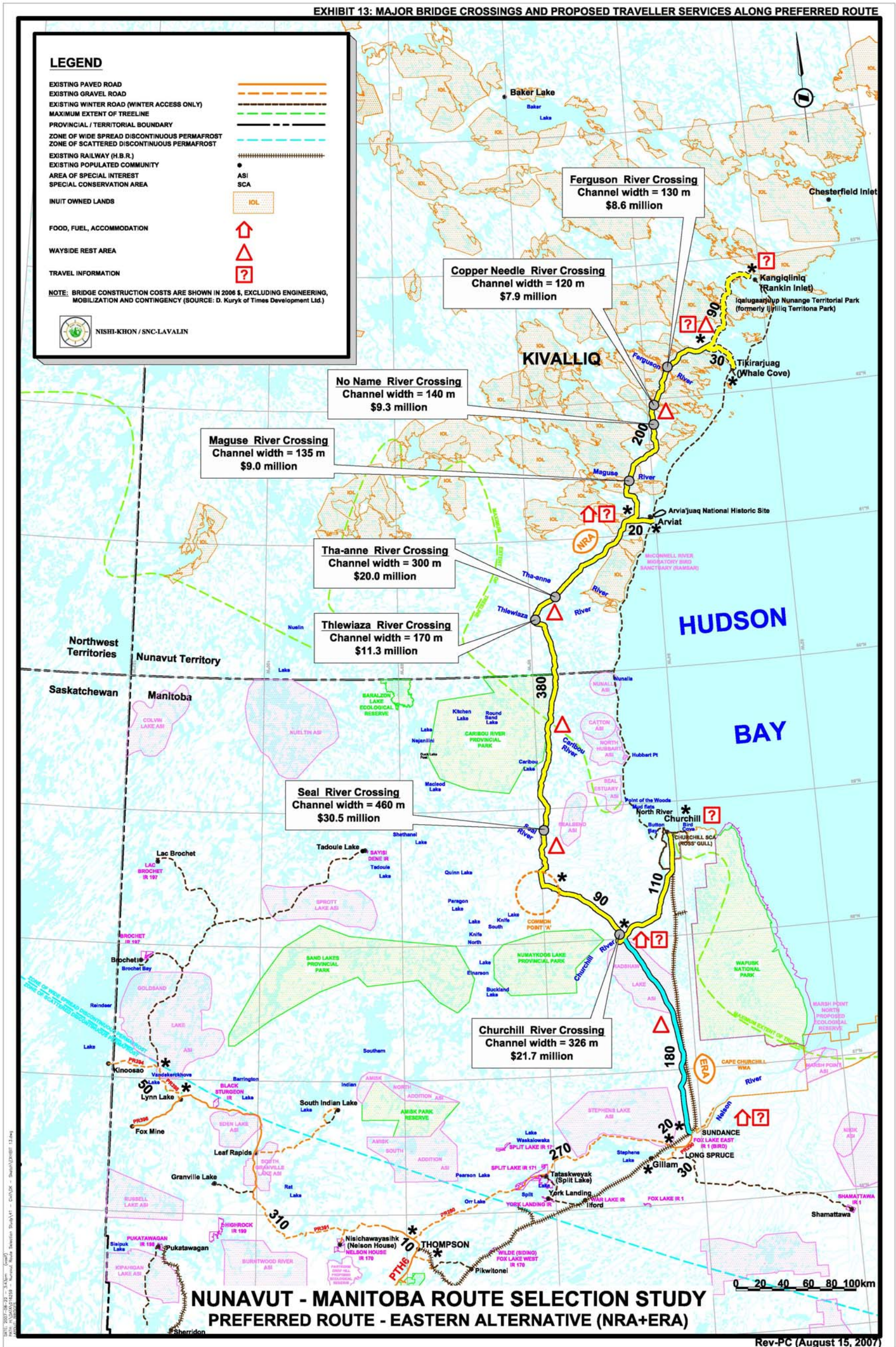
As a result of this analysis, a total of 63 stream or river crossings have been identified along the preferred route of the Nunavut-Manitoba Road. Of these crossings, 48 are located along the NRA segment from Rankin Inlet to Churchill, and 15 are located along the ERA portion from Churchill River to Sundance/PR290. These crossings are identified by J.D. Mollard & Associates in their route engineering analysis and are numbered from north to south starting in Rankin Inlet, NU⁹. For cost estimates, the crossings are classified into 12 types of bridge crossings based on the channel width of each crossing.¹⁰ Of the total proposed 63 bridge structures, 8 are considered major bridges with a channel width of more than 120 m. These major bridges are shown in Figure 4-3.

⁹ See “Bridge Sites on ERA and CRA Road Routes”, J.D.Mollard & Assoc., Ltd, Sept 28, 2006.

¹⁰ See “Cost Estimate” report by D. Kuryk of Times Development Ltd., Section 4.0.



Figure 4-3: Major Bridge Crossings and Proposed Traveller Services along Preferred Route (NRA+ERA)





As noted above, considerable study and analysis by J.D.Mollard & Associates has been undertaken to define the preferred locations of the major river crossings along the preferred route. In the next phase of work needed to bring this important project to fruition, it will be necessary to carry out more detailed engineering, environmental assessment and stakeholder consultations. This is required to meet the following objectives:

- Engineering feasibility: The major river crossings identified to date need to be confirmed as being feasible from structural, hydraulic and geometric perspectives, as well as being cost effective and facilitating construction;
- Environmental acceptability: The locations must cause only a minimal impact on the natural and social environment and do so in a manner that can be readily mitigated or compensated for.

To achieve the above objectives the detailed engineering at the major river crossings will need to include:

- New low-level large-scale ground-referenced aerial photography and topographical mapping at an appropriate contour interval;
- On-site geotechnical investigations on the crossing approaches (to identify ground conditions and potential aggregate sources for building approach embankments), the river banks and along the river bed. Any evidence of erosion of the banks or river bed should be carefully noted. The geotechnical work would be undertaken in tandem with a survey of water elevations, as well as depths to the river bed at the crossing and immediately upstream and downstream of the crossing. Rapids that could influence the crossing will also need to be identified. Observations should be made if possible, of the river in the vicinity of the crossing during spring break up of ice;
- Preparation of estimates of the hydraulic capacity required for the bridge opening based on historic river flows, if available (as for instance from Manitoba Hydro, for the Churchill River from which water is diverted to the Nelson River to feed the hydro electric generation stations on that system); or if not, based on the gradient of the river, historic precipitation in the river's watershed area, assumed run-off coefficients and so on;
- Development of preliminary geometrics of the roadway alignment and profile for the crossing and its approaches;
- Confirmation of the clear roadway width to be provided on the bridge (assumed 4.3 m in this study);
- Confirmation of the loadings to be accommodated on the bridge (assume 120 tonne capacity in this study);
- Development and evaluation of a number of span arrangements for the bridge, with or without piers in the river, as well as materials to be used for the superstructure, substructure and foundations of the bridge, their cost including maintenance, and their suitability to facilitate construction in a remote northern region;
- Preparation of conceptual designs and cost estimates.



In the current Route Location Study, we have assumed use of 4.3 m wide Acrow (Bailey) type bridges at all major river crossings. Since all of the major crossings shown in Figure 4.3 are wider than 80-85 m, we have further assumed piers will be needed in the river for all bridges, since based on current practice in Northern Manitoba, this is considered to be the maximum unsupported span for this type of bridge. Clearly all these assumptions will need to be revisited in the next phase of this project.

The detailed environmental studies at the major crossings will need to include on-site investigations and address such issues as:

- Fisheries values and windows including definition of the wetted perimeter and the boundaries of adjacent riparian habitat;
- Wildlife values (flora and fauna) including information, if known, on caribou migration routes, caribou calving and post calving areas, as well as caribou exclusion areas in the vicinity as well as points where caribou may cross the river;
- The likelihood of disturbing archaeological sites, sacred sites and the like;
- Potential mitigation and compensation strategies for all of the above.
- Stakeholder consultations will need to address such issues as:
 - Identifying the boundaries of protected areas close to the crossing such as parks, areas of special interest, enduring features, or areas crossed such as treaty entitlement lands, Inuit Owned Land, trap lines and so on;
 - The need for formal consultations with First Nations;
 - Identification of important recreation/wilderness and aesthetic values such as those experienced by travellers along the Seal River (Heritage Designation).

4.4 PROPOSED TRAVELLER SERVICES

In order to provide for the safety, convenience and comfort of travellers using the proposed Nunavut-Manitoba road during its all-weather road phase, certain basic services should be provided at strategic locations along the road. These services should be inaugurated as the various segments of the all-weather road are brought into operation. Except for the general need for up to date information on whether a winter road is open or not, and its driving conditions (both of which are a provincial/territorial/contractor responsibility), the services described hereafter only apply to the all-weather road (see Figure 4-3 for the proposed service locations).

Food, Fuel and Accommodation:

We suggest that these services be based on a spacing of about 500 km, this distance being within the range of modern automobiles starting with a full tank of gasoline. Trucks used for long distance haulage have a considerably greater range than automobiles. Assuming an average travel speed of 80 km/h without stops, the associated driving time of just over 6 hours without stops or say, about 8 hours with stops, would also justify the provision of food and



accommodation at the same intervals and locations. Since the road is to be routed through a wilderness region, these services should be located:

- Where long distance and intercommunity traffic volumes are greatest in order to maximize use of the services;
- As close as possible to existing populated communities. This should increase the commercial viability of the service (i.e. by enabling it to be patronized by locals, as well as by long distance travellers) as well as making it possible for the service to be staffed from a local pool of labour.

Based on the above criteria we propose these services be provided on a commercial basis at:

- The junction of the Arviat spur with the Nunavut-Manitoba Road (290 km south of Rankin Inlet);
- Just south of the Churchill River crossing at the junction of the Port of Churchill spur with the Nunavut-Manitoba Road (470 km south of the Arviat junction; 110 km from Churchill and 180 km north of Sundance/PR290);
- Between Gillam and Sundance at the junction of Provincial Roads 280 and 290. This location is on the direct route from Thompson to Rankin Inlet and Churchill, but avoids the need for travellers to backtrack 30 km or so into Gillam to refuel.

Wayside rest areas:

We suggest these facilities for travellers to stop and rest for short periods be provided at an approximate spacing of 100 km, representing just over one hour driving time between potential stops. These areas should preferably be located just off the roadway, with sufficient parking for 2-3 trucks or buses and 3-6 cars, together with basic picnic and toilet facilities. If there is an opportunity for a scenic overlook at no extra cost, it should be considered. Since these rest areas may be desirable havens if vehicles break down, or are caught in sudden storms or blizzards, further consideration should be given to equipping them with storm-proof shelters and some form of heating such as solar heating, wood or oil fired stove.

Based on the above spacing criteria, we propose wayside rests be provided at the following locations:

- The junction of the Whale Cove spur with the Nunavut-Manitoba Road (90 km south of Rankin Inlet);
- Near the Copper Needle River (about 100 km south of the Whale Cove junction);
- Near the Thlewiaza River (about 100 km south of the Arviat junction)
- Near the Caribou River (about 200 km south of the Arviat junction)
- Near the Seal River but respecting its heritage designation (about 300 km south of the Arviat junction and about 100 km north of the Churchill River)
- At the south end of the Bradshaw Lake Area of Special Interest (about 80 km south of the Churchill River and 100 km north of Sundance/PR 290)



Travel Information:

Because of the remote wilderness nature of the route between Rankin Inlet, Churchill and Gillam, as well as the communities in between, it will be important to notify intending travellers of what road conditions they can expect, especially in the long winter period. We therefore propose that conditions be posted at each point of entry into the system as follows:

- At Rankin Inlet
- At the Whale Cove spur
- At the Arviat spur
- At the Churchill River crossing
- At the Port of Churchill
- Between Gillam and Sundance

The information to be posted could include the following items:

- The anticipated driving conditions described in English, Inuktitut, Cree and Dene on a scale from “road closed”, “poor” through “average” to “good”, displayed in a similar manner to forest fire risks; also a reminder to always carry emergency supplies when travelling this route: food, water, blankets, candles, flashlight etc.
- A phone number to call (for satellite phone users) or radio frequency to dial with up to date road information and traveller advisories, together with access to emergency response in case of emergencies
- Web site address or television channel number with up to date road information and travellers’ advisories. These would be a useful source of information to check from home or office prior to travel.

Lockable barrier gates:

These would be located at all points of entry to the road corresponding to the travel information locations above. They would be operated by road maintenance staff and would be closed when conditions were too unsafe for travel, due for example to inclement weather or large concentrations of migrating caribou along the road corridor.

4.5 Global Climate Change and Alignment Alternatives

The potential impacts of global climate change and related thaw settlement and erosion issues were assessed such that these issues and impacts could be understood, addressed and mitigated where feasible. Efforts were made to locate a route on relatively ice-poor smooth bedrock, ice-poor sand, gravel eskers, beach ridges and low ice-content basal till landforms. In some areas basal till – by far the most common terrain type preferred on the proposed right-of-way from Rankin Inlet to the Churchill River crossing – is mantled with a discontinuous thin mantle of fine-grained marine deposits. As noted earlier, bedrock on the proposed right-of-way



is almost non-existent and granular deposits on the ROW are spotty in occurrence north of the Common Point.

Basal till along the preferred route north of the Common Point contains a relatively low content of fines (silt plus clay), typically ranging from about 5% to 20%. This till has a high content of sand, gravel and cobbles, with surface boulders in places. Basal till is expected to be relatively compact because it was deposited under the weight of thick easterly and southerly advancing ice sheets. Having a low content of fines, frozen, coarse and compact basal till is expected to contain “dry” permafrost, so is expected to drain fairly rapidly when melted, resulting in significantly lower thaw settlements.

Considerations were also given to locate the route to avoid extensive boulder-pile ridges and hummocky supra-glacial till, released from stagnant ice upon melting. Short stretches of relatively thin peat and marine silt commonly overlie basal till in shallow undrained depressions north of the Common Point. South of the Churchill River crossing, along the common northern route link to the Port of Churchill, some one-half to three metres of ice-lensed bog peat overlies marine silt and sand. Both the bog peat and the underlying marine silty and fine sandy layers can have significant ice lensing, even massive ice. Most of the peat here occurs in peat plateau bogs and in polygonal (ice-wedge) peat plateau bogs, where melting of ground ice can cause significant thaw settlement and erosion problems. The same peat and marine silt occurs in a short section of the Eastern Route Alternative (ERA) immediately north of Sundance (PR290/Nelson River). Most of the ERA route is on sand/gravel beach ridge and thus climate change is not a significant factor in the performance of this route.

Two critical issues associated with the preferred route are the crossing of the Churchill River and the crossing of the Bradshaw Lake ASI. Follow-up studies were conducted to refine the alignment of the route through these locations. Alternative crossing sites and alignments were identified, in addition to the original proposed in the preferred route, to ensure that the crossing locations and alignments were indeed the most favourable in terms of lifecycle costs, terrain, topography, availability of granular materials, and minimal impacts on protected areas and unique environmental features.

4.6 Issues for Further Studies

To ensure a smooth transition of this study to the future development phases of the all-weather road, some of the issues identified for more detailed data collection and studies are summarized in Table 4-4 below in the areas of i) route engineering, ii) environmental/social/economic assessment, and iii) consultations. This is not an all-inclusive listing.

**Table 4-4: Outstanding Issues for Further Studies and Consultations**

<p><i>i) Route Engineering:</i></p> <ul style="list-style-type: none">⊙ Review hydrology data for the Churchill River crossing (preliminary flow data from MB Hydro obtained in this study)○ Obtain flow data for hydrology design for all rivers along the preferred route○ Contact Qulliq Energy regarding hydro-electric generating potential of major rivers along the preferred route within Nunavut; also potential for joint use of the corridor for a transmission line○ Contact telecommunications companies with an interest in Nunavut-Manitoba linkages○ Identify specific tie-in locations to existing roads in Rankin Inlet, Whale Cove, Arviat, Churchill and PR 290 near Bird○ Obtain new, large-scale, ground-controlled aerial photography with ground elevation data along the preferred route○ Obtain community land use plans and study the feasibility of incorporating existing trails into the preferred route, including: Rankin Inlet west and south; Whale Cove west and Arviat to Maguse River.
<p><i>ii) Environmental/Social/Economic Assessment:</i></p> <ul style="list-style-type: none">⊙ Update renewable and non-renewable resource and harvesting data (e.g. caribou, quarries/mineral extraction, forestry, fisheries)⊙ Update mining and mineral exploration data and economic development potential in the vicinity of the preferred route⊙ Confirm caribou calving ground avoidance in consultation with the Beverly Qamanirjuaq Caribou Management Board (BCQMB)○ Investigate and cite road impacts on caribou from Northern Quebec, Dempster Highway and other comparable locations○ Identify potential conflicts between the preferred route (NRA+CRA), caribou migration corridors and caribou water crossings; assess potential severity of conflicts and range of feasible mitigation measures⊙ Confirm McConnell River Migratory Bird Sanctuary avoidance⊙ Confirm location of east boundary of the Caribou River Provincial Park in order to minimize encroachment○ Conduct detailed environmental survey (archaeological/cultural artifacts, flora & fauna, fisheries and fish habitat, and enduring features such as soil, climate and surface geology) for crossing the Bradshaw Lake ASI○ Conduct detailed environmental survey for the entire route from Rankin Inlet to Churchill to Sundance/PR290 and provide an inventory of the natural and social environmental features (archaeological/cultural artifacts, flora & fauna, fisheries and fish habitat, wildlife and wildlife habitat, trap lines, sacred sites to avoid, mitigate or compensate)○ Identify the enduring feature north of Latitude 59°N and provide mitigation strategy for the preferred route
<p><i>iii) Consultations:</i></p> <ul style="list-style-type: none">○ Maintain contacts with all stakeholders, government agencies and non-government organizations regarding issues and opportunities related to the development of the Nunavut-Manitoba road○ Hold public meetings at appropriate junctures in the project development○ Conduct official consultation with the First Nations communities along and affected by the preferred route as required by the regulatory guidelines

Legend:

⊙= Started in current study; to be completed in next phase of road development project

○= Outstanding; to start in next phase of project



5.0 MINING INTERESTS, HYDRO-ELECTRIC AND UTILITIES DEVELOPMENT

5.1 Mining Interests and Activities

In the early phases of the Route Selection Study, a cursory review of mineral exploration activities in the Kivalliq Region and northern Manitoba was conducted to understand the mining activities and interest in the study area. As documented in the “Ecological Values and Related Issues” report by Hubert and Associates (see Appendix 7 of Milestone Report A), current exploration in Northern Manitoba is focused on the area along the northern common route south of the Nunavut/Manitoba border while exploration in Nunavut is generally inland from the northern route (see also Appendix 1 of this report for the Nunavut and Manitoba Mining Maps). While the interest for mineral exploration is strong, the distribution of resources is, in general, widespread in the region. Based on this initial assessment, the Consultant Team believed that the location of potential mine sites in the study area should not be a major determinant in the route selection for the Nunavut-Manitoba road. Despite the significant number of potential mine sites in the area, questions remain as to which ones will proceed, when they may open, and how long they may remain in operation. The route location was determined based primarily on an assessment of currently known transportation policy, engineering, natural and social environmental factors, all incorporated in the Multiple Account Evaluation (MAE) framework presented earlier.

Having established the above, it should be noted that the timing of construction of the new road could be influenced by mining development in the study area. There is the potential of a mining company cost sharing in the construction of the road if it can form a component of the required land access to the mine. In addition, the new road would provide a backbone for access to the region and exploration activities would likely increase in the corridor along the proposed road. After the selection of the preferred route for the proposed Nunavut-Manitoba road, the Consultant Team met with representatives from the mining industry to present the location of the preferred route and to understand the current status of mining interest and activities in Kivalliq and Northern Manitoba. Based on these discussions, there was general agreement in the mining industry that the proposed road would be needed to support exploration activities in potential mine sites and to enhance mining interest in the region as a whole. There was also strong support that the government and industry should work together in the development of the proposed road.

The known mining sites that could benefit from the preferred route are identified below. The location of these sites are shown in Figure 5-1 as extracted from the Nunavut Mining Map (see Appendix 1 for the full version of this map).

i) Baker Lake Gold Project (Site 45)

- Known as the Meadowbank Project, the mining site is located 70 kilometres north of the Hamlet of Baker Lake. The project covers an area of 30,521 hectares and consists of 10 Crown mining leases encompassing 7,395 hectares and three exploration concessions held 100% by Cumberland Resources Ltd.
- The Meadowbank project is currently serviced by sea via Baker Lake, which has summer shipping access and year-round airport facilities. Winter access is also available via an ice



road from Baker Lake and a private all-weather road is currently under construction from Baker Lake to the mine site.

- An all-weather road from Rankin Inlet to the south could benefit the mining project and would likely expedite the construction of an all-weather road from Rankin Inlet to Baker Lake, the subject of an earlier route selection study.¹¹

ii) Baker Lake Uranium Project (Site 35)

- The 200,000-hectare property is located within the Baker Lake Basin and is owned by Kaminak Gold Corporation. The property is host to at least 20 known uranium prospects that occur along 75 kilometers of the Archean–Proterozoic unconformity. A number of other exploration and feasibility studies are also being carried out for the discovery of iron-oxide-copper-gold deposits.
- Similar to the Meadowbank project, this site would benefit from the proposed Nunavut-Manitoba road from Rankin Inlet to the south, and from an extension of this road from Rankin Inlet to Baker Lake.

iii) Meliadine East and West (Sites 46 and 47)

- The Meliadine property, being developed under two separate projects called Meliadine West and Meliadine East, is located about 15 km north of Rankin Inlet and is held by Cumberland Resources Ltd. and Comaplex Minerals Corp. The sites are currently serviced by air and barge from Rankin Inlet, and to some extent, by overland hauling on the private winter road from Rankin Inlet with various all-terrain vehicles.
- The entire Meliadine property is over 80 kilometers long with total land holdings of 94,558 hectares. The target of exploration on the Meliadine property is a mesothermal lode gold deposit and regional exploration work is being carried out on concession lands owned by Nunavut Tunngavik Inc.

iv) Churchill Diamond Project (Site 36)

- The Churchill Diamond Project is comprised of mineral rights to more than 800,000 hectares located between the communities of Rankin Inlet and Chesterfield Inlet. The project is owned by joint venture partners Shear, Stornoway and BHP Billiton. To date, the joint venture has drilled 45 kimberlites over a 60 km by 60 km area on the Churchill and Churchill West projects. The partners have now narrowed down the areas of interest to two priority indicator mineral corridors -- the Josephine River Corridor and the Sedna Corridor. The joint venture intends to ramp up exploration activities on the property in the 2007 season.
- The site is currently serviced by rail to the Port of Churchill and then by barge across the Hudson Bay . The proposed road from Churchill to Rankin Inlet would provide significant benefits to this project, particularly with a road extension from Rankin Inlet to Chesterfield Inlet, the subject of an earlier road study in the area¹².

¹¹ See “Route Selection, Terrain Mapping and Estimation of Construction Quantities and Costs of Two Road Route Alternatives from Rankin Inlet to Chesterfield Inlet, Whale Cove and Baker Lake Communities”, J.D. Mollard and Associates, August 28, 2003.

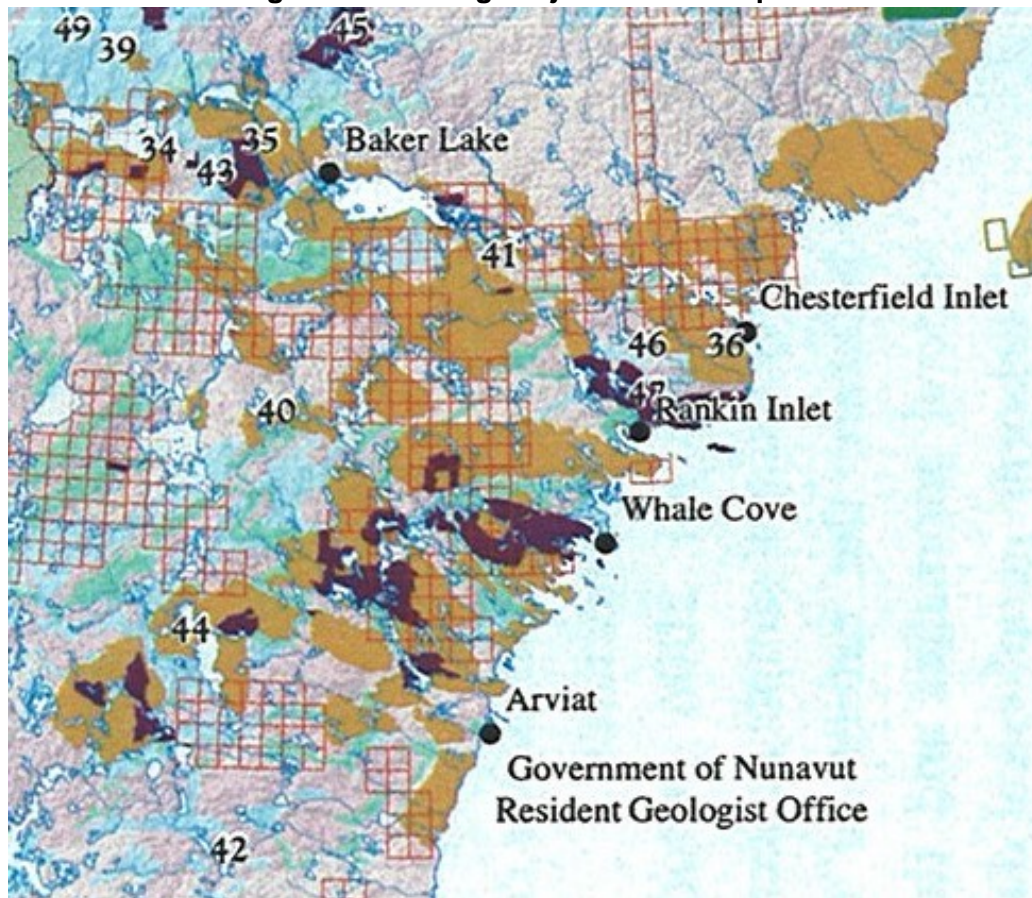
¹² Ibid.



v) Ferguson Lake Project (Site 40)

- The Ferguson Lake project is located about 240 km west of Rankin Inlet and 160 km south of Baker Lake. The property, which contains world class amounts of nickel and copper, was initially discovered by Canadian Nickel Company Ltd. (now Inco Ltd.) in 1950 and was held in its mineral inventory for over 40 years. Significant quantities of palladium, platinum and cobalt were found in 1987 and the property was acquired by Starfield Resources Inc. in 1998. Starfield Resources has continued to explore and define the resource and has spent over \$56 million on drilling over the 15-km long strike since 1999.
- The project is currently serviced from Rankin Inlet and Starfield has plans to expand the existing runway at Ferguson Lake. The proposed Nunavut-Manitoba road could provide benefits for the future exploration phases of the project. If a mine is opened, the proposed Rankin Inlet-Sundance road could be used as a segment of the Ferguson Lake resupply route as well as for the transport of ore or refined products.

Figure 5-1: Mining Projects in Kivalliq

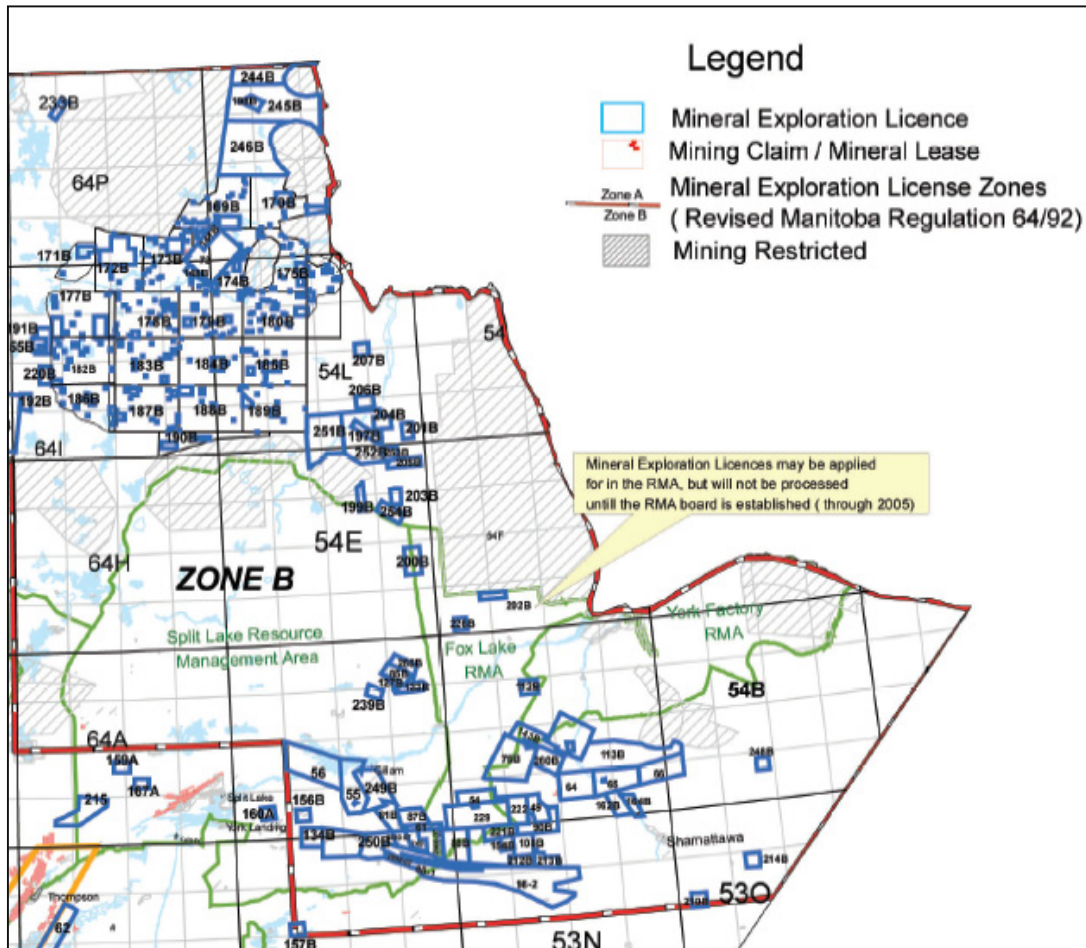


Source: Government of Nunavut, September 2005. Map shown for illustrative purposes only.



Within the study area in Northern Manitoba, the current exploration activities are concentrated along the preferred route south of the Nunavut/Manitoba border. In the absence of confirmed mining information in the area, mineral exploration licences are used as proxy to indicate the mining prospects of the area (see Figure 5-2 below). The preferred route is located through some potential hot spots in the area and the new road would likely spur exploration activities leading to potential opening of mining sites. To date, De Beers, Western Warrior and Peregrine Minerals are among the leading companies currently exploring for diamonds west of Churchill near the Seal River.

Figure 5-2: Mineral Exploration Licenses in Northern Manitoba



Source: Manitoba Industry, Economic Development and Mines, January 4, 2007. Map shown for illustrative purposes only.



5.2 Hydro-Electric And Utilities Development

In 1999, a “Transmission Pre-Feasibility Study” was completed under the Canada-Manitoba Economic Development Partnership Agreement¹³ to evaluate the viability of constructing a transmission line from Manitoba into the Kivalliq Region of Nunavut. The study was based on a transmission line originating at Churchill and terminating at Rankin Inlet for supplying hydro-electric power to the Kivalliq communities. The transmission line corridors would generally follow the coast line along the western shore of Hudson Bay, with a nominal length of 640 km from Churchill to Rankin Inlet. As shown in Figure 5-3, the proposed Nunavut-Manitoba road and transmission line corridors follow independent as well as common routes due to their respective functional, design, construction and operation requirements. Even though the Transmission Pre-Feasibility Study concluded that the benefits of shifting the transmission line location to align with the Nunavut-Manitoba road might not be justified, further synergies in joint development should be explored.

Currently the generation of electricity in Nunavut is from diesel power together with a wind turbine at Rankin Inlet. Qulliq Energy (formerly Nunavut Power Corporation) is evaluating alternative energy sources including hydro-electric generation. There are a number of rivers in Kivalliq that have the potential to generate electricity such as the Ferguson, Maguse, Tha-anne and Thlewiaza Rivers (see Figure 5-4), all crossed by the preferred Nunavut-Manitoba road route. If these rivers were to be used to produce electricity, the road would clearly be useful in accessing the generation sites. In addition to power generation for local consumption, Nunavut has the potential to export hydro power south to the USA. Hydro power is considered a renewable resource and is currently paid for at high premiums. The Nunavut-Manitoba road could be built to transport fuel to the north initially, but the corridor could also be used to transport hydro power to the south for exports in the future.

There is also a possibility that, at some future date, a north-south power grid may be developed for power transfer or sharing between Manitoba and Nunavut. Since the road will have a generally linear impact on the natural environment, as do power transmission lines, there would be a benefit in the future to locate both the road and a transmission line alongside each other. This would have the added advantages of providing a generally sound foundation for transmission towers (since the road will be generally located on good ground), as well as enabling the transmission line to follow a route in which every attempt has already been made to minimize environmental impacts. Furthermore, the road would facilitate year-round access to the transmission line for routine maintenance and to respond to any extraordinary events leading to power outages. We understand that the communities of Rankin Inlet, Whale Cove and Arviat currently rely on wireless communications with the rest of Canada. A new road route to the south would provide a right-of-way in which to place a landline linking these communities to each other and to the rest of Canada, significantly increasing communication reliability.

If, in the future, there is a need to bring northern oil or gas to southern Canada by pipeline through Kivalliq, portions of the right-of-way of the road corridor could be considered for the pipeline location, in those areas where it is sufficiently remote from human habitation not to pose risk in the event of a pipeline incident. The advantages of joint corridor use would be similar to those for electric transmission lines with the proviso that there would need to be

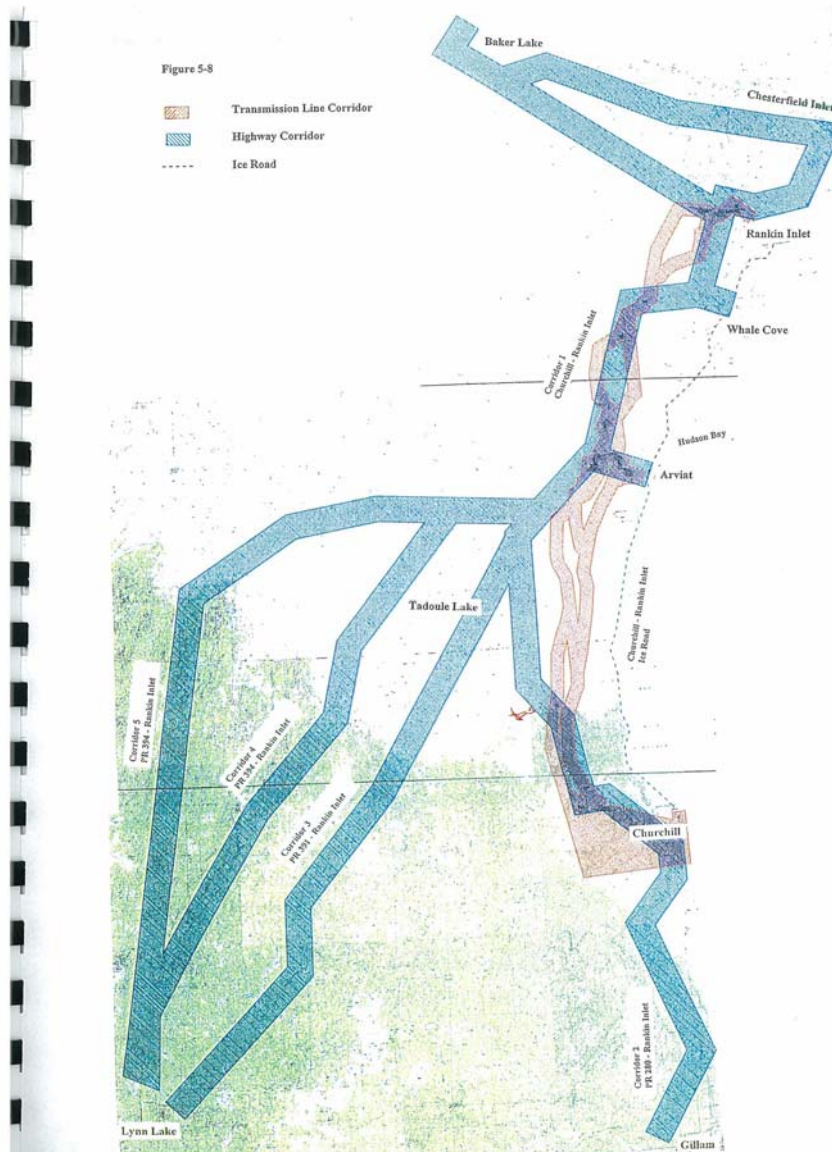
¹³ See “Churchill to Kivalliq Region Transmission Pre-Feasibility Study”, Manitoba Hydro, May 1999.



adequate lateral separation between the various utilities to ensure safe operation and maintenance.

Within the study area in Northern Manitoba, it is noted that the northwest communities of Brochet, Lac Brochet and Tadoule Lake all rely on diesel generation for their electricity needs. In the northeast, Churchill is linked to the Manitoba electricity grid by an overland 138 KV transmission line that connects to the grid in the vicinity of Gillam. If Manitoba Hydro extends their grid in the future to the northwest communities, it may be debatable as to whether Tadoule Lake should be serviced from Lynn Lake or Common Point “A”, should, in the latter case, a power transmission line be built along the road between Rankin Inlet and Manitoba.

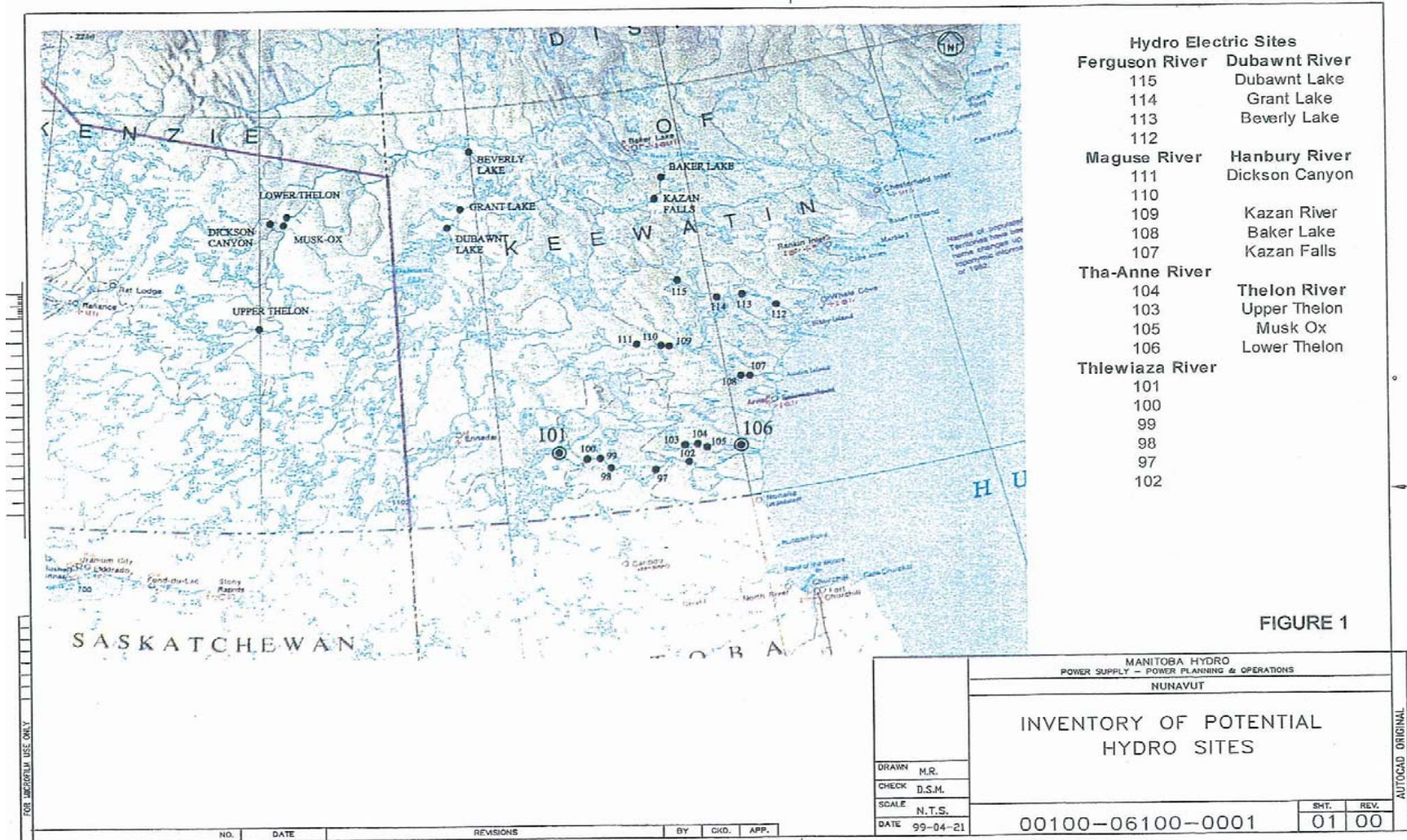
Figure 5-3: Churchill to Kivalliq Region Transmission Line Corridors



Source: “Churchill to Kivalliq Region Transmission Pre-Feasibility Study”, Manitoba Hydro, May 1999



Figure 5-4: Potential Hydro Sites in Kivalliq



SOURCE: "CHURCHILL TO KIVALLIQ REGION TRANSMISSION PRE-FEASIBILITY STUDY", MANITOBA HYDRO, MAY 1999.



6.0 WORK STAGING AND PRELIMINARY IMPLEMENTATION STRATEGY

The proposed Nunavut-Manitoba road along the preferred route (NRA+ERA) will involve a total of 1,100 km of new road construction between Rankin Inlet in Nunavut and Sundance/PR290 in Manitoba, including the link to Churchill. For construction phasing of the all-weather road, it was assumed that five years would be required for the road development from feasibility study, environmental assessment, functional and detailed engineering, financial modelling, land assembly, to permits application. This assumption, as confirmed by members of the Project Steering Committee and Project Working Group, is considered achievable given strong support from the communities, willingness from the governments to proceed, timely project funding approvals, and a coordinated and expedited permitting process. The road construction would then occur between Year 6 and Year 25 from the present time of 2007, a 20-year construction period (resulting in an overall average of 55 km of road construction per year). To sequence the construction of this road along its entire length, considerations are given below for the all-weather road phase and the winter road phase respectively.

6.1 All-Weather Road Phase

In consultation with the Project Steering Committee and Project Working Group, two preliminary options of work staging were developed for the all-weather road (AWR) between Nunavut and Manitoba. These options are described as follows.

i) AWR Option 1: North to South Staging

- 6-10 years: Rankin Inlet – Whale Cove – Arviat (340 km; \$388 million)
- 11-20 years: Arviat – Common Point – Churchill (580 km; \$664 million)
- 21-25 years: Sundance/PR290 – Churchill River (180 km; \$128 million)

This option involves constructing the Nunavut-Manitoba road from north to south, starting in the Nunavut section between Rankin Inlet and Arviat (340 km) in 6 to 10 years, followed by the cross-boundary section between Arviat and Churchill (580 km) in 11 to 20 years, and finally the Manitoba section between Sundance/PR290 and the Churchill River (180 km) in 21 to 25 years. The rationale for this staging plan is that:

- Early completion of the 340 km Nunavut section will provide inter-community connection between Rankin Inlet, Whale Cove and Arviat, thereby delivering social and economic benefits to these and other Kivalliq communities in the region. This section will also be part of the future National Highway System as soon as the road is completed between Arviat and Churchill.
- Since rail access currently exists between Thompson, Sundance/PR290 and Churchill, all-weather access to Kivalliq from Manitoba can be completed by Year 20¹⁴ without having to build the entire length of the Nunavut-Manitoba road. The section between Churchill and Arviat may be considered a higher priority than the section between Sundance/PR290 and Churchill from the perspective of the Government of Canada.

¹⁴ Assuming 20 years from the current year 2007, including 5 years of road development, engineering and environmental assessment before construction begins.



- Construction equipment and materials can be shipped north from the rail head at Churchill; duplication of rail/road service between Sundance/PR290 and Churchill can be deferred in the short to medium term.
- The entire Nunavut-Manitoba road can be completed in 25 years (including 5 years of further studies and 20 years of construction), allowing a staged process for funding approvals, detailed engineering, environmental permitting and land assembly.

ii) AWR Option 2: Fast-tracked Staging

- 6-10 years: Rankin Inlet – Whale Cove – Arviat (340 km; \$388 million)
- 6-10 years: Sundance/ PR290 –Churchill (290 km; \$245 million)
- 11-20 years: Churchill River – Arviat (470 km; \$547 million)

This option entails commencing construction in the Nunavut section from Rankin Inlet, Whale Cove to Arviat (340 km) simultaneously with the Manitoba section from Sundance/PR290 to Churchill (290 km) in 6 to 10 years, and completing the section from Arviat to Churchill River (470 km) in 11 to 20 years. The rationale for this staging plan is that:

- Same as Option 1, early completion of the 340 km Nunavut section will provide inter-community connection between Rankin Inlet, Whale Cove and Arviat, thereby delivering social and economic benefits to these and other Kivalliq communities in the region.
- Provision of the 290 km Manitoba section between Sundance/PR290 and Churchill will ensure that extension of the existing National Highway System from Thompson to Churchill can be completed as early as possible, providing social and economic benefits to the Port of Churchill and the rest of Manitoba and Canada. These benefits could include earlier diversification in trade and an increase in international exports and imports, to offset the future decrease in barge service from Churchill to communities on the west shore of Hudson Bay, who will eventually be served by road from Winnipeg as well as Churchill.
- Simultaneous work in the two jurisdictions of Nunavut and Manitoba should not be a barrier to federal funding contributions on the two fronts and could reduce completion of the overall road link from Nunavut to Manitoba by as much as 5 years (i.e. with completion in 2027 rather than 2032).
- Starting work from Sundance/PR290 to Churchill (from south to north) should result in the lowest construction costs and easiest work staging for this segment of the project.
- To complete the 470 km cross-boundary section between Arviat and the Churchill River, the Dene/Inuit overlap land claims issue will, if it is a barrier to road development, need to be resolved within 6 to 10 years. This section could be the last phase of construction after any land issues have been settled in this area. The construction of this last section can be completed in 11 to 20 years if it were to start simultaneously from both ends: Arviat in Nunavut and Churchill River in Manitoba.

The advantages and disadvantages of these staging options are summarized in Table 6-1.



Table 6-1: Preliminary Options for All-Weather Road (AWR) Construction Staging

AWR Options	Advantages	Disadvantages
<p>1. <u>North to South Staging:</u></p> <ul style="list-style-type: none"> • 6-10 years: Rankin Inlet – Whale Cove – Arviat (340 km; \$388 million) • 11-20 years: Arviat – Churchill River – Churchill (580 km; \$664 million) • 21-25 years: Sundance/PR290 – Churchill River (180 km; \$128 million) 	<ul style="list-style-type: none"> • Early connection of Kivalliq communities: <ul style="list-style-type: none"> - Enable inter-community travel between Rankin Inlet, Whale Cove and Arviat (social benefits: health, education, reduced isolation, travel) - Increase employment in local communities via road construction/maintenance • Enhance Rankin Inlet as the regional hub in Kivalliq (economic benefits: reduced transport costs) • Enhance mining access and other resource development in local communities • All-weather access to Kivalliq from Churchill completed by Year 20 <ul style="list-style-type: none"> - Sundance/PR290 to Churchill River section can be built last since rail access already exists 	<ul style="list-style-type: none"> • Nunavut-Manitoba road completion in 25 years <ul style="list-style-type: none"> - Extension of National Highway System to Churchill and Kivalliq delayed • Higher cost of construction for central section between Arviat and Churchill due to lack of land access for southern supplies (this section also contains the 4 largest bridge crossings on the NU-MB road, i.e. the Churchill, Seal, Thlewiaza and Tha-anne River crossings)
<p>2. <u>Fast-tracked Staging:</u></p> <ul style="list-style-type: none"> • 6-10 years: Rankin Inlet – Whale Cove – Arviat (340 km; \$388 million) • 6-10 years: Sundance/PR290 – Churchill (290 km; \$245 million) • 11-20 years: Churchill River – Arviat (470 km; \$547 million) 	<ul style="list-style-type: none"> • Early connection of Kivalliq communities (same as Option 1) • Increased flexibility of service between road/rail from Sundance/PR290 to Churchill in the short/medium term • Nunavut-Manitoba road completion in 20 years <ul style="list-style-type: none"> - Early extension of National Highway System to Churchill (by Year 10) - Immediate social and economic benefits to the Port of Churchill - Simultaneous work in the two jurisdictions of NU and MB not a barrier to federal funding - Longest section between Churchill River and Arviat can be built last allowing for staged project funding and land assembly • Lower cost of construction and easy staging from the south once Sundance/PR290 is connected to Churchill 	<ul style="list-style-type: none"> • More funding required in 6-10 year period (\$633 million)

Note: Construction costs are based on the unit costs for each road section as summarized in Table 4.1 in this report.



6.2 Winter Road Phase

As set out in the study Terms of Reference, the proposed development strategy for the Nunavut-Manitoba road was based on initial staging as a winter road, followed in time by possible construction of a single-lane, all-weather road, then finally, construction of a two-lane, all-weather road. During the evaluation of the route alternatives, it was suggested that construction of an overland winter road above the tree line (between Latitudes 59°N and 60°N across the preferred route) might be challenging. Unless the level of the winter road is higher than the adjacent land, the lack of trees will likely result in the rapid filling in and blocking of the winter road by blowing snow, thus decreasing the reliability and increasing the annual maintenance cost of the winter road. Based on the experience of winter roads in the Northwest Territories, annual operating costs for winter roads in the tundra could be in the range of \$12,000 to \$15,000 per kilometre per year¹⁵, compared to \$3,000 in northern Manitoba.

In light of the length (total 1,100 km) and high construction cost (\$1.2 billion) of the all-weather Nunavut-Manitoba road, questions were raised whether a winter road could be constructed as an interim annual solution for this road link such that the winter road could be upgraded to all-weather road as and when funding becomes available. As suggested by experienced engineers and road contractors who have worked in similar terrain regions, winter roads above the tree line could be expensive and difficult to build and operate, and thus may not be a practical interim solution for the Nunavut portion of the road. The following reasons were provided related to the feasibility of winter roads in the tundra:

- Local contractors who have worked or lived in Rankin Inlet do not build their winter roads in a similar manner as those in north central Manitoba. Trails are opened and sleds are pulled by tractor to move materials.
- A former professional construction engineer from the Northwest Territories suggested that building a winter road in open tundra and for the distances required from Rankin Inlet and approximately the Caribou River would not be practical or recommended.
- The requirements to constantly maintain and clear the winter road would make it impractical from a logistics perspective.
- Safety would be a concern due to potential road break-down, snow “white-outs” and disrupted communications.

In light of the above considerations, the sheer length, and therefore high construction cost, of the all-weather road, particularly in the cross-boundary section between Arviat and Churchill (580 km), poses the question of whether an all-weather road could be afforded at initial construction (i.e. \$1.2 million per kilometre for all-weather road construction, compared to \$15,000 per kilometre per year for winter road maintenance). The business case for the all-weather road and the optimal construction timing will need to be further established in the next phase of this project. At the feasibility study level, the governments of Canada, Manitoba and Nunavut may consider the following options to construct a winter road as an interim phasing for the all-weather road.

¹⁵ Based on the Tibbitt to Contwoyto Winter Road between Yellowknife and Contwoyto Lake in the Northwest Territories.



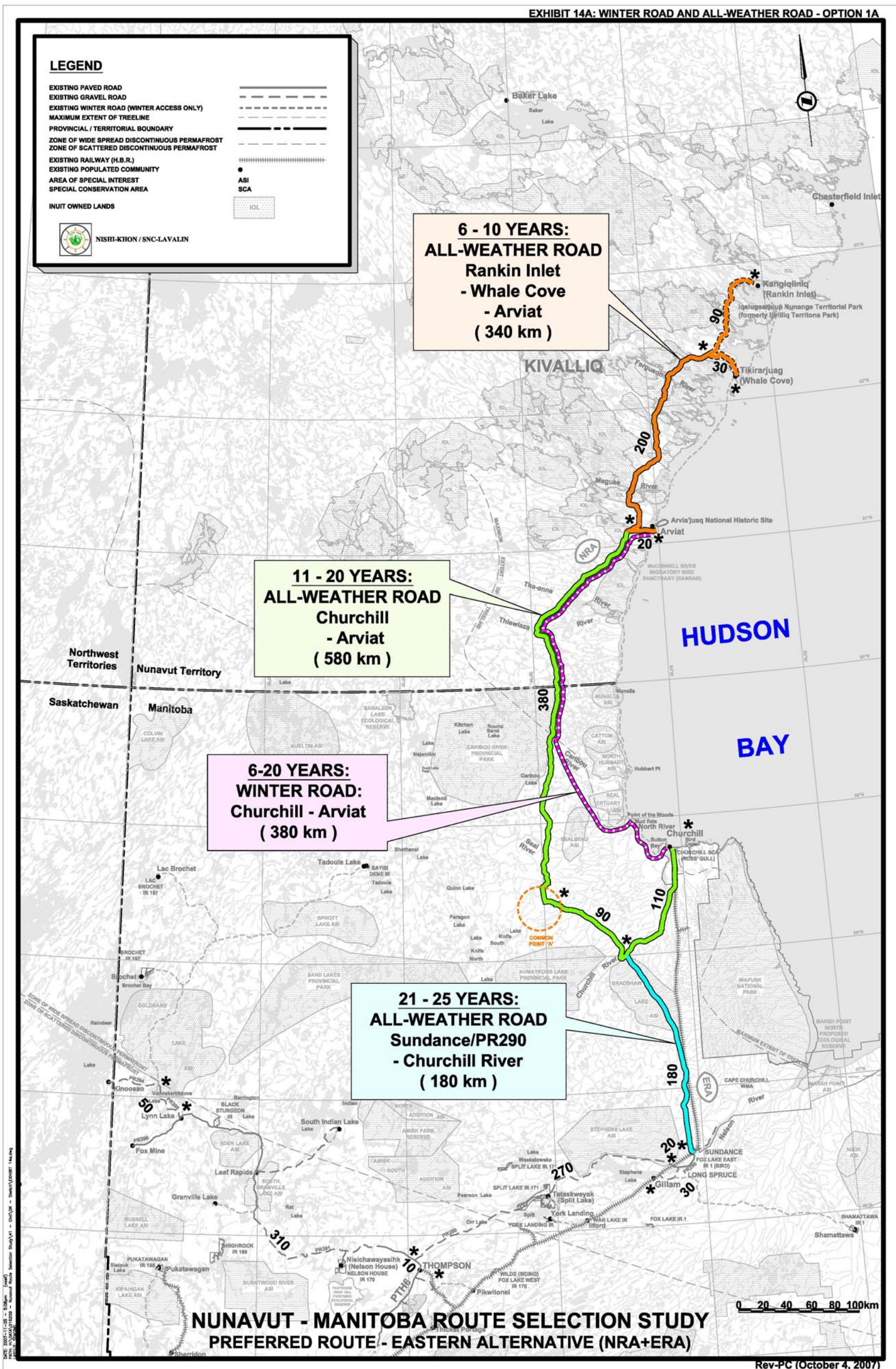
In the case of AWR Option 1:

- A winter road between Rankin Inlet, Whale Cove and Arviat is not recommended to serve the inter-community travel needs between these communities. The winter road would be expensive to maintain and would unlikely prove competitive compared with the existing private route along the coast. Consequently, it may only poorly serve the intercommunity travel needs in the area.
- For the section between Churchill and Arviat, a private, shorter winter road currently exists along the west coast of Hudson Bay. A new winter road further inland following the preferred all-weather Nunavut-Manitoba route might not receive much use due to the longer distance of travel.
- If a winter road between Churchill and Arviat is preferred by the governments of Nunavut and Manitoba in order to defer expenditures on the all-weather road, the alignment of the winter road could follow the existing sea ice route from Churchill, then proceed overland between the Seal Bend and Seal Estuary Areas of Special Interest (ASI's) in the vicinity of the Seal River and connect to the all-weather road from Arviat near the tree line (see Option 1A in Figure 6-1). This winter road could start construction in Year 6 and connect to the Nunavut all-weather road between Rankin Inlet and Arviat (to be completed by Year 10).
- Once the winter road is in operation between Churchill and Arviat, community supplies and construction equipment could be transported to Kivalliq by tractors or trucks, thus providing early benefits to the communities and cost savings in the all-weather road construction between Rankin Inlet and Arviat. The all-weather road construction in this section could start whenever funding is made available, possibly proceeding concurrently from the north (from Arviat) and south (from the Port of Churchill).
- It should be noted that since the southern portion of this winter road (from Churchill to just south of the Caribou River) does not follow the alignment of the ultimate all-weather road, a route selection study will be required to confirm its location and technical/environmental feasibility. Temporary bridges would be desirable across the Churchill and Seal Rivers, both major rivers with potentially significant flows. The winter road route will be located in close proximity to a numbers of ASI's, thereby posing potential environmental concerns. Other than crossing on the ice, finding a temporary crossing of the Churchill River near the Port of Churchill would be very challenging. The weir completed by Manitoba Hydro, and opened in 1999 to impound the waters of the Churchill River, is 2,400 m long, where the river estuary narrows upstream from the port facilities. Areas upstream and immediately downstream of the weir were selected for environmental enhancement, making any consideration of a temporary bridge structure with associated in-river piers, likely unacceptable. Furthermore, providing a winter road location going directly north west from Churchill, once established, could generate pressure to make it the all-weather route, although the Route Selection Study has already concluded that the NRA+ERA is the preferred route from engineering, environmental and long term maintenance perspectives.
- A winter road between Sundance/PR290 and Churchill would have questionable value since all-weather rail access currently exists along this corridor: freight unit costs by rail would be lower than those by trucks on winter roads¹⁶. For this particular option, a winter road phase is not recommended for this section of the Nunavut-Manitoba road.

¹⁶ Based on data collected in the "Nunavut-Manitoba Transportation Assessment" (Prolog, 2000), freight unit costs were \$0.163/Tonne-km by rail, \$0.135/Tonne-km by trucks on all-weather roads, and \$0.500/Tonne-km by trucks on winter roads (in 1999 Dollars).



Figure 6-1: Staging of the Preferred Route (WR and AWR - Option 1A)



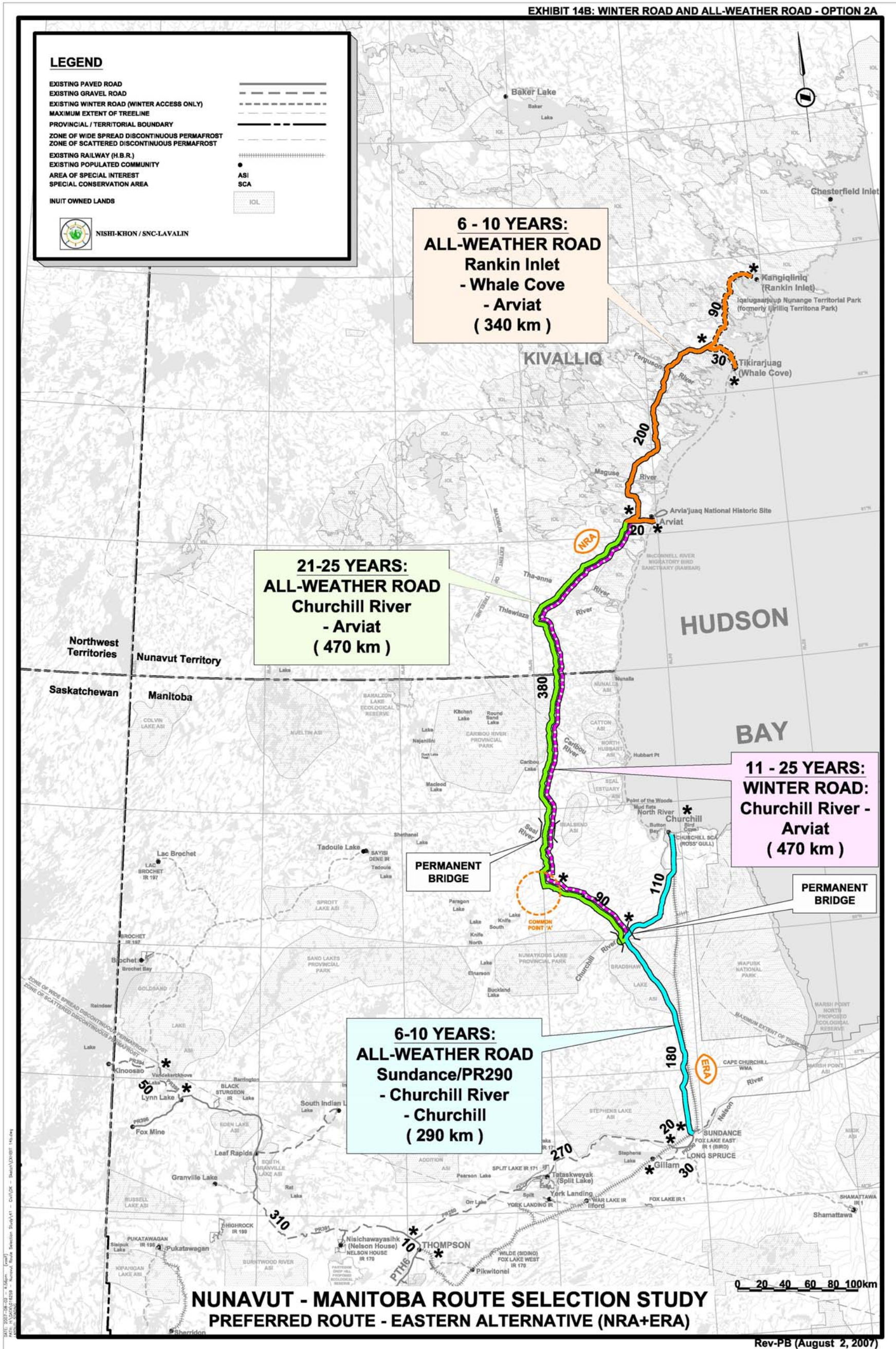


In the case of AWR Option 2:

- Similar to AWR Option 1 above, a winter road between Sundance/PR290 and Churchill would have questionable value since all-weather rail access currently exists along this corridor: freight unit costs by rail would be lower than those by trucks on winter roads. A winter road phase is not recommended for this section of the Nunavut-Manitoba road.
- For the cross-boundary section between Arviat and Churchill River, a winter road might have some value in serving as an interim solution until funding for this long stretch of the all-weather road is made available. A winter road could be constructed in Year 11 from Churchill River to Arviat along the alignment of the all-weather road, and connect to the all-weather road between Arviat and Rankin Inlet (see Figure 6-2 for Option 2A). This winter road will then connect the Manitoba all-weather road to the Nunavut all-weather road (both completed by Year 10).
- Compared with the winter road under AWR Option 1, this winter road route, being located overland along the future all-weather route, would be safer and more reliable since, in all likelihood, early construction of permanent bridges would be justified over crossings such as the Caribou, Seal and Churchill Rivers. This route is also well removed from designated Areas of Special Interest.
- Freight diversion to this winter road from the existing Churchill-based rail/barge service might still be limited (due to longer road distance and the lower freight unit costs by rail and barge when compared to those by trucks on the winter road), but freight and possibly some limited passenger travel could use this winter road as an alternative to the existing high cost air travel.
- Once the winter road is in operation between Churchill and Arviat in Year 11, the all-weather road between Arviat and Churchill River could be built whenever funding is allocated for such construction.



Figure 6-2: Staging of the Preferred Route (WR and AWR - Option 2A)





6.3 Preferred Implementation Sequence

In considerations of the staging of the Nunavut-Manitoba all-weather road, the Project Steering Committee and Project Working Group have expressed their preference for Option 1, the north to south staging. In addition, the construction of a winter road for the cross-boundary section between Churchill and Arviat is desired such that early benefits of the Nunavut-Manitoba road could be realized, particularly in enabling freight movements to Kivalliq by surface transportation during the winter to augment barge service.

There are a number of location options for a winter road between Churchill and Arviat:

- Option 1A: the route shown in Figure 6-1;
- Option 2A Modified: the route shown in Figure 6-2, with the addition of a winter road along the south bank of the Churchill River from the Port of Churchill to the crossing of the Churchill River 110 km to the south west (following the route of the future all-weather road);
- The existing winter road ice route along the west coast of Hudson Bay; shown in a dashed line in Figures 6-1 and 6-2.

The above three winter road route options are shown in Figure 6-3, and any one of them could, after the appropriate environmental approvals have been obtained, be implemented in a 6-10 year time frame, to coincide with the 6-10 year time frame for building an all-weather road from Rankin Inlet to Arviat. Each route option has positive and negative aspects: those of the two overland routes have already been referenced earlier in this section of the report. The coastal route has the advantage of being the shortest and most level route, as well as already being familiar to local private operators. Since it is located just offshore, over the waters of Hudson Bay, we understand that it will essentially fall within the jurisdiction of Nunavut. Its disadvantages are that it may be the route that thaws the earliest in the spring. Being located entirely over frozen sea ice, it may pose greater safety and environmental risks than the inland routes. Furthermore there is no realistic way of extending its operating season by bridging the major river outflows it crosses.

We believe it may be premature at this point to make a recommendation on the preferred route for the winter road. There are three realistic options, and a final decision could in fact rest with decision makers closer to the time when construction of the all-weather road is due to commence between Rankin Inlet and Arviat. We do, however, feel it would be prudent to include the three winter road route options, along with the preferred all-weather route, in applications to the appropriate government agencies for environmental approval.

The winter road would augment barge service, and be used for shipping equipment and materials north for construction of the all-weather road, as well as shipping general freight to Arviat for distribution. The winter road could remain in operation during the 11-20 year period while the all-weather road is under construction between Arviat and the Port of Churchill.



There are four significant issues associated with all three route options for the winter road between the Port of Churchill and Arviat:

- i) The magnitude of the one-way travel distance and travel time between the 2 communities (assuming an average travel speed of 20-30 km/h on the winter road):

Route	Approx Length Churchill to Arviat (km)	Non-Stop Travel Time (hrs)	Required No. of 10 hr shifts
Option 1A	380	13-19	2
Option 2A Modified	600	20-30	2-3
Existing Coastal Ice Route	290	10-15	2

- In the case of Option 1A and the Existing Coastal Route, a minimum of one rest area will be needed at the midway point (near the Manitoba/Nunavut boundary) to provide adequate overnight shelter for the transport operators. In the case of Option 2A Modified a minimum of two overnight rest areas will be needed. Potential winter road rest areas are also shown in Figure 6-3.

- ii) The condition and depth of ice:

- This is an issue along Hudson Bay in the case of the Existing Coastal Route as well as Option 1A which follows the coastal route for a short distance. It is also an issue at the major river crossings for the inland portion of Option 1A, as well as for Option 2A Modified. The most problematic situation is likely the condition and depth of ice along the course of the Churchill River, and where it outflows into Hudson Bay at the Port of Churchill. Most of the time Manitoba Hydro diverts a substantial portion of the waters of the Churchill River into the Nelson River hydro-electric generating system through the use of the Missi Falls and Rat River (Notigi) control structures. However, the volume of upstream flows in both rivers can fluctuate considerably, and there are times when the flow in the Churchill can rapidly increase. In the winter, the flow of water may swell over the existing ice cover, then freeze again in a relatively thin layer, separated by slush from the lower layer of ice.
- This condition can prove treacherous for vehicular crossings in the winter. Furthermore the Churchill and other major river crossings may thaw earlier in the season than the rest of the winter road, rendering it impassable. Where the winter road route follows the future all-weather route, the safety and environmental risks associated with the river crossings can be eliminated by building permanent bridge structures.

- iii) The type of equipment to be used for hauling along the winter road:

- Based on our observations during trips to the Kivalliq communities of Rankin Inlet, Whale Cove and Arviat, together with discussion with one major freight hauler, we believe that the safest and most reliable method of transporting freight along the winter



road during its initial operating period will be by using Challenger type tractors, with large diameter tires and hauling sleds. These operate successfully on the existing coastal ice route, and would likely be suitable on an inland route, especially where there may be a relatively steep climb down and up the sides of river valleys in order to access the ice on the river crossing.

- At such time as permanent or temporary bridges are in place at all river crossings, it may be possible to introduce the use of regular highway tractor-trailer units (A-trains and B-trains) along the winter road. Challengers would continue to be the vehicle of choice throughout the entire period of operation, if the coastal ice route is used.
- iv) To ensure the safety and effectiveness of the winter road, a contractor should be chosen to clear the route, carry out annual winter maintenance, ensure environmental compliance and provision the rest areas, and provide emergency services. It is anticipated that funding of the winter road operation would be a joint federal, provincial and territorial government responsibility, with possible participation by mining companies, who may wish to use the route to re-supply their operations. In the 11-20 year period, there would need to be close coordination between the winter road contractor and the contractor retained to build the all-weather road. Perhaps the latter could be contracted to assume the responsibilities of the former.

The following is a summary of the preferred overall implementation sequence:

6-10 years:	All-Weather Road: Rankin Inlet – Whale Cove – Arviat (340 km); Winter Road: Churchill to Arviat (initial use, then phasing out of winter road to all-weather road)
11-20 years:	All-Weather Road: Arviat – Common Point – Churchill (580 km)
21-25 years:	All-Weather Road: Sundance/PR290 – Churchill River (180 km)

The rationale for this preferred staging is stated as follows:

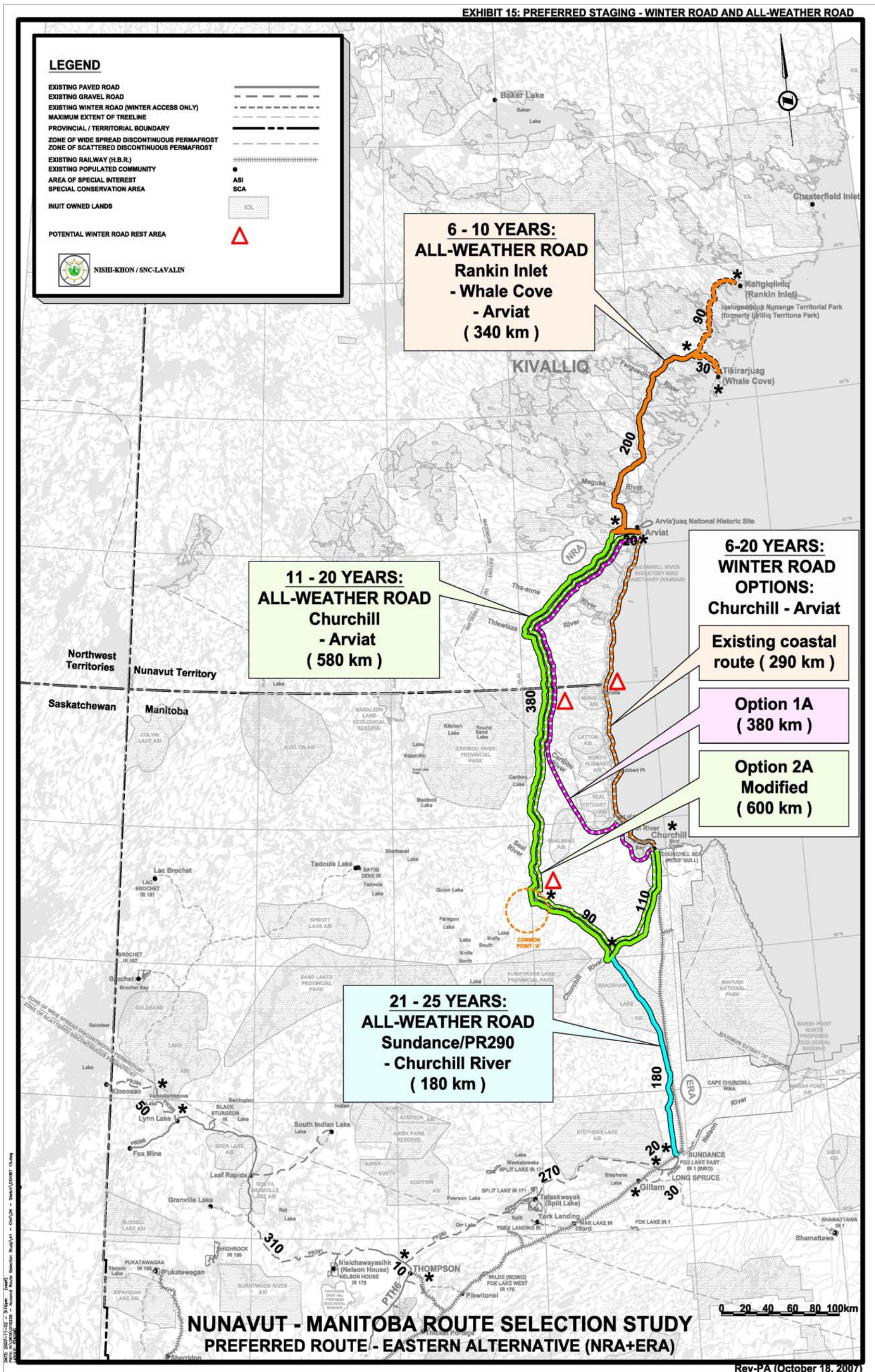
- Early connection of the communities of Rankin Inlet, Whale Cove and Arviat in the Kivalliq Region. Interconnectivity among these communities is considered the highest priority of the Nunavut-Manitoba road.
- Road connection of the Kivalliq communities to the Port of Churchill is considered a higher priority than the road connection between Churchill and Sundance/PR 290. Since rail connection currently exists between Churchill and the south, the road extension from Churchill to Kivalliq will complete the Nunavut-Manitoba surface transportation network before the entire road is built to Sundance/PR 290.
- Due to the length of the cross-boundary section between Churchill and Arviat (580 km), a longer implementation period may be required for funding, land claims settlement and construction. A winter road can be considered as an interim staging in this section to provide early connection to the Kivalliq communities.



- Once the winter road is in operation between Churchill and Arviat (in 6 to 10 years), community supplies and construction equipment could be transported to Kivalliq by tractors or trucks, thus providing early benefits to the communities and cost savings in the all-weather road construction between Rankin Inlet and Arviat.
- The section between Sundance/PR 290 and the Churchill River will be the last section to construct once the all-weather road is completed between Churchill and Rankin Inlet.



Figure 6-3: Preferred Staging of Nunavut-Manitoba Road





One possible construction stage for the NU-MB road would be to build a one-lane road (with a 5 m top and assured 8 m top passing opportunities) in the all-weather road phase. A preliminary cost analysis was conducted to evaluate the merits of this one-lane road phase. As shown in Table 6-2 below, reducing the cross section of the entire road from Rankin Inlet to Sundance/PR290 would result in a capital cost saving of \$245 million. Constructing a one-lane road in the cross-boundary section between Arviat and Churchill River (470 km) will result in a capital cost saving of \$118 million. Upon consultation with the Project Working Group, it was determined that these cost savings were not justified for the one-lane road phase. The Project Working Group is of the opinion that the development of a single lane roadway is an unnecessary stage in the construction process and that this stage is not justified due to the following reasons: 1) the incremental cost between a single lane roadway and a two lane roadway is relatively small; 2) as a National Highway System route, the expectation of road users is, at minimum, a two-lane road; and 3) development of a single lane road would impact benefits to road users. In particular, a one-lane road between Rankin Inlet, Whale Cove and Arviat would be unlikely to meet expectations for and inter-community traffic service between these communities.

**Tables 6-2: Capital Cost* and B/C Ratio
(Two Lane Road vs One Lane All-Weather Road)**

	Capital Cost 8 m Top (two-lane all-weather road from Rankin Inlet to Sundance/PR290)	Capital Cost 5 m Top**(one-lane all-weather road from Rankin Inlet to Sundance/PR290)	Capital Cost 5 m Top** Arviat to Churchill River (one-lane all-weather) and 8 m Top Other Sections (two-lane all-weather)
Total Capital Cost (\$ million)	1,180	935	1,062
Cost Savings (\$ million)	-	245	118

*Note: Capital cost includes engineering, mobilization, construction and contingency in 2006 dollars.

** Note: 5 m top road option would include frequent 8 m top width sections to provide assured passing opportunities.

The final phase of the Nunavut-Manitoba Road, beyond the initial 20-year construction period, possibly in the 50+ year range, may consist of paving the travel lanes and providing partially paved, partially gravel shoulders, in keeping with guidelines for the National Highway System.

In order to ensure the functional integrity of the route well into the future, as an extension of the National Highway System, it will be important in the early phases to:

- Protect a sufficient width of right-of-way for the highway as well as for all associated services required for the travelling public;
- Provide the flexibility to achieve safe high-speed operation in the horizontal as well as the vertical alignment of the highway;



- Control land use and access along the highway;
- Ensure the preservation of aggregate sources along the highway corridor, to be used for ongoing maintenance and future upgrading; and
- Meet all necessary environmental permitting requirements.

6.4 Corridor Land Use Policy

The proposed all-weather road linking the Kivalliq Region of Nunavut to the Port of Churchill and the existing Manitoba all-weather road system, Provincial Road PR 290 near Gillam, and thence via PR280 and PR391 to the Provincial Trunk Highway PTH6 at Thompson, will initially, in all likelihood, be the sole year-round overland link between Nunavut and the rest of Canada. Portions of the route south of the tree line within Manitoba may initially be staged as a winter road. Since the Nunavut-Manitoba route will link Rankin Inlet, the economic and administrative centre of the Kivalliq Region to Churchill, and in turn Churchill, Canada's foremost international port on the Arctic Ocean, to Canada's National Highway system at Thompson, the proposed all-weather road should, we believe, when it is completed, be incorporated in the National Highway System and designated as a major provincial and territorial highway. Furthermore, the portions of Manitoba's Provincial Roads PR 280, 290 and 391 that link the Nunavut-Manitoba route to Thompson, should be elevated to major provincial highway status and also included in the National Highway System. In the meantime, drawing from Manitoba's Provincial Land Use Policy Number 8, "Provincial Highways", we propose that any development or uses on lands in the Nunavut-Manitoba Route corridor and along the relevant portions of PRS 280, 290 and 391 should be planned:

- to complement the future highway system's function as an important component of sustainable development in Nunavut and northern Manitoba;
- to minimize environmental impacts attributed to future highway operations and to protect the public investment in the Nunavut-Manitoba route from any development which may jeopardize its intended safe and economical operation, or the implementation of future improvements to enhance its safe operation.

We suggest the following draft land use policy objectives and application be considered for adoption by the territorial, regional and provincial authorities for the corridor containing the proposed Nunavut-Manitoba route (NRA + ERA). This draft policy could be used by the appropriate levels of government, in Nunavut, Kivalliq and Manitoba, as a benchmark in the reviews of developments in areas where a development or land use plan has not been adopted or requires review to accommodate the proposed Nunavut-Manitoba route. Once such a plan has been adopted it would replace this draft policy as the instrument guiding development within the route corridor. This draft policy would not derogate from the Nunavut Land Claims Agreement or Treaty and Aboriginal rights within Manitoba.

A. Policy Objectives

Efficient transportation is an essential element in sustaining existing economic viability and ensuring sustainable economic growth. The primary role of the proposed Nunavut-Manitoba highway system will be to move goods and people safely and with minimal interruption. Although many types of land uses adjacent to the proposed highway may not interfere with this



function, certain uses may cause unsafe highway travelling conditions, result in delays for the travelling public, and accelerate the need for costly highway improvements. In addition, some land uses, particularly those containing residential components could be negatively affected by highway traffic operations if located immediately adjacent to the highway transportation network.

The objectives of the Policy therefore are:

1. to sustain the economic viability of communities, promote sustainable economic growth, and prevent negative environmental and economic consequences to land uses adjacent to the proposed highway;
2. to maintain and improve a high level of service and safety on the proposed highway;
3. to protect the public investment in the proposed facilities and prevent premature obsolescence of the transportation network; and
4. to minimize disruption to local development in the future, and reduce the cost to the public for land acquisition when highway upgrading is required.

B. Policy Application

1. Where appropriate, land use plans shall implement this Policy by:
 - a) Identifying the proposed major highway as per the map set out in this route selection study;
 - b) Developing policies that ensure the protection of the proposed highway and adjacent land uses.
2. Compatible land uses (for example, natural resources harvesting, wayside parks and highway commercial operations) may be permitted adjacent to the proposed highway where interference with other resources is minimized and the safe and efficient operation of the proposed highway can be maintained.
3. Proposed development that lies within 300 m of the centre line of the proposed highway or within an 800 m radius of the intersection with another major highway must be reviewed by the appropriate government authorities prior to approval to determine whether and to what degree:
 - a) the development may have a detrimental impact on the safety and function of the proposed highway;
 - b) the proposed highway may have a detrimental impact on the development;
 - c) the development may lead to further development that is contrary to this section;
 - d) appropriate functional improvements and environmental mitigative measures may be incorporated into the development.
4. A review by the appropriate government authorities will determine whether a proposed development should proceed.
5. If a review determines that a proposed development should proceed, appropriate functional improvements and environmental mitigative measures should be incorporated into the development.



6.5 Environmental Permitting and Approval

The proposed Nunavut-Manitoba road between Rankin Inlet, Whale Cove, Arviat, Churchill and Manitoba's road transportation system will be subject to a number of review processes set out by the applicable government authorities. In Nunavut, the Nunavut Impact Review Board (NIRB) will be responsible for administering the environmental assessment and review process under Article 12 of the Nunavut Land Claims Agreement (NLCA). Depending on the staging of the NU-MB road, the review process may involve either a Part 5 review for proposals in the Nunavut territory or a Part 6 review to address cross-boundary issues among various jurisdictions. The Part 5 review will be led by the NIRB whereas a Part 6 review will be conducted by a Federal Environmental Assessment Panel with representatives from all affected provincial and territorial governments. The NIRB review process consists of 16 steps from Project and Issue Scoping, submission of a Draft Environmental Impact Statement (DEIS), technical review, NIRB determination, approval by the Department of Indian and Northern Affairs, issuance of Project Certificate, and finally, monitoring and enforcement upon project approval (see Appendix 8 of Milestone Report B for the detailed NIRB Review Process guidelines). The assessment process could take up to 280 days from the receipt of the DEIS.

In harmony with the NIRB review process, the Nunavut Planning Commission (NPC) will be responsible for determining whether the project proposal is in conformity with the applicable land use plans. The Keewatin Regional Land Use Plan (KRLUP), approved by the Governments of Nunavut and Canada in June 2000, contains specific conformity requirements relating to transportation corridors. The study team received a letter by NPC on April 10, 2007, confirming the regulatory approval requirements for the project and NPC's commitment to working with the project team and other agencies to ensure that any project proposals related to the proposed NU-MB road will be fairly and efficiently tested for conformity with the KRLUP (see Appendix 2 at the end of this report). In addition, the Nunavut Water Board and the Nunavut Wildlife Management Board will be responsible for reviewing and approving any proposals related to the use, management and regulations of water bodies and wildlife in the region. These agencies have been consulted during the second round of public consultation of the Route Selection Study in February 2007.

In Manitoba, environmental pre-screening should be initiated at the early project design phase to identify any environmental issues that need to be addressed in the design process. An iterative process should be put in place to allow for timely feedbacks on environmental impacts at major decision points in the design process. Regular and comprehensive communication should be maintained between the Project Manager, Regional Design staff and the Environmental Section of Highway Planning and Design at the Department of Infrastructure and Transportation. Consultation with relevant project stakeholders and agencies (local governments, interest groups, environmental, transportation or business lobbies) should also be maintained in the form of an on-going communication program.

As detailed in Appendix 3, the following approvals should be obtained at the end of the Functional Design Phase:

Manitoba Environment Act License

The proposed Nunavut-Manitoba road, in both winter and all-weather road phases, will require licensing under the Manitoba Environment Act. The proposal for licensing will be filed by the



Environmental Section of the Department of Infrastructure and Transportation, after which an interdepartmental technical review will be conducted under a Technical Advisory Committee. The proposal will then be advertised in a local newspaper and subject to public review. Additional information may be required to undertake a more detailed Environmental Impact Assessment to address any issues raised in the review process. A minimum of three months is required to obtain the license.

Canadian Environmental Assessment Act

The project will be subject to the Canadian Environmental Assessment Act since the federal government will be involved as a decision-making authority - as a source of funding, a land owner and a regulator. Canada and the Province of Manitoba have entered into a harmonization agreement regarding environmental assessments whereby the licensing application is filed under the Manitoba Environment Act and the Canadian Environmental Assessment Agency will be responsible for circulating the proposal to various federal government departments for review and approval. The Environmental Section of the Manitoba Department of Infrastructure and Transportation will be responsible for liaising with the federal agency which has been designated as the responsible authority for the project approval.

Fisheries and Oceans and Navigable Waters Authorization

Authorization will be required by Fisheries and Oceans Canada for works affecting fish habitat in the project area pursuant to the Canada Fisheries Act. Construction of water crossings will also be subject to the Transport Canada Navigable Waters Protection Act. In light of the scale and number of water crossings in the project, a formal authorization will likely be required where project impacts will need to be evaluated, mitigated and compensated as required. The Environmental Section of the Manitoba Department of Infrastructure and Transportation will be responsible for liaising with these federal agencies in the relevant screening, review and application processes. A minimum of three months will be required to obtain an authorization under each of these acts.

In light of the number of regulatory agencies involved in the environmental permitting and approval phase of the project, it is recommended that an External Team be formed in the immediate next phase of this project to represent the regulatory agencies for the proposed NU-MB road. This External Team will consist of representatives from the KIA Lands Department, the Nunavut Impact Review Board, Nunavut Water Board, Nunavut Planning Commission, Nunavut Planning Division (Environmental Lands Affairs Officer), Environmental Section of the Manitoba Department of Infrastructure and Transportation, Fisheries and Oceans Canada, Environment Canada, Manitoba Conservation and Manitoba Industry, Economic Development & Mines. Early engagement of this External Team will allow for timely stakeholder input and ensure that all project issues are identified and constraints addressed at critical decision points in the project design phases. The next phases of the project are further elaborated in Section 8.0 of this report.



7.0 BUSINESS CASE AND PROJECT FUNDING OPPORTUNITIES

As documented in the earlier studies for the Nunavut-Manitoba road link, the Governments of Canada, Nunavut and Manitoba see implementation of the new road as a means of supporting the objectives of healthy communities, simplicity and unity, self-reliance and continued learning¹⁷. The proposed road is expected to enhance opportunities for resource development such as mining and tourism; benefit employment, small business development and standard of living; and reduce the cost of transporting people and goods between the Kivalliq Region and urban centres in Manitoba.¹⁸

In this study, direct benefit cost analysis was conducted for each of the route alternatives (the Western, Central and Eastern Alternatives, all in combination with the Northern Common Route from Rankin Inlet to Churchill). This benefit cost analysis compared the life-cycle cost of the proposed road (including engineering, construction, maintenance and salvage value over a 25-year project life) to the direct user benefits in the terms of cost, time and safety benefits associated with the various modes of freight and passenger travel along the corridor. The benefit to cost ratios were determined to be 0.32, 0.30 and 0.25 for the Eastern, Central and Western Alternatives respectively. For the preferred Eastern Alternative, the total project benefit in net present value over a 25-year project life was \$358 million, compared to a total project cost of \$1,106 million. This result is consistent with earlier assessments of the economics of the Nunavut-Manitoba road link in that the project may not be viable from a strictly economic perspective.

However, many public investments in infrastructure and programs are made on the basis of social and public policy imperatives, rather than solely on economic considerations. The proposed Nunavut-Manitoba road would deliver the greatest benefits from a sovereignty and national interest perspective. It is considered essential to public service in the Kivalliq communities, to address the isolation, unemployment, and high costs of goods and services associated with the lack of reliable public road infrastructure connecting the local communities to one another and to the rest of Canada. The proposed road is critical to the further development of the Port of Churchill as a trade and naval base for the Canadian Arctic region, and to provide improved access to world trade markets from Nunavut and northern Manitoba. The social and economic benefits of the proposed road are further discussed in the following sections, as well as opportunities for project funding and procurement among the public and private sectors.

7.1 Social and Economic Benefits

In addition to the direct and immediate benefits of the proposed Nunavut-Manitoba road in reduced freight and passenger transport costs (included in the benefit cost analysis for the Route Selection Study), the project will generate other social and economic benefits to the region associated with the construction of the new road. The phased \$1.2 billion construction expenditure will create “spin-off” benefits to the provincial, territorial and Canadian economies in the form of increased employment, income and Gross Domestic Product (GDP). The potential employment and training opportunities provided to the aboriginal communities in Kivalliq and

¹⁷ These are priorities specified in the Bathurst Mandate, on which the Nunavut Transportation Strategy 2001 is based.

¹⁸ See “Manitoba Nunavut Transportation Assessment” (Prolog, 2000) and “Nunavut Transportation Strategy 2001”.



northern Manitoba, in particular, will need to be understood in the regional context. Unemployment rates in Kivalliq currently range from 14% in Rankin Inlet to 36% in Arviat¹⁹, while 49% of the population in Nunavut is under the age of 19²⁰. Without access to gainful employment, these people and communities are supported by transfer payments from the federal government. The social dependency rate in the remote communities in northern Manitoba ranges from 30 to 80 percent.²¹ Education, training and employment benefits to the youth are cited as the single, largest concern expressed by the communities during the two rounds of public consultations conducted in this current study.

The “spin-off” economic benefits associated with the construction of the Nunavut-Manitoba road will have significant impacts to the regional economy in the following ways:

- Local hiring of construction workers and project spending on wages, materials and equipment during construction (direct impacts)
- Local hiring of maintenance workers and spending on wages, materials and equipment for the operational period of a winter road and eventually the all-weather road (direct impacts)
- Additional economic activities generated as a result of the construction-related purchases of goods and services from local and non-local suppliers (indirect impacts)
- Additional economic activities associated with the purchase of consumer goods and services incurred by the construction and maintenance employees within the region (induced impacts)

The new road will provide improvements in essential service to the local communities (e.g. medical and emergency services). In the year 1999/2000, a total cost of \$22 million was estimated for Medevac travel (emergency evacuation of patients from remote communities to regional health facilities) and Medial travel (travel by patients and families on a non-emergency basis) in Nunavut. It can be expected that substantial savings can be achieved with the provision of an all-weather road and more advanced medical facilities in Rankin Inlet, Churchill and other regional centres in northern Manitoba.

Furthermore, the proposed new road will bring about business and economic development opportunities in the region as a result of the improved access to labour, attraction of investment capital for resource development, reduction of supply and servicing costs, and greater recreational and tourism activities between and within the local communities. Given the size and scale of the project, the proposed road will likely be constructed as a long-term regional development initiative. Notable economic development opportunities associated with the proposed Nunavut-Manitoba road are discussed under the following headings: mineral exploration and development, tourism, commercial fishing, hydro-electric and utilities development, and the Port of Churchill.

¹⁹ Source: Sakku Investments Corp., an investment organization owned by the KIA.

²⁰ Government of Nunavut, 2006.

²¹ “All-Weather Road – East Side of Lake Winnipeg Justification and Scoping Study”, Manitoba Highways and Government Services, August 28, 2000.



Mineral Exploration and Development

It is anticipated that the new road would promote mineral resource development in the Kivalliq Region and northeastern Manitoba. In particular, the Rankin-Ennadai-Qamanirjuaq greenstone belt is considered to have excellent mineral potential and is comparable to the Abitibi greenstone belt in Ontario and Quebec for copper, gold, lead, nickel, platinum, silver and zinc.²² The preferred route of the Nunavut-Manitoba road is located in the vicinity of a number of known mining sites (see Section 5.1) that could benefit from the construction of the road in terms of reduced exploration and mining development costs, and reduced transport costs of supplies, equipment and ore concentrates at the operational phase of the mine. Road access will also increase the mining potential of the region as a whole since mineral deposits that are uneconomic without a road link may become economic if a road were available.

Mineral exploration and mining activities have the potential to generate significant social and economic benefits to the region in terms of employment, training and business opportunities, as well as direct taxes and royalties from the capital investments and mining revenues. According to economic models developed by the Government of Northwest Territories, a diamond mining operation could generate royalties in excess of \$600 million over a 25 year mine life, gold operations could provide \$60 million royalties over a 15-year mine life, and a base metal operation could provide \$20 to \$25 million royalties over a 20-year mine life.²³ Economic models developed by the Nunavut Tunngavik Incorporated (NTI), the organization responsible for the management of all Inuit-Owned Lands in Nunavut, suggested similar results in that a low-profit mine might pay royalties of \$35 to \$40 million, while a high-profit mining operation would be expected to pay royalties of up to \$80 and \$90 million over the life of the mine.²⁴ The NTI model further suggested that the Government of Nunavut would receive an amount of taxes equivalent to the royalties described above, while the Government of Canada would receive twice this amount in taxes. Taxes paid to the Nunavut Government would help to provide benefits to the local communities in the areas of housing, education and health care.

To ensure that the benefits from mining development in an area would flow to local residents and businesses, impacts and benefits agreements could be formulated between the regulatory authorities and the mining companies such that employment and business opportunities would largely stay in the local communities. The NTI has a mining policy requiring that, to the extent possible, the benefits of mining will remain in Nunavut. The Diavik Diamond Mine is a successful example of such an agreement.

Case Study: Diavik Diamond Mine

The Diavik Diamond Mine is located on a 20 square kilometre island approximately 300 kilometres northeast of Yellowknife, capital of Canada's Northwest Territories. The area was surveyed in 1992 and construction began in 2001, with production commencing in January 2003 and a mine life of 20 years. The Diavik Diamond Mine is an unincorporated joint venture between the UK-based Diavik Diamond Mines Inc. (60%) and Aber Diamond Limited Partnership (40%), a wholly owned subsidiary of Aber Diamond Corporation of Toronto, Ontario.

²² “Keewatin Regional Land Use Plan”, Nunavut Planning Commission, May 2000.

²³ Bullen, W. and Zhang, J. (2003): “The Economics of Mining Projects in the Canadian Arctic”, in Proceedings, Seventh International Symposium on Mining in the Arctic; CIMM, pp. 3-18.

²⁴ “Background Paper On the NTI Uranium Policy”, Department of Lands and Resources, Nunavut Tunngavik Incorporation, November 2006.



The site is connected by an ice road to Yellowknife and a 1.6 km gravel runway that regularly accommodates Boeing 737 jet aircraft. The project has now become an important part of the regional economy, employing an average of 700 people, grossing \$100 million in sales, and producing 8 million carats (1,600 kg) of diamonds annually.

Under the Diavik Social-Economic Monitoring Agreement (SEMA) established in 1999, the project is committed to providing training, employment and business opportunities to residents in Northwest Territories and the west Kitikmeot Region of Nunavut, including the following:²⁵

- During project construction: 40% northern workforce and 74% of northern purchasing, representing \$900 million worth of northern contracts, of which \$600 million was with Aboriginal companies; direct annual wages to all employees during the 20-year mine life is forecast to be \$30 million per year.
- During project operations: 66% northern employment and 40% aboriginal employment, 70% of annual supplies of goods and services from northern companies (\$223 million total operations spending in 2004)
- Scholarship programs to support education among aboriginal bands, communities and schools at all levels (close to \$1 million awarded through some 500 individual scholarships); community-based training partnerships created 250 graduates during construction
- Total \$6.4 million provided to communities for capacity building and general wellness programs
- Total cumulative spending with northern businesses in excess of \$1.7 billion, or 74% of \$2.3 billion project spending since 2003

Tourism

It is likely that the new road would stimulate tourism and recreation activities in the region by providing land access to the parks, lakes and communities along the road. In the study area, the combination of large lakes and wilderness areas will provide measurable benefits to local businesses providing goods and services to the road travellers and tourists. Net tourism benefits will result in additional employment within the region and capital investments in lodges, restaurants and other recreational facilities. These benefits could be significantly enhanced if the road development were conducted in conjunction with a regional tourism development plan in Kivalliq and northern Manitoba.

Commercial Fishing

The proposed all-weather road will provide access to more commercial fishing quotas in northern Manitoba and Kivalliq. The Kivalliq region is home to large populations of fresh and saltwater fish which are currently harvested for subsistence use in the local communities. The new road will enable development of larger-scale commercial fishing in the region and generate an increase in the economic value to the industry.

²⁵ Source: Diavik Diamond Mines website: <http://www.diavik.ca>.



Hydro-electric and Utilities Development

As discussed in Section 5.2 above, the proposed Nunavut-Manitoba road could provide significant benefits to hydro-electric, utilities, and other land-based communications development in the region. The road corridor will offer a natural transmission line route interconnecting potential hydro-electric generating sites to the various load centres along and beyond the road limits. The supply of hydro-electricity to the northern communities could displace remote diesel generated electricity with its attendant concerns, such as dependence on non-renewable fossil fuel, as well as air quality and greenhouse gas implications. Dam structures would provide crossing opportunities for the NU-MB road. In fact, river crossings along the preferred route were selected at or near potential hydro sites

Port of Churchill

The Port of Churchill is a strategic connection point for the Nunavut-Manitoba road for a number of reasons. It is Canada's foremost international arctic port and is key to the northern regions' integration into the world economy. With the existing rail and port system, the port supports a network of northern communities and industries, and is the principal staging and supply centre for the Kivalliq communities. To date, the port contributes \$26 million to the national GDP and employs over 359 person-years annually.²⁶ The new road is expected to provide significant economic benefits to the port in terms of increased north-south imports and exports through the port. It will reinforce Manitoba as the service centre for the Kivalliq Region in the provision of efficient, cost-effective and reliable supply of dry goods, perishables and fuel to the Kivalliq communities, and increase Manitoba's competitiveness with other regional gateways in Quebec, Ontario and Saskatchewan. At the national level, the Port of Churchill is Canada's gateway to the arctic region and the proposed terminal of the Marine Arctic Bridge from Russia, Europe and Asia. All these developments would hinge, to a large degree, on the provision of an all-weather road linking Churchill to the rest of Canada and North America.

In summary, construction of the new road will provide direct economic "spin-off" benefits to the region and to local communities in terms of employment, income and GDP. Indirect and induced benefits will also be realized in the form of increased travel, education and business opportunities when the road is in place. To estimate and quantify these "spin-off" benefits of the Nunavut-Manitoba road, a multiplier analysis could be conducted. Regional and national versions of Statistics Canada's Interprovincial Input-Output Model could be used to capture the direct, indirect and induced impacts from the road construction upon employment, income and GDP in Manitoba, Nunavut and Canada respectively. This analysis is not in the scope of the current Route Selection Study, but could be conducted on a stand-alone basis to support funding decisions before proceeding to the next phase of the project. The Manitoba Bureau of Statistics has developed their own models for highway construction and maintenance in their jurisdiction and could be approached to run the models for the Manitoba portion of the Nunavut-Manitoba road.

In addition, a comprehensive economic impact analysis could be conducted as part of the Route Feasibility Study in the immediate next step of the project to quantify the benefits associated with economic development opportunities as a result of the new road. Further studies on the

²⁶ "Manitoba's Northern Transportation Partnerships", Presentation to Northern Transportation Conference, November 14, 2005, Manitoba Transportation & Government Services.



renewable and non-renewable resources in the region would be carried out, and the impacts of the road on the development potential of these resources would be estimated.

7.2 National Highway Policy

During the last two decades, considerable effort has been undertaken by Transport Canada and the provincial and territorial highways and transportation ministries to identify criteria for inclusion of existing highways in the national system; the condition of these highways relative to nationally agreed performance criteria; and the financial costs, environmental impacts and social benefits associated with bringing deficient highways up to the agreed performance criteria. It is generally recognized by the national, provincial and territorial transportation ministries that: *“A national highway is any existing, primary route that provides for interprovincial and international trade and travel by connecting as directly as possible a capital city or major provincial (or territorial) population and commercial centre in Canada with:*

- *another capital city or major population and commercial centre*
- *a major port of entry or exit to the U.S.A. highway network*
- *another transportation mode served directly by the highway mode²⁷*

National highways also include regionally important primary routes that currently serve resource or recreation purposes. Historically, when the Government of Canada have created national infrastructure improvement cost sharing programs, provinces and territories have often earmarked a substantial proportion of the available funding to achieve improvement and strengthening of the National Highway System.

Currently the identified National Highway System in Manitoba includes the Trans Canada Highway i.e. Provincial Trunk Highways (PTHs) 1, 16 and 100; PTH 6 from Winnipeg to Thompson; and PTH75 from Winnipeg to Interstate 29. The Port of Churchill has no all-weather road connection to the rest of Manitoba or Canada. It is connected by rail to the National Highway System at Thompson. Passengers and freight are transported on the railway, known as the Hudson Bay Railway, which connects to the CNR at The Pas. The passenger service is not daily.

The new territory of Nunavut has some limited road segments (often a few kilometres long) within communities but no roads connecting the often widely scattered communities to one another. Iqaluit, the capital of Nunavut, located on Baffin Island across the Hudson Strait from northern Quebec and Labrador, cannot, in practice, be connected by road to the rest of Canada. However, Rankin Inlet, the administrative and commercial centre of the Kivalliq Region of Nunavut, can be connected by road to both Churchill and the National Highway System in Thompson. The proposed Nunavut-Manitoba road, together with portions of Provincial Roads (PRs) 280, 290 and 391 in Manitoba, will accomplish this connection.

²⁷ “National Highway Policy Study for Canada”, Steering Committee Report on Phase 3, September 1990.



To bring this connection up to national highway criteria would eventually require the following:

- Design speed 100 km/h
- Operating speed 90 km/h
- Two lanes, arterial, undivided (RAU)
- Full shoulders (0.8 m paved shoulder)
- All-weather service (no seasonal load restrictions) carrying national standards for vehicle weights and dimensions
- Riding Comfort Index (RCI) of 6.0 or greater

While satisfying all of these criteria may not be achievable for many decades, we believe implementation of a pioneer all-weather, gravel top road, with a top width of 8 m (two-way operation) connecting Rankin Inlet and Churchill to the National Highway System at Thompson, would meet national transportation policy objectives and as such make the project eligible to receive funding from a federal infrastructure cost sharing program

7.3 Project Funding Considerations

Considering that one key mandate of the Nunavut-Manitoba road is to provide a road connection to Nunavut to reinforce Canadian sovereignty and national interest in the north, it is assumed that the project will be funded primarily using public funds. To understand the scale of capital investments required for the road, a sample capital budget is shown in Table 7-1 based on the preferred staging plan for the all-weather road discussed in Section 6.3.²⁸ From Year 6 to 10, an annual capital budget of \$78 million will be required for the Nunavut portion of the all-weather road between Rankin Inlet, Whale Cove and Arviat. For Year 11 to 20, an annual capital budget of \$24 million and \$43 million will be required respectively for Nunavut and Manitoba to complete the cross-boundary section between Arviat and Churchill. For Year 21 to 25, an annual capital budget of \$26 million will be required for the last section of the road from Sundance/PR290 to Churchill River in Manitoba. Such funding commitments will likely be beyond the reach of the regional and territorial capacities of Manitoba and Nunavut for construction of a single highway project. It is anticipated that the Government of Canada will be the primary funding partner for the Nunavut-Manitoba road, given what we understand to be the federal mandate for the proposed road.

²⁸ Since the location and phasing of the winter road has yet to be confirmed at later stages of this project, the sample capital budget discussed here excludes the cost of the winter road.



Table 7-1: Sample Capital Budget for Nunavut-Manitoba Road (Preferred Staging AWR)

		Year 6-10 All-weather Road Capital Budget	Year 11-20 All-weather Road Capital Budget	Year 21-25 All-weather Road Capital Budget
Nunavut	i) Rankin Inlet– Whale Cove – Arviat (340 km)	Total \$388 million \$78 million/yr		
	ii) Arviat – NU/MB Boundary (190 km)		Total \$238 million \$24 million/yr	
Manitoba	iii) Churchill – MB/NU Boundary (390 km)		Total \$427 million \$43 million/yr	
	iv) Sundance/PR 290 – Churchill River (180 km)			Total \$128 million \$ 26 million/yr
Total Cost (\$ million)		\$388	\$665	\$128
Total Construction		340 km (68 km/yr)	580 km (58 km/yr)	180 km (36 km/yr)

Note: Capital budget is based on the capital cost for the road segment in 2006 Dollars, including engineering, mobilization, construction and contingency, excluding property acquisition.

For project funding considerations among the various public and private entities, potential beneficiaries of the proposed all-weather Nunavut-Manitoba road (and therefore potential cost-sharing partners) are listed in Table 7-2 below.

Table 7-2: Project Beneficiaries and Cost-sharing Opportunities

Cost-sharing Entities	Project Benefits
Government of Canada	<ul style="list-style-type: none"> • Fulfillment of national policy direction to provide reliable, all-weather, year-round, surface transportation inter-connection between all provinces and territories (NU is the current exception) • Reduced cost of providing social and medical services (due to reduced passenger travel & freight costs and increased employment opportunities) • Enhanced sovereignty and security in northern Canada to counter international challenges to Canada’s jurisdiction <ul style="list-style-type: none"> ○ E.g. navigation through the Northwest Passage
Government of Nunavut	<ul style="list-style-type: none"> • Reduced resupply costs to remote communities (with no roads) served from Rankin Inlet <ul style="list-style-type: none"> ○ E.g. Baker Lake, Chesterfield Inlet, Repulse Bay, Coral Harbour • Reduced cost for exporting local products: packaged caribou meat, fish, cottage industry products such as traditional clothing, carving and artwork • Enable large-scale resource development <ul style="list-style-type: none"> ○ E.g. mining, eco-tourism, improved access to granular materials • Improved standard of living & increased employment • Opportunity to consolidate public institutions and infrastructure (economy of



	scale) in communities directly connected to road, such as colleges, medical services, docks and airports, government services
Government of Manitoba	<ul style="list-style-type: none"> • Enhanced service centre for Kivalliq region <ul style="list-style-type: none"> ○ Reliable resupply of dry goods, perishables, fuel and medical services • Develop Port of Churchill as international gateway <ul style="list-style-type: none"> ○ Improved trade opportunities and access to world markets • Improved access to parks and potential mine sites in Northern Manitoba and Kivalliq
Manitoba Hydro, Qulliq Energy Corp (NU) and other utility companies	<ul style="list-style-type: none"> • Potential for joint corridor use with reduced construction, accessibility and maintenance costs <ul style="list-style-type: none"> ○ Electricity transmission lines (shared power to and from the north) ○ New hydro-electric generation sites ○ Other electricity generation sites e.g. wind power ○ Oil or natural gas pipelines ○ Telecommunications (e.g. fibre optic cable)
Mining Companies	<ul style="list-style-type: none"> • Improved accessibility and reduced resupply costs to new mines and promising mineral exploration sites • Reduced transportation cost for exporting mining products

7.4 Community Access Program Approach

Since the Nunavut-Manitoba road is considered an important initiative of the long-term development strategies in the Canadian North, a Community Access Program Approach can be used for the road construction. This approach would shift the focus from short-term road construction to long-term economic development in the region, using a multi-jurisdictional, interdisciplinary and multi-phased approach to provide stimulus to the regional economy and training opportunities for the local population. It would provide opportunities for using existing training and business development programs and resources in the First Nations and Inuit communities for the construction and operation of the new road. This approach has already been used in Nunavut to a certain degree with the construction of all-weather trails out of Rankin Inlet, towards the Meliadine River, Iqalugaarjuup Nunanga Park and Landing Lakes; out of Whale Cove towards the west; out of Arviat towards the Maguse River; as well as at Chesterfield Inlet.

Constructing the road using a Community Access Program Approach would require that the provincial or territorial governments focus certain activities on the road, including community consultation, education and economic development, which are the focal points of this approach. Options for private sector involvement and contributions could also be explored in training and labour force development. Such options will depend on further resource development in the region, which will be an important study focus in the immediate next phase of this project.

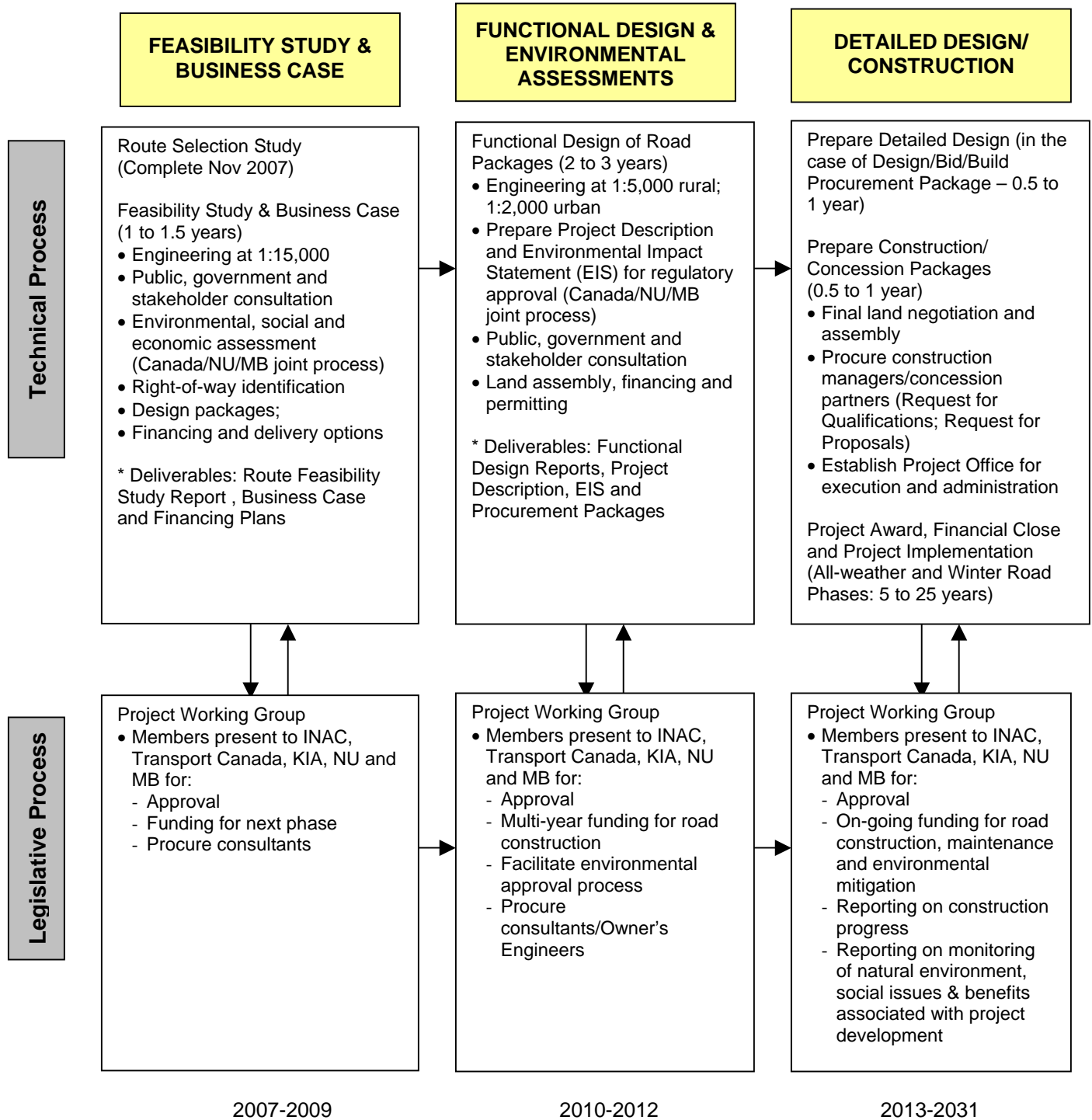


8.0 NEXT PHASES OF ROAD DEVELOPMENT PROJECT

With the completion of the Route Selection Study, it is estimated that a five year period would be required for the road development from feasibility study, environmental assessment, functional and detailed engineering, financial modelling, land assembly, to permits application. The road construction could then start in Year 6 and be completed by Year 25 depending on the funding, delivery and construction phasing decisions from the respective jurisdictions (as discussed in Sections 6.0 and 7.0 above). The future development phases of the proposed Nunavut-Manitoba Road are depicted in Figure 8-1 below. Project tasks and activities are identified in each development phase under two parallel processes: technical and legislative. Depending on the construction/procurement packages, project development could be fast-tracked by overlapping the design, permitting, financing and construction phases, by early engagement of First Nations, regulatory agencies, stakeholders and industry participants, and by possibly employing a public-private partnership model for project financing and procurement. These decisions will need to be explored in more details in Business Case and Route Feasibility Study that follow this current study.



Figure 8-1: Future Development Phases of Proposed Nunavut-Manitoba Road





9.0 CONCLUSION AND RECOMMENDATIONS

This report concludes the work completed under a two-year multidisciplinary study to determine the best location for a road route linking the community of Rankin Inlet in the Kivalliq Region of Nunavut to the Port of Churchill in Northern Manitoba and the existing all-weather road transportation network in Manitoba. Three groups of all-weather route corridors were initially generated in the route engineering, socio-economic and environmental scoping analysis. After the first round of public consultations, these corridors were refined to three competing route alternatives, namely the Western, Central and Eastern Alternatives connecting to Manitoba's all-weather road network at Lynn Lake, Thompson and Gillam respectively, all in combination with a Northern Common Route from Rankin Inlet to Churchill.

Using a Multiple Account Evaluation (MAE) framework consisting of financial costs, transportation benefits, social/community, natural environment and economy/national interest accounts, the three route alternatives were evaluated based on how each alternative met the project goals. Based on the results of the MAE, the preferred route was identified to be the Eastern Alternative (in combination with the Northern Common Route), connecting Rankin Inlet to Sundance/PR290 near Gillam, including a link to Churchill. The rationale for selecting this preferred route is summarized as follows:

- Most effective, safe and reliable route from Rankin Inlet, Whale Cove and Arviat to Churchill and Thompson in light of its length, the terrain, the lowest construction and maintenance costs and ease of staging
- Strong support from directly affected communities along the route
- Moderate environmental impact due to shortest length of new road construction and avoidance of all protected areas except the Bradshaw Lake ASI (the width of the Great Beach on which the route is located through this protected area appears to be sufficient to allow for adequate mitigation of impacts along this feature).
- Greatest potential for early extension of the National Highway System to Churchill and Nunavut and in so doing, to address inter-jurisdictional trade opportunities, national sovereignty and security needs.

The preferred route was then presented to the Project Steering Committee, the Project Advisory Committee, the affected communities along the route, and other government/non-government agencies in the second round of public consultations. Generally, strong support was received from the stakeholders and the general public on the prospect of the Nunavut-Manitoba road via the preferred route. First Nations representatives stated that their communities have come to recognize the need for an all-weather road and would adapt to changes associated with a new road. There were concerns that the three remote communities in northwestern Manitoba (i.e. Brochet, Lac Brochet and Tadoule Lake) would not be connected by an all-weather road. It was suggested that the need for an all-weather road by the western communities (in addition to an all-weather connection from Nunavut and Churchill to Gillam) be documented even though it might not be a mandate of the Nunavut-Manitoba Route Selection Study.

Following the selection and consultation of the preferred route, some further technical studies were conducted for the refinement of the preferred route in the areas of terrain analysis, bridge



crossings and potential impacts on environmentally sensitive and protected areas. Mining interests, hydro-electric and utilities development prospects were also explored to identify opportunities for joint corridor development along the preferred route. Finally, work staging and implementation considerations were undertaken, project funding opportunities explored and future development phases suggested.

9.1 Technical Feasibility

One key goal of the Route Selection Study was to determine whether it is technically feasible to build an all-weather road from Rankin Inlet to connect to Churchill and Manitoba's all-weather road network. In this study, we have concluded that the Eastern Route Alternative (NRA+ERA) is the best route for this connection and that this route would be technically feasible. Recognizing that the foundation conditions are the controlling factor vis-à-vis the technical performance of the all-weather road, we summarize the technical challenges of each road segment along the preferred route as follows:

a) Rankin Inlet to Caribou River:

- This entire segment lies within the present continuous permafrost zone. This segment is not expected to present unusual performance problems if the road foundation can be maintained frozen. How quickly the continuous-discontinuous boundary will move north from climate warming is unknown. As this boundary moves north with climate change, more of the segment south of the Caribou River is expected to become discontinuous permafrost. At that time, the alignment will develop similar problems to segments that are in the discontinuous permafrost zone, as described in the road segments further south.

b) Caribou River to Seal River:

- This segment of the preferred route is one of the more questionable segments between Rankin and Sundance with respect to foundation performance owing to the potential effects of climate change.
- This segment consists of granular material in esker sections alternating with coarse till. The segment is partly in discontinuous permafrost (south portion) and partly in continuous permafrost (north segment). Climate change may cause some of the continuous permafrost segment south of Caribou River to become discontinuous within an unknown time frame. Till sections in the approximately south half of this segment are expected to perform similar to many till segments along the Churchill railway, Thompson-Gillam, Thompson-Lynn Lake, and Leaf Rapids-South Indian highways, where local cross-section restoration from thaw settlement is required from time to time. Thaw-settlement problems and treatments of these existing road segments in Manitoba can be referenced when constructing and maintaining this new road segment of the NU-MB road.

c) Seal River to Weir River (30 km north of Sundance/PR290):

- The road foundation consists of nearly continuous granular material in a long variable width beach ridge. No significant foundation problems are expected on this segment in what is termed "widespread discontinuous permafrost", with the exception of a few short segments of grade requiring cross-section restoration from thaw settlement.



d) Weir River (30 km north of Sundance/PR290) to Sundance/PR290:

- This segment consists of extensive ice-rich bog peat in discontinuous permafrost. Expected route performance is similar to that along the Churchill railway. The grade may need cross-section restoration resulting from ground ice melt-out (thaw settlement) in the road foundation. Thermosyphons can also be used for ground cooling and stabilization for this section of the road. These have not, however, been included in the cost estimates.

While climate and snow conditions are important factors affecting the performance of the road, it is important to note that road and railway foundations built over continuous and discontinuous permafrost are presently in use in Canada as well as in other countries worldwide (e.g., Scandinavia and Siberia). Example of roads and railways built in Canada in similar climate zones include:

In the discontinuous permafrost zone:

- Churchill railway - settlement problems are ongoing while railway is still in use after 80 years;
- Leaf Rapids to South Indian Settlement in Manitoba;
- Gillam to Lynn Lake in Manitoba;
- Ponton to Thompson in Manitoba;
- Parts of the Dempster Highway in the Yukon and the Northwest Territories;
- Roads leading to Yellowknife, Northwest Territories;
- Parts of northern Saskatchewan where all-weather highways have been built.

In the continuous permafrost zone:

- Parts of the Dempster Highway in the Yukon;
- Inuvik to Arctic Red River to Fort McPherson, Northwest Territories;
- Ekati and Diavik winter roads in the Northwest Territories diamond mine area.

These roads and railways could be referenced in the more detailed design phase of the NU-MB road project to draw on lessons in road construction and maintenance in the northern region.

9.2 Study Recommendations

The key recommendations for the next phases of this project are summarized as follows:

- Conduct feasibility study and business case to confirm the alignment and financial feasibility of the preferred route, including:
 - detailed route engineering using large-scale, ground-controlled aerial photos along the preferred route
 - hydrology design for major bridge crossings along the preferred route
 - local transportation studies to determine the tie-in points of the proposed road to existing trails, municipal infrastructure and other airport/port facilities



- benefit cost analysis and financial modelling to confirm project financial feasibility, and to determine construction scope, financing options and procurement packages
- Conduct environmental, social and economic impact assessment to secure project permits and licenses required before construction commences, including:
 - Detailed environmental survey for the entire route from Rankin Inlet to Churchill to Sundance/PR290, including an inventory of the natural and social environmental features to avoid, mitigate or compensate (e.g. archaeological/cultural artifacts, flora & fauna, fisheries and fish habitat, wildlife and wildlife habitat, trap lines and sacred sites)
 - Confirm avoidance/mitigation of proposed road on caribou calving ground, McConnell River Migratory Bird Sanctuary, Caribou River Provincial Park, Bradshaw Lake ASI and other protected areas
 - Conduct an inventory of renewable and non-renewable resource and harvesting data (e.g. caribou, quarries/mineral extraction, forestry, fisheries)
 - Update mining and mineral exploration activities in the vicinity of the preferred route
 - Confirm hydro-electric development plans and prospects with Manitoba Hydro and Qulliq Energy
- Conduct official consultation with the First Nations communities along and affected by the preferred route as required by the regulatory guidelines
- Approach the Governments of Canada, Nunavut and Manitoba, First Nations and other key stakeholders for project approval and funding for the next development phases of the project.



APPENDIX 1
MINERAL EXPLORATION MAPS
NUNAVUT AND MANITOBA



APPENDIX 2

Letter from Nunavut Planning Commission

April 10, 2007



APPENDIX 3

Excerpts of Environmental Guidelines

From Manitoba Infrastructure and Transportation

July 26, 2007