Andrew Gamble & Associates
14 Mitchell Drive, Yellowknife, NT, Canada X1A 2H5

Ms. Kimberley Cliffe-Phillips
Environmental assessment Officer
Mackenzie Valley Environmental Impact Review Board
Yellowknife, NT

May 25, 2004

Dear Ms. Cliffe-Phillips;

Deh Cho Bridge – Developer's Assessment Report

Enclosed are 35 copies of the revised Developer's Assessment Report and Appendix 1 – Updated Project Description, prepared on behalf of the proponent, the Deh Cho Bridge Corporation. All other appendices remain as originally submitted on April 7.

It is our hope that the information provides a full response to the Terms of Reference and deficiency report provided by the Mackenzie Valley Environmental Impact Review Board for the Environmental Assessment of this project.

Please do not hesitate to contact us for any further information that may assist in the process.

Sincerely,

Andrew Gamble

enclosures

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Deh Cho Bridge Corporation

Deh Cho Bridge

Developer's Assessment Report
to the
Mackenzie Valley Environmental Impact Review Board

Prepared by

Andrew Gamble & Associates
&
Jivko Engineering

Revised May 25, 2004

Contents

Appendices

1. Updated Project Description – Jivko Engineering (Revised May, 2004)
  - **1-A** Plans & drawings
  - **1-B** Schematic Spills Contingency Plan

2. Key correspondence relating to permit applications (May 1, 2003 to date)

3. Mackenzie Valley Land and Water Board (MVLWB): Application for a Water License under Mackenzie Valley Resource Management Act (submitted May 2003).

4. Canadian Coast Guard (CCG): Application under Navigable Waters Protection Act, s 5(1)(a) (submitted March 2003).

5. Department of Fisheries and Oceans (DFO): Application for Authorization for Works Affecting Fish Habitat under Fisheries Act, s. 35(2) (submitted January 2003).

6. Mackenzie Valley Land and Water Board (MVLWB): Land Use Permit Application under Mackenzie Valley Resource Management Act (submitted April 2004).

7. Draft Community Benefits Commitment Plan (November 2003)

8. Report to the DCBC on Community Benefits Commitment Plan – Michael M. Nadli (Feb., 2004)

9. Motions and Letters of support

10. Deh Cho Bridge Act (Assent, June 13, 2003)

11. Memorandum of Intent between the Community (Bridge Corporation) and the GNWT (November 2002)

12. Benefit-Cost Analyses of the Deh Cho Bridge – Nichols Applied Management (September, 2002 & February, 2003)

13. Commercial vehicle Traffic Forecast, Mackenzie River Crossing – PROLOG Canada Inc. (September, 2002)

14. Golder Associates Ltd. 2004. Fisheries assessment of the Mackenzie River at Ft. Providence, NT – Proposed Deh Cho Bridge. Prepared for Jivko Engineering, Yellowknife, NT. Golder Report No. 03-1370-021: 89 p. + 6 app.

15. Trillium (Trillium Engineering and Hydrographics Inc.). 2002. Updated Hydrotechnical Information for Mackenzie River Bridge at Ft. Providence. Prepared for Jivko Engineering Ltd., 25 November 2002. 33 p. + ADDENDUM, Ice Load Analysis for New Pier Geometry, Jan 08, 2004, 14 p.

16. EBA Engineering Consultants Ltd. 2004. Geotechnical/Materials Evaluation, Proposed Deh Cho Bridge Fort Providence, NT. Prepared for Jivko Engineering, February 2004. 25 p.+ 7 app

A Summary

A.1 Non-Technical Summary

Please provide a plain language, non-technical summary of the Developer's Assessment Report (DAR) to enable the public to follow the proceedings.

A.1.1 Background

An all weather road extends 530 km from the Alberta border north, crossing the Deh Cho (Mackenzie River) at Fort Providence and continuing to Rae-Edzo and Yellowknife, the NWT capital city. Winter roads connect to other Tli Cho (Dogrib) communities and to gold and diamond mines in the Slave Geological Province. This route serves over half the NWT population. Yellowknife also serves as an important air hub for the rest of the NWT and western Nunavut.

Since the road to Yellowknife was completed in 1968, it has been steadily upgraded. As of this date, 460 km have been reconstructed to a 100-km/hr design standard and paved or surface treated. The remaining 70 km between Rae and Yellowknife are scheduled for completion over the next three years.

The River at Fort Providence is crossed by ferry from late spring to early winter and by an ice bridge in the winter and spring. Since 1987, the ferry has operated into January or February through a channel cut in the ice, until the ice bridge is strong enough for heavy trucks.

When operating normally, it is estimated that the crossing (ferry or ice bridge) adds at least 20-30 minutes to a trip. The crossing is closed for an average of 4 weeks during spring break-up. Service is also interrupted with little notice for 1 to 3 weeks in the fall and early winter, due to low water levels and ice jams and while the ice forms sufficiently to cut the ferry channel. During these periods of isolation, there is no road connection between the region and southern Canada. Any passenger traffic must be by air. Freight traffic to the region is also interrupted, with some diverted to air cargo between Edmonton or Hay River and Yellowknife. Some freight is also trucked to the river, transferred onto slings and shuttled by helicopter across the river where it is loaded onto other trucks and transported onward by road.

A bridge crossing at Fort Providence has been considered since before the road was completed. A Public Works Canada conceptual design from 1975 estimated the cost in the range of $25 - 30 million (current dollars). Inflated to today's dollars, this would be about $70 - 80 million.

It is generally accepted that a bridge crossing of the River at Fort Providence would provide a net environmental benefit as well as considerable economic stimulus and long-term direct cost savings to the Community of Ft. Providence and to business, government and consumers in the North Slave Region. However, given the cost and competing priorities for government spending, the bridge has remained in federal and GNWT plans as a 'future' priority.

A.1.2 Project Description

The Deh Gah Got'ie Dene Band and Fort Providence Métis council recognized a significant long-term business opportunity under a partnership arrangement with the territorial government. This would likely prove attractive to government and fast track the crossing construction under an ideal Private-Public Partnership agreement.

The general concept proposed is similar to that used successfully in other infrastructure projects in southern Canada - for example, the Confederation Bridge linking PEI and New Brunswick and Highway 407 in Toronto, as well as numerous other smaller scale projects.

The basic elements of the proposal are:

- The Deh Cho Bridge Corporation (DCBC) will raise sufficient equity and debt financing to design, finance and construct the bridge to agreed standards.
- The GNWT and DCBC will enter into an agreement for a 35 year *Concession Period*, during which the DCBC will own, operate and maintain the bridge.
- During this period, the GNWT will pay a contribution of approximately $1.5 million annually from ongoing ferry/ice bridge savings. The GNWT will also collect and pay a toll of $5 to $6 per tonne on commercial freight crossing the bridge, netting approximately $3 million annually.
- Total revenues (approximately $4.5 million in year 1) will be used to service and retire the debt, operate and maintain the bridge and provide a return on shareholder equity.
- Annual costs will include debt servicing (interest and principal) of approximately $3.5 million and O&M of approximately $0.5 million, for a total year 1 cost of approximately $4 million.
- Revenues will increase with traffic and inflation, while costs will increase with inflation only, resulting in an increasing return on equity.
- At the end of the Concession Period, ownership of the bridge will revert to the GNWT, free of debt. At this time, the GNWT could suspend its annual contribution and tolls. Both the government and users would continue to benefit from ongoing savings.

A.1.3 Current Status

Since inception of the proposal in 2000, the proponents have established the Deh Cho Bridge Corporation Ltd. (DCBC). The GNWT and Federal DIAND and have provided funding and loan guarantees for feasibility studies, business planning, design and environmental assessment. TD Securities has been retained to provide construction and long-term debt financing. Designs are being reviewed by the GNWT and finalized by th DCBC. The DCBC has reached an agreement-in-principle with the GNWT on the Concession Agreement.

Regulatory permits are the final key requirement for the project to proceed.

Following permit applications submitted for screening to the Mackenzie Valley Land and Water Board, the Department of Fisheries and Oceans and Coast Guard, the project was referred for environmental assessment to the Mackenzie Valley Environmental Impact Review Board in February of 2004. This was done on the basis of economic concerns expressed by the Nunavut & NWT Chamber of Mines.

The Board finalized terms of reference for the Developer's Assessment Report (DAR) on March 5, 2004. The initial DAR was submitted to the MVEIRB on April 6, 2004. It was subsequently distributed and reviewed for conformity to the terms of reference.

On April 21, the MVEIRB requested additional information to satisfy the requirements of the DAR. This revised report is the Deh Cho Bridge Corporation's response to the MVEIRB terms of reference and subsequent conformity report. The main body of the DAR and Appendix 1 have been revised. Appendices 2 through 16 have not changed.

A.1.4 Developer's Assessment of the Project

The Developer's Assessment Report describes the Deh Cho Bridge Corporation and the proposed development, including the timing, construction methods and plans for management and restoration of all construction areas and disposal of wastes. It describes the finished bridge and its ongoing operations and maintenance.

The report outlines public and stakeholder consultation and notes the broad support from government, business, the community and the general public. It identifies issues raised and developer efforts to respond to concerns.

Table A1 – Key Socio-Economic Impacts

Stakeholder	Positive Impacts	Negative Impacts	Mitigation
Community of Ft. Providence	Construction phase training, employment, local business and joint venture opportunities. Operations phase employment. Income form equity in DCBC. Future opportunities from joint ventures and skills developed. Benefits from reinvestment of DCBC dividends.	Potential for negative social impacts during construction, due to non-resident workforce and increased community incomes. Loss of seasonal ferry employment and local contracts.	yes yes
Public and consumers	Net savings in consumer goods and services Improved access and reduced isolation Reduced risk of shortages		
Trucking Industry	Reduced travel time and distance. Improved scheduling and equipment utilization. Increased volumes	Toll payment and administration	yes
Business	Lower overall cost for goods. Reduced cost for alternative transport (air freight) Reduced risk of shortages Regional economic stimulus	Reduced business for air carriers	no
Mining Industry	More reliable link to Yellowknife	Higher net transportation cost	no
Government	Reduced costs for good and services Fiscal benefits Economic stimulus Supports Aboriginal objectives		
Overall	Net Increase in community and Northern Employment Net reduction in cost of living for region Net present value of benefits exceeds costs by $38 million at 5% discount rate. Overall Internal Rate of Return is 8.5% Economic stimulus during construction and operations		

It assesses potential social, economic, cultural, heritage, land use, aesthetic and environmental (air, land and water) impacts, positive and negative. It identifies measures proposed to manage and mitigate risks and maximize benefits.

The assessment indicates that net economic benefits to users exceed the costs. It further indicates that environmental disruption and risk will be relatively low and largely confined to the construction phase and that there will be long-term environmental benefits from replacing the current ferry and ice crossing with a permanent bridge.

Table A1 summarizes the key socio-economic costs and benefits, by user group. Table A2 summarizes the significant environmental impacts, risks and proposed mitigation measures, both during and after construction.

The proponent concludes that the project will provide net long-term socio-economic and environmental benefits to the community of Ft. Providence and the North Slave Region.

Table A2 – Significant Environmental Impacts & Risks

Phase	Predicted Positive Impacts	Predicted Negative Impacts and Risks	Mitigation
2 year Construction Phase		Air quality – increase in dust and emissions. Disturbance to soils and vegetation. Release of sediments and/or chemicals into water. Disturbance to fish habitat Disturbance caused by construction noise. Risk of (fuel) spills	Yes Yes Yes Yes Yes Yes
75 year + Operations Phase	Reduced consumption of fossil fuels by ferry and reduction in trip length and waiting times. Elimination of sediments from erosion of ferry landings and ice bridge approaches. Elimination of noise, erosion and habitat disturbance from ferry propeller wash. Eliminated risk of spill on ice crossing, ferry and ferry ramps. Reduction in disturbance due to noise from ferry operation, air shuttle and trucks on winter access detours Net gain in fish habitat.	Disturbance to habitat from increase in traffic and noise on bridge and highway. Increased mortality from increase in traffic and noise on bridge and highway. Effects of structure on birds. Risk of spill (fuel or other) on bridge	Yes Yes Yes Yes
Overall	Short term construction impacts not significant with proposed mitigation measures. Anticipate net long term benefit and reduction in risk to environment		

A.2 Executive Summary

Please provide an executive summary of the DAR, containing the most relevant points for decision-makers.

A.2.1 The Developer

The Deh Cho Bridge Corporation Limited (DCBC) was incorporated in Yellowknife on November 28th, 2002). It was incorporated for the sole purpose of building, owning and operating the Deh Cho (Mackenzie River) bridge crossing on the Yellowknife Highway at Fort Providence.

The two shareholders in the Corporation are the Deh Gah Got'ie Dene Band and the Fort Providence Métis Council. The Corporation has a six member Board of Directors, consisting of three nominees of each of the two shareholders. All are Aboriginal residents of Ft. Providence.

The Board is accountable to the Shareholders, providing direction to the staff and consultants and formally approving all contracts, expenditures, major commitments, decisions and any delegation of authority. The Board's latitude is bound by territorial legislation, the DCBC Articles of Incorporation, Shareholder's Agreement and Resolutions and by the terms of agreements with the GNWT and TD Securities.

A Chief Operating Officer (COO) currently staffs the DCBC office in Ft. Providence. Operating within the direction and authority of the Board, the COO supports Board meetings and decisions and provides day-to-day liaison between the Board, consultants and contractors, community organizations and the general public. The COO also manages consultant contracts and expenditures, participates in negotiations with GNWT and TD Securities and leads co-ordination of community benefits planning.

The Corporation has also retained consultants to provide expert advice and support to the Board. The responsibilities, authorities and accountabilities for each are, or will be, defined in contracts for each phase of the work. Consultants include;

- A Project Manager
- Design Engineers and Other Engineering Specialists
- An Environmental Consultant
- A Lead Financing Agency
- Financial Structuring, Financial Management & Audit Consultants
- Legal Counsel
- An Insurance/Risk Management Consultant

The DCBC has developed a Community Benefits Commitment Plan, in consultation with community shareholder organizations. This plan outlines commitments of the corporation to ensure business, training and employment opportunities for residents during the construction and operations phases. It also outlines shareholder commitments to investment and distribution of any retained earnings and dividends.

The Corporation is relying on its design and environmental team to ensure that the design and construction of the bridge meets the highest environmental standards. The design team and environmental contractors have records of environmental responsibility. Measures are being taken to ensure that all contractor(s) have the capability, experience, performance records and contract obligations to meet the required environmental standards.

Environmental monitoring will be a key activity during and after construction.

A.2.2 Development Description

The bridge design and construction plan has been developed and optimized based on detailed investigation and analysis of:

- ✓ Topographic surveys
- ✓ Soils investigations
- ✓ River hydrology studies
- ✓ River ice studies
- ✓ Highway traffic studies
- ✓ River navigation requirements
- ✓ Wind effects on structure
- ✓ Environmental assessments
- ✓ Structural analysis
- ✓ Costs and benefits
- ✓ Climate
- ✓ Location and logistics
- ✓ Public concerns
- ✓ All applicable codes and standards

Alternative locations, designs and construction schedules have been examined to optimize the project. It has been subject to independent expert review on behalf of the GNWT.

The Deh Cho Bridge will be a two lane structure totaling 1,045 metres in length, constructed at the current ferry crossing site (See drawings in Appendix 1).

The substructure will consist of 8 reinforced concrete footings and piers and two abutments. The structure will consist of 9 steel girder spans, with a precast concrete roadway (deck). The main span will allow a clear navigational opening width of 185 metres and vertical clearance of 22.5 metres at high water level, meeting the requirements for navigation on the river.

The piers and abutments will be cast in place concrete, while the superstructure will consist of steel girders, with precast concrete deck panels. The longer main span will be supported by portals and stays to reduce the unsupported length of the main span girders.

Construction will take approximately 24 months, commencing in the fall of 2004. The total estimated construction contract value is $51 million. With project development, design, supervision and financing costs adding approximately $6 million, the total project cost is estimated at $57 million.

During the construction phase of the project, activity will focus on the 2,720m x 60m construction corridor. However, there will also be ancillary activity in other areas adjacent to the site (camp, concrete plants, materials lay down and storage) and at 7 separate quarries and pits in various locations. As a major 2-year construction project, the work will be undertaken in several distinct phases or components.

The general contractor has yet to be selected. It is anticipated that general contractors will examine a range of alternatives to optimize the construction approach. The project description makes assumptions about the most probable alternative approaches to be taken. Table A3 outlines the major construction components and timing.

Access for building materials would largely be by existing transportation corridors. Supplies (steel, concrete, equipment) would likely be mobilized from the south by Highways 1 and 3 to the site. Alternatively, materials supplied from the south may be transported via rail to Enterprise and truck to the site, or by rail to Hay River and by truck or barge to the site.

Bulk granular material would be transported by truck from identified pits and quarries. Granular material required to cross the river would be moved in the winter, via the ice crossing, not the ferry.

Summer access to in-river works for constructing the piers and erecting the superstructure may employ floating barges or temporary bridges supported on the river bottom. Winter access could use the ice or temporary bridges. Any temporary fixed or floating bridges or barges would be removed before spring and fall ice traffic on the river.

At no time would these temporary works be allowed to interfere with ferry operations or with marine traffic on the Mackenzie River.

There are comprehensive plans for waste management during construction and site restoration on completion of construction.

Table A3 - Major Construction Components and Timing

Component	**Timing**
Granular Production & Haul	Sept. 2005 – Oct 2006
Pier footings	May – Nov 2005
Piers	June-July 2006
Steel Superstructure fabrication	Mar. 2005 – Apr. 2006
Concrete deck Fabrication	Mar. 2005 – Aug. 2006
Superstructure erection	Mar. Sept 2006
Deck Installation	Aug. 2006- Oct
Finishing (rails, lighting, etc.)	Sept. – Oct 2006
Open to Traffic	Nov 2006
Final Cleanup	July 2007

Once construction is complete, the operation of the bridge will be more stable and less disruptive, with routine maintenance and repairs to the structure and approaches.

The structure is designed for a long life with minimal maintenance and rehabilitation required. Major components are reinforced concrete piers and abutments, high strength precast and pre-stressed concrete deck and an unpainted weathering steel superstructure. The substructure and superstructure components have a design life of 75 years and a practical life that should be longer.

The design also incorporates features allowing for quick repair/replacement of components, such as curbs, railings and lights that may fail prematurely or be damaged by collision.

Routine maintenance activities include regular inspection of all superstructure and substructure components for signs of wear, damage and erosion, and repair, if required. Special attention will be paid to any signs of erosion near the pier-footings or abutments and to the cleaning of bearings and expansion joints.

The bridge deck will require snow removal and the use of sand or fine gravel when icing is present. The deck would be cleaned and broomed in the spring to remove accumulated sand and other debris. There are no plans to use chemical de-icers or cleaning agents, as these may accelerate bridge deterioration as well as raising environmental concerns.

The design incorporates features to reduce the probability and reduce or eliminate any inconvenience or disruption to traffic from possible accidents.

The post-construction plan includes a program for monitoring of any changes to water quality or fish habitat. Particular attention will be paid to early detection and remediation of any signs of erosion around the pier foundations, abutments and road approaches. This will include underwater inspection of the river bottom at the pier footings.

A.2.3 Public Consultation

Development of this proposal has included almost three years of ongoing efforts to consult with all affected parties, by providing information, seeking views of stakeholders and incorporating changes to respond to concerns. Consultation efforts have included environmental and socio-economic issues.

Consultations undertaken, since inception of the proposal in July of 2000 have included:

- Periodic briefings, presentations and public forums with the community of Ft. Providence, including various local organizations, businesses and the public at large.
- Consultation with other communities and First Nations in the region and with the NWT Association of Communities and City of Yellowknife.
- Industry Associations, including the NWT and Yellowknife Chambers of Commerce, the Chamber of Mines and the NWT Motor Transport Association.
- Individual trucking, construction, engineering, mining, manufacturing and retail business
- All current commercial shippers using the Mackenzie River for barging.
- Frequent briefings and interviews with local, territorial and national print and broadcast media.
- Numerous informal discussions and meetings with business owners, political leaders and members of the general public.
- Meetings and correspondence with officials of the federal and territorial governments and regulatory agencies.

The proposal has gained and maintained broad support of the Community of Ft. Providence, Deh Cho leaders, government, business, the trucking industry and the general public. Most stakeholders believe the bridge will have positive environmental and socio-economic impacts.

Only the Chamber of Mines has expressed serious reservations about the costs and benefits for their operations and these concerns were subsequently withdrawn.

The DCBC continues to seek and respond to requests for information, presentations and meetings with the media, business organizations, community and aboriginal leaders, government and regulatory agencies.

The Board has developed a *Community Benefits Commitment Plan*, to be presented for approval at a public meeting in Ft. Providence. The Board has also made a commitment that the final decision to proceed with the project will not be made without a final public review of the project agreements by the community.

In addition to the efforts of the DCBC, there were public hearings held by the NWT Legislative Committee considering the Deh Cho Bridge Act. This legislation was amended, recommended and passed into law by the NWT Legislature in June of 2004.

Following submission of screening applications by the DCBC to the Mackenzie Valley Land and Water Board (MVLWB) and the Department of Fisheries and Oceans, the MVLWB undertook distribution to affected communities and agencies.

Issues raised generally fall into two categories - environmental and economic.

Environmental

Environmental responsibility has been a pre-requisite to community support since the inception of the proposal. On balance, the community is satisfied that their concerns have been considered in the design and construction plan and that any short term disturbance and residual risks will be mitigated and are outweighed by potential long-term benefits.

Agencies, including Federal departments of Fisheries and Oceans (DFO), DIAND and Environment Canada submitted questions for clarification and additional information during the environmental screening through the MVLWB. These questions and responses form part of the public registry with MVEIRB and are included in Appendix 2 of this report.

Economic

The proposed Concession Agreement includes a commercial vehicle toll in the range of $5-$6 per tonne of freight. This would not apply to light, non-commercial vehicles. Much of the business and public reaction has been based on individual assessment of the potential benefits of the bridge and costs of the toll.

For the Community of Ft. Providence, this project is expected to have both positive and negative socio-economic impacts, during and after construction. On the positive side, the construction phase will create community business, training and employment opportunities. During operations, there will be continued employment in maintenance and operations, while the projected return on equity will provide a sustainable source of income to the community to invest in local social and economic priorities.

On the negative side, concerns have been expressed about the social impacts of a large non-resident workforce during construction and the potential negative side effects of increased community incomes. Over the long term, there will be a loss of seasonal jobs on the ferry and ice bridge.

The Community Benefits commitment Plan is being developed by the Board of the DCBC, in consultation with the community. This plan has focused on accommodating community concerns to optimize the benefits and mitigate the potential negative impacts. The DCBC is committed to having this plan endorsed by the community and has committed to ensuring community support for a final decision to proceed with the project.

On balance, the consensus view of residents is the benefits exceed the costs and are greatest if the community participates in the project.

The proponent and the GNWT Department of Transportation has met with NWT Motor Transport Association and individual trucking companies. The industry sought and received assurances that the maximum toll would not exceed the proposed $5-$6 maximum. There was also concern about toll collection procedures and enforcement. Industry prefers a simple configuration based toll with limited administration burden. Both the DCBC and GNWT (who will administer toll collections) support this. Based on these understandings, the NWTMTA supported the bridge proposal at hearings on the Deh Cho Bridge Act.

There has been a generally positive reaction from retail and other business in the region. Most see the potential benefits of a bridge crossing. Many feel that this infrastructure should be provided without tolls, while recognizing that government would be unlikely to make the investment in the near term. Some have undertaken the analysis on the economic benefits and costs. The key concern is that tolls remain within the range proposed and that they do not result in an increase in the overall cost of doing business.

The mining industry has expressed concern through the NWT and Nunavut Chamber of Mines to the Minister of Transportation and through correspondence with the MVLWB. This industry relies on seasonal winter road resupply of mines north of Yellowknife and believes that the costs of tolls would exceed potential benefits of more reliable year round access to Yellowknife. It was this concern that resulted in a referral of the project by DFO to the MVEIRB. The Chamber has subsequently withdrawn its intervention.

The Public reaction has been positive. There is to be no toll on private vehicles. The key concern is that tolls do not result in an increase in the cost of living.

Both the GNWT and federal DIAND have been strong supporters. GNWT has provided $230,000 in contributions and a loan guarantee of $2 million for project development. The GNWT has enacted enabling legislation, signed an Agreement-in-Principle and are actively negotiating a Concession Agreement with the DCBC. DIAND has provided $292,000 in contributions and committed to a $3 million equity contribution to the project.

A.2.4 Socio-Economic Impacts

The project has been subject to independent assessment on behalf of the proponent and the GNWT. It has also been reviewed by other government and regulatory agencies during the preliminary screening of permit applications.

The impacts during the 2 year construction phase are quite different from the 35 year plus operations phase and these are considered separately.

Direct Economic Impacts

The valued components considered in assessing direct economic impacts include:

- Local employment, during and after construction
- Local business opportunity, during and after construction
- Regional employment, during construction
- Regional business opportunities, during construction
- Net user costs/savings
- Benefits of improved access - time savings, reliability and convenience
- Net cost to government
- Net societal cost (Net Present Value of quantifiable costs and benefits)

Table A4 summarizes the key positive and negative direct economic impacts identified for each of these components, indicating the duration, geographic extent, direction (positive or negative), relative magnitude and significance. This table also notes the confidence in these predicted impacts and whether measures are proposed to mitigate impacts (minimize potential negative impacts/risks and maximize positive impacts).

The overall assessment is positive, with net economic benefits quantified for every group except the mines.

Indirect Economic Impacts

The valued components considered in assessing indirect economic impacts include:

- Local spending of wages during construction
- Regional spending of wages during construction
- Local economic development stimulus from reinvestment of operating profits (dividends).

- Local employment from reinvestment of operating profits (dividends).
- Regional economic stimulus
- Regional cost of living

Table A4 - Direct Economic Impacts

Project Activity (duration)	Valued Components	Impacts					
		Extent	Direction	Magnitude	Significance	Confidence	Mitigation
Bridge Construction (2 year duration)	Local employment	L	+	M	M	M	Yes
	Regional Employment	R	+	M	M	H	
	Local Business Opportunity	L	+	M	M	H	Yes
	Regional Business Opportunity	R	+	M	M	H	
Bridge Operations (years 3 to 35+)	Local employment	L	-	M	M	M	Yes
	Local Business opportunity	L	+	H	H	M	Yes
	Net User Costs	R	+	M	H	H	
	Time/ Convenience	R	+	M	H	H	
	Net Government Cost	T	+	L	M	H	
Combined (37 years)	Net Societal Cost	T	+	H	H	M	Yes

Extent: **L**ocal **R**egional **T**erritorial **Direction:** **+** beneficial **-** negative
Magnitude, Significance, Confidence: **L**ow **M**edium **H**igh

Table A5 summarizes the key economic impacts for each of these components, indicating the duration, geographic extent, direction (positive or negative), relative magnitude and significance. This table also notes the confidence in these predicted impacts and measures proposed to mitigate impacts (minimize potential negative impacts/risks and maximize positive impacts).

The reinvestment of the net income from equity participation in the project, estimated at $35 million, is expected to provide considerable indirect economic benefits to the community.

Socio-Cultural Impacts

The valued components considered in assessing socio-cultural impacts include:

- Local social impacts during construction
- Local and Regional accessibility/reliability of access
- Local impacts of traffic patterns and volume
- Local sense of control and self-reliance
- Development of local skills and capacity
- Local social and cultural impacts of bridge corporation incomes

Table A6 summarizes the key socio-cultural impacts for each of these components, indicating the duration, geographic extent, direction (positive or negative), relative magnitude and significance. This table also notes the confidence in these predicted impacts and measures to mitigate impacts (minimize potential negative impacts/risks and maximize positive impacts).

Table A5 - Indirect Economic Impacts

Project Activity (duration)	**Valued Components**	**Impacts**					
		Extent	**Direction**	**Magnitude**	**Significance**	**Confidence**	**Mitigation**
Bridge Construction (2 year duration)	Local spending of construction incomes	L	+	M	M	H	
	Regional spending of construction incomes	R	+	M	M	H	
Bridge Operations (Indefinite duration)	Local economic development stimulus	L	+	H	H	H	Yes
	Local indirect employment	L	+	H	H	H	Yes
	General regional economic stimulus	R	+	M	M	M	
	Exploration & Mining Sector	R	-	L	L	M	
	Regional cost of living	R	+	L	H	H	

Extent: **L**ocal **R**egional **T**erritorial **Direction:** **+** beneficial **-** negative
Magnitude, Significance, Confidence: **L**ow **M**edium **H**igh

Cultural and Heritage Resources

The land based construction footprint of the bridge is entirely within the current highway right-of way, in an area already disturbed and utilized for the highway embankment and ferry infrastructure. No archeological or heritage resources have been identified by Fort Providence First Nations or by the Prince of Wales Northern heritage Centre or by any other parties during the preliminary screening of the project.

Land Use/Aesthetics

The area includes a mix of existing traditional and recreational land uses. Visual and aesthetic values are an integral component of the local recreational and tourism attraction.

The valued components considered in assessing impacts on land use and recreation include:

- Impacts on existing uses and activities during construction
- Impacts on existing uses and activities during operations

Table A7 summarizes the key potential impacts for each of these phases, indicating the duration, geographic extent, direction (positive or negative), relative magnitude and significance. This table also notes the confidence in these predicted impacts and measures to mitigate impacts (minimize potential negative impacts/risks and maximize positive impacts).

Table A6 - Socio-Cultural Impacts

Project Activity (duration)	Valued Components	Impacts: Extent	Direction	Magnitude	Significance	Confidence	Mitigation
Bridge Construction (2 year duration)	Local social impacts during construction	L	-	L	M	M	Yes
Bridge Operations (Indefinite duration)	Local and Regional accessibility/ reliability of access	R	+	M	M	H	
		L	-	M	L	M	
	Local impacts of traffic patterns and volume	L	-	L	L	M	
	Local sense of control and self-reliance	L	+	H	H	H	
	Development of local skills and capacity	L	+	M	M	M	Yes
	Local social and cultural impacts of bridge corporation incomes	L	+	M	H	H	Yes

Extent: **L**ocal **R**egional **T**erritorial **Direction:** **+** beneficial **-** negative
Magnitude, Significance, Confidence: **L**ow **M**edium **H**igh

Table A7 – Impacts on Land Use and Visual/Aesthetic Resources

Project Activity (duration)	Valued Components	Impacts: Extent	Direction	Magnitude	Significance	Confidence	Mitigation
Bridge Construction (2 year duration)	Impacts on existing uses and activities	L	-	M	M	M	Yes
	Impacts on Visual/Aesthetic Resources	L	+	M	M	H	
Bridge Operations (Indefinite duration)	Impacts on existing uses and activities	L	+	M	M	H	
	Impacts on Visual/Aesthetic Resources	L	+	M	M	M	

Extent: **L**ocal **R**egional **T**erritorial **Direction:** **+** beneficial **-** negative
Magnitude, Significance, Confidence: **L**ow **M**edium **H**igh

A.2.5 Environmental Impacts

The assessment considers impacts on air, land and water and on the habitat and related plant and animal species. For this project, the potential impacts on water quality, fish habitat and fish are very important.

The potential environmental impacts occur in two distinct phases. During construction the disturbance and risk to the environment is higher. Once construction is complete, the new regime should result in a condition that is more stable. The project design and implementation plan includes all reasonable measures to minimize risks and mitigate predicted impacts. Over the long term, it is expected that the construction of a bridge to replace the current ferry and ice crossing will result in a net environmental benefit.

Impact assessment criteria are used to rate the potential effects of the proposed project on each valued environmental component. Predicted impacts are assessed according to the following criteria: Direction, Magnitude, Extent, Duration, Frequency, Confidence, Reversibility and Significance.

Air Quality and Climate

Certain project actions will release emissions to the atmosphere, primarily due to fuel combustion (construction equipment, power generators, space heating, and transportation vehicles), explosives detonation and fugitive dust (excavation, drilling, quarrying and crushing, wind erosion, and road dust). The potential for the release of greenhouse gas is also recognized.

The key impacts to the air environment will likely result from dust and emissions from heavy equipment during construction. Although these effects will be minimized during construction, dust and emission levels in the vicinity of bridge will exceed natural background conditions. Following construction, these effects would return to normal (existing) conditions in the region.

Long-term net effects to air quality and climate are expected to be low and not significant, primarily due to the short construction period relative the to life of the project and eliminating use of ferry operations and maintenance equipment of the ferry and ice roads, thereby reducing vehicle emissions.

Terrain and Soils

Changes in soil capability may occur due to compaction, rutting, admixing of soil horizons, or as a result of changes in soil chemistry from spills. Soil erosion is a concern as a result of vegetation clearing; soils will continue to erode until successfully re-vegetated.

For this project, relatively small areas of vegetation will be affected, road construction will be limited to existing causeway approaches and impacts are primarily limited to the period of construction. Potential effects to terrain, soils, and vegetation are expected to be minimal and not significant.

Vegetation and Plant Communities

Potential impacts to vegetation could be either direct through clearing or indirect through potential increased dust or by alteration of drainage patterns. Areas most likely affected due to recommended highway improvements may include natural vegetation communities in proposed laydown areas used for staging equipment during construction (short-term effect).

Overall, the potential effects are rated as low and temporary (primarily restricted to the construction period), and not significant.

Water Quality

The following potential impacts to water quality may be associated with the various construction and operational aspects of the project:

- Suspended sediment loading during instream construction
- Release of sediments from surface runoff
- Water contamination from spills
- Water contamination from fill/construction materials

- Sediment or contaminant release during maintenance
- Sediments release from bank erosion or surface runoff
- Water contamination from spills

The main water quality issues related to the bridge project relate to the potential release of sediments or chemicals into the river channel, primarily during construction.

Mitigation measures include implementing standard erosion control measures (e.g. rip rap, re-vegetation), monitoring and follow-up maintenance, and the use of adaptive management practices (as necessary).

Table A8 summarizes potential impacts and mitigation measures related to river water quality.

Table A8 – Summary of Overall Potential Impacts to Water Quality

Project Activity (duration)	**Valued Components**	**Impacts**							
		Direction	**Magnitude**	**Extent**	**Duration**	**Frequency**	**Confidence**	**Reversibility**	**Significance**
Bridge Construction (2 year duration)	Water Quality	-	L	L	M	L	M	Y	L
Bridge Operations (years 3 to 35+)	Water Quality	+	L	L	L	H	H	Y	L

Note**:** **Direction**: '-' = Negative; '+' = Positive. **Magnitude**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High. **Extent**: 'L' = Local; 'R' = Regional; 'T' = Territorial. **Duration:** 'I' = Immediate; 'S' = Short-term; 'M' = Medium-term; 'L' = Long-term. **Frequency**: 'L' = Low; 'M' = Medium; 'H' = High. **Confidence**: 'L' = Low; 'M' = Medium; 'H' = High. **Reversibility**: 'Y' = Yes; 'N' = No. **Significance**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High. See text for more/detailed mitigation.

Overall, the Deh Cho Bridge project will not have significant water quality impacts during all phases of the project. This conclusion is primarily based on the following:

- The bridge footprint and construction areas are small relative to the large size of the Mackenzie River
- construction design/plans and schedules incorporate several mitigation measures resulting in a net effect of minimizing or avoiding the potential for water quality effects
- there are benefits to water quality associated with the discontinuation of existing ferry and ice road operations.

Water Quantity

Changes in channel shape may result as a consequence of bridge structures (e.g., approaches, abutments, and pier) encroaching instream. Erosion is a concern as a result of hydraulic/flow and ice scour alterations in and around bridge features.

The following potential impacts to water quantity were identified for activities associated with the project (e.g., construction of bridge approaches and instream pier construction/placement).

- Alteration to channel hydraulics preventing fish movement
- Changes in channel hydraulic form resulting in downstream erosion or deposition
- Channel blockage (ice jams, flow restriction)
- Channel aggradation/degradation over time

The mitigation measures for reducing / eliminating alterations to the river channel form and scour/erosion within the project area include construction to prevent ice scour and erosion (rock aprons comprising 0.5 to 1.0 m granite rip rap will be placed around the perimeters of pier footings and bridge approaches to prevent scour)

Table A9 summarizes potential impacts and mitigation measures related to river water quantity (hydrology/hydraulics) for each valued component.

Table A9 – Potential Impacts to Water Quantity

Project Activity (duration)	**Valued Components**	**Impacts**							
		Direction	**Magnitude**	**Extent**	**Duration**	**Frequency**	**Confidence**	**Reversibility**	**Significance**
Bridge Construction (2 year duration)	River Channel	-	L	L	S	L	M	Y	L
	Scour / Erosion	-	L	L	S	L	H	Y	N
Bridge Operations (years 3 to 35+)	River Channel	+	L	L	L	H	H	Y	N
	Scour / Erosion	-	N	L	L	H	H	Y	N

Note**: Direction**: '-' = Negative; '+' = Positive. **Magnitude**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High. **Extent**: 'L' = Local; 'R' = Regional; 'T' = Territorial. **Duration**'I' = Immediate; 'S' = Short-term; 'M' = Medium-term; 'L' = Long-term. **Frequency**: 'L' = Low; 'M' = Medium; 'H' = High. **Confidence**: 'L' = Low; 'M' = Medium; 'H' = High. **Reversibility**: 'Y' = Yes; 'N' = No. **Significance**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High. See text for more/detailed mitigation.

Overall, the project <u>will not have significant water quantity impacts</u> during all phases of the project. This conclusion is primarily based on the following:

- Locating the bridge at an existing ferry crossing, thereby avoiding introduction of new river channel features that may greatly affect hydraulic/channel characteristics
- Construction design/plans resulting in a net effect of widening the river, thereby reducing water velocities and any potential for 'constrictive' flows
- Bridge design and mitigation will not facilitate undue scour and ice jams.

Aquatic Resources and Habitat

The following potential impacts to aquatic resources were identified in relation to major project actions (i.e., construction of bridge approaches and piers, removal of barge landing area, normal bridge operations etc.).

- Alteration or loss of fish habitat as a result of the installation of the bridge
- Fish disturbance caused by the addition of fill, cofferdam construction and the movement of equipment (sediment impacts to fish health)
- Restriction or blockage of fish passage during construction
- Fish mortality or disturbance as a result of sediment release or chemical spills during construction
- Alteration of fish habitat as a result of the presence of the bridge
- Restriction or blockage of fish passage
- Fish mortality as a result of sediment release or chemical spills

The proposed bridge project has the potential to impact fish habitat through the loss of habitat directly associated with the footprint of the bridge, and through changes to adjacent habitat. However, the project will also result in gains of habitat due to removal of existing ferry infrastructure. Overall, the site will experience a net gain of 5970 m^2 of aquatic habitat.

Table A10 summarizes the scope, magnitude and significance of the potential impacts on aquatic resources.

Table A10 – Summary of Overall Potential Impacts to Aquatic Resources

Project Activity (duration)	**Valued Components**	**Impacts**							
		Direction	**Magnitude**	**Extent**	**Duration**	**Frequency**	**Confidence**	**Reversibility**	**Significance**
Bridge Construction (2 year duration)	Aquatic Resources	-	L	L	M	L	M	Y	L
Bridge Operations (years 3 to 35+)	Aquatic Resources	+	L	L	L	H	M	Y	L

Note**: Direction**: '-' = Negative; '+' = Positive. **Magnitude**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High. **Extent**: 'L' = Local; 'R' = Regional; 'T' = Territorial. **Duration**: I' = Immediate; 'S' = Short-term; 'M' = Medium-term; 'L' = Long-term. **Frequency**: 'L' = Low; 'M' = Medium; 'H' = High. **Confidence**: 'L' = Low; 'M' = Medium; 'H' = High. **Reversibility**: 'Y' = Yes; 'N' = No. **Significance**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High. See text for more detailed mitigation.

Overall, it appears that the Deh Cho Bridge project will have a positive effect on aquatic resources in the study area. This conclusion is based primarily on the following:

- The bridge footprint and construction areas are small relative to the large size of the Mackenzie River
- construction design/plans and schedules incorporate several mitigation measures which will minimize or avoid residual impacts to aquatic resources
- there are water quality benefits associated with the discontinuation of existing ferry and ice road operations
- there is a net increase in aquatic habitat area following installation of the bridge (due largely to the removal of the barge landing facility and the subsequent addition of high quality near-shore habitat).

Wildlife and Wildlife Habitat Species at Risk Act (SARA)

Primary impacts on wildlife associated with bridge/road construction and operation include reduction/alteration in habitat, effects on wildlife movement, and indirect effects on mortality and interference in nesting, breeding, migrating and over wintering activities.

The route will avoid key moose/ungulate habitat and other important wildlife areas (wetlands, marshes and fens). Specifically, the proposed bridge will be constructed on existing road and ferry infrastructure.

With the implementation of proposed mitigation measures, impacts of the project on wildlife are anticipated to be low and not significant.

Noise

Based on the nature of the project (e.g., effects mainly restricted to the construction phase of the project) and planned mitigation, potential long-term net effects to noise levels are expected to be low and not significant. This is primarily due to the short construction period relative the to life of the project and the elimination of ferry operations and maintenance equipment of the ferry and ice roads, thereby reducing overall noise emissions from vehicles.

A.3 Conformity Table

The DAR is requested to include a table cross-referencing the items in these Terms of Reference with relevant sections of the DAR.

Terms of Reference Section	Information Requested by MVEIRB	DAR Section(s) Containing Response
A	**Summary**	
A-1	*Non Technical Summary*: Please provide a plain language, non-technical summary of the Developer's Assessment Report (DAR) to enable the public to follow the proceedings.	A.1
A-2	*Executive Summary*: Please provide an executive summary of the DAR, containing the most relevant points for decision-makers.	A.2
A-3	*Conformity Table*: The DAR is requested to include a table cross referencing the items in these Terms of Reference with relevant sections of the DAR.	A.3
B	**Developer**	
B-1	*Company Corporate History*: Summarize the company's corporate history in Canada and the Northwest Territories. Also include the corporate histories of any partners.	B.1
B-2	*Proposed Development Ownership:* List all owners of the proposed developments and the portion each will own. Also include details of financial securities for government liabilities in the event of bankruptcy or other unforeseen failure to complete the project.	B.2
B-3	*Organizational Structure:* Identify corporate and individual responsibilities for the proposed development and associated operations.	B.3
B-4	*Operational Structure*: Describe the relationship between the parent company, its' contractors, and subcontractors. Also detail how the company will ensure the contractors and subcontractors utilized will be responsible for, and honour commitments made by the parent company.	B.4
B-5	*Environmental Performance Record:* Provide a record of environmental performance of the company and its contractors in conducting this type of development.	B.5
C	**Development Description**	
C-1	*Timing:* Provide the proposed schedule for the project, and identify any time constraints.	C.1
C-2	*Access Route:* Describe the access route for all building materials required for the proposed development. Also, describe the detour access route proposed for ferry traffic and bridge traffic during the various phases of construction, including any highway realignment activities.	C.2
C-3	*Construction Methods:* Describe the methods used to build the bridge, abutments and detour access roads.	C.3
C-4	*Operations:* Describe the operations in terms of timing, traffic volumes on the river and on the Highway. Also, describe the operations in terms of employees, contractors, schedules and worker accommodations.	C.4
C-5	*Maintenance Requirements*: Describe the projected maintenance	C.5

	requirements for the bridge, both short and long term. Include the physical nature of predicted maintenance activities as well as their frequency and potential environmental impacts. (*For example: will icing on the bridge result in the requirement for chemical control measures?*)	
C-6	*Waste Management:* Give a description of the proposed waste management plans and sites.	C.6
C-7	*Accidents and Malfunctions:* List any possible accidents or malfunctions that may occur and describe the procedures to be followed in such instances (include the probability, potential magnitude and potential environmental impacts of any such accidents or malfunctions*). Do proposed contingency plans include an alternative system of transport in the event that the bridge is closed to traffic for a long period of time due to structural damage?*	C.7
C-8	*Abandonment and Restoration:* Describe the plans for abandonment and restoration, including the construction site, detour access roads, ferry landings and the river bottom. Include plans for long term monitoring, maintenance and remediation.	C.8
C-9	*Air photos and Drawings*: Include a plan view drawing, to scale, of the proposed development superimposed on an air photo or satellite image of the site. Also include an elevation view drawing, to scale, of the proposed development.	Appendix 1a
C-10	*Other:* Describe any other relevant proposed activities or development components.	C.10
C-11	*Modifications*: Provide details of any changes or modifications to the development description as presented in the Preliminary Screening phase that may occur throughout the EA phase. This information should be provided on an ongoing basis.	C.11
D	**Effects of the Physical Environment**	
D-1	*Description of Effects:* List and describe all effects that the environment may have on your development (e.g. effects of ice movements in the Mackenzie River)	D.1
D-2	*Changes to Development:* List and describe any changes or modifications to your proposed development that may be caused by the environment (e.g. late river ice break-up, flooding).	D.2
E	**Alternatives** Provide an explanation of alternatives to the various parts of the development where appropriate alternatives are possible. This discussion shall include, but is not limited to, development timing and a description of potential environmental impacts that were considered when evaluating and selecting alternatives (e.g. why were certain types of equipment selected, why will the bridge spans be hauled by barge to the site etc.). Include consideration of environmental impacts from the current ferry system, and construction and operation of winter ice road crossing.	**E**

F	**Regulatory Regime** Provide a table summarizing relevant licenses, permits or other authorizations required for the proposed development. Also include a summary of land ownership and the present state of each license or authorization required.	**F**
G	**Public Consultation**	
G-1	*Records*: Provide minutes and a summary of consultation undertaken with the public, Aboriginal organizations, land owners, federal, territorial and municipal governments, industry, directly/indirectly affected communities of the North Slave Region and others. Include dates and participants. This should include clear evidence of, and details from, consultation directly with members of potentially affected communities (in addition to community-based corporations). It is particularly important to include details from consultation with community members from Fort Providence.	G.1
G-2	*Issues*: Identify the issues raised, how they were resolved and what issues remain unresolved.	G.2
H	**Assessment Boundaries**	
H-1	*Spatial:* Provide a rationale for setting the spatial boundaries for the impacts described below.	H.1
H-2	*Temporal*: Provide a rationale for setting the temporal boundaries for the impacts described below.	H.2
I	**Human Environment**	
I-1	*Direct Economic Impacts:* Describe potential direct economic impacts on the community of Fort Providence in particular, and on the other communities affected by all weather access across the Mackenzie River (e.g. employment, tolls, cost of local supplies and services).	I.1
I-2	*Indirect Economic Impacts:* Describe potential indirect economic impacts and their significance on the Northwest Territories (e.g. cost of living).	I.2
I-3	*Direct Socio-Cultural Impacts:* Describe potential direct impacts on the social and cultural environment of NWT communities affected by all weather access across the Mackenzie River (e.g. changes in traffic volume and results on other community attributes, effects on river users and river traffic).	I.3
I-4	*Indirect Socio-Cultural Impacts*: Describe potential indirect impacts on the social and cultural environment of NWT communities affected by all weather access across the Mackenzie River. Describe other indirect socio-cultural impacts (including impacts to current employees working on the Mackenzie River Ferry).	I.4
I-5	*Local Cultural and Heritage Resources:* Identify archeological and other heritage resources as well as sites or areas of cultural significance in or near the project area.	I.5
I-6	*Direct Cultural Impacts:* Describe potential direct impacts on sites or areas identified in I-5.	I.6
I-7	*Indirect Cultural Impacts*: Describe potential indirect impacts on any of the sites or areas identified in I-5 (e.g., through increased access by different user groups).	I.7

I-8	*Cumulative Effects*: Describe the impacts on any of the sites or areas identified in I-5 that this development may have in conjunction with previous, present, and reasonably foreseeable future developments.	I.8
I-9	*Traditional Land Use:* Discuss the potential impacts of the proposed development on traditional land use and occupation*.*	I.11
I-10	*Existing land use:* Discuss the potential impacts of the proposed project on existing land use and occupation*.*	
I-11	*Recreational Activities:* Discuss the potential impacts of the proposed development on recreational activities.	
I-12	*Visual and Aesthetic Resources*: Discuss the potential impacts of the proposed permanent structure on the visual and aesthetic resources of the area.	I.12
J	**Physical and Biological Environment**	
J-1	*Air Quality and Climate:* Discuss the potential impacts of the proposed development on the local and regional air quality and climate.	J.1
J-2	*Terrain and Soils*: Discuss the potential impacts of the proposed development on the local terrain and soils.	J.2
J-3	*Vegetation and Plant Communities*: Discuss the potential impacts of the proposed development on the local vegetation and plant communities.	J.3
J-4	*Water Quality and Quantity*: Discuss the potential impacts of the proposed development on the Mackenzie River's water quality and quantity in the immediate project area, downstream and upstream (e.g. substrate disturbance, increased suspended sediments, substrate type, water flow, water depth, channel width, ice flow, ice jamming, damming effects, and any other impacts related to spring ice breakup).	J.4
J-5	*Aquatic Resources and Habitat*: Discuss the potential impacts of the proposed project on the aquatic resources and habitat in the immediate project area and downstream (discuss the current habitat characteristics and range of species present, any potential impacts to fish and invertebrates, as well as any proposed monitoring plans).	J.5
J-6	*Wildlife and Wildlife Habitat*: Discuss the potential impacts of the proposed project on the wildlife and wildlife habitat in the project area. Specifically, examine the effects of the proposed development on wildlife movement along the riverbank as well as up and down the river itself (*e.g. what is the likelihood for collisions of migratory birds with the bridge structure under conditions of low visibility?*).	J.6
J-7	*SARA*: Pursuant to section 79 of the Species at Risk Act, conduct an assessment of the potential effects of the project on species at risk. This assessment should include: identification of species at risk that may be affected by the project, identification of measures to avoid, minimize, and mitigate potential effects on these species or their habitat, and a proposed approach to monitoring of these effects.	J.7
J-8	*Noise*: Discuss the potential impacts of the proposed project on the noise levels within the project area and surrounds.	J.8
K	**Cumulative Impacts**	
K-1	Predict the cumulative impacts that might result from the proposed development impacts in combination with other past, present or reasonably foreseeable future developments and activities*.*	K.1

B Developer

B.1 Company Corporate History:

Summarize the company's corporate history in Canada and the Northwest Territories. Also, include the corporate histories of any partners.

The Deh Cho Bridge Corporation Limited (DCBC) was incorporated in Yellowknife on November 28th, 2002). It was incorporated for the sole purpose of building, owning and operating the Deh Cho (Mackenzie River) bridge crossing on the Yellowknife Highway at Fort Providence.

B.2 Proposed Development Ownership:

List all owners of the proposed developments and the portion each will own. Also, include details of financial securities for government liabilities in the event of bankruptcy or other unforeseen failure to complete the project.

There are currently two shareholders in the Corporation – The Chief, in trust for the Deh Gah Got'ie Dene Band and the Fort Providence Métis Council. It is anticipated that additional equity partners will be identified before construction commences. However, the initial two shareholders will maintain at least 60% equity ownership.

The GNWT and federal DIAND have provided funding for feasibility studies and business planning. The GNWT has also provided a loan guarantee for DCBC investments in the pre-construction phase of the development, including design and environmental assessment.

As a public private partnership, the project includes a close contractual relationship between the GNWT and the DCBC.

Prior to commencement of construction, final agreements will be required between the DCBC, the GNWT and TD Securities. These agreements will also be subject to all parties approving the proposed construction contractor(s), contract securities and comprehensive insurance and risk management plans.

Under these agreements, the DCBC will provide $5 million in equity and TD Securities will arrange for approximately $50 million in debt financing. In the event of bankruptcy of the DCBC or unforeseen failure to complete the project, the parties will rely first on contract securities and insurance protection. TD Securities will have the right and considerable incentive to step in and complete the project to protect their investment. The GNWT will also have the right to acquire the assets of the DCBC.

Unlike some resource developments, this project does not require the production, accumulation, storage or disposal of potentially toxic waste products.

The proponent suggests that the combined equity and debt at risk from the DCBC, GNWT and TD Securities constitutes an adequate financial security for project completion.

B.3 Organizational Structure:

Identify corporate and individual responsibilities for the proposed development and associated operations.

B.3.1 The Deh Cho Bridge Corporation

The Deh Cho Bridge Corporation has a six member Board of Directors, consisting of three nominees of each of the two shareholders. All are Aboriginal residents of Ft. Providence. Current Board Members are:

- Michael Vandell - President
- Susan Christie – Secretary/ Treasurer
- Clifford McLeod - Director
- Wayne Vandell - Director
- Irene Lafferty - Director
- Berna Landry – Director

Acting on behalf of the Shareholders, the Board of Directors provides direction to the Chief Operating Officer and consultants and formally approves all contracts, expenditures, major commitments, decisions and any delegation of authority.

The Board's latitude is bound by territorial legislation, the DCBC Articles of Incorporation, Shareholder's Agreement and Resolutions and by the terms of agreements with the GNWT and TD Securities.

A Chief Operating Officer (COO) has been hired as the sole employee of the Corporation (on secondment from the Hamlet). Additional support staff will be required during the construction phase:

- Albert Lafferty

Operating within the direction and authority of the Board, the COO supports Board meetings and decisions and provides day-to-day liaison between the Board, consultants and contractors, community organizations and the general public. The COO also manages consultant contracts and expenditures, participates in negotiations with GNWT and TD Securities and leads co-ordination of community benefits planning.

B.3.2 Project Support Team

The Corporation has retained the following consultants to provide expert advice and support to the Board. The responsibilities, authorities and accountabilities for each are, or will be, defined in contracts for each phase of the work.

- **Project Manager** - *Andrew Gamble, Andrew Gamble & Associates (Yellowknife)*
  Provides overall coordination for the project and supports Board and Chief Operating Officer through advice and recommendations planning, strategies, public relations, negotiations and financial analysis.
- **Design Engineers -** *Jivko Jivkov, Jivko Engineering (Yellowknife) and John Spronken, J.R. Spronken & Associates Ltd. (Calgary)*
  The design team provides designs, estimates, construction logistics and schedule, tender documents and advice on contractor selection.
- **Other Engineering Specialists -** *Trillium Engineering and Hydraulics Inc. (Edmonton), AMEC (Vancouver), EBA Engineering Consultants Ltd. (Yellowknife), KJ Technical Services (Yellowknife), Dewinton Consulting Services (Okotoks AB), Davenport Wind Engineering group (London, Ontario)*
  Design work has been supported by specialist consultants in surveys, geotechnical investigations, hydrology, ice engineering, wind engineering and navigation.
- **Environmental Consultant -** *Golder Associates (Yellowknife)*
  Initial environmental scoping and studies required in support of the permit applications. Additional environmental support will be required for construction and post construction planning, monitoring and mitigation.

- **Financial Management & Audit -** *Dargo & Associates Ltd. (Yellowknife) and KPMG (Edmonton)*
  Provides the Deh Cho Bridge Corporation with professional advice and management assistance in the areas of financial administration, banking, board policies and audit.
- **Legal Counsel** – *Charles Thompson, Petersen Stang & Malakoe (Yellowknife) and Thomas Barlow, Fasken Martineau, Barristers and Solicitors (Toronto)*
  Provide general legal counsel and expert advice in structuring agreements.
- **Structuring and Finance** - *Michael Cautillo*, *Deloitte and Touche Structured Finance Inc. (Toronto)*
  To provide advice in overall project structuring, negotiating agreements, identifying and instructing the lead financial institution and construction contractor(s).
- **Economic Consultant** - *Nichols Applied Management (Edmonton)*
  To complete a study of benefits and costs including community and Aboriginal Benefits of the Deh Cho Bridge Project.
- **Traffic Analysis** - *PROLOG Canada Inc. (Calgary)*
  The GNWT retained consultant to undertake an analysis and forecast of commercial traffic, as the basis for agreements
- **Lead Financing Agency** – *TD Securities (Toronto)*
  To provide recommendations on and arrange for debt placement.
- **Insurance/Risk Management** - *INTECH Risk Management Inc. (Toronto)*
  To provide advice in all areas of insurance and risk management.

B.4 Operational Structure

Describe the relationship between the parent company, its' contractors, and subcontractors. Also, detail how the company will ensure the contractors and subcontractors utilized will be responsible for, and honour commitments made by the parent company.

The 2-year construction phase and 35-year plus operating phase are described separately.

B.4.1 Construction Phase

The DCBC Directors are appointed by and accountable to shareholders.

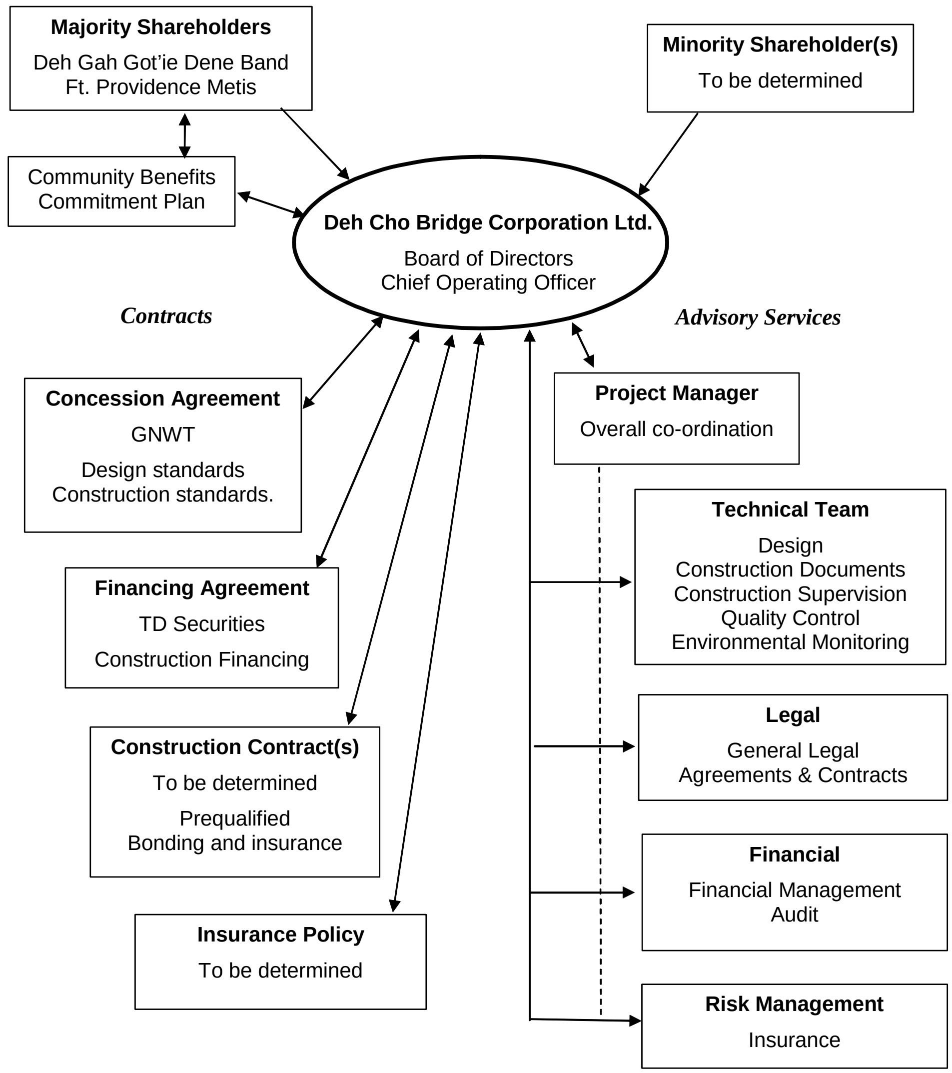
The Board is accountable to the Shareholders for the management of the corporation, including the hiring of and direction to staff and the selection and monitoring of consultants. The Board will review and approve all agreements and contracts to ensure they meet the interests and obligations of the shareholders, as defined in the Concession Agreement, financing agreement and Community Benefits Commitment Plan.

The DCBC office in Ft. Providence is currently staffed by a Chief Operating Officer, responsible to the Board. During construction, office staff will include a community employment co-ordination and clerical staff.

During the construction phase, the COO will support Board meetings and decisions and provides day-to-day liaison between the Board, consultants and contractors, community organizations and the general public. The COO will manage and monitor consultant contracts and expenditures, participate in negotiations with general contractor(s), GNWT and TD Securities. He will lead co-ordination monitoring and reporting of community benefits commitments, including training, hiring, subcontract and joint venture agreements.

Figure B1 shows the overall operational structure during the construction phase.

Figure B1 - Operational Structure
Construction Phase



The DCBC has developed a Community Benefits Commitment Plan (Appendix 7), in consultation with community shareholder organizations. This plan outlines commitments of the corporation to ensure business, training and employment opportunities for residents during the construction phase.

Key contracts and agreements during this phase are:

- Concession Agreement – with GNWT. This agreement outlines the developer's responsibility and GNWT approvals for design and construction standards and includes due diligence review of all DCBC contact arrangements.
- Financing Agreement – with TD securities. This agreement outlines the commitment to construction financing and includes due diligence by TD Securities.
- Construction Contracts – Contractor(s) to be determined. Potential contractors will be pre-qualified and approved by DCBC, GNWT and TD Securities, based on relevant

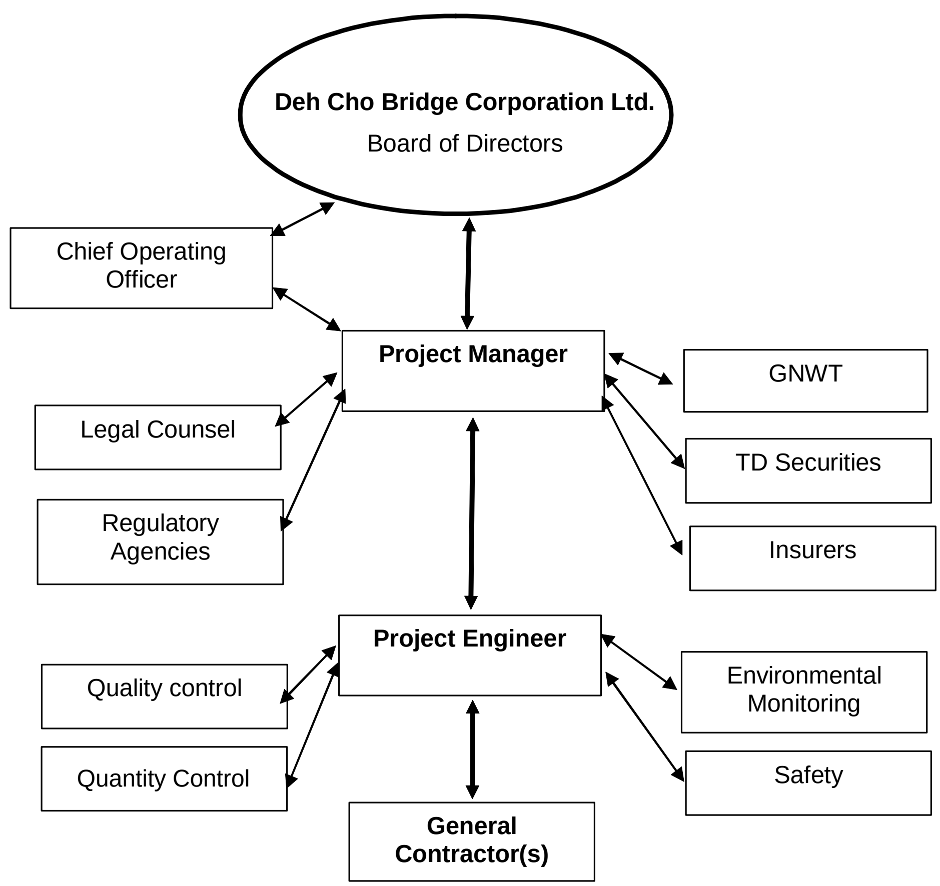
experience, past performance and financial capacity. Contacts will include commitments to environmental performance, community benefits, bonding and insurance. All contracts will include clear requirements to meet environmental and safety standards and community benefits commitments. Quality control procedures will ensure adherence to these commitments.

- Insurance Policy – Insurer to be determined. During this phase, insurance coverage will include builder's all-risk, wrap up liability and errors and omissions insurance. Policies and coverage will be reviewed by the DCBC, TD Securities, the GNWT and contactor(s), to ensure that they meet the needs all parties.
- Advisory Services (Consultant Contracts) – The DCBC has retained consultant expertise required to support the development and construction phase, including technical team (project management, engineering and environmental), legal, financial and risk management.

Construction Management

The level of activity and critical nature of this phase will require a high degree of organization and co-ordination, including clear definition of responsibilities and authorities and decision making processes.

Figure B2 - Construction Management



The construction management structure is illustrated in Figure B2. The Project manager would be given overall responsibility for construction progress, cost control and meeting the terms of all agreements, commitments and requirements. This will entail considerable authority to direct and co-ordinate overall construction activities and financial management, including day to day direction to the project engineer, progress payments and liaison with the lender, the GNWT, legal counsel, insurers and the COO. The Project Manager will provide regular progress reports to the COO and the Board.

The Project Engineer will direct the site work, providing day-to-day supervision of the general contractor(s). He would direct the work of all site support staff, including those responsible for environmental monitoring, safety compliance, construction testing/quality control, quantity measurement, cost control and scheduling. The Project Engineer will provide regular reports and recommendations to the Project Manager on all construction issues.

The COO will provide liaison between the Board and Project Manager and regular reports to the Board. He will also provide community liaison, local employment coordination and monitoring of community benefits obligations.

B.4.2 Operations Phase

During the operations phase, the Board will accountable to the Shareholders for the management of the corporation, including the hiring of and direction to staff and the selection and monitoring of consultants. The Board will review and approve all agreements and contracts to ensure they meet the interests and obligations of the shareholders, as defined in the Concession Agreement, financing agreement and Community Benefits Commitment Plan. The Board will also monitor and manage the overall financial health of the Corporation and ensure that earnings are managed in accordance with the Community Benefits Commitment Plan.

During this phase, the COO will support Board meetings and decisions and provide day-to-day liaison between the Board, consultants and maintenance contractors, community organizations and the general public. During the fist few years of operations, it is expected that there will be a higher level of environmental monitoring and inspections to ensure that the structure is performing as expected. The COO will manage and monitor consultant contracts and corporation finances (expenditures, revenues, retained earnings), participate in negotiations with maintenance contractor(s), GNWT and TD Securities. He will lead co-ordination, monitoring and reporting of community benefits commitments, including training, hiring, subcontract and joint venture agreements and management and distribution of retained earnings and dividends.

The DCBC has developed a Community Benefits Commitment Plan (Appendix 7), in consultation with community shareholder organizations. This plan outlines commitments of the corporation to ongoing business, training and employment opportunities for residents during the operations phase. It also outlines shareholder commitments to investment and distribution of any retained earnings and dividends.

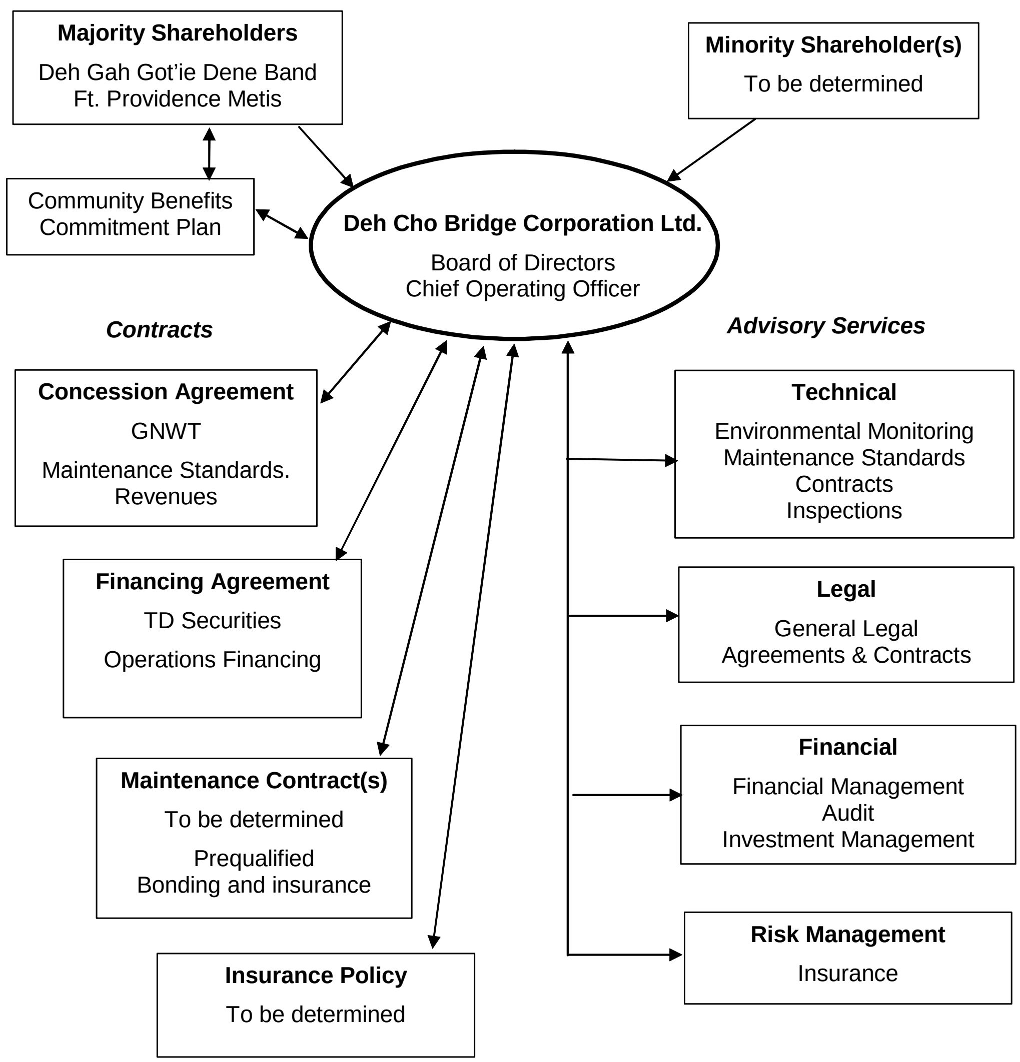
Figure B3 illustrates the operational structure anticipated during the 35-year concession period.

Key contracts and agreements during this phase are:

- Concession Agreement – with GNWT. This agreement outlines the developer's responsibility and GNWT approvals for inspection and maintenance standards and includes due diligence review of all DCBC contact arrangements.
- Financing agreement – with TD Securities. This agreement outlines the commitment to long-term bond financing and includes due diligence by TD Securities.

- Maintenance Contracts – Contractor(s) to be determined. Potential maintenance contractors will be pre-qualified and approved by DCBC, GNWT and TD securities, based on relevant experience, past performance and financial capacity. Contacts will include commitments to environmental performance, community benefits, bonding and insurance.
- Insurance Policy – Insurer to be determined. Coverage in the operations phase will include wrap up liability and accidental losses, as approved by the DCBC, GNWT and lenders.
- Advisory Services (Consultant contracts) – During the operations phase, the DCBC will continue to require technical expertise in environmental monitoring, bridge inspection and setting and monitoring maintenance contracts. There will also be an ongoing requirement for legal, financial and risk management advice.

Figure B3 - Operational Structure
Operations Phase



B.5 Environmental Performance Record*:*

Provide a record of environmental performance of the company and its contractors in conducting this type of development.

As a new company, the Deh Cho Bridge Corporation has no record of environmental performance. However, it is noted that the shareholders and directors are all Aboriginal residents of Ft. Providence and have made environmental responsibility a key requirement for the project.

The Corporation is relying on its design and environmental team to ensure that the design and construction of the bridge meets the highest environmental standards.

B.5.1 Design Team

J.R. Spronken & Associates

The listing below represents a partial listing of the bridge design and construction projects undertaken by J. R. Spronken & Associates.

In no case have there been any problems associated with these projects or concerns expressed concerning our work or the work of others where we have been in position of authority over the work undertaken.

Of particular interest is the work which was undertaken in the Athabasca River. This project was constructed during the winter months and during highly sensitive fish breeding season. The work included deep excavation within a cofferdam involving a large tremie concrete operation without causing any contamination to the river under the strictest guidelines ever encountered.

Cofferdam structures

- Muskeg River Project river inlet – Fort McMurray, Alberta
- John Hart Bridge – Calgary, Alberta
- Stoney Trail Bridge – Calgary, Alberta
- River inlet structure – Edmonton, Alberta
- Clover Bar Bridge – Edmonton, Alberta

Temporary Access Bridge

- Lytton Bridge– Highway #12, British Columbia
- Provencher Bridge – Winnipeg, Manitoba
- Old Man River Bridge – Taber, Alberta
- Smokey River Bridge – Grande Prairie, Alberta
- Lower Bosworth Bridge Rehab – Norman Wells, N.W.T.
- Margaree Harbour Bridge – Nova Scotia
- Woods Bridge – British Columbia
- Pembina River Bridge – Edmonton, Alberta
- 37 Street Bridge – Calgary, Alberta
- Camp Site Road Bridge
- 232nd Street Bridge – Maple Ridge, British Columbia
- Whitemud Drive / 34 Street Bridge – Edmonton, Alberta

Proposals

- Jacques Cartier Bridge – Montreal, Québec
- Lions Gate Bridge – Vancouver, British Columbia
- James McDonald Bridge – Nova Scotia

Bridge Review Advisory

- Yoho Bridge – Cache Creek, British Columbia

Jivko Engineering

For the last 18 years the principal of the firm Mr. Jivkov has been involved in the in design and construction management of over 60 bridges, 12 breakwaters, a number of fixed and floating docks, boat launch facilities, marine resupply terminals and many other projects delivered in aquatic environment throughout the NWT and Nunavut. All of the projects designed and managed by Mr. Jivkov and his firm had been delivered on the basis of sound engineering practices, in accordance with the governing environmental regulations and in conformity with the strict conditions of the applicable construction permits.

Following is a list of some of the projects delivered by Jivko Engineering in the last several years in Arctic and Sub-arctic regions:

Bridges:

- West Channel Bridge, 2 @ 59.0m spans, km 40 Hay River HWY #2, NT, 1999
- Campbell Creek bridge, 36m span, km 247 Dempster HWY #7, NT, 1999
- Jack-fish Creek Bridge, 24,0m span; km 22Jean Marie Access Road, NT – 1999
- Kirchoffer River Bridge, 84.0 m span; Coral Harbour Water Falls Road , NU - 1998
- Prince River Bridge, 48.0m span; Baker Lake Prince River Road, NU- -1998
- Ochre River Bridge, 2@51 m cont. spans, km 722, Mackenzie HWY #1, NT - 2000
- Aliarusik River Bridge 1, 60 m span, km 11 Trail to FOL, Pelly Bay, NU - 2000
- Aliarusik River Bridge 2, 36 m span, km 23 Trail to FOL, Pelly Bay, NU – 2001

Marine Facilities

- Gjoa Haven, NU-Rasmusen Basin, NW Passage: Dock for marine resupply, 2000
- Kugluktuk, NU-Coronation Gulf: Dock and Breakwater for marine resupply, 2002-2003
- Yellowknife, NT-Great Slave Lake: Public Boat Launch at Weaver Road, 2002
- Yellowknife, NT-Great Slave Lake: Public Boat Launch and dock Giant Mine, 2003
- Deline, NT-Great Bear Lake: Community Dock, 2002

B.5.2 Environmental Consultant

Golder Associates Ltd.

Golder Associates Ltd. (Golder) and the recently merged RL&L Environmental Services Ltd. (merger occurred in 2001) have been involved in fisheries research and management since 1977.

The company and its present staff have participated in numerous investigations throughout western Canada, including several projects in the Northwest Territories and Nunavut. These projects, related to oil/gas activity (pipelines, roads, culverts, bridges), mining (roads, crossing structures, development footprints), and marine docking facilities, include some carried out in association with Jivko Engineering.

Selected examples of bridge and construction related projects include the following:

- Project: Fisheries Assessment of the Proposed Marine Docking Facility (2002)
  Client: Nunavut Department of Public Works and Services; Nunavut Department of Community Government Transportation; Jivko Engineering
  Location: Kugluktuk, Nunavut

- Project: Fisheries Assessment of Habitat Structures at Three Watercourse Crossings (2002)
  Client: Jivko Engineering

Location: Kugaaruk, Nunavut

- Project: Mackenzie Valley and Deline Winter Roads Fish Habitat Assessment (1996)
  Client: Department of Transportation, Government of Northwest Territories
  Location: Ft. Simpson to Deline, Northwest Territories
- Project: Fisheries Assessment of the Mackezie River at Fort Providence, NT - Proposed Deh Cho Bridge (2003 – 2004)
  Client: Jivko Engineering
  Location: Ft. Providence, NT
- Project: Sediment Monitoring in the North Saskatchewan River: Dredging of Water Intake Channels (2001 and 2003)
  Client: TransAlta Utilities Corporation
  Location: Keephills, Alberta
- Project: Sediment Monitoring at the Smoky River Pipeline Crossing (1999)
  Client: NOVA Gas Transmission Ltd.
  Location: Grande Prairie, Alberta
- Project: Construction Monitoring on the Little Smoky River Related to Installation of a Water Outlet (2001)
  Client: ATCO Power
  Location: Valleyview, Alberta

B.5.3 Environmental Performance Record of the Contractors

The general contractor and other contractors and subcontractors have not yet been selected. However, in August of 2003, general contractors were invited to submit an expression of their qualifications and interest in being invited to bid on construction. Five submissions were received:

1. Graham Construction & Engineering Inc.
2. Peter Kiewit & Sons Ltd.
3. PCL Constructors Ltd.
4. RTL – Robinson Enterprises Ltd.
5. SNC Lavalin Inc. & Walter Construction Ltd. (Joint submission)

All of the above have good environmental performance records.

Contractors performing construction work on the bridge will be selected via competitive process once all agreements and permits have been obtained.

Environmental performance will be a key factor in final selection of all contractors and sub-contractors. All contracts will include strict requirements for adherence to environmental standards and permits.

In order to ensure good environmental performance the DCBC will apply the following measures during selection of the contractors and during the construction process:

✓ ***Ensure good Environmental Performance Record****:*

During the pre-qualification process the DCBC will request the contractors to present a list of recently completed projects of similar nature and corresponding references. DCBC will check the references and will rate the contractors according to their environmental performance record.

- ✓ ***Ensure contractors are committed to a good environmental performance practices during performance of this work:***

  DCBC will include in the Project Specifications all terms and conditions of the Environmental Permits pertinent to every particular type of work. Particular attention will be given to waste disposal methods, spill contingency plans, land and wild life protection, etc. In pre-tender and pre-construction meetings the DCBC will indicate that good environmental performance is high priority for the DCBS and for the environmental authorities and the contractors will have to make all efforts to adhere to the conditions of the Environmental Permits.

- ✓ ***Ensure contractor's adherence to good environmental performance practices during the construction process.***

  DCBC will organise and implement a competent monitoring of the construction process for compliance with environmental regulations. In addition DCBC will carry out:

  - weekly "lunch-box" safety and environmental awareness meetings with contractor's staff,
  - 5 minutes daily meeting with contractor's on-site management,
  - daily visual inspection for leaks of contractor's heavy equipment engaged in the work,
  - periodic check of the spill containment equipment

C Development Description

The developer is only asked to provide details on the development itself, not on impacts from the development.

Note: *All plans and drawings referred to as 'attachments' in this section can be found in Appendix 1A.*

General

During the construction phase of the project, activity will focus on the 2,720m x 60m construction corridor. However, there will also be ancillary activity in other areas adjacent to the site (camp, concrete plants, materials lay down and storage) and at 7 separate quarries and pits in various locations. As a major 2-year construction project, the work will be undertaken in several distinct phases or components.

The general contractor has yet to be selected. It is anticipated that general contractors will examine a range of alternatives to optimize the construction approach. For example, it is considered technically feasible to construct the pier foundations in the open water season, using barges or a temporary bridge for access or in the winter from the ice surface. The project description makes assumptions about the most probable alternative approaches to be taken, while allowing some flexibility.

Once construction is complete, the operation of the bridge will be more stable and less disruptive, with routine maintenance and repairs to the structure and approaches.

Bridge Location

The proposed bridge site is located at the crossing of the Yellowknife HWY #3, NT and the Mackenzie River. It is located on the existing highway right-of-way, at km 23 HWY #3, near Fort Providence, NT.

Mackenzie River, originating at the south-western extremity the Great Slave Lake, NT and flowing into the Beaufort Sea, is shown on a 1:5,000,000 NT geographic map (*Attachment #1).* The proposed bridge site is shown on the 1:50,000 topographic map 85F/5 *(Attachment #2).* The proposed bridge site is located at km 66 of Mackenzie River Navigation Route, between the Beaver Lake and the Providence Rapids, as shown on the Canadian Hydrographics Service Chart #6453, edition 1999 *(Attachment #3).*

The co-ordinates of the bridge are: Latitude: **61° 15' 45" N** Longitude: **117° 31' 30" W**

Components & Parameters

The proposed bridge, consisting of nine spans is 1,045 m long, and is configured as steel truss-concrete deck composite construction. The static scheme is a simple main span supported on the cantilevered ends of two opposing continuous four span approaches. Enclosed are Preliminary Design Drawings prepared by the bridge designer J.R. Spronken & Associates of Calgary, AB. *(Attachment #4, Attachment #5 & Attachment #6).*

The geometric parameters of the bridge presented in the context of the existing ferry facilities, the navigation track, the existing road approaches, etc., could be found in *Attachment #7.* General arrangement of the bridge plotted in scale 1:6,000 on an air photo mosaic of the bridge surroundings could be found on *Attachment # 17*

The superstructure is supported on eight piers constructed in the watercourse and two abutments constructed on the approach berms. Under the main span there is a navigation channel used by large tug-barges configurations. The main span, including the cantilevers, is 190 m long with a vertical clearance of 22.56 m at H.W.L. The main span is flanked by three 112.5 m spans and one at 90.0 m end span. In order to reduce the depth of the trusses on the main span the design contemplates a system of portal and stays installed on the piers on both sides of the main span. The vertical clearance under the portal is 9.0 m over the 8.6 m width of bridge deck. It is anticipated that such clearances will not present limitation for oversize loads traveling between Alberta and the NWT.

The roadway width on the bridge deck is 10.40 m, allowing for two 3.70 m wide traffic lanes and two at 1.50 m shoulders. On each side of the deck there are 0.82 m high safety rails consisting of 0.25 m high concrete curbs and 0.57 m high steel rail. The maximum longitudinal grade on the bridge is 3.5%.

The Design Live Load for the bridge is CL-750 (GVW of 750 kN) in accordance with the CSA-S6-00. There is a 40% dynamic allowance and additional 60% safety factor incorporated in the design. Additionally, the design allows for special, overload truck configurations as shown on the drawings.

The superstructure is composite construction of two steel trusses with pre-cast concrete deck panels. The trusses are 4.5 m deep with 7.3 m horizontal distance between. The steel part of the superstructure, involves of 4,750,000 kg non-painted weathering steel. The concrete panels are 11.5 m wide and 0.3 m thick. The panels are pre-stressed transversely during fabrication, and post-tensioned longitudinally after installation. The deck is built of 4,520 cu m (11,300,000 kg) concrete with 40 Mpa strength.

The abutments are cast in place reinforced concrete structure consisting of pile cap, back wall, and wing walls at 45 degree to the centre line of the bridge. The abutment construction involves placing of 560 cu m concrete and 40,000 kg reinforcing steel.

Each abutment is supported 16 @ 12.0 m long HP-350 piles (173 kg/m), predrilled and driven to refusal into the underlying till.

The substructure of the piers consists of cast-in-place concrete flat footings and pedestals. The lower part of the pedestals, located below the ice action is of cylindrical shape. The top part is of conical shape. In order to reduce friction with moving ice and to improve durability the top part is encased in 16 mm thick steel casing.

Potential scouring will be controlled by placing on the riverbed around each pier 0.6 m layer of selected blast-rock over an elliptic area with radiuses 33 m and 28 m.

The substructure is designed to resist the impact of a colliding stray vessel. Friction and deformation of the colliding vessel will absorb the energy of the impact.

The superstructure of the piers, or the pier shafts are composed of prefabricated steel elements assembled on site. The shafts of the piers supporting the main span are of triangular shape with the horizontal side on top. The shafts of the remaining piers are hollow steel columns with a hammerhead widening on top. The shafts are built of 315,000 kg non-painted weathering steel.

The proposed bridge approaches are 12.0 m wide *(Attachment #8)*. Both approaches coincide with the existing causeways of the north and south ferry landings. The north approach is projected into the river 350 m, and the south one 230 m. In order to avoid potential flooding and ice shove accumulations, the approaches are set at elevation not less than 2.0 m above the calculated ice jam. This elevation is the same as the one of the highway-winter road intersection on the north side of the bridge, which historically has never been flooded.

The footprints on the riverbed of the bridge approaches exceed the ones of the existing causeways. The required extension and widening of the footprints comprises placing into the river of 25,200 cu m clean limestone rock, to an elevation of 1.0 m above the Mean Water Level. In order to resist the river current selected larger rock sizes will be placed as a berm on the upstream side of the south causeway. The approach embankments above that elevation will be constructed of 96,200 cu m common backfill and will be dressed with 1 m thick layer of blasted rock rip rap.

The head-slopes of the approaches and their upstream shoulders exposed to ice action will be armored with approx. 3,000 cu m large size granite rip-rap.

The roadway on the approaches will be paved. There is a standard highway guardrail installed on each side of the roadway.

Access for public and commercial vehicles to both ferry landings and clear route for the ferryboat will be maintained without interruption for the duration of the bridge construction. Since sections of the existing access roads to the ferry landings overlap with the bridge approaches it is proposed to construct detours as follows:

- ✓ South Approach: Construct approx. 250 m detour road and arrange for temporary south ferry landing 10 m downstream of the existing one. This involves minor road improvement works with no in-stream construction activities.
- ✓ North Approach: Construct approx. 450 m detour road 25 m downstream of the existing access. This involves placing approx. 6,000 cu m blasted rock into the watercourse. The detour embankment above the High Water Level and the surfacing will be built of gravel. The detour arrangements are depicted on *Attachment #9 & Attachment #10*.

C.1 Timing*:*

Provide the proposed schedule for the project, and identify any time constraints.

Tables C1 – C4 show the proposed construction schedule, with granular materials preparation commencing in the fall of 2004 and construction of the bridge commencing in the spring of 2005. The bridge would be ready for use before Christmas 2006, while final cleanup would be done in the spring of 2007. This schedule assumes all permits and agreements will be in place by August/September of 2004 and a contract is awarded shortly after.

Table C1 - Schedule for Operation of Construction Support Facilities

#	Activity	days	dates
Construction Camp			
1	Site Preparation	21	01 Oct- 21 Oct 2004
2	Mobilization	15	15 May-30 May 2005
3	Operation 2005	150	01 Jun -30 Oct, 2005
4	Operation 2006	150	01 Jun -30 Oct, 2006
TwoTemporary Concrete Plants			
1	Site Prep (2 sites)	15	01 Oct -14 Oct, 2004
2	Mobilization	15	15May -30 May,2005
3	Material Supply		
	Cement: Edm-North Plant	70	01 Jun - 08 Aug 2005
	Cement: Edm-South Plant	70	09 Aug - 20 Oct 2005
	Water: Prov-North Plant	70	01 Jun - 08 Aug 2005
	Water: Prov-South Plant	70	09 Aug - 20 Oct 2005
4	Operat&Transp		
	Concrete Delivery: North Plant to Bridge	70	01 Jun - 08 Aug 2005
	Concrete Delivery: South Plant to Bridge	70	09 Aug - 20 Oct 2005
5	Demobilization	2	01 Oct -15 Oct 2006

Table C2 - Schedule for Bridge Construction Activities in the Construction Corridor

#	Activity	days	dates
Earthworks:			
1	Placing 15,500 cum N Appr. Limestone Base	14	23Mar- 07Apr, 2005
2	Placing 18.300 cum S Appr. Limestone Base	14	08 Jul - 23 Jul, 2005
3	Placing 41,000 cu m on N. Embankment	30	16 Jun- 15 Jul, 2005
4	Placing 26,000 cum on S. Embankment	21	01Aug -21Aug, 2005
5	Dressing N&S Embankments 6,800 cum stone	7	23Aug-31 Aug,2005
6	Armouring w/ 6,000 cum granite	7	23Aug-31 Aug,2005
7	Placing 12,000 cu m on N. Emb.	15	16 Jul - 30 Jul, 2006
8	Placing 12,000 cum on S. Emb.	15	01 Jul - 15 Jul, 2006
9	Placing 700 cum structural backfill on abutments	2	15 Jun -17 Jun 2006
10	Placing 10,600 cum gravel for sub-base & base	7	07 Sep -14 Sep 2006
11	Placing 1,000 cum chips for chip-sealing	2	25Aug -27Aug 2007
Pier Foundations			
1	Barge-Bridge	140	05 Jun -25 Oct, 2005
2	Installation of 8 Cofferdams		
	.1 - Mobilization	4	01 Jun-05 Jun, 2005
	.2; .3; .4 -Work	140	05 Jun -25 Oct, 2005
3	Placing 11,200 cum concrete		
	.1 Mobilization	4	01 Jun-05 Jun, 2005
	.2 Placing concrete	140	05 Jun -25 Oct, 2005
Pier Shafts			
1	Mobilization	4	25 Feb- 01 Mar, 2006
2	Ice Preparation	30	01Feb-01 Mar, 2006
3	Installation of shafts	45	01 Mar- 15 Apr, 2006
Abutment Construction			
1	Mobilization	7	01Aug- 07 Aug, 2005
2	Pile driving	7	07Aug- 14Aug, 2005
3	Placing concrete 2005	15	15Aug- 30Aug, 2005
4	Placing Concrete 2006	15	01 Jun - 14 Jun, 2006
Steel Superstructure			
1	Mobilization	90	01 Feb- 30 Apr, 2006
2	Site prep. & Offloading	90	01 Feb- 30 Apr, 2006
3	Installation 4,750,000 steel	90	01 Mar - 31 May, 2006
Bridge Deck			
1	Mobilization	105	01Mar-15 Jun, 2006
2	Installation deck pannels	75	18 Jun-Aug 31,2006
3	Install curbs, rail, lights, etc	45	01 Sep-15 Oct, 2006

Table C3 - Schedule for Land Reclamation Activities

#	Activity	days	dates
Two Reclamation Areas			
1	Preparatory work	7	01Aug -07Aug, 2007
2	Excav.20,000 cum granular	14	08Aug -22Aug, 2007
Transportation of excavated material			
3	Bridge to North Borrow Area	7	08Aug -14Aug, 2007
4	Bridge to South Borrow Area	7	15Aug -22Aug, 2007
5	Transp. 30 t scrap iron	2	10Aug -11Aug, 2007

Table C4 - Schedule for Land Use for Quarrying and Granular Supply

	Activity	days	dates
Mackenzie HWY #1, km 188.5 – Proposed Limestone Quarry			
1	Site Prepartion	7	16 Oct- 23 Oct, 2004
2	Produce 40,000 cum rock	14	16 Mar-31Mar, 2005
	Transportation		
3	Transp.15,400cum: Quarry-North side	14	23 Mar-07 Apr, 2005
4	Transp.16,500cum: Quarry-South side	14	08 Jul -23 Jul, 2005
5	Transp. 6,800cum: Quarry-bridge	7	23Aug -31Aug, 2005
Mackenzie HWY #1, km 188.5 – Existing Gravel Pit			
1	Site Prepartion	7	23 Jun -31 Jun 2005
2	Produce 15,000 cum gravel	15	01 Jul -15 Jul 2005
3	Crush. 6,500 cum gravel	7	16 Jul -21 Jul 2005
4	Transp. 700 cum str bkfill abtm	2	15 Jun -17 Jun 2006
5	Transp. 10,600 cum grav.	7	07 Sep -14 Sep 2006
6	Transp. 1,000 cum chips	2	25Aug -27Aug 2007
Yellowknife HWY #3, km 23+270 – Proposed South Borrow Area			
1	Site Prepartion	14	15 Jul -31 Jul 2005
2	Produce 26,000 cum fill	14	01Aug-14 Aug 2005
3	Transp. 26,000 cum fill	21	01Aug-21 Aug 2005
4	Produce 12,000 cum fill	7	01 Jun -07 Jun 2006
5	Transp. 12,000 cum fill	15	01 Jun -15 Jun 2006
Yellowknife HWY #3, km 26+240– Proposed North Borrow Area			
1	Site Prepartion	15	01 Jun -15 Jun 2005
2	Produce 41,000 cum fill	30	16 Jun -15 Jul 2005
3	Transp. 41,000 cum fill	30	16 Jun -15 Jul 2005
4	Produce 12,000 cum fill	7	01 Jun -07 Jun 2006
5	Transp. 12,000 cum fill	15	01 Jun -15 Jun 2006
Yellowknife HWY #3, km 87 – Gravel Pit for Concrete Aggregate			
1	Site Prepartion	7	24 May -31May 2005
2	Produce 21,000 cum crush	21	01 Jun -21 Jun 2005
3	Transp. 16,000 cum aggreg	70	07 Jun -21 Aug 2005
Yellowknife HWY #3, km 156 – Existing Grey Limestone Quarry			
1	Produce 9,000 cum rock	7	01 Jul -07 Jul 2005
2	Transp. 9,000 cum rock	30	01 Jul -30 Jul 2005
Yellowknife HWY #3, km 232 – Proposed Granite Rock Quarry			
1	Produce 6,000 cum rock	7	01 Jun- 07 Jun 2005
2	Transp. 6,000 cum rock	20	08Aug -28Aug 2005

C.2 Access Route*:*

Describe the access route for all building materials required for the proposed development. Also, describe the detour access route proposed for ferry traffic and bridge traffic during the various phases of construction, including any highway realignment activities.

Access for building materials would largely be by existing transportation corridors.

- Supplies (steel, concrete, equipment) would likely be mobilized from the south by Highways 1 and 3 to the site. Alternatively, materials supplied from the south may be transported via rail to Enterprise and truck to the site, or by rail to Hay River and by truck or barge to the site. Materials would cross the river via the ice crossing or ferry.
- Bulk granular material would be transported by truck from identified pits and quarries. Granular material required to cross the river would be moved in the winter, via the ice crossing, not the ferry.
- Summer access to in-river works for constructing the piers and erecting the superstructure may employ floating barges or temporary bridges supported on the river bottom. Winter access could use the ice or temporary bridges. Any temporary fixed or floating bridges or barges would be removed before spring and fall ice traffic on the river. At no time would these temporary works be allowed to interfere with ferry operations or with marine traffic on the Mackenzie River.
- The permanent road approach to the bridge will utilize the existing highway/ferry right-of-way.

C.3 Construction Methods*:*

Describe the methods used to build the bridge, abutments and detour access roads.

C.3.1 Construction Corridor for Bridge Structure & Approaches *(Attachment 11)*

All Bridge Components including Detours and Bridge Approaches are situated in a Construction Corridor that extends from km 23+120 to km 25+840 of Yellowknife HWY #3. The Corridor is 2,720 m long, 60 m wide (30 m on each side of HWY centre line), and covers an area of 163,200 sq m. The corridor coincides with the highway Right-of-Way.

The bridge construction activities taking place in the Construction Corridor are not presented in chronological order, but are rather grouped by type of different construction activities as follows:

Earthworks

Completion of the Earthworks is divided into stages interdependent with the rest of the construction activity of the bridge as follows:

- Placing 15,500 cu m limestone base for detour (8,600 cu m) and for widening of the North Approach (6,900 cu m)
- Placing 18.300 cu m limestone base for extension of the South Approach
- Placing 41,000 cu m common backfill for Phase One- lower portion of the North Embankment. The material will be placed to the elevation of the bridge bearing seat.
- Placing 26,000 cu m common backfill for the Phase One - lower portion of the South Embankment. The material will be placed to the elevation of the bridge bearing seat.
- Dressing with 6,800 cu m limestone the side slopes of the North Embankment (3,400 cu m) and South Embankment

- Armoring with 6,000 cu m granite the upstream slopes of the North Embankment (3,000 cu m) and the South Embankment (3,000 cu m).
- Placing 12,000 cu m common backfill for the Phase Two- upper portion of the North Embankment. The material will be placed to the elevation of the sub-grade.
- Placing 12,000 cu m common backfill for the Phase Two- upper portion of the South Embankment. The material will be placed to the elevation of the of the sub-grade.
- Placing 700 cu m pit-run gravel for structural backfill behind the abutments
- Placing 10,600 cu m gravel:
  - 5,900 cu m pit-run gravel for sub-base on the North Approach
  - 2,100 cu m crushed gravel for base on the North Approach
  - 2,600 cu m crushed gravel for base on the South Approach
- Placing 1,000 chips for chip-sealing N & S approaches

Pier Foundation Works

Includes:

- Deployment & Operation of Barge-Bridge
- Installation of 8 Cofferdams
- Placing 11,200 cu m concrete for footings & pedestals

Pier Shafts Fabrication & Installation

Includes

- Fabrication of 315,000 kg structural steel in southern Canada
- Transportation and installation of same

Abutments Construction

Includes:

- Installation of 32 piles HP 350
- Placing 560 cu m concrete for pile caps, back walls and wing walls

Steel Superstructure Fabrication & Installation

Includes:

- Fabrication of 4,750,000 kg structural steel in southern Canada
- Transportation and installation of same

Bridge Deck Fabrication & Installation

Includes:

- Fabrication of 4,520 cu m concrete elements (11,300,000 kg) in southern Canada
- Transportation and installation of same

C.3.2 Area for Construction Camp *Attachment 11*

This is an area of 15,000 sq m (150 m by 100 m) located on the south side of the river adjacent to the existing Ferry Camp at km 23+270 of Yellowknife HWY #3. Access from the highway is via 70 m long existing trail. The area is fairly flat and is vegetated with spruce and poplar trees.

C.3.3 Two Areas for construction and operation of Temporary Concrete Plants *Attachment 11 & Attachment 12*

Two areas, one on each side of the river, are designated for Temporary Concrete Plants. The

Primary Concrete Plant will be set on the north side of the river at km 30.2 HWY #3, approximately 6.0 km from the bridge site. The Secondary Plant is optional depending to the Contractor's work plan. If required, it will be set on the south side of the river, at 23+270 HWY #3, less than 1 km from the bridge site. Both sites are located near existing sources of electric power.

The Primary Concrete Plant (North Plant), km 30.2 HWY #3 will be constructed on an area of 5,600 sq m (70 m by 80 m). Access from the highway is via 20 m long existing trail. The area is cleared of trees and it appears to have been partially leveled and covered with gravel in the past. Presently it is vegetated with grass and second-growth shrubs.

The Secondary Concrete Plant (South Plant) km 23+270 HWY #3 will be constructed on an area of 5,600 sq m (70 m by 80 m) adjacent to the South Borrow Area and will share the same access from the highway. The area is vegetated with fairly large spruce and poplar trees.

C.3.4 Two Areas for temporary storage and parking *Attachment 11*

These areas are located on the north side of the river, adjacent to the highway right-of-way near km 25+700 of the Yellowknife HWY #3. Both areas are leveled, covered with gravel, and have dimensions of 40 m by 110 m (4,400 sq m) and 50 m by 300 m (15,000 sq m) respectively.

These areas are readily available for parking of vehicles and construction equipment, also for storage of clean construction materials including structural steel, pre-cast concrete elements, structural timber, gravel, etc. No fuel, lubricants or other substances harmful to aquatic life will be stored on these areas.

C.3.5 Reclamation Areas related to removal of existing ferry infrastructure *Attachment 7 & Attachment 11*

These areas are located within the watercourse, adjacent to the Construction Corridor. They are part of the existing ferry infrastructure owned and operated by the GNWT. Details on land reclamation issues are discussed in **item C-8** below.

C.3.6 Pits and Quarries

Granular materials, concrete aggregates and rock required for the construction of the bridge will be obtained from the following areas:

Mackenzie HWY #1, km 188.5 – Proposed Limestone Quarry *Attachment 13*
(Also known as HWY #1, km 191-east)

Large limestone deposit is located 2 km to the south of km 188.5, Mackenzie HWY #1. The parcel identified for development is situated on the north slope of 20 m high hill. The area is vegetated with 6" to 10" diameter spruce trees. On top of the hill there is a forest-fire monitoring tower and a helicopter pad installed on a large clearing. There is an existing trail in good condition leading to this area.

40,000 cu m limestone will be produced in this quarry and will be used as follows:

- 8,600 cu m for the 'in water' base of detour on the North Approach
- 6,800 cu m for widening the 'in water' base of the North Approach
- 16,500 cu m for extension the 'in water' base of the South Approach
- 6,800 cu m for dressing the shoulders of the North and South Approaches

Mackenzie HWY #1, km 188.5 – Existing Gravel Pit *Attachment 13-*
(This pit is also known as HWY #1, km 191-east)

The area proposed for development is located 600 m to the east of the Limestone Quarry This area is part of larger section reserved for development of granular source by the GNWT Department of

Transportation. The area is fairly flat, vegetated with 6" to 10" diameter spruce trees. The material in this area is coarse gravel mixed with pebble and cobbles of limestone origin.

6,000 cu m pit-run gravel will be excavated from this pit and will be used as follows:

- 700 cu m (2@350) for structural backfill behind the abutments
- 5,900 cu m will be used for Sub-base on the North Approach
- 1,900 cu m for surfacing the camp area, the concrete plant area and for other misc. purposes
- 6,500 cu m will be crushed, screened and stockpiled in different fractions, to be used for:
- 2,100 cu m for base material on the North Approach
- 2,600 cu m for base material on the South Approach
- 800 cu m for surfacing and maintaining the detours
- 1,000 cu m (after screening) for chip-sealing of the bridge approaches.

Yellowknife HWY #3, km 23+270 – Proposed South Borrow Area *Attachment 11*

The proposed area is located 200 m to the west of km 23+270, Yellowknife HWY #3, adjacent to the access road leading to the CCG docking facility. The deposit of sandy-silty clay is found on a flat area elevated an average of 1.0 m above the road elevation. The area is vegetated with fairly large spruce and poplar trees. Test holes excavated randomly in the area indicate that the material is dense with little or no evidence of underground water. However, during operation of the pit, provision will be made to dewater the rain-water by pumping.

38,000 cu m pit-run material will be excavated from this area and will be used for common backfill in the embankment construction of the South Approach embankment.

After completion of the bridge construction part of the excavated pit will be used for disposal of the material removed from the Reclamation Area #2 as specified above in **Item C-8** below.

Yellowknife HWY #3, km 26+240– Proposed North Borrow Area *Attachment 11*

The proposed area is located 80 m to the north of km 26+240, Yellowknife HWY #3. The deposit of sandy-silty clay is found on a flat area slightly elevated above the road grade. The area is vegetated with fairly large spruce and poplar trees. Test holes excavated randomly in the area indicate that the material is dense with little or no evidence of underground water. However, during operation of the pit, provision will be made to dewater the rain-water by pumping.

53,000 cu m pit-run material will be excavated from this area and will be used for common backfill in the embankment construction of the North Approach embankment.

After completion of the bridge construction part of the excavated pit will be used for disposal of the material removed from the Reclamation Area #1 as specified above in **Item C-8. below.**

Yellowknife HWY #3, km 87 – Gravel Pit for Concrete Aggregates *Attachment 14*

This is an existing, large gravel pit located 500 m to the west of km 87.0, Yellowknife HWY #3. The area proposed for development is located on the south-east section of the pit immediately behind the existing communication tower. The area is moderately undulated. Part of it is sparsely vegetated with spruce trees and is covered with thin organic layer.

The material in this area consists of well graded gravel, clean of silt, with constituents ranging from fine sands to 3" diameter cobbles. Lab tests of several samples collected from different sections of the area indicated suitability for concrete aggregates.

21,000 cu m gravel will be excavated screened and crushed for obtaining 16,000 cu m of concrete aggregates.

Yellowknife HWY #3, km 156 – Existing Grey Limestone Quarry *Attachment 15*

This is an existing rock quarry located 50 m to the west of km 156, Yellowknife HWY #3. The rock in this quarry consists of laminated grey limestone that breaks into 4" to 24" material after blasting. The existing pit is nearly 20,000 sq m (90 m by 220 m) with depth in excess of 4.0 m. An estimated 80,000 cu m rock has been extracted from this pit for the reconstruction of the highway.

9,000 cu m rock will be extracted from this quarry and will be used for:

- Construction of upstream berm on the South Causeway extension: 1,800 cu m
- Placing around the pier footings for scour protection: 7,200 cu m

Yellowknife HWY #3, km 232 – Proposed Granite Rock Quarry *Attachment 16*

The proposed for development area is located 200 m to the west of km 232, Yellowknife HWY #3. The deposit of granite is found in several exposed bedrock formations, of height ranging between 10 m and 50 m. The area is vegetated with occasional 4" to 6" diameter spruce trees. There is an existing trail in good condition leading to this area.

6,000 cu m rock will be produced and will be used for armoring the head slopes and part of the side slopes of the bridge approaches which are exposed to heavy ice traffic.

C.4 Operations:

Describe the operations in terms of timing, traffic volumes on the river and on the Highway. Also, describe the operations in terms of employees, contractors, schedules and worker accommodations.

The number of workers on site during construction will vary with the time of year and the stage of construction. The construction workforce is expected to peak at 40 non-resident workers at the construction camp and 20 local workers. There will also be staff involved in contract supervision, quality control and environmental monitoring. During the operations phase it is estimated that the DCBC will employ directly or through contact 2-3 persons in bridge maintenance and company operations.

Table C5 provides an overall summary of traffic volume in the bridge area, while Table C6 provides a summary of fuel consumption related to the bridge construction

C.4.1 Construction Corridor

The Land Use Permit for the Construction Corridor is required for the period between March 01, 2005 and October 30, 2007.

Earthworks

Completion of the Earthworks is divided into stages interdependent with the rest of the construction activity of the bridge as follows:

1. Placing 15,500 cu m limestone base for detour (8,600 cu m) and for widening of the North Approach (6,900 cu m) is "in-stream" activity. It is scheduled for March 23-April 07, 2005. The work on the placing includes:

   - Ripping and removal of ground-fast ice from the 4,800 sq m footprint area. The removed ice will be left to melt on top of the natural river ice cover.

   - Placing the rock over "dry" riverbed. The rock will be delivered on site by trucks; end-dumped in the excavated pits; and spread to the design grade with a bulldozer. No equipment will be placed in the water during this work.

2. Placing 18.300 cu m limestone base for extension of the South Approach is "in-stream" activity. It is scheduled for July 08-23, 2005. The rock will be delivered on site by trucks; end-dumped directly in the water; and spread to the design grade with a bulldozer. No equipment will be placed in the water during this work.
3. Placing 41,000 cu m common backfill for Phase One- lower portion of the North Embankment is not "in-stream" activity. It is scheduled for June 16-July 15, 2005. The material will be placed to the elevation of the bridge bearing seat.
4. Placing 26,000 cu m common backfill for the Phase One - lower portion of the South Embankment is not "in-stream" activity. It is scheduled for August 01-21, 2005. The material will be placed to the elevation of the bridge bearing seat.
5. Dressing with 6,800 cu m limestone the side slopes of the North Embankment (3,400 cu m) and South Embankment (3,400 cu m) is not "in-stream" activity. It is scheduled for August 23-31, 2005.
6. Armoring with 6,000 cu m granite the upstream slopes of the North Embankment (3,000 cu m) and the South Embankment (3,000 cu m) is in part "in-stream activity. It is scheduled for August 08-31, 2005. The granite will be placed with an excavator deployed on top of the existing embankment. Only the bucket and part of the boom will be immersing in the water to place the rock. No equipment will be placed in the water during this work.
7. Placing 12,000 cu m common backfill for the Phase Two- upper portion of the North Embankment is not "in-stream" activity. It is scheduled for July 16-30, 2006. The material will be placed to the elevation of the of the sub-grade..
8. Placing 12,000 cu m common backfill for the Phase Two- upper portion of the South Embankment is not "in-stream" activity. It is scheduled for July 01-15, 2006. The material will be placed to the elevation of the of the sub-grade.
9. Placing 700 cu m pit-run gravel for structural backfill behind the abutments is not "in-stream" activity.
10. Placing 10,600 cu m gravel for:
    - 5,900 cu m pit-run gravel for sub-base on the North Approach) is not "in-stream" activity.
    - 2,100 cu m crushed gravel for base on the North Approach is not "in-stream" activity.
    - 2,600 cu m crushed gravel for base on the South Approach is not "in-stream" activity.
11. Placing 1,000 chips for chip-sealing N & S approaches is not "in-stream" activity.

Equipment & Labour:

1. Placing 15,500 cu m limestone base: Equipment: 1 midsize bulldozer equipped with ripper; Labour: 1 operator accommodated in Construction camp
2. Placing 18.300 cu m limestone base: Equipment: 1 midsize bulldozer equipped with ripper; Labour: 1 operator accommodated in Construction camp
3. .Placing 41,000 cu m - N. Embankment: Equipment: 1 midsize bulldozer, 1 heavy compactor; Labour: 2 operators accommodated in Construction camp
4. Placing 26,000 cu m - S. Embankment: Equipment: 1 midsize bulldozer 1 heavy compactor; Labour: 2 operators accommodated in Construction camp

5. Dressing N & S Embankments with 6,800 cu m stone: Equipment: 1 midsize excavator; Labour: 1 operator accommodated in Construction camp
6. Armouring with 6,000 cu m granite: Equipment: 1 midsize loader and 1 midsize excavator; Labour: 2 operators accommodated in Construction camp
7. Placing 12,000 cu m on N Emb; Equipment: 1 midsize bulldozer, 1 heavy compactor; Labour: 2 operators accommodated in Construction camp
8. Placing 12,000 cu m S Emb: Equipment: 1 midsize bulldozer, 1 heavy compactor; Labour: 2 operators accommodated in Construction camp
9. Placing 700 cu m pit-run for abutments: Equipment: 1 midsize excavator, 1 Bomag compactor; Labour: 2 operators accommodated in Construction camp
10. Placing 10,600 cu m pit-run & crush: Equipment: 1 midsize bulldozer, 1 grader and one large vibrating compactor; Labour: 1 local operator and 2 operators in camp
11. Placing 1,000 cu m chips for chip-sealing: Equipment: 1 grader, 1 compactor, 1 truck for asphalt emulsion; Labour: 4 operators and 3 workers in Big River Motel

Schedule:

		Schedule		Labor	Accomm. (man/day)	
#	Activity	days	dates	(men)	Con.Camp	Other
1	Placing 15,500 cum N lmstn base	14	23Mar- 07Apr, 2005	1	14	-
2	Placing 18.300 cum S lmstn base	14	08 Jul - 23 Jul, 2005	1	14	-
3	Placing 41,000 cu m on N. Emb	30	16 Jun- 15 Jul, 2005	2	60	-
4	Placing 26,000 cum on S.Emb	21	01Aug -21Aug, 2005	2	45	-
5	Dressing Emb 6,800 cum stone	7	23Aug-31 Aug,2005	1	7	-
6	Armouring w/ 6,000 cun granite	7	23Aug-31 Aug,2005	2	15	-
7	Placing 12,000 cu m on N. Emb	15	16 Jul - 30 Jul, 2006	2	60	-
8	Placing 12,000 cum on S.Emb	15	01 Jul - 15 Jul, 2006	2	60	-
9	Placing 700 cum str bkfill abtm	2	15 Jun -17 Jun 2006	2	4	-
10	Placing 10,600 cum grav.	7	07 Sep -14 Sep 2006	3	15	7
11	Placing 1,000 cum chips	2	25Aug -27Aug 2007	7	-	14

Fuel:

#	Activity	Diesel fuel (litres)	Gasoline (litres)
1	Placing 15,500 cum N lmstn base	10,500	-
2	Placing 18.300 cum S lmstn base	11,500	-
3	Placing 41,000 cu m on N. Emb	33,000	-
4	Placing 26,000 cum on S.Emb	23,100	-
5	Dressing Emb 6,800 cum stone	2,100	-
6	Armouring w/ 6,000 cun granite	4,900	-
7	Placing 12,000 cu m on N. Emb	15,400	-
8	Placing 12,000 cum on S.Emb	15,400	-
9	Placing 700 cum str bkfill abtm	880	-
10	Placing 10,600 cum grav.	10,010	-
11	Placing 1,000 cum chips	2,640	100
		129,430	100

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling will take place on a designated location not less the 100 m from any water body. Trucks will be refuelled at the Big River gas station located at km 31, HWY #3.

Pier Foundation Works

Construction of the pier foundations is "in-stream" activity scheduled for completion throughout the 2005 open water season (June-October 2005). The work includes:

1. Deployment & Operation of Barge-Bridge: The barge-bridge will be used to access from shore four consecutive piers from each side of the river and for deployment of working equipment and material. It will be 405 m long, composed of nine barges series 600 connected end-to-end and anchored to shore and upstream against the current. Additionally, spud-barges of series 1000 will be deployed perpendicular to the barge-bridge, along each of the four pier locations. A configuration of small tug and barge will be deploying and maintaining the bridge and will shuttle some equipment and material across the river. The barge-bridge will be deployed alternatively on the north and south side, maintaining the navigation track on the main span open at all times. The barge-bridge will be composed of surplus inventory of the NTCL, and will be deployed and maintained by them.

   The Barge-Bridge will be operated by a crew of 3 mariners and 3 general labourers, for 140 days between June 05 and October 25, 2005. The crew will be accommodated on the tug.

2. Installation of 8 Cofferdams: The sheet piles for the cofferdams are AZ-26 of 155 kg/sq m mass. The cofferdams are of oval shape pier with diameters 18 m and 13 m. The sheet piles will be driven to approx. 5.0 m below the riverbed and will be cut-off 1.0 m above the High Water Level.

   After installation of the cofferdam a 4.0 m thick layer of riverbed material (850 cu m per cofferdam), will be excavated and disposed of directly into the river. The bottom of the will be sealed with 0.6 m thick "mud-slab" of tremie concrete (110 cu m per pier) and the cofferdam will be dewatered directly into the river (1,900 cu m water per cofferdam).

   The rate of discharge into the river of excavated material and water will be controlled according to methodology described in the enclosed Golder Associates report.

   The sheet-piling material will be inventory of the Contractor. After completion of the pier foundation works this material will be extracted and shipped down south for reuse.

   Scour Protection around the piers will be provided by placing of 650 cu m of blasted rock over an area of 720 sq m around each pier. 5,200 cu m of this rock will be placed into the river. The remaining 2,000 cu m will account for some waste and reserve for unforeseen uses.

   Mobilisation:

   - Material from ED, AB: 850,000 kg steel including sheet piles, walers, tie rods and fasteners;
   - Equipment from ED, AB: 3 Hydraulic Crawler Drills, 1 150t crawler crane, 1 50t mobile crane, 1 welding truck, 80,000 kg portable bridges, diesel hammers, vibrating extractors, water pumps, etc.
   - Equipment available on site: excavators, loaders and bulldozers

   Installation of 4,800 sq m steel sheet piling includes:

   - Pre-drilling one 8" hole for each sheet pile with Hydraulic Crawler Drill
   - Driving sheet piles with diesel hammer mounted on150 t crane

- A loader and a welding truck will assist the operation.

The work will be completed within 96 days (12 days per cofferdam) between June 15 and September 20, 2005. If the contractor schedule is delayed by unforeseen circumstances the First Pier on the north side will be completed in October and early November 2005. A 25 m long temporary causeway will be built of limestone to link the North Ferry Approach with the cofferdam.

Excavation of 7,000 cu m riverbed material from the cofferdams includes:

- Pre-drilling three 8" holes per sq m using 2 Hydraulic Crawler Drills
- Excavation and disposal of riverbed material 1 large excavator and 1 large loader
- Dewatering of the cofferdam using two or three 8"Ø pumps.

This work will go in tandem with the Installation of the sheet piling and will follow the same schedule.

Scour control includes:

- Placing of 650 cu m of blasted rock per pier using a large excavator and 50t crane with clamp

3. Placing 11,200 cu m concrete: A total of 11,200 cu m concrete (900 cu m mud slab concrete and 10,300 cu m structural concrete) will be placed for the foundations of 8 piers. The mud-slab concrete will be placed in 8 pours of 100 cu m (1 pour per pier). The concrete for each pier (1,300 cu m) will be placed in three pours: footing – 780 cu m, lower pedestal – 300 cu m, and upper pedestal – 220 cu m. The upper pedestal will be encased in steel casing and will not need formwork.

   Mobilisation:
   - Material from ED, AB: 830,000 kg reinforcing steel; 240,000 kg steel cone-casing, 80,000 kg reusable prefab forming, bracing, hardware, etc.
   - Equipment from ED, AB: 3 concrete pumps mounted on trucks, 4 pickups for crew
   - Equipment available on site: loaders

   This concrete will be divided into 32 pours, average 3 days apart, within a period of 96 days between July 01 and October 05 2005. Three crews of 6 men will be working different piers on forming, rebar installation and concrete placing. The rebar will be preassembled down south in mats and cages between 3,000 kg and 12,000 kg. The forming will be prefab reusable panels and will be needed for the lower pedestals only.

Equipment, Labour & Traffic

1. Barge-Bridge: Equipment: 1 tug-pusher 1 pickup truck; Labour: 3 labourers from Ft. Providence and Crew of 3 mariners accommodated on the tug
2. Installation of 8 Cofferdams:
   - Mobilisation from Edmonton: Equipment: 32 truckloads (B-trains or semi trailers) and 6 pickups (1 welding truck & 4 pickups for crew); Labour: 38 operators in commercial accommodation
   - Equipment: 1 150 t crane, 1 50t mobile crane 3 Hydraulic Crawler Drills, 1 welding truck, 2 midsize loaders, 1 large excavator, 3 pickups for the crew and 3 water pumps
   - Labour: 10 local labourers and 10 operators in camp
3. Placing 11,200 cu m concrete:

- Mobilisation from Edmonton: Equipment: 39 B-trains, 3 pump trucks, 4 pickup trucks; Labour: 46 operators
- Placing concrete: Equipment: 2 concrete pumps, 4 pickups for the crew. Labour: 8 local labourers, 2 operators and 12 carpenters in camp

Schedule:

		Schedule		Labor	Accomm. (man/day)		Traffic
#	Activity	days	dates	(men)	Con.Camp	Other	veh/day
.1	Barge-Bridge	140	05 Jun -25 Oct, 2005	6	-	840	-
.2	Installation of 8 Cofferdams						
	.1 - Mobilization	4	01 Jun-05 Jun, 2005	37		152	19
	.2; .3; .4 -Work	140	05 Jun -25 Oct, 2005	20	1,400	1,400	-
.3	Placing 11,200 cum concrete						
	.1 Mobilization	4	01 Jun-05 Jun, 2005	46		184	24
	.2 Placing concrete	140	05 Jun -25 Oct, 2005	22	1,400	1,120	-

Fuel:

#	Activity	Diesel fuel (litres)	Gasoline (litres)
.1	Barge bridge-Tug-pusher, 2005	403,200	7,000
	Barge bridge-Tug-pusher, 2006	403,200	7,000
.2	Installation of 8 Cofferdans		
	.1 - Mobilization	40,960	4,000
	.2 .3 & .4 -Work	532,000	21,000
.3	Placing of 11,200 cun concrete		
	.1 Mobilization	67,200	2,560
	.2 Placing Concrete	140,000	28,000
	Totals	1,586,560	69,560

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling will take place on a designated location not less the 100 m from any water body. Trucks will be refuelled at the Big River gas station located at km 31, HWY #3.

Pier Shafts Fabrication & Installation:

Construction of the Pier Shafts is not "in-stream" activity. However, material, equipment and workers have to cross the water body in order to access the piers.

- Fabrication: The 8 pier shafts are composed of 48 prefabricated structural steel elements of 315,000 kg total weight. For easy transportation and installation each individual element will be fabricated within the limits of 12 m length, 3.6 m width/height and 15,000 kg weight. Fabrication of the steel will take place in a specialized shop in southern Canada.
- Mobilization: The 48 prefab elements, scaffold frames and tools will be transported on B-trains to the south side of the river and skidded to each pier location. 80t mobile crane will be mobilised from Edmonton. A 50t mobile crane, midsize loader, bulldozer and welding truck will be available locally.
- Ice Preparation: An access ice road will be build along the pier locations by clearing the snow with light bulldozer and increasing the thickness of the natural ice by flooding by augers mounted on trucks.
- Installation of the pier shafts: This will be completed between March 01 and April 15, 2006 with an 80 t mobile crane deployed on the ice. Shaft elements will be transported from

shore on skids pulled by light bulldozer. Two crews of six men will be working simultaneously on different pier shafts

Equipment, Labour & Traffic:

- <u>Mobilisation</u>: Equipment: 12 B-trains, 1 80t crane, 4 pickups for the crew; Labour: 17 drivers.
- Ice preparation: Equipment: 1 light bulldozer, 1 pickup truck equipped with auger;
- Labour: 3 local operators
- Installation of pier shafts: Equipment: 1 80t mobile crane, 1 50 t mobile crane, 1 light bulldozer, 1 welding truck and 4 pickups for the crew:
- Labour: 5 local labourers and 13 operators/steel workers accommodated in Big River Motel.

Schedule:

		Schedule		Labor	Accomm. (man/day)		Traffic
#	Activity	days	dates	(men)	Con.Camp	Other	veh/day
1	Mobilization	4	25 Feb- 01 Mar, 2006	17	-	68	9
2	Ice Preparation	30	01Feb-01 Mar, 2006	3		90	-
3	Installation of shafts	45	01 Mar- 15 Apr, 2006	18	-	810	-

Fuel:

#	Activity	Diesel fuel (litres)	Gasoline (litres)
1	Mobilization	20,800	2,560
2	Ice Preparation	4,500	1,500
3	Installation of shafts	49,500	9,000
	Totals	25,300	13,060

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling will take place on a designated location not less the 100 m from any water body. Trucks will be refuelled at the Big River gas station located at km 31, HWY #3.

Abutment Construction:

Construction of the bridge abutments is not "in-stream" activity. The work includes:

Mobilisation:

- Material from ED, AB: 70,000 kg piles HP350; 40,000 kg rebar; 10,000 kg forming material
- Equipment from YK, NT: 20,000 kg Hydraulic Crawler Drill; 50 t mobile crane; diesel hammer, concrete bucket, etc
- Fuel consumption and traffic volume for Mobilization of Material will be increased by 20% to reflect Mobilisation and Demobilisation of Equipment.

Pile Driving:

- Pre-drilling 32 holes (250 mm diameter) with hydraulic crawler drill deployed on top of partially completed approach embankment.
- Driving 32 piles HP 350 to refusal in the till strata below the riverbed.

Placing concrete:

- Preparation, installation & removal of forming; installation of rebar, pouring and curing of 560 cu m concrete. Supply and delivery of concrete is accounted for in **item 4.iii.)** of this document. Placing of the concrete will be done in 2 phases:
  - Phase One: Placing 300 cu m (150 on each abutment) for pile cap, scheduled

for summer 2005
- Phase Two: Placing 260 cu m (130 on each abutment) for Back-wall and wing-walls, scheduled for summer 2006

Equipment, Labour & Traffic:

Mobilisation: Equipment: 3 B-train truckloads from Edmonton (1,200 km); Labour: 3 operators, (6 man days in commercial accommodation)

Pile Driving: Equipment: 1 hydraulic crawler drill (2 days), 1 wheel crane-50t (7 days), 1 midsize loader (7 days), 1 welding truck (7 days); Labour: 5 operators (26 man days in Camp)

Placing concrete 2005: Equipment: 1 wheel crane-50t with concrete bucket (5 days), 1 midsize loader (5 days), 1 pickup for the crew (10 days); Labour: 3 labourers from Ft. Providence, 2 operators (10 man days in Camp) and 2 carpenters (20 man days in Camp).

Placing concrete 2006: Equipment: 1 wheel crane-50t with concrete bucket (5 days), 1 midsize loader (5 days), 1 pickup for the crew (10 days); Labour: 3 labourers from Ft. Providence, 2 operators (10 man days in Camp) and 2 carpenters (20 man days in Camp).

Schedule:

	Schedule			Labor	Accomm. (man/day)		Traffic
#	Activity	days	dates	(men)	Con.Camp	Other	veh/day
1	Mobilization	7	01Aug- 07 Aug, 2005	3	-	6	7
2	Pile driving	7	07Aug- 14Aug, 2005	7	26	-	0
3	Placing concrete 2005	15	15Aug- 30Aug, 2005	7	30	42	0
4	Placing Concrete 2006	15	01 Jun - 14 Jun, 2006	4	30	42	0

Fuel:

Activity	Diesel fuel (litres)	Gasoline (litres)
Mobilization	4,800	-
Pile driving	9,400	350
Placing concrete 2005	6,300	700
Placing Concrete 2006	6,300	700
Totals	26,800	1,750

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling will take place on a designated location not less the 100 m from any water body. Trucks will be refuelled at the Big River gas station located at km 31, HWY #3.

Steel Superstructure Fabrication & Installation

Fabrication and installation of the steel superstructure are not "in-stream" activities. However, during installation material and labour will be moved on and over the water body.

- Fabrication: The steel structure will be fabricated in a specialized shop in southern Canada. The total of 4,750,000 kg steel will be broken down into several hundred prefabricated truss panels, portal column sections, diaphragm panels, braces, rods, etc. The fabrication will be done within 12 months (March 2005-February 2006).
- Mobilization: All bridge material will be transported to the NT in approximately 180 truckloads by road. The largest transported section will not exceed 37 m in length, 4.5 m in width and 40,000 kg in weight.

Material for the four end spans on each side of the bridge will be delivered on site, offloaded and sorted on the bridge approaches and on the highway right-of-way on both sides of the river. Material for the main (centre) span will be delivered to the shipyard in Hay River.

The delivery of material will be done within 90 days between February and April 2006. Vehicles delivering material to the north side will cross the river on the ice road.

- Site Preparation & Offloading steel: This includes clearing the snow and levelling the areas for offloading the bridge components and the area of the approaches for the preassembly. The work will be done in stages in concert with the arrival of the material. Offloading will be done with a 150t crawler crane.
- Installation: The trusses for the four end spans on each side of the bridge will be fully preassembled and braced on the corresponding approaches and launched towards the center. For better deflection control during launching a 50 m long "launching nose" will be attached on the leading end of the truss. Assembly and launching will be completed within 60 days between March 01 and May 31, 2006.

  The main span will be preassembled on a large barge in the Hay River shipyard, will be sailed to site and lifted into position with winches mounted on the cantilevered sections of the launched end spans. Installation of portals stays and main span will be done between June 07 and June 21, 2006, or earlier ice traffic permitting.

  Two crews of 6 steel erectors will be working simultaneously on each side of the river. After completion the launching the same crews will assemble and install the portals the stays and the main span.

Equipment, Labour & Traffic:

- Mobilisation from Edmonton: Material: 180 truckloads bridge material; Equipment: 30 truckloads launching mechanisms, scaffolds, compressors, cables, tools, etc. 1 150t crawler crane (4 truck loads), 1 50t mobile crane and 6 pickups; Labour: 5 truck drivers in commercial accommodation.
- Site Preparation & Offloading: Equipment: 1 150 t crawler crane, 1 light bulldozer and 2 pickup trucks; Labour: 3 local operator/labourers and 1 operator accommodated in Big River Motel.
- Installation of 4,750,000 kg steel: Equipment: 2 150t crawler cranes, 2 mobile cranes, 2 large loaders, 6 pickups for the crew; Labour: 8 local labourers and 18 steel erectors and operators accommodated in Big River Motel.

Schedule Steel Superstructure:

Schedule			Labor	Accomm. (man/day)		Traffic
Activity	days	dates	(men)	Con.Camp	Other	veh/day
Mobilization	90	01 Feb- 30 Apr, 2006	5	-	450	5
Site prep. & Offloading	90	01 Feb- 30 Apr, 2006	4	-	360	-
Installation 4,750,000 steel	90	01 Mar - 31 May, 2006	26		2,340	-

Fuel:

Activity		Diesel fuel (litres)	Gasoline (litres)
Mobilization		275,200	3,840
Site Preparation		58,500	4,500
Installation 4,750,000 steel		199,400	2,700
	Totals	533,100	11,040

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling will take place on a designated location not less the 100 m from any water body. Trucks will be refueled at the Big River gas station located at km 31, HWY #3.

Bridge Deck Fabrication & Installation

Fabrication and installation of the concrete deck are not "in-stream" activities. However, during installation material and labour will be moved over the water body.

- Fabrication: The pre-cast and pre-stressed concrete panels and curb elements will be fabricated in a specialised plant in Southern Canada. The deck panels are 11.5 m long, 2.5 m wide, with 0.3 m thickness. Each panel weights 21.5 tonnes. The curb elements are 5.0 m long, 1.0 m wide, with 0.45 m average thickness. Each curb element weights 5.6 t. The fabrication involves a total of 4,520 cu m concrete (11,300,000 kg). The fabrication will be done within 15 months (March 2005-June 2006).
- Mobilization: Deck panels will be transported, two at a time, on customized truck configurations. Curbs will be delivered on flat deck B-train trucks. The resulting 266 truckloads will be delivered within 90 days (3 truckloads per day) between March and May 2006. Vehicles delivering material to the north side will cross the river on the ice road. The delivered material will be offloaded and stacked on the highway right-of-way on both sides of the river. Offloading will be done with the 150 crane used for the offloading of the steel superstructure. Bridge railing, light posts, expansion joints, post-tensioning and grouting equipment and other miscellaneous will be delivered in 50 truckloads (3 truckloads per day) in the first two weeks of June 2006.
- Installation: Installation of the deck panels will proceed simultaneously from each end of the bridge towards the centre. The panels will be delivered to the deck on customized truck configurations and will be placed with 80 t mobile crane deployed on previously installed panels. After installation, the panels will be post-tensioned with specialized hydraulic jacks and will be grouted to the steel trusses. The work will be completed within 10 weeks between June 15 and August 31, 2006. One crew of ten men will be working on each side of the bridge.

  Concrete curbs, handrails and bridge lights will be installed on both sides of the finished deck using 2 mid size loader and one 20t mobile crane. Installation will be completed between September 01 and October15, 2006 by 2 crews of 10 men.

Equipment, Labour & Traffic:

- Mobilisation from Edmonton: Material & Equipment: 316 truckloads; Labour: 6 truck drivers in commercial accommodation.
- Installation of concrete deck: Equipment: 2 80t mobile cranes, 2 large loaders, 2 customized bed trucks, 6 pickups for the crew; Labour: 8 local labourers and 18 concrete installers & operators accommodated in Camp.
- Installation of rail, lights & misc.: Equipment: 1 20t mobile crane, 2 midsize loaders, 6

pickups for the crew; Labour: 8 local labourers and 15 concrete installers & operators accommodated in Camp

Schedule Bridge Deck

Schedule			Labor	Accomm. (man/day)		Traffic
Activity	days	dates	(men)	Con.Camp	Other	veh/day
Mobilization	105	01Mar-15 Jun, 2006	6	-	630	6
Installation deck pannels	75	15 Jun-Aug 31,2006	24	1,350	600	-
Install curbs, rail, lights, etc	45	01 Sep-15 Oct, 2006	23	675	360	0

Fuel:

Activity	Diesel fuel (litres)	Gasoline (litres)
Mobilization	505,600	-
Installation deck panels	210,000	22,500
Install curbs, rail, lights, etc	31,500	13,500
Totals	747,100	36,000

C.4.2 Construction Camp *Attachment 11*

Site Preparation: This includes removal of the trees from an area of 15,000 sq m (100 m by 150 m). The trees could be harvested by local residents, or burned. The overburden will be spread along the east limit of the area and landscaped. During the site preparation a portable "pump-out" toilet cell will be installed on site.

Description of the Camp: The Camp will consist of 6 specialized trailer units including kitchen, dining room, bathrooms & showers, laundry services, mechanical, storage, and 30 bed sleeping quarters in addition to the Camp personnel of 4. A 200 sq m light frame-canvas mechanical shelter will be installed in the area as well. Storages for fuel and lubricants will include:

Operation:

- Electric power for the camp will be supplied from the power plant that provides electricity for the adjacent Ferry Camp.
- Fresh water will be delivered from Fort Providence with specialized water truck and will be stored in 5,000 litres tank. Assuming 50 litres/man-day fresh water consumption and 90% average occupancy the daily demand for fresh water is calculated at 1,600 litres.
- Sewage will be collected in a 10,000 litres sewage tank, will be pumped out with specialised truck and will be discharged in the Ft. Providence sewage lagoon.
- Food supplies will be delivered to camp with a truck from Hay River.
- It is not anticipated any significant fuel consumption in the Camp. There will be not fuel storage in the camp area.
- Solid organic wastes will be incinerated on site. Non-organic wastes estimated at 1,500 kg per month containerised and transported to Pt. Providence landfill area for disposal.
- Water supply, sewage removal, catering services and garbage disposal will be contracted out to professional outfits.

Personnel: Full time camp personnel include 1 Chef, 1 helper cook, 1 maintainer/mechanic and 1 camp Manager. 3 part-time workers residing in Ft. Providence will provide additional kitchen help and room cleaning services.

Operating Schedule: The Camp will be in operation for 10 months (June-October 2005 and June-

October 2006) and will be able to provide accommodation services for a total of 9,000 man-day. Contractor's personnel working in the winter as well as overflow workers during the summer months will be accommodated in the Big River Motel, 7 km to the north of the bridge sit.

Demobilization: After closing of the Camp all facilities and inventory will be removed from site. The remaining debris will be incinerated or disposed off in environmentally friendly manner. The area will be thoroughly cleaned from any foreign objects and landscaped.

Schedule

The Land Use Permit for the Area for Construction Camp is required for the period between October 01, 2004 and October 30, 2006.

#	Schedule			Labor	Accomm. (man/day)		Traffic
	Activity	days	dates	(men)	Con.Camp	Other	veh/day
1	Site Preparation	21	01 Oct- 21 Oct 2004	6		126	4
2	Mobilization	15	15 May-30 May 2005	6		90	4
3	Operation 2005	150	01 Jun -30 Oct, 2005	27	4,050		2
4	Operation 2006	150	01 Jun -30 Oct, 2006	27	4,050		2

Summary operation Construction Camp:

Calculated average occupancy 90% for the duration of 10 months

		daily	10 months
Item	unit	Quantity	Quantity
Provided accommodation	man-day	27	8,100
Provided local employment	man-day	6	1,800
Fuel consumption	litres	120	36,000
Fresh water consumtion	litres	1,400	420,000
Waste water disposal	litres	1,400	420,000
Solid waste disposal	kg	50	15,000
Traffic generated	veh	2	600

Impact on the Community: The camp will generate 5 full time or part-time employments for the residents of Ft. Providence.
The impact on the municipal services (fresh water plant, sewage lagoon and garbage dump) the operation of the camp would equivalent to an increase of the Ft Providence population by less than 5% for the duration of 10 months.

Construction and operation of Temporary Concrete Plants
Attachment 11 & Attachment 12

Capacity of the Plants

The total demand for cast in place concrete is 13,000 cu m, required for the construction of the piers, the abutments and other smaller bridge components. This concrete will be produced in approx. 30 reprises distributed almost evenly between early June and mid October 2005. Each plant will be able to produce in excess of 50 cu m concrete per hour and to maintain this rate of production for a period of not less than 15 hours.

Description of the Plants

Technologically both plants will most likely be identical. Since they would not need to be operated simultaneously, the contractor may choose to move some of the specialized plant components from one plant to the other, depending on the location of the corresponding demand for concrete.

Each Concrete Plant will be operated with electric power and will consist of 3 mixer-truck stalls, 3 aggregate scales, 3 @ 70 cu m cement-silos, 3 @ 50 cu m water tanks and systems of hoppers and elevator belts. On the area surrounding the plant there will be a mechanical trailer, an office trailer equipped with pump-out toilet and not less than 3,000 cu m stockpiled concrete aggregates. For operation in temperature near or below zero (October) some of the plant components might need to be hoarded and the water and aggregates, heated.

Site Preparation

- North Plant: Includes partial grubbing, leveling and covering the area with a layer of gravel. The removed overburden will be spread along the north limit of the area and landscaped.
- South Plant: Preparation of this site is similar to the adjacently located South Borrow Area.

Mobilisation & Setup: Includes installation of all mechanical components of the Plants and test run. Vehicle traffic involved in the mobilization is not accounted for, since it is considered a negligible contribution to the total amount of traffic generated by the Concrete Plants activity.

Material Supply: Includes and supply of ingredient materials for concrete production including:

- 4,600 t bulk cement delivered from Edmonton
- 2,600 cu m mixing water delivered from the water treatment plant in Ft Providence
- Supply of 16,000 cu m concrete aggregates is accounted for in **item 4 .x)** of this document.

Operation & Transportation: Includes production and delivery of 13,000 cu m concrete from the concrete plant to the location of the corresponding pour on the bridge site. Over 97% of the concrete will be produced in summer 2005. The remaining less than 3% will be produced in summer 2006. This later is considered to generate negligible amount of activity and is omitted in the construction schedule.

Demobilisation: Includes dismantling of the mechanical components and landscaping of the areas.

Equipment, Labour & Traffic:

- Site Preparation: Equipment: 1 large size bulldozer equipped with ripper, 1 large size loader and 3 pickup trucks for the crew. Labour: Crew of 6 residents of Ft. Providence and 2 operators.
- Mobilisation: Equipment: 2 large size loaders, 50 t crane and 3 pickups for the crew. Labour: Crew of 2 residents of Ft. Providence and 6 operators accommodated in Big River Motel.
- Material Supply: B-train trucks of capacity 40 t bulk cement, water-truck with 15 cu m tank: Traffic: Cement -115 loads from Edmonton, average 1 load/day; Water -180 loads from Ft. Providence, average 1.5 loads/day. Labour: 2 B-train drivers
- Operation & Transportation: Equipment: 9 trucks concrete-mixers (a mixer will make one round trip per hour and will carry 6 cu m concrete per trip), 3 mid size loaders and 3 pickup trucks for the crew. Traffic: total 2,170 loads of concrete; average18 loads per/day from plant to bridge; Labour: 2 labourers from Ft. Providence and crew of 18 accommodated in Camp (9 drivers, 6 plant operators, 3 loader operators)
- Demobilisation: Equipment: 2 large size loaders, 50 t crane and 3 pickups for the crew; Labour: 6 labourers from Ft. Providence and 6 operators accommodated in Camp.

Schedule

The Land Use Permit for the Two Areas for Temporary Concrete Plants is required for the period between March 01, 2005 and October 30, 2006.

	Schedule			Labor	Accommodation (man/days)		Traffic
#	Activity	days	dates	(men)	Constr.Camp	Other	veh/day
1	Site Prep (2 sites)	15	01 Oct -14 Oct, 2004	8	0	120	6
2	Mobilization	15	15May -30 May,2005	8	0	120	0
3	Material Supply						
	Cement: Edm-North Plant	70	01 Jun - 08 Aug 2005	2	0	140	2
	Cement: Edm-South Plant	70	09 Aug - 20 Oct 2005	2	0	140	2
	Water: Edm-North Plant	70	01 Jun - 08 Aug 2005	1	0	70	2
	Water: Edm-South Plant	70	09 Aug - 20 Oct 2005	1	0	70	2
4	Operat&Transp						
	Conc.Delivery: N Plant-Bridge	70	01 Jun - 08 Aug 2005	20	1260	140	36
	Conc.Delivery: S Plant-Bridge	70	09 Aug - 20 Oct 2005	20	1260	140	36
5	Demobilization	2	01 Oct -15 Oct 2006	8	0	120	0

Fuel:

Activity	Diesel fuel (litres)	Gasoline (litres)
Site Prep (2 sites)	23,800	2,100
Mobilization	26,600	2,100
Mateial Supply	175,000	-
Operation & Transp.	46,800	18,000
Demob	26,600	2,100
Totals	298,800	24,300

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling of heavy equipment will be taking place on a designated location not less the 100 m from any water body. Trucks will be refuelled at the Big River gas station located at km 31, HWY #3.

Two Areas for temporary storage and parking *Attachment 11*

These areas are located on the north side of the river, adjacent to the highway right-of-way near km 25+700 of the Yellowknife HWY #3. Both areas are levelled, covered with gravel, and have dimensions of 40 m by 110 m (4,400 sq m) and 50 m by 300 m (15,000 sq m) respectively.

These areas are readily available for parking of vehicles and construction equipment, also for storage of clean construction materials including structural steel, pre-cast concrete elements, structural timber, gravel, etc. No fuel, lubricants or other substances harmful to aquatic life will be stored on these areas.

The Land Use Permit for the Two areas for temporary storage is required for the period between March 01, 2005 and September 30, 2007.

Reclamation Areas related to removal of existing ferry infrastructure

This item is discussed in itemC.8 below

Mackenzie HWY #1, km 188.5 – Proposed Limestone Quarry *Attachment 13*
(Also known as HWY #1, km 191-east)

Site Preparation includes removal of the trees and the thin layer of organic overburden from an area of 20,000 sq m (100 m by 200 m). The trees could be harvested by local residents, or burned. The overburden will be spread along the east limit of the area and landscaped. During this and the following phases of work a portable "pump-out" toilet cell will be installed on site.

Production of 40,000 cu m limestone will be done by drilling and blasting. The produced material will be used as follows:

- 8,600 cu m for the 'in water' base of detour on the North Approach
- 6,800 cu m for widening the 'in water' base of the North Approach
- 16,500 cu m for extension the 'in water' base of the South Approach
- 6,800 cu m for dressing the shoulders of the North and South Approaches

Transportation

- The 15,400 cu m limestone destined for the North Approach will be transported immediately after production using the ice crossing.
- The 16,500 cu m will be left on site to be transported to the South Approach later in summer according to schedule.
- One half of the remaining 6,800 cu m destined to the north side will be transported across the river on the shuttle barge contracted to maintain the barge-bridge..

Equipment Labour & Traffic:

- Site Preparation: Equipment: 1 large bulldozer equipped with ripper, 1 medium loader and 3 pickup trucks for the crew; Labour: A crew of 6 residents of Ft. Providence and 2 equipment operators accommodated in the Big River Motel near Ft Providence.

- Production of 40,000 cu m rock: Equipment: 2 hydraulic crawler drills, 1 trailer for explosives, 1 strong box for primers, and 2 pickup trucks for the crew; Labour: 4 operators accommodated in Big River Motel.

- Transportation of 15,400 cu m rock (8,600 cu m+6,800 cu m) to the North Approach: Equipment: 1 large excavator, 8 trucks-semi trailers with 15 cu m boxes, and 1 pickup. The distance to the North Side is approx 30 km, which will result in 1 ¼ hour round trip for each truck. Assuming 12 hour workday the resulting traffic volume will be 80 truck trips per day in each direction for the duration of 2 weeks; Labour: 8 operators accommodated in Bid River Motel.

- Transportation of 16,500 cu m rock to the South Approach: Equipment: 1 large excavator, 8 trucks-semi trailers with 15 cu m boxes and 1 pickup. The distance from the quarry to the South Side is approx 25 km, which will result in 1 hour round trip for each truck. Assuming 10 hour workday the resulting traffic volume will be 80 truck trips per day in each direction for the duration of 2 weeks; Labour: 9 operators accommodated in Camp.

- Transportation of 6,800 cu m rock to the bridge site: Equipment: 1 large excavator, 8 trucks-semi trailers with 15 cu m boxes and 1 pickup. The distance to the bridge site is approx. 25 km, which will result in 1 hour round trip for each truck. Assuming 10 hour workday the resulting traffic volume will be 80 truck trips per day in each direction for the duration of 6 days; Labour: 9 operators accommodated in Camp.

*Schedule***:**

The Quarry Permit for extraction of 40,000 cu m rock from Mackenzie HWY #1, km 188.5 – Proposed Limestone Quarry is required for the period between October 01, 2004 and October 31, 2006.

	Activity	Schedule days	dates	Labor (men)	Accommodation (man/day) Constr.Camp	Other	Traffic veh/day
1	Site Prepartion	7	16 Oct- 23 Oct, 2004	8	0	14	6
2	Produce 40,000 cum rock	14	16 Mar-31Mar, 2005	4	0	60	0
	Transportation						
3	15,400cum: Quarry-N Appr	14	23 Mar-07 Apr, 2005	9	0	135	160
4	16,500cum: Quarry-S Appr	14	08 Jul -23 Jul, 2005	9	135	0	160
5	6,800cum: Quarry-bridge	7	23Aug -31Aug, 2005	9	70	0	160

Fuel:

Activity		Diesel fuel (litres)	Gasoline (litres)
Site preparation		9,600	1,200
Production of 40,000 cu m rock		18,000	400
Transportation of 15,400 cu m rock		54,000	700
Transportation of 6,800 cu m rock		25,000	350
Transportation of 16,500 cu m rock		52,000	700
	Totals	158,600	3,350

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling will be taking place on a designated location not less the 100 m from any water body. Trucks will be refuelled at the Big River gas station located at km 31, HWY #3.

Mackenzie HWY #1, km 188.5 – Existing Gravel Pit *Attachment 13-*
(This pit is also known as HWY #1, km 191-east)

Site Preparation includes removal of the trees and the thin layer of organic overburden from an area of 25,500 sq m (300 m by 85 m). The trees could be harvested by local residents, or burned. The overburden will be spread along the east limit of the area and landscaped. During this and the following phases of work a portable "pump-out" toilet cell will be installed on site.

Production of 16,000 cu m pit-run gravel will be completed by ripping and scraping the ground to a depth of 1.2 m below the average surface level. The pit-run gravel will be used as follows:

- 700 cu m (2@350) for structural backfill behind the abutments
- 5,900 cu m will be used for Sub-base on the North Approach
- 1,900 cu m for surfacing the camp area, the concrete plant area and for other misc. purposes
- 6,500 cu m will be crushed, screened and stockpiled in different fractions, to be used for:
- 2,100 cu m for base material on the North Approach
- 2,600 cu m for base material on the South Approach
- 800 cu m for surfacing and maintaining the detours
- 1,000 cu m (after screening) for chip-sealing of the bridge approaches.

Transportation:

The structural backfill for abutments will be delivered in July 2006 after completion concrete for abutments. The 350 cu m for the north abutment will be moved across the river on the shuttle barge.

The pit-run gravel for sub-base of the north side will be delivered for placement in late summer 2006 using the bridge. The material for chip-sealing will be delivered for placing in August 2007 after completion the gravel haul for the Reclamation Areas.

Equipment, Labour & Traffic:

- Site Preparation: Equipment: 1 large size bulldozer equipped with ripper, 1 midsize wheeled loader and 2 pickup trucks for the crew; Labour: A crew of 6 residents of Ft. Providence and 2 operators accommodated in Camp.
- Production of 15,000 cu m pit-run gravel: Equipment: 1 large bulldozer equipped with ripper, 1 midsize loader and 1 pickup truck for the crew; Labour: 2 operators accommodated in Camp.
- Crushing of 6,500 cu m gravel: Equipment: 1 midsize crusher, 1 midsize loader and 2 pickups for the crew. Labour: 4 operators accommodated in Camp.
- Transportation of 700 cu m structural backfill: Equipment: 4 trucks-semi trailers with 15 cu m boxes, 1 mid size loader and 1 pickup truck. The travel distance of approx 30 km will result in 2 hour round trip for each truck. Assuming 12 hour workday the resulting traffic volume will be 24 truck trips per day in each direction for the duration of 2 days. Labour: 5 operators accommodated in Camp.
- Transportation of 10,600 cu m gravel (5,900 for Sub-base N, 2,100 for base N and 2,600 for base S): Equipment: 8 trucks-semi trailers with 15 cu m boxes, 1 mid size loader and 1 pickup truck. The travel distance of approx 24 km will result in 45 min round trip for each truck. Assuming 10 hour workday the resulting traffic volume will be 104 truck trips per day in each direction for the duration of 7 days. Labour: 9 operators accommodated in Camp.
- Transportation of 2,700 cu m gravel (1,900 for surfacing misc. and 800 for detours): This gravel will result in 180 truck loads material that will be used in small volumes on "as & when" required basis throughout the 10 months construction period and will generate only negligible amount of daily traffic.
- Transportation of 1,000 cu m chips: 3 tandem trucks with 15 cu m boxes, 1 midsize loader and 1 pickup truck. The average distance to the bridge site is approx. 25 km, which will result in 1 hour round trip for each truck. Assuming 11 hour workday the resulting traffic volume will be 33 truck trips per day in each direction for the duration of 2 days.

Schedule:

The Quarry Permit for extraction of 16,000 cu m gravel from Mackenzie HWY #1, km 188.5 – Existing Gravel Pit is required for the period between October 01, 2004 and October 31, 2007.

Activity	Schedule		Labor	Accommodation(man/day)		Traffic
	weeks	dates	(men)	Constr.Camp	Other	veh/day
Site Prepartion	1	23 Jun -31 Jun 2005	8	14	42	6
Produce 15,000 cum grav.	2	01 Jul -15 Jul 2005	2	30	0	0
Crush. 6,000 cum gravel	1	16 Jul -21 Jul 2005	4	28	0	0
Transp. 12,000 cum grav.	2	01 Mar -15 Mar 2006	9	135	0	128
Transp. 9,000 cum grav.	2	01Aug -15 Aug 2006	4	60	0	180
*Transp. 6,000 cum crush	1	01Sep -07 Sep 2006	5	0	35	150

* The 6,000 cum crush is the combined volume transported to the North and South Approaches.

Fuel:

#	Activity	Diesel fuel (litres)	Gasoline (litres)
1	Site Prepartion	7,700	700
2	Produce 15,000 cum grav.	16,800	700
3	Crush. 6,500 cum gravel	16,300	350
4	Transp. 700 cum str bkfill abtm	4,200	100
5	Transp. 10,600 cum grav.	25,900	350
6	Transp. 1,000 cum chips	3,740	100
		74,640	2,300

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling will be taking place on a designated location not less the 100 m from any water body. Trucks will be refueled at the Big River gas station located at km 31, HWY #3.

Yellowknife HWY #3, km 23+270 – Proposed South Borrow Area *Attachment 11*

Site Preparation: This includes removal of the trees and the layer of organic overburden from an area of 32,000 sq m. The trees could be harvested by local residents, or burned. The overburden will be spread in a layer along the south limits of the corresponding areas and landscaped. A 30 m wide strip of undisturbed forest will be left between the road and the borrow area. During this and the following phases of work a portable "pump-out" toilet cell will be installed on site.

Production & Transportation: Production of 38,000 cu m pit-run material involves ripping, pushing and stockpiling. The ground will be cut to a depth of 2.0 m below the average surface elevation. The excavated material will be used for common backfill in the embankment construction of the South Approach embankment. The material will be produced and transported for placement in the embankment in two phases:

- Phase One: 26,000 cu m placed to the elevation of the bridge bearing seats will be placed before the installation of the bridge superstructure.
- Phase Two: 12,000 cu m placed to the final sub-grade elevation before the installation of the concrete deck panels.

Equipment, Labour & Traffic:

- Site Preparation: Equipment: 1 large size bulldozer equipped with ripper, 1 midsize loader and 2 pickup trucks for the crew; Labour: A crew of 6 residents of Ft. Providence and 2 operators accommodated in Camp.
- Production of 26,000 cu m common fill: Equipment: 1 large bulldozer equipped with ripper; Labour: 1 operator accommodated in Camp.
- Production of 12,000 cu m common fill: Equipment: 1 large bulldozer equipped with ripper; Labour: 1 operator accommodated in Camp.
- Transportation of 26,000 cu m common fill: Equipment: 3 trucks-semi trailers with 15 cu m boxes or articulated dump trucks of similar capacity, 1 midsize loader and 1 pickup. The travel distance of approx 1 km will result in 20 min round trip for each truck. Assuming 10 hour workday and some standby required for placing the material the resulting traffic volume will be 80 truck trips per day in each direction for the duration of 3 weeks. Labour: 4 operators accommodated in Camp.
- Transportation of 12,000 cu m common fill: Equipment: 3 trucks-semi trailers with 15 cu m boxes or articulated dump trucks of similar capacity, 1 midsize loader and 1 pickup truck. The travel distance of approx 1 km will result in 20 min round trip for each truck. Assuming

10 hour workday and some standby required for placing the material the resulting traffic volume will be 45 truck trips per day in each direction for the duration of 2 weeks; Labour: 4 operators accommodated in Camp.

Schedule:

The Quarry Permit for extraction of 40,000 cu m material from the South Borrow Area is required for the period between October 01, 2004 and October 31, 2007.

Activity	Schedule		Labor	Accommodation (man/day)		Traffic
	days	dates	(men)	Constr.Camp	Other	veh/day
Site Prepartion	15	01Oct -15 Oct 2005	8	0	120	6
Produce 26,000 cum fill	14	01Aug-14 Aug 2005	1	15	0	0
Transp. 26,000 cum fill	21	01Aug-21 Aug 2005	4	90	0	160
Produce 12,000 cum fill	7	01 Jun -07 Jun 2006	1	7	0	0
Transp. 12,000 cum fill	15	01 Jun -15 Jun 2006	4	60	0	90

Fuel:

Activity	Diesel fuel (litres)	Gasoline (litres)
Site Prepartion	15,400	1,400
Produce 26,000 cum fill	9,800	-
Transp. 26,000 cum fill	33,600	1,050
Produce 12,000 cum fill	4,900	-
Transp. 12,000 cum fill	22,400	700
Totals	86,100	3,150

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling will be taking place on a designated location not less the 100 m from any water body. Trucks will be refuelled at the Big River gas station located at km 31, HWY #3.

Yellowknife HWY #3, km 26+240– Proposed North Borrow Area *Attachment 11*

Site Preparation includes removal of the trees and the layer of organic overburden from an area of (23,400 sq m (130 m by 180 m). The trees could be harvested by local residents, or burned. The overburden will be grubbed, spread in a layer along the east limit of the area and landscaped. A 50 m wide strip of undisturbed forest will be left between the road and the borrow area. During this and the following phases of work a portable "pump-out" toilet cell will be installed on site.

Production of 53,000 cu m pit-run material involves ripping, pushing and stockpiling. The ground will be cut to a depth of 2.5 m below the average surface elevation. The excavated material will be used for common backfill in the embankment construction of the North Approach embankment. The material will be produced and transported for placement in the embankment in two phases:

- Phase One: 41,000 cu m placed to the elevation of the bridge bearing seats will be placed before the installation of the bridge superstructure.
- Phase Two: 12,000 cu m placed to the final sub-grade elevation before the installation of the concrete deck panels.

Equipment Labour & Traffic:

- Site Preparation: Equipment: 1 large size bulldozer equipped with ripper, 1 midsize wheeled loader and 2 pickup trucks for the crew; Labour: a crew of 6 residents of Ft. Providence and 2 operators accommodated in Camp.

- Production of 41,000 cu m common fill: Equipment: 1 large bulldozer equipped with ripper and 1 pickup truck for the crew; Labour: 1 operator accommodated in Camp.
- Transportation of 41,000 cu m common fill: Equipment: 3 trucks-semi trailers with 15 cu m boxes or articulated dump trucks of similar capacity, 1 midsize loader and 1 pickup truck for the crew. The travel distance of approx 1 km will result in 20 min round trip for each truck. Assuming 10 hour workday and some standby required for placing the material the resulting traffic volume will be 90 truck trips per day in each direction for the duration of 4 weeks; Labour 4 operators accommodated in Camp.
- Production of 12,000 cu m common fill: Equipment: 1 large bulldozer equipped with ripper and 1 pickup truck for the crew; Labour: 1 operator accommodated in Camp.
- Transportation of 12,000 cu m common fill: Equipment: 3 trucks-semi trailers with 15 cu m boxes or articulated dump trucks of similar capacity, 1 midsize loader and 1 pickup truck for the crew. The travel distance of approx 1 km will result in 20 min round trip for each truck. Assuming 10 hour workday and some standby required for placing the material the resulting traffic volume will be 45 truck trips per day in each direction for the duration of 2 weeks; Labour: 4 operators accommodated in Camp.

Schedule:

The Quarry Permit for extraction of 55,000 cu m material from the **North Borrow Area** is required for the period between **October 01, 2004** and **October 31, 2007.**

	Activity	Schedule		Labor	Accommodation (man/day)		Traffic
		days	dates	(men)	Constr.Camp	Other	veh/day
1	Site Prepartion	15	16 Oct -30 Oct 2004	8		120	6
2	Produce 41,000 cum fill	30	16 Jun -15 Jul 2005	1	30	0	0
3	Transp. 41,000 cum fill	30	16 Jun -15 Jul 2005	4	90	0	180
4	Produce 12,000 cum fill	7	01 Jun -07 Jun 2006	1	7	0	0
5	Transp. 12,000 cum fill	15	01 Jun -15 Jun 2006	4	60	0	90

Fuel:

Activity		Diesel fuel (litres)	Gasoline (litres)
Site Prepartion		15,400	1,400
Produce 41,000 cum fill		21,000	-
Transp. 41,000 cum fill		48,000	1,500
Produce 12,000 cum fill		4,900	-
Transp. 12,000 cum fill		22,400	700
	Totals	111,700	3,600

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling will be taking place on a designated location not less the 100 m from any water body. Trucks will be refueled at the Big River gas station located at km 31, HWY #3.

Yellowknife HWY #3, km 87 – Gravel Pit for Concrete Aggregate *Attachment 14*

Site Preparation: All trees and the layer of organic overburden will be removed from an area of (7,200 sq m (120 m by 60 m). The trees could be harvested by local residents, or burned. The overburden will be grubbed, spread in a layer along the west limit of the area and landscaped. The crusher will be setup and tested. During this and the following phases of work a portable "pump-out" toilet cell will be installed on site.

<u>Production</u> of 21,000 cu m gravel involves ripping, pushing and stockpiling. The ground will be cut to a depth of 1.5 m below the average surface elevation. The excavated gravel will be crushed, screened and sorted by size of aggregates in three or four stockpiles.

<u>Transportation:</u> Approx. 16,000 cu m of the sorted aggregates will be transported to the Temporary Concrete Plant located at km 30.2, HWY #3. In case the contractor decides to set a second concrete plant on the south side of the river, part of the aggregates will have to be transported there directly from the gravel pit. The land reserved for second concrete plant is located at 23+270, HWY #3. The difference in distance between the gravel pit and each of the concrete plant sites is negligible.

Equipment Labour & Traffic:

- <u>Site Preparation:</u> Equipment: 1 large bulldozer equipped with ripper, 1 midsize loader, 1 mid size crusher, camp trailer and 3 pickups for the crew; Labour: A crew of 4 residents of Ft. Providence; 5 operators accommodated in Big River Motel.
- <u>Production of 21,000 cu m crushed gravel</u>: Equipment: 1 large bulldozer equipped with ripper, 1 midsize loader, 1 mid size crusher with 3 dedicated operators and 2 pickup trucks for the crew; Labour: 4 operators accommodated in the Big River Motel.
- <u>Transportation 16,000 cu m aggregates:</u> Equipment 3 truck-semi trailers with 15 cu m boxes and 1 midsize loader. The distance from the Gravel Pit to the Concrete Plant is approx 65 km, which will result in 2 hour round trip for each truck. Assuming 10 hours workday the resulting traffic volume will be 15 truck trips per day in each direction for the duration of 10 weeks; Labour: 2 operators accommodated in the Big River Motel.

Schedule: Labour & Camp

The Quarry Permit for extraction of 23,000 cu m material from Yellowknife HWY #3, km 87 – Gravel Pit for Concrete Aggregate is required for the period between May 01, 2004 and October 31, 2006.

	Activity	Schedule		Labor	Accommodation (man day)		Traffic
		days	dates	(men)	Constr.Camp	Other	veh/day
1	Site Prepartion	7	24 May -31May 2005	9	0	63	6
2	Produce 21,000 cum crush	21	01 Jun -21 Jun 2005	6	0	126	0
3	Transp. 16,000 cum aggreg	70	07 Jun -21 Aug 2005	4	0	280	30

*Fuel***:**

Activity		Diesel fuel (litres)	Gasoline (litres)
Site Prepartion		7,700	1,050
Produce 21,000 cum crush		93,240	2,100
Transp. 16,000 cum aggregates		120,000	-
	Totals	220,940	3,150

Fuel will be delivered on site by local contractor using specialized fuel truck. Fuel will be stored on site in 5,000 gallons self contained "enviro-tank". Re-fuelling will be taking place on a designated location not less the 100 m from any water body. Trucks will be refuelled at the Big River gas station located at km 31, HWY #3.

Yellowknife HWY #3, km 156 – Existing Grey Limestone Quarry *Attachment 15*

Site Preparation & Production: Includes: Improvement of the access to the blasting area. Equipment and labour is accounted for in the Production phase. During this and the following phases of work a portable "pump-out" toilet cell will be installed on site.

Production: The required 9,000 cu m rock will be produced by drilling and blasting from 2,400 sq m area (60 m by 40 m) located on the north east corner of the pit.

Transportation: 3,600 cu m of the produced rock will be transported and stockpiled in the North Borrow Area. The remaining 5,400 cu m, or 360 truck loads will be delivered to the South Side crossing the river on the ferry at a rate 12 vehicles per day for the duration of one month (July, 2005). 3,600 cu m of this rock will be stockpiled on the South Borrow Area, and 1,800 cu m will be placed directly on the extension of the South Causeway.

Equipment, Labour & Traffic:

- Production 9,000 cu m rock: Equipment: 1 hydraulic crawler drill, 2 pickup trucks, 1 trailer for explosives, 1 strong box for primers; Labour: 4 operators accommodated in the Big River Motel.
- Transportation of 9,000 cu m rock: Equipment: 10 truck-semi trailers with 15 cu m boxes and 1 large size excavator. The distance from the Gravel Pit to the bridge site is approx 130 km, which will result in 5 hour round trip for each truck. Assuming 10 hours workday the resulting traffic volume will be 20 truck trips per day in each direction for the duration of 4 weeks; Labour: 11 operators accommodated in Camp.

Schedule:

The Quarry Permit for extraction of 9,000 cu m material from this quarry is required for the period between **May 01, 2005** and **October 31, 2006**

	Activity	Schedule		Labor	Accommodation (man/day)		Traffic
		days	dates	(men)	Constr.Camp	Other	veh/day
1	Produce 9,000 cum rock	7	01 Jul -07 Jul 2005	4	0	28	6
2	Transp. 9,000 cum rock	30	01 Jul -30 Jul 2005	11	330	0	40

Fuel:

Activity	Diesel fuel (litres)	Gasoline (litres)
Produce 9,000 cum rock	4,200	700
Transp. 9,000 cum rock	132,000	-
Totals	136,200	700

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling will take place on a designated location not less the 100 m from any water body. Trucks will be refuelled at the Big River gas station located at km 31, HWY #3.

Yellowknife HWY #3, km 232 – Proposed Granite Rock Quarry *Attachment 16*

Site Preparation: Includes improvement of the access to the blasting area only. Equipment and labour is accounted for in the Production phase. During this and the following phases of work a portable "pump-out" toilet cell will be installed on site.

Production: 6,000 cu m rock will be produced by drilling and blasting from an area of 3,000 sq m (50m x 60 m) located to the north of the access road.

Transportation: 3,000 cu m of the produced rock will be transported and stockpiled on North Storage near the bridge. The remaining 3,000 cu m will be stockpiled on the South Approach right-of-way. Vehicles delivering rock on the south side will cross the river using the shuttle barge.

Equipment Labour& Traffic:

- Production 6,000 cu m rock: Equipment: 1 hydraulic crawler drill, 2 pickup trucks, 1 trailer for explosives, 1 strong box for primers; Labour: 4 operators accommodated in hotel in Rae-Edzo.
- Transportation of 6,000 cu m rock: Equipment: 10 truck-semi trailers with 15 cu m boxes and 1 large excavator. The distance from the quarry to the bridge site is approx 210 km, which will result in 5½ hour round trip for each truck. Assuming 11 hours workday the resulting traffic volume will be 20 truck trips per day in each direction for the duration of 20 days; Labour: 11 operators accommodated in Camp.

Schedule:

The Quarry Permit for extraction of 6,000 cu m rock from this quarry is required for the period between June 01, 2005 and October 31, 2006

Activity	Schedule		Labor	Accommodation (man/day)		Traffic
	days	dates	(men)	Constr.Camp	Other	veh/day
Produce 6,000 cum rock	7	01 Jun- 07 Jun 2005	4	0	0	0
Transp. 6,000 cum rock	20	08 Aug -31Aug 2005	10	300	0	40

Fuel:

Activity		Diesel fuel (litres)	Gasoline (litres)
Produce 6,000 cum rock		3,000	700
Transp. 6,000 cum rock		101,640	-
	Totals	104,640	700

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling will take place on a designated location not less the 100 m from any water body. Trucks will be refueled at the Big River gas station located at km 31, HWY #3.

C.5 Maintenance Requirements:

Describe the projected maintenance requirements for the bridge, both short and long term. Include the physical nature of predicted maintenance activities as well as their frequency and potential environmental impacts. (For example, will icing on the bridge result in the requirement for chemical control measures?)

The structure is designed for a long life with minimal maintenance and rehabilitation required. Major components are reinforced concrete piers and abutments, high strength pre-cast and pre-stressed concrete deck and an unpainted weathering steel superstructure. The substructure and superstructure components have a design life of 75 years and a practical life that should be longer.

The design also incorporates features allowing for quick repair/replacement of components, such as curbs, railings, stays and lights that may fail prematurely or be damaged by collision.

Routine maintenance activities include regular inspection of all superstructure and substructure components for signs of wear, damage and erosion, and repair, if required. Special attention will be paid to any signs of erosion near the pier-footings or abutments and to the cleaning of bearings and expansion joints.

Routine Maintenance

The bridge deck will require snow removal and the use of sand or fine gravel when icing is present. The deck would be cleaned and broomed in the spring to remove accumulated sand and other debris. There are no plans to use chemical de-icers or cleaning agents, as these may accelerate bridge deterioration as well as raising environmental concerns.

Some of the sand or gravel for ice control and materials tracked onto the bridge. This as well as any fluids or deposited by vehicles may be washed by rain or melt water into the river or blown or the air. However, the quantities should be small and less than that the amount now deposited from the ferry and ice bridge.

Long term Maintenance/Rehabilitation

This could include replacement and upgrading of bearings, expansion joints, cable stays, curbs and railing. During replacement of these elements the bridge will remain open for traffic one lane at a time. However, need for replacement of these elements may arise well beyond the concession period of 35 years for operation of the bridge by the DCBC.

Eventually, after 60 – 70 years the deck will have to be rehabilitated or replaced. It is unknown what technology and method of replacement will be used at that time.

Bridge Inspections

According to standard bridge inspection practices three levels of inspections are identified for maintenance purposes:

1. *Routine daily inspection*:

This is a visual inspection, carried out early morning by the Highway Foreman or the person in charge with maintenance of the bridge. Usually it is a "drive-by" inspection to check the deck condition (gravel, snow, ice…), the integrity of the bridge rail, curbs, expansion joints, pavement and guard-rail on approaches, etc…). Deficiencies as specified above, if found, are dealt with within the same day. In case of deficiencies causing safety problems, action is taken immediately (i.e. the bridge might be temporarily closed for traffic in freezing rain condition, one lane of the bridge might be closed and the speed reduced in case of guardrail damage, etc…)

Occasionally the maintainer will check the underside of the bridge to assess the condition of rip-rap.

2. *Yearly "check-list" inspection:*

This is a visual inspection carried out every spring by a qualified bridge maintenance technologist instructed by bridge engineer. It includes checking and recording the condition of more than sixty different elements and aspects of the bridge and accounts mostly for geometrical deformities of different elements. Evidence of minor deformities and wear-tears are photographed. Few of the most important elements on the check-list include: bolted connections, ice defenses on piers, bearings, railings, expansion joints, underside of deck, riprap on approaches, etc...

3. *Four to six year detailed inspection:*

This inspection is carried out by a team of bridge engineer, the maintenance technologist and the maintenance Foreman. The engineer will review the records of the yearly inspections, interview the Foreman and inspect all bridge components. The engineer will prepare Inspection

Report for future references or for action, depending on the case.

This inspection will be carried out in the first two consecutive summers after the bridge opening and will include inspection of the of the scour protection around the piers by a diver.

C.6 Waste Management*:*

Give a description of the proposed waste management plans and sites.

Activities potentially producing significant amount of wastes include:

- Excavation and disposal of riverbed material from the cofferdams and dewatering the cofferdams directly into the river
- Excavation and disposal of material from Reclamation Areas related to removal of existing ferry infrastructure
- Disposal of sewage and solid wastes in the Construction Camp

C.6.1 Excavation and disposal of riverbed material from the cofferdams and dewatering the cofferdams directly into the river

This is part of the Pier Foundation works described in detail in item C-4 Operations. According to the proposed plan 8 sheet pile cofferdams will be installed around the pier footings. The cofferdams are of oval shape pier with diameters 18 m and 13 m. The sheet piles will be driven to approx. 5.0 m below the riverbed and will be cut-off 1.0 m above the High Water Level.

After installation of the cofferdams a 4.0 m thick layer of riverbed material (approx 850 cu m per cofferdam for a total of 7,000 cu m), will be excavated and disposed of directly into the river. The bottoms of the cofferdams will be sealed with 0.6 m thick "mud-slab" of tremie concrete (110 cu m per pier) and the cofferdam will be dewatered directly into the river (1,900 cu m water per cofferdam for a total of 15,200 cu m water).

Excavation and disposal of riverbed material: 7,000 cu m

The excavated material consists of hard till with low grade of dissolvability. Tests conducted by the geotechnical consultant EBA Engineering indicate that submitted to intensive shaking in water environment for 5 minutes the till is releasing not more than 15% suspended fraction. It is anticipated that over 85% of the excavated till will settle on the riverbed within a distance of 15m to 20 m from the location of discharge and the suspended fraction will affect appreciably the water quality of the section of water around the pier for not more than 100 m downstream.

On some of the pier locations the till is overlaid with a 0.3 m to 1.0 m strata of coarse gravel mixed with cobbles and boulders. It is anticipated that since this porous material is exposed to continuous washout, it will release in the water smaller amounts of suspended fraction than the till.

The excavation the total of 7,000 cu m material will be completed within 100 between June 15 and September 30, 2005. Excavation of 850 cu m from one individual pier will be done in 2 days. Assuming 12 hours work day the rate of release into the river of excavated material is 35 cu m per hour.

The water quality in the river and the rate of discharge of excavated material will be monitored and controlled according to methodology described in the enclosed Golder Associates report. At least three water quality monitoring posts will be established upstream and downstream from the excavation. The rate of discharge will be reduced and adjusted if it results in higher than admissible suspended fraction.

Dewatering of Cofferdams directly into the river: 15,200 cu m

After completion of the excavation a layer of tremie concrete will be placed under water and approximately 1,900 cu m water will be pumped out of each cofferdam and discharged into the river. It is anticipated that most of the fine material fractions in the cofferdam will be consolidated below the concrete. Previous experience indicates that the water above the concrete is as clean as the river water. However, prior to discharging the water in the cofferdams will be tested and the Ph adjusted if found different to the one of the water in the river.

The water of each cofferdam will be released into the river within 24 hors continuous pumping at a rate of 80 cu m per hour. The Water quality monitoring Program described in above in *Excavation and disposal of riverbed material* will apply.

C.6.2 Excavation of material from Reclamation Areas related to removal of existing ferry infrastructure

Detailed description of the reclamations is provided below in item C-8 Abandonment and Restoration. According to the proposed plan a total of material will be excavated from the North Ferry Landing and from the South Ferry Haul-out. The excavated material is composed of 20,000 cu m granular backfill, 80 cu m structural concrete, 90 cu m structural timber and 30,000 cu m structural steel. The timber will be salvaged for reuse on other ferry landings. The steel will be sent to smelter in southern Canada.

The concrete and the granular material will be placed below ground level and will be covered with 1 m native ground in the Borrow Areas located in the vicinity of the bridge. The disposal areas will be graded and landscaped to match the surrounding ground.

It is possible that the material is contaminated with hydrocarbons or other substances harmful to the fish habitat. In order to establish if any contaminants are present, the GNWT Department of Transportation has commissioned a study with the environmental consultant Dillon Consulting Ltd. It is noted that it will be Department's liability should any contaminants are found.

Disposal of sewage and solid wastes in the Construction Camp

Detailed description of the camp is provided above in item C-4 Operations. The Camp will be in operation for 10 months (June-October 2005 and June-October 2006) and will be able to provide accommodation services for a total of 9,000 man-days. Contractor's personnel working in the winter as well as overflow workers during the summer months will be accommodated in the Big River Motel, 7 km to the north of the bridge site.

Operational details relevant to the waste production and disposal include:

- Electric power for the camp will be supplied from the power plant that provides electricity for the adjacent Ferry Camp.
- Fresh water will be delivered from Fort Providence with specialized water truck and will be stored in 5,000 litres tank. Assuming 50 litres/man-day fresh water consumption and 90% average occupancy the daily demand for fresh water is calculated at 1,600 litres.
- Sewage will be collected in a 10,000 litres sewage tank, will be pumped out with specialized truck and will be discharged in the Ft. Providence sewage lagoon.
- Food supplies will be delivered to camp with a truck from Hay River.
- It is not anticipated any significant fuel consumption in the Camp. There will be not fuel storage in the camp area.
- Solid organic wastes will be incinerated on site. Non-organic wastes estimated at 1,500 kg per month containerised and transported to Pt. Providence landfill area for disposal.
- Water supply, sewage removal, catering services and garbage disposal will be contracted out to professional outfits.

The impact on the municipal services (fresh water plant, sewage lagoon and garbage dump) the operation of the camp would equivalent to an increase of the Ft Providence population by less than 5% for the duration of 10 months.

After closing of the Camp all facilities and inventory will be removed from site. The remaining debris will be incinerated or disposed off in environmentally friendly manner. The area will be thoroughly cleaned from any foreign objects and landscaped.

C.7 Accidents and Malfunctions*:*

List any possible accidents or malfunctions that may occur and describe the procedures to be followed in such instances (include the probability, potential magnitude and potential environmental impacts of any such accidents or malfunctions). Do proposed contingency plans include an alternative system of transport in the event that the bridge is closed to traffic for a long period of time due to structural damage?

Possible accidents would include but not necessarily be limited to the following:

i. Ship/barge collision with piers – Low probability
ii. Vehicle collision on bridge – high probability
iii. Loss of control of vehicle on bridge – high probability
iv. Collision with stay cable – Low probability
v. Fire from combustible material being transported – Low probability
vi. Ship/barge collision with superstructure – Low probability
vii. Major spill on bridge deck – Low probability

Possible malfunction would include but not necessarily be limited to the following:

viii. Deterioration of bearings – Low probability
ix. Defects in stay cables – Low probability
x. Defects in structural steel member(s) – Low probability
xi. Deterioration of expansion joints – Low probability

The following steps have been taken to reduce the probability and reduce or eliminate any inconvenience or disruption to traffic from possible accidents:

i. The main span opening provides a significant clearance for the largest vessels using the river. The piers have been designed to resists the impact from a 2500 ton barge plus tug traveling at a speed of 11 knots coming into direct contact with the piers. In the event of collision, there would be damage, possibly severe, to the vessel. This may include the spill of refined petroleum products.

ii. A vehicle collision on the bridge between two passenger cars would probably not result in any significant damage to the deck railing. Collision between two trucks may cause significant damage to the railing. It is proposed that a reasonable supply of replacements be stockpiled to the north of the bridge to permit timely repairs to be effected. A collision may result in a spill of refined petroleum products.

iii. Loss of vehicle control of a loaded truck may well result in the loss of guard rail section depending on the conditions under which this loss of control occurred. The guardrail is designed to limit damage to the superstructure while providing the restraint required by the relevant Codes governing this aspect. A single vehicle accident would be less likely to result in a spill.

iv. While this is highly improbable, the design of the bridge allows for the complete severance of stay cables. The loss of one (1) cable would not affect normal traffic, while the loss of two (2) cables of the same set would require a speed reduction. The complete loss of an entire set of cables would require both a speed reduction and flagging of traffic until repairs could be made. No environmental impact is anticipated.

v. A fire may result in a spill of products of combustion as well as refined petroleum products. The location of the fire, the type of material being transported, the time of year all are relevant in this scenario. It is anticipated that because of the bridge slope that any volatile fluid would be dispersed over a large area thus reducing the fuel mass necessary to cause damage from overheating. Local damaged areas that may be subject to heat concentration are not anticipated to be extensive and could be easily repaired.

vi. The only case where this could be of any significance is in the first or second approach spans, where the superstructure is low enough. Only the upper portion of the vessel would impact the lower chord of the truss. This portion of the vessel is not generally constructed to resist the impact of the vessel and therefore it is unlikely that significant damage would be caused to the truss. In any event, the damage would have to be assessed at the time and repairs, if required, effected as necessary.

vii. A major spill on the bridge deck is possible (refined petroleum products being the most likely). However, it is no more likely than on any other bridge in this drainage system and probably less likely than on the ice bridge or ferry ramps. Existing regulations for transportation of dangerous goods and spill contingency planning would apply.

In terms of possible malfunctions, which normally fall under the aegis of maintenance, the remedies are addressed below. Many of these fall under the same procedure as those described for Accidents. None should pose environmental concerns.

viii. Deterioration of bearings. The bearings are of two types: elastomeric pads and sliding pot-bearings. The elastomeric pads are virtually maintenance free. The details allow for quick replacement (should this ever be necessary) with the minimum degree of labour. The sliding pot bearings require occasional cleaning (every 2 to 5 years) to remove dirt and grit from the sliding surfaces. No other maintenance should be required. Similarly, details provide for quick changeover. The life expectancy of all bearings is 75 to 100 years.

ix. Defects in stay cables. Refer to item iv above.

x. As in any other structure, regular structural inspection is required as part of the due diligence. Space does not permit to examine every possible scenario and timely assessment would be required. The design of this structure has been purposely maintained as a robust structure to eliminate any such occurrence.

xi. Expansion joints require regular cleaning and maintenance. The greater attention paid to keeping these clean will result in longevity of the joint components. Normal repairs are limited to replacement of the rubber bladders.

In the very unlikely event that the bridge structure were damaged severely enough to cause a prolonged closure, the alternative would be to revert to an ice crossing and/or remobilize a ferry for the crossing. On a temporary emergency basis, a tug and barge arrangement could be used.

C.8 Abandonment and Restoration

Describe the plans for abandonment and restoration, including the construction site, detour access roads, ferry landings and the river bottom. Include plans for long-term monitoring, maintenance and remediation.

Lands directly affected by the physical construction of the bridge and the construction support facilities include:

i.) Construction Corridor for Bridge Structure & Approaches

The Construction Corridor is located entirely in the Highway "right-of-way". The Works in the Corridor are described in item C.4, Operations above.

Work on the Riverbed including excavation and placing of rock will be done carefully with minimal damage to the aquatic environment. A plan for post construction monitoring the water quality and the recovery of the aquatic life is presented in Appendix 14- Fisheries Assessment Report prepared by Golder Associates.

After completion of the Works the "right-of-way" cleaned and landscaped according to the current HWY Operation standards.

i.) Area for Construction Camp

ii.) Two Areas for Temporary Concrete Plants

iii.) Two areas in the vicinity of the bridge for temporary storage and parking

Development, use and abandonment of these areas is discussed in detail in item C-4, Operations above.

Lands involving Reclamation activities include:

iv.) Reclamation areas related to removal of existing ferry infrastructure

These areas are located within the watercourse, adjacent to the Construction Corridor. They are part of the existing ferry infrastructure owned and operated by the GNWT. Details on land reclamation issues related to the ferry infrastructure are discussed in this item C-8 below.

Granular materials, concrete aggregates and rock required for the construction of the bridge will be obtained from the following areas:

v.) Mackenzie HWY #1, km 188.5 – Proposed Limestone Quarry
vi.) Mackenzie HWY #1, km 188.5 – Existing Gravel Pit
vii.) Yellowknife HWY #3, km 23 – Proposed South Borrow Area
viii.) Yellowknife HWY #3, km 26 – Proposed North Borrow Area
ix.) Yellowknife HWY #3, km 87 – Existing Gravel Pit for Concrete Aggregate
x.) Yellowknife HWY #3, km 156 – Existing Grey Limestone Quarry
xi.) Yellowknife HWY #3, km 232 – Proposed Granite Rock Quarry

During operation of these areas no accommodation facilities, fuel storages, maintenance shops, or any other temporary or permanent facilities will be established on site. A portable "pump-out" toilet cell will be installed and maintained for use by the contractor's personnel. After completion of the quarrying operations the areas will be thoroughly cleaned and landscaped. The organic debris will be incinerated. Anticipated negligible amounts of non-organic debris will be transported for disposal in the Fort Providence Land Fill Area.

The development, operation and restoration of each individual gravel pit and quarry is discussed in more detail in item C-4, Operations above.

The infrastructure related to the ferry operation will not be needed after completion of the bridge. As owner of the infrastructure the GNWT is responsible for its removal and reclamation of the corresponding lands. In agreement with the GNWT the DCBC accepted to participate in the reclamation only for the facilities affecting the construction of the bridge. Following is a list of the ferry facilities and description of the reclamation works corresponding to the DCBC:

<u>Ferry Camp and Power Plant</u>

These facilities occupy an area of approx 15,000 sq m (100 m x 150 m) located near km 23+200, HWY #3. They do not affect the construction of the bridge, and their removal remains with the GNWT. However, upon agreement with the GNWT, the DCBC may use electric power from the power plant during the bridge construction.

<u>North and South Causeways</u>

Both Causeways lay within the footprints of the proposed bridge approaches. Material on the causeways will not be excavated, but will be covered with backfill to form the bridge approaches.

<u>North Ferry Landing, South Ferry Landing & Ferry Haul-out</u>

As depicted on *Attachment 7 & Attachment 11* these facilities are located within the watercourse, adjacent to the Construction Corridor and affect the bridge construction. As part of the reclamation, backfill material and structural components will be removed from the watercourse. All material will be removed to the elevations of the adjacent natural riverbed found between 2.0 m to 4.0 m below the water level. Equipment involved in this work will be not be deployed in the water.

It is possible that the areas of these facilities are contaminated with hydrocarbons or other harmful to the fish habitat materials. In order to establish if any contaminants are present, the GNWT Department of Transportation has commissioned a study with the environmental consultant Dillon Consulting Ltd. It is noted that it will be Department's liability should any contaminants are found.

It is anticipated that the reclaimed areas will attract aquatic life within one to two years. Detailed plan for monitoring the recovery could be found in the Appendix 14: Fisheries Assessment of Mackenzie River, Proposed Deh Cho Bridge, prepared by Golder Associates.

The areas subject to reclamation are identified on Attachment #7 and could be described as follows:

Area "E" (4,300 sq m) comprising the North Ferry Landing: This area is projected into the watercourse 80 m beyond the north bridge approach. The material to be removed from this area consists of 9,000 cu m granular backfill for embankment, 500 cu m blasted rock for rip rap, 80 cu m concrete for landing pad and 30,000 kg structural steel for sheet-pile wall. In order to accommodate equipment working on the reclamation a Land Use Permit for a larger area of 9,100 sq m is required.

Area "D" (9,500 sq m) comprising the South Ferry Landing and the Ferry Haul-out: This area is located on the downstream side of the south the bridge approach. The material to be removed from this area consists of 11,000 cu m granular backfill and 90 cu m structural timber. In order to accommodate equipment working on the reclamation a Land Use Permit for a larger area of 24,000 sq m is required. The work on both sides will be carried out consecutively, commencing with the

North Area.

<u>Preparatory Work</u>: The concrete aprons will be demolished into fragments suitable for loading, transportation and disposal. The steel sheet-pile wall will be extracted and cut/sorted for transportation. The timber of the haul-out will be dismantled and sorted/stacked for transportation. During this and the following phases of work a portable "pump-out" toilet cell will be installed on site.

<u>Excavation of 20,000 cu m granular material</u>: Material excavated below water level will be piled to drain before transportation. Material above the water level could be loaded directly.

<u>Transportation & Disposal</u>:

- The excavated granular will be disposed of and landscaped in the North and South Borrow Areas, within 1 km from the corresponding ferry landings.
- The concrete fragments will be buried in the Borrow Areas and the gravel cover landscaped
- The steel will be transported to a smelter in Edmonton (1,200 km) and sold for scrap iron.
- Over 80% of the timber will be salvaged and stacked in the South Borrow Area for use by the GNWT on other ferry landings. The remaining fragments will be piled and burned on site.

Equipment Labour & Traffic:

<u>Preparatory Work:</u> Equipment: 1 large excavator equipped with bucket and concrete jack-hammer, 1 large size loader, 1 welding truck and 3 pickup trucks; Labour: local crew of 6 men from Ft Providence; 4 operators accommodated in the Big River Motel.

<u>Excavation of 20,000 cu m granular</u>: Equipment: 1 large excavator, 1 large loader equipped with forks and bucket, and 3 pickup trucks; Labour: local crew of 6 men from Ft Providence; 2 operators accommodated in the Big River Motel.

<u>Transportation & Disposal: of 20,000 cu m granular & concrete debris</u>: Equipment: 1 large loader, 1 large bulldozer (in the pit), 1 pickup truck for the crew, and 3 trucks-semi trailers with 15 cu m boxes or articulated dump trucks of similar capacity. The travel distance of approx 1 km will result in 20 min round trip for each truck. Assuming 10 hour workday the resulting traffic volume will be 90 truck trips per day in each direction for the duration of 2 weeks. Labour: 5 operators accommodated in the Big River Motel.

<u>Transportation of 30,000 kg scrap iron</u>: Equipment: 1 B train-flat bed; Labour: 1 driver accommodated in commercial accommodation.

Schedule:

The Land Use Permit for these Reclamation Areas is required for the period between July 01, 2007 and September 30, 2007.

		Schedule		Labor	Accommodation (man/day)		Traffic
	Activity	days	dates	(men)	Constr.Camp	Other	veh/day
1	Preparatory work	7	01Aug -07Aug, 2007	10	0	70	8
2	Excav.20,000 cum granular	14	08Aug -22Aug, 2007	8	0	120	0
	Transportation						
3	Bridge to N Borrow Area	7	08Aug -14Aug, 2007	5	0	35	180
4	Bridge to S Borrow Area	7	015Aug -22Aug, 2007	5	0	35	180
5	Transp. 30 t scrap iron	2	10Aug -11Aug, 2007	1	0	4	1

*Fuel***:**

Activity		Diesel fuel (litres)	Gasoline (litres)
Preparatory work		5,600	1,050
Excav.20,000 cum granular		11,200	2,100
Tranp.21,000 cum material		33,600	700
Transp. 30 t scrap iron		1,500	-
	Totals	51,900	3,850

Fuel will be delivered on site by local contractor using specialized fuel truck. Re-fuelling will be taking place on a designated location not less the 100 m from any water body. Trucks will be refueled at the Big River gas station located at km 31, HWY #3.

C.9 Air photos and Drawings:

Include a plan view drawing, to scale, of the proposed development superimposed on an air photo or satellite image of the site. Also, include an elevation view drawing, to scale, of the proposed development.

See Appendix 1a for air photos and plans.

C.10 Other:

Describe any other relevant proposed activities or development components.

None identified.

C.11 Modifications:

Provide details of any changes or modifications to the development description as presented in the Preliminary Screening phase that may occur throughout the EA phase. This information should be provided on an ongoing basis.

There have been few conceptual modifications introduced in the bridge design since the submission of the Application for Water License of May 23, 2003:

- The pier foundations originally presented as predrilled concrete caisson have been replaced with cast in place concrete spread footing and pedestals. This modification was introduced to satisfy the actual geotechnical conditions defined by the geotechnical investigation report prepared by EBA Engineering in July 2003. Detailed description of the new pier design including geometry, materials and method of construction are presented in Appendix 1.
- The steel plate girders of the bridge superstructure have been replaced with steel trusses of same height width and position. This modification was introduced to achieve a better response of the bridge structure to the wind forces. Detailed description of the new superstructure, including geometry, materials and method of construction are presented in Appendix 1.
- The steel hanger suspenders installed on the piers on both sides of the main span has been replaced with vertical steel towers with stays. This modification was introduced to accommodate larger horizontal and vertical clearances for the traffic on the bridge deck. Details of this modification are presented in Appendix 1.
- Proposed sources for quarried rock, aggregates and granular materials have now been identified.
- The schedule has been revised to reflect the currently anticipated timing of approvals.

Table C6
Summary of Traffic Volume in the Bridge Area

		2004	2005								2006									2007
	Item	Oct	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Aug
i.)	Construction Corridor																			
2	Earth Works																			
3	Pier Foundations					152														
4	Pier Shafts										36									
5	Abutment Construction							49												
6	Steel Superstructure										150	150	150							
7	Bridge Deck											180	180	180	90					
ii.)	Construction Camp	84	60		60	60	60	60	60	60					60	60	60	60	60	
iii.)	Concrete Plants	90				1200	1200	1200	1200	620										
iv.)	Areas for storage																			
v.)	Reclamation Areas																			2522
vi.)	HWY #1, km 188.5- Lmstn Quarry	42	1120	1120			2240	1120												
vii.)	HWY #1, km 188.5-Gravel Pit														96			1456		132
viii.)	HWY #3, km 23+270-S Borrow A	90						3360							1350					
ix.)	HWY #3, km 26+240–N Borrow A	90				2700	2700								1350					
x.)	HWY #3, km 87-Concr. Aggregates					660	930	630												
xi.)	HWY #3, km 156-Grey Lmstn Quarry						1200	800												
xii.)	HWY #3, km 232 -Granite Quarry																			
	Total Vehicles per month	396	1180	1120	60	2072	5630	3859	1260	680	186	330	330	180	2946	60	60	1516	60	2654
	Average Vehicles per day	13.2	39.3	37.3	2.0	69.1	187.7	128.6	42.0	22.7	6.2	11.0	11.0	6.0	98.2	2.0	2.0	50.5	2.0	88.5
	Average Vehicles per hour	1.20	3.58	3.39	0.18	6.28	17.06	11.69	3.82	2.06	0.56	1.00	1.00	0.55	8.93	0.18	0.18	4.59	0.18	8.04

Notes:
1. The table reflects only traffic related to the Bridge Construction
2. Numbers refer to number of vehicles traveling in both directions on both sides of the bridge
3. Numbers in shaded areas refer to vehicles crossing the Highway only in the area of the Bridge Approaches

Table C7
Summary of Fuel Consumption

	Activity	Diesel Fuel	Gasoline
		litres	litres
i	Construction Corridor for Bridge Structure & Approaches		
	Earth Works	129,430	100
	Pier Foundations (includes tug& barges)	1,586,560	69,560
	Pier Shafts	23,500	13,060
	Abutments Construction	26,800	1,750
	Steel Superstructure	533,100	11,040
	Concrete Deck	747,100	36,000
ii	Construction Camp	-	36,000
iii	Temporary Concrete Plants	298,800	24,300
iv	Two areas for temporary storage & parking	-	-
v	Reclamation areas related to removal of existing ferry infrastructure	51,900	3,850
vi	Mackenzie HWY #1, km 188.5 – Proposed Limestone Quarry	158,600	3,350
vii	Mackenzie HWY #1, km 188.5 – Existing Gravel Pit	121,400	3,400
viii	Yellowknife HWY #3, km 23 – Proposed South Borrow Area	86,100	3,150
ix	Yellowknife HWY #3, km 26 – Proposed North Borrow Area	111,700	3,600
x	Yellowknife HWY #3, km 87 – Exist. Gravel Pit-Concrete Aggregate	220,940	3,150
xi	Yellowknife HWY #3, km 156 – Existing Grey Limestone Quarry	136,200	700
xii	Yellowknife HWY #3, km 232 – Proposed Granite Rock Quarry	104,640	700
	Sub-total Fuel	4,336,770	213,710
	5% contingency	216,838.50	10,685.50
	Fuel Total	4,553,609	224,396

Notes:
1. The fuel amounts are based on Average Fuel Consumption for construction equipment provided by the manufacturer catalogs
2. Most of the amounts for mobilization refer to material and equipment transported from long distances (Edmonton, AB)
3. The 5% contingency accounts for short distance mobilizations (Yellowknife, Hay River, etc) and other minor misc. consumptions

D Effects of the Physical Environment:

This section pertains to potential changes to the development, e.g. timing or alternative methods, caused by the environment.

D.1 Description of Effects

List and describe all effects that the environment may have on your development (e.g. effects of ice movements in the Mackenzie River)

Construction schedule and logistics at this location are subject to assumptions made about the weather, water and ice conditions.

Weather – The cold, dark winters and longer daylight in the summer are key considerations in the design and construction schedule and logistics. The weather conditions are reasonably predictable and variations from the norm in temperature and precipitation will not affect the project, except to the extent that the weather affects ice formation and breakup.

Ice formation at the winter road crossing – Ice formation upstream of the bridge site, affects the timing of vehicle crossing and ferry removal. This has proven to be consistent within a few weeks each year (figure D1). This will be important for hauling aggregates across the river in both directions and for the movement of heavier structural components and equipment. The proposed schedule can accommodate these variations.

Figure D1 – Ferry and Ice Road Seasons

	Ice Road			Ferry	
	Light Traffic < 5 Tonne	> 60 Tonne Capacity	Closed	First Trip	Last Trip
2000 / 2001	Dec 21/00	Jan 15/01	Apr 15/01	May 09/00	Jan 15/01
Earliest	Nov 28/90	Jan 07/92	Apr 12/96	May 06/93	Dec 27/86
Latest	Jan 09/98	Feb 16/88	May 05/66	May 31/62	Feb 10/88
Last 5 years avg.	Dec-26	Jan-19	Apr-18	May-12	Jan-18
Last 10 years avg.	Dec-19	Jan-15	Apr-19	May-12	Jan-16
Last 15 years avg.	Dec-18	Jan-19	Apr-18	May-13	Jan-16

Ice formation at the bridge site – because of the faster currents and the channel cut for the winter ferry operation, formation of ice at the bridge site is later and less predictable. Depending on the approach used, contactors may face additional risk in relying on this ice to support construction of piers and erection of the superstructure. For this reason, the schedule assumes that contractors will chose to construct in-river foundations in open water and will launch the superstructure from each shore out and/or from barges. Ice formation also causes varying degrees of ferry service interruptions in the fall.

Ice movement – During Spring breakup, access is interrupted for up to six weeks. Any temporary structures or partially completed pier footings (below high water) will not withstand the forces of heavy ice movement of Mackenzie River ice. Breakup is also predictable and is accommodated in the schedule.

Water levels – spring breakup is accompanied by higher water levels, due to runoff and ice damming. However, this location is not downstream, in distance or elevation, from Beaver Lake and Great Slave Lake. These lakes provide a large reservoir and serve to dampen the severity of flooding at Ft. Providence. Fluctuations in water level have been accommodated in the design and construction plan.

D.2 Changes to Development

List and describe any changes or modifications to your proposed development that may be caused by the environment (e.g. late river ice break-up, flooding).

As noted above, it is technically feasible to undertake in-river construction of pier foundations in the winter, taking advantage of natural and man-made ice as a working platform. However, given the risk of inadequate ice thickness and strength, as well as the colder weather and darkness, it is expected that contractors will undertake this work in the open water, relying on barges and/or temporary bridges as working platforms.

The variability in ice formation and ice breakup are understood and can be accommodated in the proposed schedule.

E Alternatives

Provide an explanation of alternatives to the various parts of the development where appropriate alternatives are possible. This discussion shall include, but is not limited to, development timing and a description of potential environmental impacts that were considered when evaluating and selecting alternatives (e.g. why were certain types of equipment selected, why will the bridge spans be hauled by barge to the site etc.). Include consideration of environmental impacts from the current ferry system, and construction and operation of winter ice road crossing.

E.1 Alternative to Bridge

The only viable alternative to the proposed bridge is continuation of the current ferry and ice bridge operation. The bridge is being proposed based on the long term economic and environmental benefits, as outlined in Sections I and J of this report.

E.2 Alternative Location of Bridge

Several alternative crossing locations were examined.

The proposed site was first recommended in the study - *Preliminary Hydraulic Design, Mackenzie River Bridge, Liard River Bridge, Great Bear River Bridge* prepared for PWC by Northwest Hydraulic Consultants Ltd (NHCL) of Edmonton, AB in 1975. The Study establishes that the waterway could be constricted to 3,000 feet (915 m) or less without serious hydraulic effects, and concludes that a design value of less than 3,000 feet would be acceptable from a river engineering viewpoint. The Study evaluated three potential sites for a bridge crossing between Fort Providence Rapids and Beaver Lake, and recommended the site at the existing ferry crossing.

The proposed site was confirmed by PWC and it was the basis for their *Mackenzie River Bridge, Fort Providence, Yellowknife HWY #3, NT, Preliminary Design and Cost Estimate*, dated December 1975.

It is proposed to construct the bridge at the existing ferry crossing, for the following technical, economic and environmental reasons:

- ✓ It is the most economic location.
- ✓ The bed of the river at the proposed site is highly stable and scour resistant with changes occurring only in geologic time scale.
- ✓ The direction of flow does not vary markedly from point to point across the section
- ✓ The structure is not located in a curve of the navigation channel
- ✓ The depth of the river at the proposed site is fairly uniform. The maximum depth is substantially less than the other locations.
- ✓ The bridge would use the existing highway and will not require additional road construction, as would a new location.
- ✓ Maintaining the existing highway corridor will prevent disturbance to current land use along the shoreline.

At this site, the natural riverbed is approximately 1,560 m wide. For the purpose of the ferry operation, partial causeways were extended on the north and on the south shore, more than 30 years ago. The north causeway is projecting 430 m into the river, and the south one 165 m. Presently, the constricted river is 965 m wide at the ferry crossing. The proposed bridge is 1,045 m long and will allow an increase of the waterway to 995 m.

The banks of the Mackenzie River in the vicinity of the proposed site are stable with no appreciable changes having occurred during a 50-year interval based on inspection of aerial photographs. A distinctive feature of the banks is numerous spur-like projections, some of which exceed 300 m in length. Although portions of them are submerged during high open water or ice jam high water, there is no sign of recent erosion.

The bed of Mackenzie River in the vicinity of the proposed crossing is comprised of hard dry clay-till overlain by 0.8 m to 1.2 m layer of alluvium. At the ferry crossing, divers have reported that the bed was clay scattered with large, partially embedded boulders. The riverbed is considered stable, and general scour is not anticipated.

E.3 Alternative Bridge Designs

There are almost unlimited variations and combinations possible in the conceptual design and choice of materials. The design concept proposed considers such issues as:

- Soils and the foundation conditions
- river flow
- ice characteristics and forces,
- climatic conditions
- transportation and logistical challenges
- river navigation requirements
- operational constraints during construction
- all relevant codes and standards
- traffic
- risks (environmental, safety, financial)
- durability
- aesthetics
- costs

The proposed design has been optimized to meet all operational, safety and environmental requirements at the lowest cost and risk. It is subject to detailed peer review and approval by the GNWT.

E.4 Alternative Construction Schedule

The proposed schedule assumes that all permits and approvals will be in place by early fall of 2004 and that granular production can commence shortly after. On-site construction would commence in the spring of 2005, with substantial completion by the winter of 2006.

Once construction starts, it is generally accepted that it should be completed in as short a time as practical, to reduce the length of time of disruptions, minimize the construction debt and begin to see the benefits.

For this project, the most critical component will be the construction of the pier foundations and pier shafts up to high water level. This phase requires work to be done on the riverbed, under water. Once the structure is above water, work becomes relatively more straightforward and less susceptible to water and ice forces.

It is technically feasible to utilize a natural or man-made winter ice cover as a working platform for installing cofferdams, excavation of foundations and construction of footings and pier shafts. In theory, the relatively low cost of construction of an ice bridge makes winter construction attractive. However, the ferry operates at this location until well into the winter, when the ice bridge is open to heavy traffic. There is a risk that it may be difficult to build sufficient ice at all pier locations and/or that piers cannot be constructed in the time available before spring breakup. Piers must be completed at least to the high water level and cofferdams removed before spring breakup, as partially complete foundations could be damaged by ice movement.

The alternative is to construct the piers during the open water season. This would require the use of temporary bridges or barges as working platforms for construction. While this approach may be more costly, it offers advantages of a longer season and better light and weather conditions. The proposed schedule assumes this approach will be preferred by the foundation contractor, and that most piers will be constructed during the open water season of 2005. Abutments and the piers close to each shore may be constructed in the winter or the summer.

The other critical component of the schedule is the transportation of rock and aggregates across the river. Material quarried from the south side will be required on the north side and vice versa. It will not be feasible to haul large quantities of granular material on the ferry. It will therefore be critical that granular material is hauled on the winter crossing during the previous winter. For example, concrete aggregates required in the summer of 2005 for the North piers and abutments must be hauled and stockpiled in the winter of 2004-05. Similarly, depending on the source, precast deck panels should be stockpiled during the winter.

Contractors must plan around the interruption of access during the spring breakup and possibly during the fall.

Other major components, including completion of the piers above water, erection of superstructure and installation of the deck are less critical in terms of schedule.

The proposed schedule anticipates the constraints and risks noted above. At the same time, the proponent wishes to remain open to alternatives proposed by the general contractor.

F Regulatory Regime:

Provide a table summarizing relevant licenses, permits or other authorizations required for the proposed development. Also, include a summary of land ownership and the present state of each license or authorization required.

F.1 Licenses and Permits

Agency	Authority	Requirement	Status
Mackenzie Valley Environmental Impact Review Board	Mackenzie Valley Resource Management Act	Water License	Environmental assessment In progress
Mackenzie Valley Land and Water Board	Mackenzie Valley Resource Management Act	Land Use Permit	Submitted – consideration pending approval by MVEIRB
Mackenzie Valley Land and Water Board	Mackenzie Valley Resource Management Act	Water License	Submitted for screening – referred to MVEIRB
Department of Fisheries and Oceans	Fisheries Act, s. 35(2)	Authorization for Works Affecting Fish Habitat	Screening complete – referred to MVEIRB for Assessment – consideration pending approval by MVEIRB
Department of Fisheries and Oceans – Canada Coast Guard	Navigable Waters Protection Act, s 5(1)(a)	Permit under Navigable Waters Protection Act	Submitted – consideration pending approval by MVEIRB

F.2 Land

Land use permits for all temporary and permanent works have been applied for through the Mackenzie Valley Land and Water Board.

The land to be occupied permanently for the bridge structure is within the current highway right-of-way. For legal reasons, it is intended that the title to this land will be vested in the Commissioner for the GNWT. The GNWT will lease the land to the DCBC, for the term of the concession. The DCBC will make the improvements (the bridge) and lease the land and improvements back to the GNWT.

This has been agreed by DCBC, GNWT and Canada and the necessary administrative arrangements are being made.

G Public Consultation

G.1 Records:

Provide minutes and a summary of consultation undertaken with the public, Aboriginal organizations, land owners, federal, territorial and municipal governments, industry, directly/indirectly affected communities of the North Slave Region and others. Include dates and participants. This should include clear evidence of, and details from, consultation directly with members of potentially affected communities (in addition to community-based corporations). It is particularly important to include details from consultation with community members from Fort Providence.

Consultation on stakeholder views and concerns relating to potential environmental, economic and social impacts of this project has been critical to developing and advancing the proposal.

Development of this proposal has included almost three years of ongoing efforts to consult with all affected parties, by providing information, seeking views of stakeholders and incorporating changes to respond to concerns

Table G1 lists the consultations undertaken, since inception of the proposal in July of 2000. This listing does not include:

- Numerous informal discussions and meetings with business owners, political leaders and members of the general public.
- Meetings and correspondence with officials of the federal and territorial governments and regulatory agencies.
- Numerous press interviews and resulting newspaper, radio and television reports.
- Consultation with engineering, financial and legal advisors.

Copies of letters and presentations are available for most sessions. For the most part, detailed minutes of meetings were not prepared. The focus was to identify and respond immediately to questions and concerns and, where necessary, to arrange follow up work or modifications to project plan. The proponent has also offered to provide additional information and detailed briefings to all affected parties.

The DCBC continues to seek and respond to requests for information, presentations and meetings with the media, business organizations, community and aboriginal leaders, government and regulatory agencies.

Following several meetings with the three Ft. Providence elected councils (Dene, Métis and Hamlet), various community agencies and groups and with the general public, The Board developed a draft *Community Benefits Commitment Plan* (Appendix 7). This plan was then explained to community groups and individuals by an independent consultant, Michael Nadli in a series of focus groups. Following this Mr. Nadli has prepared a report and recommendations (Appendix 8). The Board is in the process of incorporating these recommendations in a revised commitment plan. This will be presented for approval at a public meeting within the next few weeks.

The Board has also made a commitment to members that the final decision to proceed with the project will not be made without a final public review of the project agreements by the community.

In addition to the efforts of the DCBC, there were public hearings held by the NWT legislative committee considering the Deh Cho Bridge Act. This legislation was amended, recommended and passed into law by the NWT legislature in June of 2004.

Following submission of screening applications by the DCBC to the Mackenzie Valley Land and

Water Board (MVLWB) and the Department of Fisheries and Oceans, the MVLWB undertook distribution to affected communities and agencies listed in Table G1.

The DCBC has received formal support from NTCL, the major commercial user of the river for shipping and from Cooper Barging. DCBC is also seeking comments and support for the proposed bridge location and design from other users, including Gruben's Transport and the owners of the MS Norweta.

Key efforts planned in the upcoming months include:

1. Ongoing community consultation in Ft. Providence, including formal community endorsement of the Community Benefits Commitment Plan.
2. Briefings of media, business, community and other interested organizations throughout the project development and implementation phases (before, during and after construction).

Table G1

Listing of Consultation Efforts

DATE	ORGANIZATION	PURPOSE
July 2000	Ft. Providence Combined Council	Initial Meeting of Alliance leaders to consider proposal
Sept.18, 2000	Ft. Providence Public Meeting	Initial public meeting to seek community support.
Sept. 26, 2000	GNWT & Canada	Initial Proposal submitted to Ministers Nault & Handley. Contributions approved
Apr. 26, 2001	Ft. Providence Public Meeting	Community update on status of project
Apr. 27, 2001	Ft. Providence Resource Management Board and Elders Council	Consultation for environmental scoping (Golder Associates)
Nov. 27, 2001	Ft. Providence Public Meeting	Presentation of draft report, including environmental scoping, design and business case
Feb. 4, 2002	Yellowknife City Council	Presentation at public meeting of City Council
Feb.11, 2002	GNWT	Pre-Feasibility Study and formal proposal submitted to Minister Handley
Feb.12, 2002	Press	Press briefing at Legislative Assembly to explain proposal
Feb.12, 2002	RTL Robinson's Trucking	Meeting with Marvin Robinson to discuss trucking reaction
Feb.12, 2002	NWT Chamber of Mines	Meeting and presentation
Mar. 21, 2002	NTCL	Initial Meeting with NTCL in Hay River to discuss navigation requirements
Apr. 26, 2002	Yellowknife Chamber of Commerce	Chamber luncheon presentation

May 5, 2002	NWT Association of Communities	Resolution presented and passed at 2002 Annual general meeting.
June - Jan, 2002	NTCL	Meeting with NTCL in Hay River to discuss navigation requirements
Oct./Nov., 2002	Trucking, construction, engineering, mining, manufacturing and retail business	Consultation by Nichols Applied management for Aboriginal Benefits report
Nov. 13, 2002	Ft. Providence Public Meeting	Update community on status of Memorandum of Understanding (MOI)
Nov. 15, 2002	Public Event & celebration	MOI signed between GNWT & Ft. Providence Combined Council Alliance
Nov. 18, 2002	Press Briefing	Joint GNWT/Alliance Press Briefing and technical presentation at Legislative Assembly. Briefing, MOI and fact sheets posted on Department of Transportation web site
Nov. 19, 2003	NWT Motor Transport Association (NWTMTA)	Briefing of NWTMTA at AGM
Jan. 9, 2003	NTCL	NTCL agreement on navigation channel formalized
Feb. 20, 2003	NWT Chamber of Commerce	Meeting with President and Directors
Feb. 27, 2003	Ft. Providence Public Meeting	Community update and newsletter
Mar. 5, 2003	MLAs	Information package to all members of Legislative Assembly in support of Deh Cho Bridge Act
March 12, 2003	Ft. Providence Leaders	Letter in support of permit applications
April 25, 2003	Tli Cho (Dogrib) Chiefs	Meeting with Grand Chief and four community chiefs to confirm support
April 30, 2003	NWT Legislature Standing Committee	Presentation made at public hearings of Standing Committee on Governance and Economic Development (on Deh Cho Bridge Act)
May 13, 2003	Meet the North Conference - Edmonton	Presentation and panel discussion
May 1, 2003	Affected communities	Letter and information package sent to affected communities (MVLWB list)
May 1, 2003	Dene Leaders	Resolution presented and passed at annual Dene Leadership Meeting
June 4, 2003	Community of Ft. Providence	Public meeting, project update and discussion of community benefits
June 12, 2003	Chief Fred Norwegian, Jean Marie River First Nation	M. Vandell met in Jean Marie. Positive support and no concerns
May – June, 2003	NWT Public	Public Hearings undertaken by the NWT Legislature on the Deh Cho Bridge Act.

		(Appendix 10)
July – August, 2003	Affected communities and agencies: ▪ Deh Gah Got'ie Dene Council (Ft. Providence) ▪ Fort Providence Métis Council ▪ Liidli Kue First Nation (Fort Simpson) ▪ Metis Local #52 (Fort Simpson) ▪ Jean Marie River First Nation ▪ Ka'a'gee Tu First Nation (Kakisa) ▪ Pehdzeh Ki Dene Council (Wrigley) ▪ Northwest Territory Metis Nation ▪ Deh Cho First Nation ▪ Hamlet of Fort Providence ▪ Village of Fort Simpson, ▪ GNWT Health ▪ DIAND - South Mackenzie District ▪ Prince of Wales Heritage Mark Davy, ▪ GNWT –MACA, ▪ GNWT – RWED ▪ Environment Canada ▪ DFO ▪ MVEIRB ▪ GNWT DOT	Mackenzie Valley Land & Water Board screening distribution for comments (Appendix 2)
December, 2003 – February, 2004	Community of Ft. Providence	Community Benefits Plan and M. Nadli consultation and report. (Appendices 7 & 8)

G.2 Issues:

Identify the issues raised, how they were resolved and what issues remain unresolved.

Support to date has been <u>very</u> positive. In general, most stakeholders believe the bridge will have positive environmental and socio-economic impacts.

Key indicators of support from community, Aboriginal, territorial and federal leaders and industry include:

- Community of Fort Providence - Letter of support from elected leaders of Dene, Métis and Hamlet Councils and Resource Management Board.
- NWT Association of Communities - Resolution of 2002 Annual General Meeting.
- Dene Nation - Unanimous resolution of Dene Nation Leaders at May 2003 meeting.
- NWT Legislature and Government - GNWT Memorandum of Intent, project financial support and passage of the Deh Cho Bridge Act (Appendix K).
- Government of Canada - Financial support from federal DIAND.
- Northern Transportation Company Limited - letter of support regarding navigational clearances.
- NWT Motor Transport Association - Letter of support at NWT legislative Committee hearings

Evidence of support is included in Appendix 9.

Issues raised generally fall into two categories - environmental and economic.

G.2.1 Environmental

Community of Ft. Providence – as noted, environmental responsibility has been a pre-requisite to community support since the inception of the proposal. Concerns focus on water quality, potential disturbance of fish habitat and migratory birds, recreational use of the river and preventing bison from entering the bridge.

The community also recognizes that the replacement of the ice bridge and ferry operation will have long term positive impacts, by reducing disturbance and siltation of the river, reducing the risk of spills, reducing fuel consumption and reducing ongoing noise and activity at the crossing.

On balance, the community is satisfied that their concerns have been considered in the design and construction plan and that any short term disturbance and residual risks are outweighed by potential long-term benefits.

Government and Regulatory Agencies – Agencies, including Federal departments of Fisheries and Oceans (DFO), DIAND and Environment Canada submitted questions for clarification and additional information during the environmental screening through the MVLWB. These questions and responses form part of the public registry with MVEIRB and are included in Appendix 2.

G.2.2 Economic

The proposed Concession Agreement includes a commercial vehicle toll in the range of $5-$6 per tonne of freight. This would not apply to light, non-commercial vehicles. Much of the business and public reaction has been based on individual assessment of the potential benefits of the bridge and costs of the toll.

Community of Ft. Providence – This project is expected to have positive and negative socio-economic impacts, during and after construction. On the positive side, the construction phase will create community business, training and employment opportunities. During operations, there will be continued employment in maintenance and operations, while the projected return on equity will provide a sustainable source of income to the community to invest in local social and economic priorities.

On the negative side, concerns have been expressed about the social impacts of a large non-resident workforce during construction and the potential negative side effects of increased community incomes. Over the long term, there will be a loss of seasonal jobs on the ferry and ice bridge.

The Community Benefits commitment Plan is being developed by the Board of the DCBC, in consultation with the community. This plan has focused on accommodating community concerns to optimize the benefits and mitigate the potential negative impacts. The DCBC is committed to having this plan endorsed by the community and has committed to ensuring community support for a final decision to proceed with the project.

On balance, the consensus view of residents is the benefits exceed the costs and are greatest if the community participates in the project.

Trucking Industry – The proponent and the GNWT Department of Transportation has met with NWT Motor Transport Association and individual trucking companies. The industry sought and received assurances that the maximum toll would not exceed the proposed $5-$6 maximum. There was also concern about toll collection procedures and enforcement. Industry prefers a simple configuration based toll with limited administration burden. Both the DCBC and GNWT (who will administer toll collections) support this. Based on these understandings, the NWTMTA supported the bridge proposal at hearings on the Deh Cho Bridge Act.

Business – There has been a generally positive reaction from retail and other business in the region. Most see the potential benefits of a bridge crossing. Many feel that this infrastructure should be provided without tolls, while recognizing that government would be unlikely to make the investment in the near term. Some have undertaken the analysis on the economic benefits and costs. The key concern is that tolls remain within the range proposed and that they do not result in an increase in the cost of doing business.

Mining Industry – the mining industry has expressed concern through the NWT and Nunavut Chamber of Mines to the Minister of Transportation and through correspondence with the MVLWB. This industry relies on seasonal winter road resupply of mines north of Yellowknife and believes that the costs of tolls would exceed potential benefits of more reliable year round access to Yellowknife. It was this concern that resulted in a referral of the project by DFO to the MVEIRB. The Chamber has subsequently withdrawn its intervention.

Public – The general reaction has been positive. There is to be no toll on private vehicles. The key concern is that tolls do not result in an increase in the cost of living.

Barging Companies – NTCL is the major user of the Mackenzie River for commercial shipping. In March of 2002, NTCL advised that the main channel clearances were not adequate for their operations. In ensuing discussions, the DCBC and NTCL agreed on the lateral and vertical clearances and the positioning of the main span piers and the design was subject to significant modifications and a cost increase. NTCL provided a formal agreement in January of 2003. Cooper Barging provided a letter of support in March of 2004. Other users are being canvassed and are expected to support the current proposal.

Government – Both the GNWT and federal DIAND have been strong supporters. GNWT has provided $230,000 in contributions and a loan guarantee of $2 million for project development. The GNWT has enacted enabling legislation, signed into an Agreement-in-Principle and are actively negotiating a Concession Agreement with the DCBC. DIAND has provided $292,000 in contributions and committed to a $3 million equity contribution to the project.

H Assessment Boundaries:

H.1 Spatial

Provide a rationale for setting the spatial boundaries for the impacts described below.

The spatial boundaries for the environmental and socio-economic are different. Both are far-reaching but more pronounced locally.

H.1.1 Environmental

The key focus of environmental concern, both positive and negative, is in the immediate vicinity of the bridge itself. This is largely focused on the fish habitat and water quality of the river and on the terrestrial environment in the immediate area. However, consideration must include impacts on downstream water quality for the entire Mackenzie River. Potential also exists for impacts in the quarry and pit locations. Consideration has also been given to potential impacts on air quality.

Spatial boundaries for environmental impacts therefore include all land included and adjacent to the areas identified for construction activity and quarries and all watercourses draining from these areas, including the Mackenzie River and the air in the immediate vicinity of the project.

H.1.2 Socio-economic

The project will have local and regional socio-economic impacts, particularly north of the Mackenzie River and in proportion to proximity to the project. Spatial boundaries for socio-economic impacts include, in order of relative degree of impact:

1. The community of Ft. Providence.
2. The North Slave Region of the NWT (Yellowknife, Detah, Tli Cho communities, Slave Province mineral region)
3. South Slave communities (Kakisa, Enterprise, Hay River)
4. The Western Arctic Region Communities relying on air supply from Yellowknife (NWT and Nunavut)
5. The NWT

H.2 Temporal

Provide a rationale for setting the temporal boundaries for the impacts described below.

From both an environment and economic view, the short-term construction phase impacts are expected to be more pronounced and variable, while the long-term operations phase impacts are expected to be more stable.

The 2-year construction phase will continue to receive the greatest attention in maximizing positive benefits and in minimizing and mitigating potential negative impacts.

During operations, the concession agreement and revenues to the community will continue for 35 years. The bridge has a 75-year design life. However, in practice, once constructed this bridge is expected to be in place for the foreseeable future. During this phase, the environmental impacts are expected to be relatively stable, while the socio-economic impacts will vary somewhat, in proportion to population and traffic.

The temporal boundary for assessment is the foreseeable future, with particular attention to the construction phase and early operations years.

I Human Environment:

Socio-Cultural and Economic Matters

I.1 Direct Economic Impacts

Describe potential direct economic impacts on the community of Fort Providence in particular, and on the other communities affected by all weather access across the Mackenzie River (e.g. employment, tolls, cost of local supplies and services).

The valued components considered in assessing direct economic impacts include:

- Local employment, during and after construction
- Local business opportunity, during and after construction
- Regional employment, during construction
- Regional business opportunities, during construction
- Net user costs/savings
- Benefits of improved access - time savings, reliability and convenience
- Net cost to government
- Net societal cost (Net Present Value of quantifiable costs and benefits)

Table I1 summarizes the key economic impacts for each of these components, indicating the duration, geographic extent, direction (positive or negative), relative magnitude and significance. This table also notes the confidence in these predicted impacts and measures proposed to mitigate impacts (minimize potential negative impacts/risks and maximize positive impacts).

As noted in Section H, the impacts during the 2 year construction phase are quite different from the 35 year plus operations phase and these are considered separately. The project will have significant local and regional economic impacts. During construction, the 'region' would include communities on both sides of the river, focusing on businesses and workers engaged in construction. During operations, the 'region' would largely be defined as communities north of the river.

Benefit-cost analysis prepared by Nichols Applied Management for the GNWT in September of 2002 (Appendix 4b) estimated direct economic and employment impacts and the costs and benefits from the bridge. Follow up studies, completed for the GNWT and DCBC in February of 2003, updated the original study to reflect new information (Appendix 4a) and identified the costs and benefits specifically to Aboriginal and local residents (Appendix 4c).

The Nichols studies estimates the economic impacts and benefits resulting from:

- Reduced travel time and vehicle operation costs for commercial transportation companies;
- Avoided cost of running the ferry and building the ice bridge for the GNWT;
- Avoided cost of extra warehousing, inventory, shrinkage, and labour, for retail and other businesses in the bridge service area; and
- Reduced travel time and vehicle costs for non-commercial travelers.
- Employment and business benefits from construction and operation of the bridge

It also estimates the costs from:

- The bridge construction
- The proposed toll of up to $6 per tonne
- The loss of jobs from suspension of the ferry and ice bridge

Nichols concludes that the project will provide an overall net benefit of $38.6 million (Net Present Value) over 35 years, resulting in an internal rate of return (IRR) of 8.5% and notes that this is well above the normally accepted benchmark of 5.0% for Canadian public sector projects.

This estimate does not include the profits to the bridge corporation. It does not quantify the benefits of regional economic stimulus, reduced sense of isolation, or the residual value of the bridge at the end of the concession. Nor does it attempt to quantify benefits to the environment. It also excludes indirect government fiscal benefits.

Nichols estimates 250 person years of direct employment during construction and an average of about 2 – 10 person years for each year of operation (depending on the toll collection system), not including indirect employment. There will be a loss of 8 person years in seasonal employment from suspension of the ferry.

Nichols also allocates the costs and benefits to various user groups. Significant net economic benefits accrue to the community, businesses, the general public and the government, while there is a marginal cost increase to mining companies.

While the construction phase will generate considerable short-term spending and economic activity, the 35 year concession period and the permanent positive impact of this infrastructure on the local and regional economies will be far more significant. The most significant direct long term economic impacts include significant new income for the community of Ft. Providence and the improved access and reduced costs for the region.

The following sections identify and discuss economic impacts for each stakeholder group.

I.1.1 Community of Ft. Providence

Construction Phase

The construction activity itself will bring direct economic impacts to the community including training and employment, opportunities for local business and opportunities for joint ventures.

Opportunities for local businesses include:

- Joint venture(s) in general contract or major subcontracts (foundation, concrete panels, superstructure components)
- Camp and catering for foundation crew, erection crew, concrete crew
- Earthworks/granular/rock
- Concrete production
- Transportation (concrete, aggregate, superstructure, deck panels)
- Concrete panel production
- Finishing work

Opportunities for local employment include:

- Bridge Corporation staff,
- Employment with general contractor and/or foundation, concrete, erection, deck production, deck installation, earthworks contractors, surveying, traffic control.
- Heavy equipment, light equipment, trucking
- Camp and catering
- Project management, financial and clerical
- Environmental monitoring
- Quality control

According to Nichols, the bridge is expected to provide about 11 person years of direct local employment during construction.

Minimizing the community economic benefits is a key objective of the Community Benefits Commitment Plan (Appendix 7).

Operations Phase

Once construction is complete and the bridge is opened, the level of community activity will reduce significantly. The corporation will need to operate and maintain the bridge and manage finances (revenues, expenditures and profits). There will also be a requirement for environmental monitoring for the first several years.

Although a toll collection system has not yet been decided upon, any employment opportunities created will be available to the people of Fort Providence.

Opportunities for local business and employment:

- Bridge maintenance
- Provision of Corporation office.
- Environmental monitoring
- Toll collection

Operations are expected to result in 2 – 10 person years for each year of operation to community residents (depending on the toll collection system).

This phase holds fewer direct business and employment opportunities, but promises substantial profits for 35 years. The Concession Agreement guarantees a minimum return (after costs) of $225,000 per year. Current projections suggest that this will be significantly higher and rise steadily over the concession period. This will be shared with any equity partners and will be subject to taxes. The current plan suggests a target minimum of 70% community equity, but this could be as high as 100%.

Once the bridge is open, potential negative impacts include:

- Loss of ferry and ice crossing contracts and jobs.

There will be a loss of 8 person years (6 local) of seasonal employment in the current crossing operations.

Minimizing and mitigating the negative impacts is a key objective of the Community Benefits Commitment Plan. This plan identifies investment in a workforce adjustment and training plan for impacted local employees.

I.1.2 The Public and Consumers of the Region

For the construction phase, Nichols estimates that about 50% of the employment, or 125 person years, will accrue to NWT-based workers.

During operations, there will be no tolls for non-commercial traffic. The Nichols study estimates the savings to non-commercial traffic over the 35-year concession period to be valued at $80.1 million. Discounted at 5%, these savings have a present value of $15.7 million.

Commercial transportation savings, coupled with savings from the reduction of storage will reduce overall retail prices benefiting to the average North Slave Region consumer. The Nichols Applied Management study estimates this benefit to be an average of $7.17 per tonne. The difference between this benefit and the toll of $5-6 per tonne should flow through retailers to consumers.

Employment gains and losses during operations will largely be local, as noted above.

The Nichols study highlighted but did not quantify a range of other public benefits. These include improved connections between communities, reduced isolation, more reliable supply of goods and services and improved access to government services, employment and business opportunities.

I.1.3 Trucking Industry

RTL - Robinson Enterprises provides trucking services including major freight and fuel re-supply contracts, LTL (less than truckload) service, equipment mobilization and specialized and oversize loads for business, mines and individual customers. In 1997 this company moved over 100 million litres of fuel and 45,000 tonnes of freight in the N.W.T.

RTL notes several costs of the current ferry/ice bridge crossing:

- During 'normal' ferry/ice bridge operations, there is a delay/detour adding of 20-30 minutes at the crossing. This can extend to several hours during peak times, when trucks are forced to line up at the ferry.
- In the worst case, trucks can encounter unscheduled interruptions in service during freeze-up and wait several days for service to resume.
- Some oversized loads cannot be accommodated on the ferry and must wait for the ice bridge to reach full capacity.
- During periods of extended service interruption, the RTL fleet is idle. There is usually a rush just before spring break-up to get ahead and after break-up to catch up on demand. This results in less than optimum fleet utilization.

Nichols estimates the bridge would result in direct savings (time and distance savings) to trucking companies in the range of $2 to $3.83 per tonne, including only the first two of the above noted benefits. The per-tonne savings is higher for traffic diverted from the ferry than it is for traffic diverted from the winter crossing.

I.1.4 NWT Businesses

The construction phase is expected to result in $24 million (44% of the $55 million) construction expenditures going to NWT business.

Currently, suppliers must provide storage and finance the cost of 6-8 weeks of inventory or fly supplies in or risk depletion of inventory. The Deh Cho Bridge will provide savings to businesses in the form of reduced disruptions and costs in financing, transporting and storing inventory. The savings in transportation costs include those noted under trucking companies above, as well as the cost for air transportation. For example:

- The Yellowknife Direct Charge Co-op provides groceries, dry goods and gasoline to over 2,800 member families, representing approximately 9,000 people.
- In 2001, the Co-op sold about 10,000 tonnes of goods and 4.3 million litres of fuel. The total Co-op tonnage, including fuel, was about 14,000 tonnes. The Co-op spent about $2.5 million on transportation, paying an average of 22 cents per kg for general freight and about 7 cents per litre for fuel. The bridge toll on all Co-op freight would amount to about $70,000 – $85,000.
- The General Manager identified potential savings in airfreight, inventory financing, the cost of renting and storing extra fuel tankers, the cost of renting and heating extra trailers and the losses due to handling and spoilage. He estimated that a bridge would result in savings to the Co-op of about $300,000 per year.
- Even if the full toll costs were passed on, Co-op net costs would decrease by about $230,000/year, or over $16/tonne. This represents a net annual savings of at least $80 per member family.

Nichols notes that the benefit to businesses will vary depending on individual circumstances and estimates a weighted average benefit for community resupply of about $7.17/tonne.

I.1.5 Mines

The mines north of Yellowknife rely on annual winter resupply via winter road. The benefit is therefore less than for community rsupply, since most mine traffic is on the ice bridge, rather than the ferry and even with a bridge, there will be no year round road access to these mines.

The Nichols study estimated only the transportation (trucking) cost savings of a bridge compared to the ice crossing at $2.18 per tonne. After including the proposed toll, there would be a net increase of about 1/3 of one cent in the cost of a litre of fuel.

However, there are some additional benefits to the mines that were not quantified:

- With a bridge, materials may be shipped to Yellowknife at a lower cost and on a more reliable basis, for air freighting to the mines.
- Some oversize loads cannot be accommodated on the ferry and must wait until the ice bridge is up to full capacity before shipping.
- Materials are marshaled in Yellowknife in preparation for the short winter road season. The bridge will eliminate the potential for disrupting schedules caused by delays in ice bridge construction and/or interruptions in ferry service.

I.1.6 Government

As individual consumers, government will benefit from the improved level of access to cheaper and more consistently delivered goods.

Government will gain direct and indirect corporate and personal income taxes, during and after construction.

The GNWT will benefit from direct savings from ceasing the operations and maintenance of ferry, shore infrastructure, ice bridge and ice bridge access roads. Once the bridge is built there will no requirement for capital upgrading or replacement ferry, ice crossing access and support infrastructure. The GNWT will also benefit from the salvage value of the ferry and infrastructure. Nichols estimates the GNWT savings at $121 million over 35 years ($28 million, discounted at 5%).

At the end of the concession period, the GNWT will acquire this major infrastructure asset at no cost, with a remaining useful life of at least 40 years. After that time, the GNWT can suspend its annual contribution and continue to benefit from substantial annual savings.

Should traffic meet or exceed forecasts, the GNWT will 'profit share' in the toll revenues.

The Deh Cho Bridge project supports government objectives to foster regional economic development and to secure First Nations participation in, and expand economic benefits from, major regional development initiatives. The Deh Cho Bridge project will also support Aboriginal training, employment, and business development and equity investment opportunities.

I.2 Indirect Economic Impacts

Describe potential indirect economic impacts and their significance on the Northwest Territories (e.g. cost of living).

The valued components considered in assessing indirect economic impacts include:

- Local spending of wages during construction
- Regional spending of wages during construction
- Local economic development stimulus from reinvestment of operating profits (dividends).

- Local employment from reinvestment of operating profits (dividends).
- Regional economic stimulus
- Regional cost of living

Table I2 summarizes the key economic impacts for each of these components, indicating the duration, geographic extent, direction (positive or negative), relative magnitude and significance. This table also notes the confidence in these predicted impacts and measures proposed to mitigate impacts (minimize potential negative impacts/risks and maximize positive impacts).

As noted in Section H, the impacts during the 2 year construction phase are quite different from the 25 year operations phase and these are considered separately. The project will have significant local and regional indirect economic impacts.

I.2.1 Community of Ft. Providence

The reinvestment of the net income from equity participation in the project, estimated at $35 million, is expected to provide considerable indirect economic benefits to the community.

The Community Benefits Commitment Plan outlines areas of planned investment, including Investments in other for-profit ventures, community economic development initiatives, training, employment and community social development. The plan also contemplates a trust fund to ensure that these investments can be sustained after the concession period has ended.

Nichols states that a <u>conservative</u> estimate of the employment benefit from reinvestment would be an average of 9.1 jobs, or 318 person years over 35 years.

Other indirect impacts would accrue from the spending of incomes generated, the opportunities created by the skills and experience gained by the community and from the development of joint ventures that continue beyond the construction phase.

I.2.2 Other

A range of indirect impacts on other groups have been identified:

+ Reduced cost of living in the region. This is included as a direct impact in I1 above, through inclusion in net user costs.
+ Better scheduling and equipment utilization for all businesses relying on this route for transportation.
+ Fiscal benefits to governments, from reduced costs and taxation of direct and indirect business and employment incomes.
+ Potential use of highway corridor and bridge for utilities (e.g. communications and power transmission)
- Potential to discourage mineral exploration and development

I.3 Direct Socio-Cultural Impact

Describe potential direct impacts on the social and cultural environment of NWT communities affected by all weather access across the Mackenzie River (e.g. changes in traffic volume and results on other community attributes, effects on river users and river traffic).

The valued components considered in assessing direct socio-cultural impacts include:

- Local social impacts during construction
- Local and Regional accessibility/reliability of access
- Local impacts of traffic patterns and volume
- Local sense of control and self-reliance
- Development of local skills and capacity

Table I3 summarizes the key socio-cultural impacts for each of these components, indicating the duration, geographic extent, direction (positive or negative), relative magnitude and significance. This table also notes the confidence in these predicted impacts and measures to mitigate impacts (minimize potential negative impacts/risks and maximize positive impacts).

The bridge is intended to improve the level of service on this transportation corridor. The key social impact will be the reduced sense of isolation and increased convenience from year round 24-hour access.

There is some concern in the community of Ft. Providence that this will eliminate the imposed daily and seasonal 'quiet times' when the crossing is shut down.

At the same time, community residents believe that a bridge will eventually be built and that the proposed approach will ensure that the community has some control over the manner in which it is constructed and an opportunity to benefit from it.

According to Prolog (appendix 13) total traffic volumes are expected to increase only marginally, largely due to diversion of air traffic.

There should be no impact on river users or river traffic.

Success in the project will be a considerable source of pride and will increase the skills, capacity and confidence of the community.

I.4 Indirect Socio-Cultural Impacts

Describe potential indirect impacts on the social and cultural environment of NWT communities affected by all weather access across the Mackenzie River. Describe other indirect socio-cultural impacts (including impacts to current employees working on the Mackenzie River Ferry).

The valued component considered in assessing indirect socio-cultural impacts is:

- Local social and cultural well being

The community has considered how profits from ownership of the bridge are to be reinvested in the community. The Community Benefits Commitment Plan (Appendix 7) proposes allocation of profits to long-term investment in:

1. Employment & Training Programs – Enhancing existing investments in infrastructure, employment support and career development, pre-employment and on-the-job training and literacy programs.
2. Business Development – Investments in community based economic development initiatives.
3. Community Social Development – Enhancing existing community based programs in the areas of family assistance, recreation and cultural programs.
4. A trust fund to provide for continued investment in the above three areas after the concession period ends (a pension).

Table I3 includes direct and indirect socio-cultural impacts of the project

The impact (and mitigation) of job losses to current seasonal employees is addressed in Section I.1.1.

Cultural and Heritage Resources

I.5 Local Cultural and Heritage Resources

Identify archeological and other heritage resources as well as sites or areas of cultural significance *in or near the project area.*

The land based construction footprint of the bridge is entirely within the current highway right-of way, in an area already disturbed and utilized for the highway embankment and ferry infrastructure. No archeological or heritage resources have been identified by Fort Providence First Nations or by the Prince of Wales Northern heritage Centre or by any other parties during the preliminary screening of the project.

I.6 Direct Cultural Impacts

Describe potential direct impacts on sites or areas identified in I-5.

None identified.

I.7 Indirect Cultural Impacts

Describe potential indirect impacts on any of the sites or areas identified in I-5 (e.g., through increased access by different user groups).

None identified.

I.8 Cumulative Effects

Describe the impacts on any of the sites or areas identified in I-5 that this development may have in conjunction with previous, present, and reasonably foreseeable future developments in this area.

None identified.

Land and Resource Use

The area includes traditional, existing and recreational land use. These are difficult to categorize/distinguish and are discussed together.

I.9 Traditional Land Use

Discuss the potential impacts of the proposed development on traditional land use and occupation.

I.10 Existing land use

Discuss the potential impacts of the proposed project on existing land use and occupation.

I.11 Recreational Activities

Discuss the potential impacts of the proposed development on recreational activities.

The valued components considered in assessing impacts on land use and recreation include:

- Impacts on existing uses and activities during construction
- Impacts on existing uses and activities during operations

Table I4 summarizes the key potential impacts for each of these phases, indicating the duration, geographic extent, direction (positive or negative), relative magnitude and significance. This table also notes the confidence in these predicted impacts and measures to mitigate impacts (minimize potential negative impacts/risks and maximize positive impacts).

The river, its estuaries and riverbanks in the immediate vicinity of the proposed bridge are used for subsistence and recreational fishing and wildfowl hunting. Recreation and tourism uses in the area include camping, boating, skidooing, and big game hunting and viewing (notably bison). There is a day use park at Dory Point on the South shore.

The area along the North winter crossing access road between the ferry landing and the river has many cabins used for recreation and harvesting by community residents.

The construction phase of the project will increase noise and traffic during peak periods of activity, due to material transport and storage, the camp and concrete plant and heavy equipment operations. However, it is intended that activity be largely confined to the existing right-of way. The camp will be located on the south shore, away from areas of local recreational use.

Once complete, the bridge will have the positive effect of eliminating the heavy commercial traffic and noise adjacent to cabins on the north winter access during the ice bridge season. It will eliminate the helicopter traffic during spring breakup. The ferry landings, camp and ferry and ice bridge shore infrastructure and equipment will no longer be required and will be removed or cleaned up.

Visual and Aesthetic Resources

I.12 Visual and aesthetic resources

Discuss the potential impacts of the proposed permanent structure on the visual and aesthetic resources of the area.

Visual and aesthetic values are an integral component of the local recreational and tourism attraction. The potential impacts, during and after construction, on visual and aesthetic resources are included in Table I4:

The Deh Cho (Mackenzie River) itself is the most notable local attraction and the community of Ft. Providence is located on the riverbank.

The bridge crossing is located on the existing highway corridor, about 10 km upstream from the community. It will not affect vistas from the community.

The construction of a project of this size and significance will draw considerable interest and attention from residents, the public, media and the professional community (engineers and builders).

Rising 90 feet above the water, the bridge itself will become a highly visible local landmark and attraction. Although highly subjective, most people will regard the structure as aesthetically pleasing compared to the existing ferry, camp and landings. The local terrain and horizon is flat and the bridge will not block views or vistas of any outstanding or unusual local features.

The view when crossing the bridge will provide an impressive new panorama.

Notes to Tables I1 – I4

The following tables identify project activities and duration (typically the 2 year bridge construction phase and the 35 plus year operations phase) and the valued components considered when predicting potential impacts of these activities. Predicted impacts are assessed as noted below and a summary rationale/comments provided. Finally, any proposed mitigation measures are noted. These could include measures to reduce negative impacts or risks or to maximize positive impacts.

Impact Measure

Extent	**Local:** the community of Ft. Providence and immediate vicinity of the crossing.
	Regional: During construction this would include North and South Slave region/communities (eg Yellowknife , Hay River) affected by construction activity and employment. During operations the region would include the communities and region (mines) north of the crossing. This region will be the direct beneficiary of the bridge and contribute through tolls.
	Territorial: The NWT as a whole.
Direction	**+ :** the net impact is considered beneficial
	- : the net impact is considered negative
Magnitude	**Low/Medium/High:** these are relative terms. For example 10 jobs or $500,000 in income would have a larger relative impact on Ft. Providence than on Yellowknife, which has times the labour force and 50 times the total incomes.
Significance	**Low/Medium/High:** These are relative terms. How significant is the valued component, relative to others, for that region or community. For example, new jobs may be more significant to the community of Ft. Providence, with an unemployment rate of 30%, than to Yellowknife, with an unemployment rate of 6%.
Confidence	**Low/Medium/High:** This is an indication of the certainty of the predicted impact, taking into account risks, external variables and proposed mitigation measures. For example, some forecast impacts on valued components depend on traffic forecasts. These have a degree of uncertainty that can reduce confidence in predictions. Measures may also be taken to mitigate the negative risks of variations in traffic.

Table I1 - Direct Economic Impacts

Project Activity (duration)	Valued Components	Impacts: Extent	Direction	Magnitude	Significance	Confidence	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	Local employment	L	+	M	M	M	Estimate 11 PYs local employment. $860,000 labour spending.	Community Benefits Plan to maximize local training & employment
	Regional Employment	R	+	M	M	H	Estimate 125 PYs northern employment. $10 million northern labour cost.	
	Local Business Opportunity	L	+	M	M	H	Joint ventures and subcontracts. Estimate $780,000 local business.	Community Benefits Plan to maximize local business opportunities
	Regional Business Opportunity	R	+	M	M	H	Estimate $14 million northern business, in addition to labour noted above.	
Bridge Operations (years 3 to 35+)	Local employment	L	-	M	M	M	Estimate loss of 6 local PYs and gain of 2-10 PYs, depending on toll system.	Community Benefits Plan includes investment in training and job creation
	Local Business opportunity	L	+	H	H	M	Return on shareholder investment projected to average $1 million per year, depending on traffic. Opportunities in management, environmental monitoring, bridge maintenance and toll collection.	Agreement includes guaranteed minimum $225,000 per year.
	Net User Costs	R	+	M	H	H	Analysis shows that quantified benefits exceed tolls overall and for all user groups, except mines. No tolls required after 35 years.	
	Time/ Convenience	R	+	M	H	H	Time savings for all users. Improved reliability & scheduling. Reduced risk of shortage.	
	Net Government Cost	T	+	L	M	H	Net government savings in operations through suspension of ferry. Government owns bridge after 35 years.	
Combined (37 years)	Net Societal Cost	T	+	H	H	M	Estimated net benefit $38.6 million, based on Net Present value of all costs and benefits. (Does not include profits to shareholders).	

Extent: **L**ocal **R**egional **T**erritorial **Direction:** **+** beneficial **-** negative **Magnitude, Significance, Confidence:** **L**ow **M**edium **H**igh

Table I2 - Indirect Economic Impacts

Project Activity (duration)	Valued Components	Impacts						
		Extent	Direction	Magnitude	Significance	Confidence	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	Local spending of construction incomes	L	+	M	M	H	Some labour income will be spent by workers in community during construction phase	
	Regional spending of construction incomes	R	+	M	M	H	Much of northern labour income will be re-spent in the region	
Bridge Operations (Indefinite duration)	Local economic development stimulus	L	+	H	H	H	Investment of dividends in local infrastructure and economic development initiatives.	Community benefits plan includes sustainable economic development fund
	Local indirect employment	L	+	H	H	H	Conservative estimate of 9 (ongoing) PYs , through investment of dividends. Increased capacity of community.	
	General regional economic stimulus	R	+	M	M	M	Lower net costs and more reliable access may stimulate additional investment.	
	Exploration & Mining Sector	R	-	L	L	M	Toll costs may exceed benefits from transportation savings and improved access, reducing investment in sector.	
	Regional cost of living	R	+	L	H	H	Lower costs to business and consumers with tolls. Improves further after 35 years, without tolls.	

Extent: **L**ocal **R**egional **T**erritorial **Direction:** **+** beneficial **-** negative **Magnitude, Significance, Confidence:** **L**ow **M**edium **H**igh

Table I3 - Direct and Indirect Socio-Cultural Impacts

Project Activity (duration)	Valued Components	Impacts						
		Extent	Direction	Magnitude	Significance	Confidence	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	Local social impacts during construction	L	-	L	M	M	Some concern about possible negative social impacts from non-resident workforce during construction phase.	Addressed in Community Benefits Plan. Construction camp to be outside community. Contracting policies will minimize potential impacts. Monitoring program to be established.
Bridge Operations (Indefinite duration)	Local and Regional accessibility/ reliability of access	R	+	M	M	H	24 hour access 365 days per year will reduce uncertainty and sense of isolation	
		L	-	M	L	M	Some concern about potential negative impacts of improved access.	
	Local impacts of traffic patterns and volume	L	-	L	L	M	Marginal increase in traffic, noise and activity	
	Local sense of control and self-reliance	L	+	H	H	H	Local sense of ownership, pride and accomplishment. Income to invest in community priorities.	
	Development of local skills and capacity	L	+	M	M	M	Experience in major project and skills development through reinvestment.	Community Benefits Plan includes local training, employment, social, cultural, recreational and economic development components
	Local social and cultural impacts of bridge corporation incomes	L	+	M	H	H	Investment of profits in community development programs	

Extent: **L**ocal **R**egional **T**erritorial **Direction:** **+** beneficial **-** negative **Magnitude, Significance, Confidence:** **L**ow **M**edium **H**igh

Table I4 – Impacts on Land Use and Visual/Aesthetic Resources

Project Activity (duration)	Valued Components	Impacts						
		Extent	Direction	Magnitude	Significance	Confidence	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	Impacts on existing uses and activities	L	-	M	M	M	Some disturbance due to construction activity and noise. Potential for disturbance to subsistence and recreation fishery in immediate vicinity of north ferry landing	Camp, concrete plant, borrow pits and storage areas located to minimize potential disturbance. Contracting policies will minimize potential impacts. Monitoring program to be established.
	Impacts on Visual/Aesthetic Resources	L	+	M	M	H	The construction itself will be a significant attraction, drawing considerable public, media and professional interest and attention to the community and construction site	
Bridge Operations (Indefinite duration)	Impacts on existing uses and activities	L	+	M	M	H	Reduction in activity and noise due to elimination of ferry launching and operation, ice bridge construction and helicopter shuttle. Removal of ferry, shore infrastructure and equipment and cleanup of sites. Reduced traffic near cabins on north winter access	
	Impacts on Visual/Aesthetic Resources	L	+	M	M	M	On existing corridor, existing ferry and infrastructure will be replaced by bridge structure. Aesthetic value is highly subjective. Will be an impressive visible structure, but will not block unique views or vistas. Will provide new view/vistas when crossing bridge.	

Extent: **L**ocal **R**egional **T**erritorial **Direction:** **+** beneficial **-** negative **Magnitude, Significance, Confidence:** **L**ow **M**edium **H**igh

J Physical and Biological Environment

Impact assessment criteria are used to rate the potential effects of the proposed project on each environmental component within Section J. Predicted impacts are assessed according to the following criteria: Direction, Magnitude, Extent, Duration, Frequency, Confidence, Reversibility and Significance. Each environmental component contains a section titled Impact Assessment. Included is a summary table with assigned ratings for each of these criteria, and for each Valued Ecosystem Component (VEC).

J.1 Air Quality and Climate (Table J3)

Discuss the potential impacts of the proposed development on the local and regional air quality and climate.

Valued Ecosystem Components (VECs)

Air quality is essential for the maintenance of a healthy environment for all living organisms on land, air and water. The quality of air is expressed not only as a necessity for human consumption, but also as an integral component of the ecosystem (e.g., climate warming). The following assessment will address the effects of the Deh Cho Bridge project on air quality as a whole, as well as potential impacts the project has on the production and management of greenhouse gas emissions and, by extension, climate. Physical and chemical changes to air quality in the vicinity of the Deh Cho Bridge project will be used as the air quality VEC.

Potential Effects

Certain project actions will release emissions to the atmosphere. These releases will be primarily due to fuel combustion (construction equipment, power generators, space heating, and transportation vehicles), explosives detonation and fugitive dust (excavation, drilling, quarrying and crushing, wind erosion, and road dust). The potential for the release of greenhouse gas is also recognized.

The key impacts to the air environment will likely result from dust and emissions from heavy equipment during construction. Although these effects can be minimized during construction, dust and emission levels in the vicinity of bridge will exceed natural background conditions. Following construction, these effects would return to normal (existing) conditions in the region.

Dust and emissions from heavy equipment may cause animals and birds to re-locate away from the area surrounding the construction site. This potential impact would be limited to the construction phase of the proposed bridge project when heavy equipment is on site. Mitigating, or limiting, the effect of dust and emissions during construction can be achieved by limiting the size of the construction footprint (e.g., stagger construction events) and by implementing a dust control program.

Over the long term, the bridge might increase traffic volume on the highway, leading to higher vehicle emissions in the area. This impact would occur for the life of the bridge but is related to traffic volume rather actual bridge itself. Although there would be no mitigating measures for this concern, PROLOG (2002; Appendix 13 of DAR) noted that the 'uplift' of commercial traffic due to the installation of a bridge would be small (about 2 to 5%). Much of the increase would be diversion of freight and passengers that would otherwise use aircraft.

Increased releases of sulphur dioxide (SO_2) and oxides of nitrogen (NO_X) and greenhouse gas emissions, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) from the project can be expected during construction (exhaust from generators, construction equipment, etc.) and operation (exhaust from increased bridge traffic). Impacts associated with the increased greenhouse gas emissions are expected to be very small, with negligible effects on climate. This is primarily due to the following:

- short construction period (two years)
- increase in commercial bridge traffic anticipated to be 2% above projected levels without a bridge
- eliminating the ferry operation will reduce fuel consumption by over 400,000 litres per year
- overall vehicular fuel consumption will be reduced by eliminating the winter detour and shortening the trip distance for all vehicles that would have used the ice crossing. This 15 km short-cut will save approximately 300,000 kilometers per year for commercial vehicles alone
- elimination of fuel consumed by equipment in the construction and maintenance of the ice crossing and approach roads
- reduction in fuel consumed by idling vehicles, waiting to for the ferry to cross the Mackenzie River
- reduction in fuel consumed by aircraft used during the air shuttle periods (spring and fall, when ice break-up prevents use of ferry and ice road).

Another factor potentially affecting air quality is the release of air contaminants during chemical spill events. This could affect the people and wildlife in the surrounding area. During construction, this would be mitigated by: proper storage and handling practices, availability of appropriate and sufficient spill response equipment, and proper spill contingency planning and training.

Mitigation Measures

The overall impact of the project, particularly during the construction phase, on air quality will be minimized by the following mitigation measures:

- applying water or acceptable chemical suppressants to roadways to reduce dust
- haulage and grading kept to a minimum
- Installing dust covers, sonic sprays, etc. to suppress dust generation from equipment in the quarrying and crushing facility
- servicing all mobile and stationary engines to maintain optimum fuel efficiency

Impact Assessment

Based on the above, and the nature of the project (e.g., effects mainly restricted to the construction phase of the project, implementation of best management practices/mitigation), potential long-term net effects to air quality and climate are expected to be low and not significant (Table J3). This is primarily due to:

- short construction period relative the to life of the project
- eliminating use of ferry operations and maintenance equipment of the ferry and ice roads, thereby reducing vehicle emissions.

J.2 Terrain and Soils (Table J4)

Discuss the potential impacts of the proposed development on the local terrain and soils.

Valued Ecosystem Components (VECs)

The soil and terrain VECs were selected based on:

- sensitivity to disturbance; and
- overall ecological and social importance in the area.

Soil capability and soil erosion potential will be used as terrain and soil VECs for this project. Changes in soil capability may occur due to compaction, rutting, admixing of soil horizons, or as a result of changes in soil chemistry from spills. Soil erosion is a concern as a result of vegetation clearing; soils will continue to erode until successfully re-vegetated.

Potential Effects

The following potential impacts to terrain and soil capability were identified for activities associated with the project (right-of-way clearing, lay-down area clearing, topsoil salvage and grading):

- permanent loss of soil;
- lowering of soil capability through water/wind erosion, especially on soil with shallow bedrock;
- lowering of soil capability through admixing of topsoil/subsoil; and
- lowering of soil capability through compaction and rutting.

Road construction near the Mackenzie River may cause slope instability, depending on the slope of the terrain, texture and moisture content of the material, and vegetative cover.

The fine-grained texture of the fluvial deposits of the Mackenzie River valley makes this area sensitive to erosion. Erosion from roadways can cause an alteration of terrain along the road length.

Soil erosion is a process involving soil movement from one area to another by wind and water. Soil erosion can result in alteration or loss of soil quality, a process that can subsequently affect vegetation growth. The Project will result in vegetation removal, thereby exposing the soil and increasing the probability for erosion. Mineral soils will be more at risk than organic soils since they are on upland topography and can have clayey soil textures. Organic soils are not typically at risk of erosion due to level topography and high moisture conditions.

Soil handling and reclamation for the Project will involve stripping, salvage and storage of organic and mineral soil materials for use during reclamation. Soil admixing may result from improper soil handling procedures, and can affect soil fertility and consequently vegetation growth.

Soil compaction results in a reduction in porosity and an increase in soil bulk density. It can be caused by external pressure resulting from construction related equipment and vehicle traffic. The potential loss of soil structure from compaction can affect vegetation growth, especially root development, aeration and drainage. Soil moisture may be affected by construction in wetland areas. Changes in soil moisture can affect vegetation growth.

Spills and leaks during construction and operations may result in the alteration of soil chemistry and physical properties, which in turn can affect vegetation, surface water and groundwater quality.

Mitigation Measures - Disturbances to Soil

Wind/Water Erosion

The overall impact of soil erosion on soil capability during the construction phase will be minimized by the following mitigation measures:

- working surfaces and slopes will be graded to minimize run-off erosion;
- progressive reclamation during operations will minimize slope erosion;
- the road right-of-way will be seeded with an erosion controlling plant cover as soon as practical following access road construction;
- where required, diversion berms can be placed and designed to minimize erosion and sedimentation; and
- topsoil stripping will be discontinued during periods of high winds.

Where necessary, surface diversion berms will be installed to control surface and subsurface (groundwater seepage) flows and bring them to the surface. Berms will be constructed at the crests and breaks in slope, as well as where groundwater is encountered. Locations will be selected in detail at the time of construction. Special consideration should be made in areas with shallow bedrock.

Soil Compaction and Rutting

Any off road surfaces that have been compacted can be deep ripped and cultivated to prepare the surface for re-vegetation. Any soils that are rutted will be flattened with a blade prior to topsoil re-vegetation.

Stability at the river crossings will be ensured by implementing the following recommendations:

- control surface runoff to minimize water erosion during construction (use berms, dams, or erosion control blankets); and
- re-establish vegetation as soon as possible following construction.

Mitigation along the right-of-way will focus on minimizing erosion. Grading during construction should be minimized or avoided, as much as practicable. Areas where the surface vegetation is disturbed should be re-vegetated as soon as possible, and water breaks should be installed to interrupt flow paths along ditches on steep slopes.

Mitigation Measures -Disturbances to Vegetation from Clearing

The mitigation measures for reducing/eliminating disturbances to vegetation resources within the project area include:

- minimizing right-of-way width and the extent of new clearing where possible;
- maximizing construction during the winter months; and
- salvaging and replacing the surface soil to support successful re-vegetation.

Based on the above, and the nature of the project (e.g., small areas of vegetation to be affected, road construction limited to existing causeway approaches, impacts primarily limited to period of construction), potential effects to terrain, soils, and vegetation are expected to be minimal and not significant.

J.3 Vegetation and Plant Communities (Table J5)

Discuss the potential impacts of the proposed development on the local vegetation and plant communities.

Valued Ecosystem Components (VECs)

Selection of vegetation VECs was based on resource components that are considered to be ecologically important, important to local and landscape level biodiversity, have identified resource value, and provide valuable habitat to wildlife species. The VECs used for assessing impacts to vegetation resources include the following:

- native plant communities;
- rare plant potential in the project area; and
- commercially important forests.

The potential for the Project to affect each of the vegetation VECs was considered.

Potential Effects

Potential impacts to vegetation could be either direct through clearing or indirect through potential increased dust as a result of increased traffic. Vegetation could also be affected indirectly through clearing or by alteration of drainage patterns (i.e. associated with grading). Areas most likely affected due to recommended highway improvements may include natural vegetation communities in proposed laydown areas used for staging equipment during construction (short-term effect). During construction, spoil materials will be deposited in old abandoned pits, therefore, natural vegetation communities will not be affected by this aspect of the project. The bridge approaches will be widened and the present ferry causeways will be shortened on the north side of the river and lengthened on the south side (net effect of shortening overall causeway lengths). As such, vegetation communities presently along the ferry causeways will be affected. However, these areas are small, sparsely vegetated, and vegetation communities will be re-established following completion of the project.

Several of the new clearing areas proposed for the project are currently vegetated with commercially important tree species such as spruce and poplar. Table J1 highlights proposed project activities associated with new clearings of native vegetation and approximate size of clearing required.

Table J1 - Proposed New Clearings as a Result of Project Activities

Proposed Activity	**Vegetation Type**	**Approximate Area (ha)**
Temporary construction camp	spruce/poplar forest	1.5 ha
Temporary concrete plant #2 (South)	spruce/poplar forest	0.6 ha
Limestone quarry	spruce (6"-10" diameter)	2.0 ha
Proposed gravel pit	spruce (6"-10" diameter)	2.4 ha
Proposed south borrow area	spruce/poplar forest	3.2 ha
Proposed north borrow area	spruce/poplar forest	2.3 ha
Gravel pit for concrete aggregate	spruce (sparse and only a portion will be cleared)	n/a
Proposed granite rock quarry	spruce (6"-10" diameter)	1.6 ha
Total	**n/a**	**13.6 ha**

Because vegetation is closely tied with terrain and soils, additional information on the interactions (impacts, mitigation, net effects, etc.) of the project with vegetation communities is provided (see Section J.2 above). In particular, mitigation to minimize effects on vegetation communities is discussed. Overall, the potential effects are rated as low and temporary (primarily restricted to the construction period), and not significant.

J.4 Water Quality and Quantity

Discuss the potential impacts of the proposed development on water quality and quantity in the Mackenzie River in the area upstream and downstream of the proposed bridge crossing. The water quantity discussion focused on: substrate disturbance, increased suspended sediments, substrate type, water flow, water depth, channel width, ice flow, ice jamming, damming effects, and any other impacts related to spring ice breakup.

J.4.1 Water Quality (Tables J6, J7)

Valued Ecosystem Components (VECs)

Water quality is essential for the maintenance of a healthy environment for all living organisms both in water and on the land (including people). Good quality water is a necessity for human consumption, and is an integral component of the ecosystem. Physical and chemical changes to the quality of water in the Mackenzie River within the zone of influence of the project was used as a VEC.

Potential Effects

The following potential impacts to water quality may be associated with the various construction and operational aspects of the project:

Construction:

- Suspended sediment loading during instream construction
- Release of sediments from surface runoff
- Water contamination from spills
- Water contamination from fill/construction materials

Operations:

- Sediment or contaminant release during maintenance
- Sediments release from bank erosion or surface runoff
- Water contamination from spills

The main water quality issues related to the bridge project relate to the potential release of sediments or chemicals into the river channel, primarily during construction. The potential effects of the project on aquatic resources and habitat (i.e., fish and fish habitat) were assessed by Golder (2004, Appendix 14 of DAR). Many of the aquatic resources related project actions and mitigation also apply to water quality (i.e., refer to Section J-5 of present report and Golder [2004] for further information; Appendix 14 of DAR).

If sediments are released during construction the main impacts would occur downstream of the bridge. Sediment loading resulting from bridge construction would be short-term. A variety of construction techniques could be used to minimize, or eliminate, the possibility of large and sustained sediment releases. Timing of construction to avoid critical periods for key fish species and life-requisite activities (e.g. northern pike spawning) also may be an effective mitigation tool (Table J6).

Sediment release can also occur during the operation period of the bridge as a result of shoreline erosion, from surface runoff along ditches, and from fine sediments washing off the bridge deck into the river (e.g., sand, gravel, and dust from road maintenance activities and traffic). Other potential water quality impacts include the release of contaminants into the river from fuel or chemical spills. This could occur during construction when heavy equipment is working on or near the river as well as during operations from traffic or maintenance activities.

Mitigation Measures

Mitigation measures include implementing standard erosion control measures (e.g. rip rap, re-vegetation), monitoring and follow-up maintenance, and the use of adaptive management practices (as necessary). A summary of project effects and mitigation measures for the Deh Cho Bridge is provided in Table J6. Additional mitigation measures could include:

- building coffer dams to isolate abutments during construction; complete construction of abutments during winter conditions
- maximizing construction during frozen river conditions
- use industry "best management practices" for explosives use, to reduce potential effects of nitrogen (ammonia, nitrite, nitrate) residues on quarried rock
- ensure appropriate spill response equipment is on site during all project phases; provide adequate spill response training for personnel and ensure that immediate spill response takes place if an incident occurs.

Present Ferry and Ice Road Impacts to Water Quality

Recently the Government of the Northwest Territories (GNWT) Department of Transportation investigated the impact of ferry operations at the Tsiigehtchic Ferry Crossing on the Mackenzie River (GeoNorth 2003). In terms of the effects of this ferry operation on aquatic resources at the site and at ferry locations on the Mackenzie River, the results of the study were largely inconclusive. However, a substantial amount of sand and gravel is used annually to maintain the integrity of the north and south ferry landings at Fort Providence. This material is regularly washed into the river and is replaced on a periodic, as-needed basis. In addition, sand and gravel currently enter the river at the ice road crossing from traffic crossing the river and from maintenance of the crossing area. The effects of ferry propeller wash in temporarily increasing suspended sediment levels was noted by Golder (2004, Appendix 14 of DAR).

It is certain that some sediment will be introduced into the river during bridge construction. The amount of sediment released will depend on the specific construction activity and the location of the construction in the channel. The severity and significance of the impact on the aquatic resources will depend on the timing of the construction and the natural background sediment levels. However, it is possible to time construction activities to limit the amount of sediment released and to complete some of the construction activities during non-sensitive time periods for fish and other aquatic life. The background level of natural sediment in the river should also be taken into account. This way any predicted increase can be compared to the natural range of variability. Guidelines for sediment release can also be set and monitored during construction to ensure that the suspended sediment load does not reach levels that would cause significant water quality problems in the area. During construction there is also some increase in the potential of a spill contaminating the river mainly because of the amount of heavy equipment operating in the area. This can be reduced by proper construction practices.

The community has expressed concerns over the possibility of trucks going through the ice especially at the beginning and end of the season (Golder 2002). They feel that if a spill incident were to occur on the bridge, it might be easier to clean up than if it occurred on a ferry or on the ice road. The ferry has immediate response equipment immediately available and a trained staff. However, until the equipment was employed, the material spilled would disburse in the river and could not be recovered. Spills on ice are easily cleaned up as long as the material does not enter moving water. Major spills on a bridge would present a clean-up challenge. However, the bridge design could incorporate features to facilitate spill containment and clean up.

Bridge installation would remove the possibility of a spill incident related to ferry and winter road operations. However, there would still be a possibility of contaminants entering the water, and the bridge would be subject to poor weather conditions. Several mitigation measures and the positive effects of discontinuing ferry and ice road operations for reducing / eliminating water quality alterations to Mackenzie River are described above (Table J6).

Impact Assessment

Table J7 summarizes potential impacts and mitigation measures related to river water. The potential of the project to water quality are similar to those for fish and fish habitat, which was assessed in detail by Golder (2004). Overall, the Deh Cho Bridge project will not have significant water quality impacts during all phases of the project. This conclusion is primarily based on the following:

- The bridge footprint and construction areas are small relative to the large size of the Mackenzie River
- construction design/plans and schedules incorporate several mitigation measures resulting in a net effect of minimizing or avoiding the potential for water quality effects

- there are benefits to water quality associated with the discontinuation of existing ferry and ice road operations.

J.4.2 Water Quantity (Table J8)

Valued Ecosystem Components (VECs)

The valued components considered in assessing water quantity impacts include:

- Shape of river channel
- Overall ecological and social importance in the project area

Changes in river channel shape and scour/erosion potential will be used as water quantity VECs. Changes in channel shape may result as a consequence of bridge structures (e.g., approaches, abutments, and pier) encroaching instream. Erosion is a concern as a result of hydraulic/flow and ice scour alterations in and around bridge features.

Potential Effects

The following potential impacts to water quantity were identified for activities associated with the project (e.g., construction of bridge approaches and instream pier construction/placement).

- Alteration to channel hydraulics preventing fish movement
- Changes in channel hydraulic form resulting in downstream erosion or deposition
- Channel blockage (ice jams, flow restriction)
- Channel aggradation/degradation over time

Hydrology and hydraulics relate the flow of the river and the shape of the river channel upstream and downstream from the bridge. Potential impacts of a bridge include changes to channel hydraulics upstream and downstream of the structure as well as immediately around the bridge piers. Any narrowing of the channel can restrict flows and increase river velocity at the crossing site. This increase in velocity can lead to erosion around the bridge abutments and piers. The channel restrictions can also impede the movement of ice at break-up and lead to ice jams if the bridge is not designed properly. During construction, depending on construction techniques, the river may be constricted to allow construction to occur away from the flow of the river to reduce sediment release. Overall, these types of changes may lead to erosion of the banks or channel bed, increased sedimentation, changes in river velocity in the vicinity of the bridge, deposition of sediments in new areas of the channel (e.g., sandbar formation) and restriction of fish movements.

Changes in river hydrology resulting from bridge construction have been studied and well documented. One example is the Suncor Bridge on the Athabasca River in Northern Alberta (Golder 1996). Prior to development and design, potential effects of the placement of the Deh Cho Bridge on river hydrology and fish habitat were modeled and predicted (Trillium 2002; Golder 2004). In addition, various construction techniques will be used to minimize hydrological changes (outlined in Table J8).

During consultation, Fort Providence residents raised the concern regarding the bridges' effects on break-up and the potential for ice jamming (Golder 2002). The effects of the bridge on the current ice regime were modeled and potential effects predicted (Trillium 2002 and 2004). The bridge design will accommodate the predicted maximum flood level. As well the bridge structure will be designed and reinforced to deal with the effects of ice impact.

Mitigation Measures

The mitigation measures for reducing / eliminating alterations to the river channel form and scour/erosion within the project area include:

- Deck height planned to account for 100 year flood levels that not only allows for continued navigation, but minimizes the potential for complete channel blockage by ice jams under severe flood conditions
- Piers are designed to break-up ice and withstand extreme ice events
- Bridge alignment is compatible with river morphology
- Narrowing of channel during construction is minimized
- Bridge abutments, approaches and piers will be constructed to prevent ice scour and erosion (rock aprons comprising 0.5 to 1.0 m granite rip rap will be placed around the perimeters of pier footings and bridge approaches to prevent scour)

Impact Assessment

Table J8 summarizes potential impacts and mitigation measures related to river water quantity (hydrology/hydraulics) for each valued component. Overall, the project will not have significant water quantity impacts during all phases of the project. This conclusion is primarily based on the following:

- Locating the bridge at an existing ferry crossing, thereby avoiding introduction of new river channel features that may greatly affect hydraulic/channel characteristics
- Construction design/plans resulting in a net effect of widening the river, thereby reducing water velocities and any potential for 'constrictive' flows
- Bridge design and mitigation will not facilitate undue scour and ice jams.

J.5 Aquatic Resources and Habitat (Tables J9, J10)

Discuss the potential impacts of the proposed project on the aquatic resources and habitat in the immediate project area and downstream (discuss the current habitat characteristics and range of species present, any potential impacts to fish and invertebrates, as well as any proposed monitoring plans).

A comprehensive review of baseline information on aquatic resources (fish, habitat, water quality, water quantity) is provided in Golder (2004). The companion document also discusses the effects of the proposed Deh Cho Bridge on fish and fish habitat; key portions of this assessment were adapted to the current document.

Valued Ecosystem Components (VECs)

Based on the Ft. Providence domestic fish harvest and the 2003 capture results (Golder, 2004), it is apparent that northern pike and lake whitefish are the key fish species inhabiting the Mackenzie River in the vicinity of the proposed Deh Cho Bridge. These species accounted for over 85 % of the domestic harvest near the townsite between 1994 and 2001. Other highly valued species include Arctic grayling, walleye, burbot, and inconnu; however, they are captured on a more seasonal and site specific basis. Fish groups such as suckers (white and longnose) and minnows (emerald shiners, spottail shiners, etc.) are also important members of the fish community due to their value as a food source for predatory fish species (e.g., northern pike, walleye, inconnu, and burbot). Based on the above, northern pike and lake whitefish are assigned VEC status to represent fish resources in the study area.

The key questions to consider when assessing project effects include:

- How will the Deh Cho Bridge project affect the quality and availability of fish habitat?
- How will the project affect fish abundance?

Potential Effects

The following potential impacts to aquatic resources were identified in relation to major project actions (i.e., construction of bridge approaches and piers, removal of barge landing area, normal bridge operations etc.).

Construction:
- Alteration or loss of fish habitat as a result of the installation of the bridge
- Fish disturbance caused by the addition of fill, cofferdam construction and the movement of equipment (sediment impacts to fish health)
- Restriction or blockage of fish passage
- Fish mortality or disturbance as a result of sediment release or chemical spills

Operations:
- Alteration of fish habitat as a result of the presence of the bridge
- Restriction or blockage of fish passage
- Fish mortality as a result of sediment release or chemical spills

Fish Habitat

The proposed bridge project has the potential to impact fish habitat through the loss of habitat directly associated with the footprint of the bridge, and through changes to adjacent habitat. However, the project will also result in gains of habitat due to removal of existing ferry infrastructure. Overall, the site will experience a net gain of 5970 m^2 of aquatic habitat.

Fish Populations

The potential effects of the Deh Cho Bridge project on fish resources are summarized in Table J9.

Mitigation Measures

A summary of mitigation opportunities and measures for the Deh Cho Bridge is provided in Table J9; the techniques include the following:
- design piers and abutments to provide new, higher quality habitat to compensate for any losses
- design the bridge works to prevent channel and bank erosion, subsequent sediment input
- following "best management practices" during construction and maintenance to prevent sediment release or spills
- timing major instream construction activities to avoid critical spawning, egg incubation and early-rearing periods, at and upstream of known or potential spawning sites
- implementation of a water quality monitoring program during major instream construction periods (including a feedback monitoring component to alleviate/control impacts)
- application of appropriate controls to prevent surface runoff and ,where required, the installation of sediment control devices (e.g., sediment traps, silt fencing
- re-contouring and re-vegetation of banks with native vegetation

Impact Assessment

Table J10 assesses the scope, magnitude and significance of the potential impacts on aquatic resources. Overall, it appears that the Deh Cho Bridge project will have a positive effect on fish resources in the study area. This conclusion is based primarily on the following:
- The bridge footprint and construction areas are small relative to the large size of the Mackenzie River
- construction design/plans and schedules incorporate several mitigation measures which will minimize or avoid residual impacts to aquatic resources
- there are water quality benefits associated with the discontinuation of existing ferry and ice road operations
- there is a net increase in aquatic habitat area following installation of the bridge (due

largely to the removal of the barge landing facility and the subsequent addition of high quality near-shore habitat).

J.6 Wildlife and Wildlife Habitat (Table J11)

Discuss the potential impacts of the proposed project on the wildlife and wildlife habitat in the project area. Specifically, examine the effects of the proposed development on wildlife movement along the riverbank as well as up and down the river itself (e.g. what is the likelihood for collisions of migratory birds with the bridge structure under conditions of low visibility?).

Valued Ecosystem Components

Selection of wildlife VECs were based on important requisites for wildlife species that may be influenced by the project. The wildlife VECs chosen are as follows:

- wildlife habitat
- wildlife movement
- wildlife abundance

The potential for the Project to affect each of these wildlife VECs was considered.

Potential Effects

Primary impacts on wildlife associated with bridge/road construction and operation include reduction/alteration in habitat, effects on wildlife movement, and indirect effects on mortality and interference in nesting, breeding, migrating and over wintering activities. Potential impacts to wildlife include:

Habitat

- reduction in habitat effectiveness along the river due to increased noise from bridge crossings; and
- reduction in wildlife habitat directly through site clearing or indirectly through sensory disturbance and barriers to movement;

Movement

- sensory disturbance from road traffic along bridges may obstruct daily or seasonal wildlife movements;

Abundance/Biodiversity

- interference in nesting activity;
- disturbance to wildlife during construction; and
- increased mortality risks from changes in vehicular access and increased vehicle use.

The proposed Deh Cho Bridge may affect aerial wildlife (e.g., waterfowl, raptors, songbirds and bats) by impeding flight patterns resulting in strikes, and by associated lighting which may act as an attractant during migration periods. Structures (e.g., bridges, towers, poles, associated overhead powerlines and other vertical towers) may lead to bird or bat strikes, especially during migration under adverse weather conditions, such as fog, and during night feeding. For more specific discussions on the effects and mitigation of infrastructure on wildlife see Appendix F of Golder (2004).

The potential impacts on reduced habitat effectiveness due to sensory disturbance and on wildlife movement within riparian areas due to bridge traffic would be the greatest potential impact on wildlife. However, the proposed Project may result in less of an effect than effects from existing ferry operations which occur at the ground-level.

Mitigation Measures

The route will avoid key moose/ungulate habitat and other important wildlife areas (wetlands, marshes and fens). Specifically, the proposed bridge will be constructed on existing road and ferry infrastructure. Mitigation of potential impacts includes the following measures:

- installation of a "Texas barrier" will prevent undesired movement of wildlife across the bridge (i.e., primarily to prevent mixing of the bison populations on the north and south sides of the Mackenzie River);
- noise reduction (decreased speed limit, wooded or vegetated buffers) near the bridge would reduce noise levels, which may reduce impacts on wildlife;
- avoid raptor nests and bear dens by conducting pre-construction surveys;
- prompt reclamation of habitat where possible; or re-vegetation with non palatable species, using native seed mixes;
- markers, such as aviation spheres, can be used to mark suspension lines, guy wires and appropriate infrastructure;
- the use of solid red or pulsating red lights should be avoided;
- open span bridge to allow for wildlife movement underneath;
- ensure bridge visual inspections are as unobtrusive as possible, particularly during the breeding season;
- restrict any obtrusive mechanical inspections and maintenance of bridge until after the breeding season (15 May-15 July); and
- during years of intensive bridge maintenance, prevent nesting of species, if required, through strategies such as visual deterrents or surface gels.
- low-impact construction techniques;
- reduction in speed limits and adherence to posted limits and avoid usage at night;
- maintain maximum line of sight along road to reduce collisions;
- all wildlife collisions will be reported to responsible authorities;
- properly dispose of garbage in bear-proof containers to avoid attracting nuisance wildlife such as bears; and
- educate workers with regards to garbage cleanup, speeding and documenting and reporting incidents/collisions.

With the implementation of these mitigation measures impacts of the project on wildlife are anticipated to be low and not significant.

J.7 Species at Risk Act (SARA) (Table J12)

Pursuant to section 79 of the Species at Risk Act, conduct an assessment of the potential effects of the project on species at risk. This assessment should include: identification of species at risk that may be affected by the project, identification of measures to avoid, minimize, and mitigate potential effects on these species or their habitat, and a proposed approach to monitoring of these effects.

Valued Ecosystem Components (VECs)

There are over 400 species listed at risk in Canada encompassing all major groups of animals (wildlife, birds, fishes, plants, amphibians, and lizards). VECs considered for the SARA component will include all potentially affected SARA (COSEWIC-listed; not provincially listed) species as per Schedules I-III (SARA) and are provided below.

Endangered

- whooping crane - not in the project area (i.e., out of range);
- Eskimo curlew – as barren-ground nesters, are unlikely to be affected by the project. Last observed in the NWT and Nunavut in 1992, possibly extinct (RWED, 2000a).

Threatened

- wood bison - potentially affected by increased traffic which may lead to more vehicle collisions. The risk of tuberculosis and brucellosis traveling from infected bison on the south side of the river to disease-free herds on the north side of the river will not be increased by bison crossing the bridge because a Texas gate will be installed.
- woodland caribou – known to range widely on both sides of the Mackenzie River, but potential for overlap with the project area is unlikely.
- peregrine falcon – no nesting habitat (cliffs) near the project area, and has not been reported in the area (NWT/NU Bird Checklist Survey).
- Ross's gull – as a predominantly arctic marine bird, Ross's gull probably does occur in the project area, but has not been reported in the area (NWT/NU Bird Checklist Survey). However, some unconfirmed observations have been made on Great Slave Lake (RWED, 2000a).

Special Concern

- grizzly bear – not found in the project area (RWED, 2000a).
- wolverine - wolverines are wide ranging and naturally occur in low densities; as such, it is unlikely that the project will have an effect on wolverines
- ivory gull – as a predominantly arctic marine bird, the ivory gull probably does occur in the project area, but has not been reported in the area (NWT/NU Bird Checklist Survey).
- short-eared owl – the known distribution of the short-eared owl does not overlap with the project area (RWED, 2000a). Has not been reported in the project area (NWT/NU Bird Checklist Survey).
- yellow rail – the known distribution of the yellow rail in the NWT, southeast of Great Slave Lake, make it unlikely to be found in the project area. Further, the yellow rail has not been reported in the project area (NWT/NU Bird Checklist Survey).
- northern leopard frog – Considered to be at the northern limit of its range in the NWT (RWED 2000b).
- western toad - Considered to be at the northern limit of its range in the NWT (RWED 2000b).

Potential Effects

Potential effects to SARA-listed species would be the same as for wildlife species in general as described in Section J.6. Potential effects are related to loss/alteration of habitat, effects on movement and effects on abundance.

Mitigation Measures

Measures to avoid, minimize, and mitigate potential effects on these species or their habitat, and a proposed approach to monitoring of these effects is discussed in the response to J.6 above.

J.8 Noise (Table J13)

Discuss the potential impacts of the proposed project on the noise levels within the project area and surrounds.

Valued Ecosystem Components (VECs)

Noise assessment is a discipline that does not lend itself to evaluation using the concepts of valued ecosystem components (VECs). The quality of noise is expressed not only as a necessity for human comfort and integrity, but also as a component of the ecosystem (e.g., scaring off wildlife). Changes to noise levels in the vicinity of the Deh Cho Bridge project will be used in the present assessment to answer the key question, "what effects will the Deh Cho

Bridge project have on local noise levels?"

Potential Effects

Noise can be described as "unwanted" sound, and the terms noise and sound are often used interchangeably. However, while all noises are a form of sound, not all sounds are unwanted. Therefore, the term noise will be used in this assessment most often to describe emissions, while sound will be used to describe ambient levels.

Noise volumes are expressed on a logarithmic scale, in units called decibels (dB). Since the scale is logarithmic, a noise that is twice as loud as another will be three decibels (3 dB) higher. A noise with double the number of decibels is much more than twice as loud.

Table J2 provides listings of noise levels associated with common sources and is provided as a reference when exploring the noise levels predicted from the Deh Cho Bridge project. The levels listed in the table represent average values and could vary from one situation to the next.

Table J2 - Summary of Sound Levels Associated with Common Activities

Activity	Noise Level [dBA]
Lawnmower	95
loud shout	90
motorcycle passing 15 m away	85
car travelling 100 km/hr passing 15 m away	80
vacuum cleaner	75
Faucet	62
normal conversation	60
Moderate rainfall	50
bird singing	50
quiet living room	40
whispered speech	40
average rural sound level at night	35

A number of environmental factors will result in attenuation of emitted noise. These include the absorption of noise energy by air, the effect of barriers or hills on noise levels and the effect of the ground on the emitted sounds.

As sound passes through the atmosphere it collides with the air molecules, converting some of the energy into heat. This transfer of energy results in a decrease in the sound energy. The amount of energy that the atmosphere absorbs varies with weather conditions and the frequency of sound. Low frequency sounds (those not readily detected by the human ear) are relatively unaffected by the atmosphere. The mid-range frequency sounds, which are most readily detected by the human ear, can lose significant energy to the atmosphere. The atmosphere can dissipate sounds in the optimal frequencies by as much as 3 dBA for every 100 feet, given the right weather conditions.

Barriers and hills can also attenuate noise in the environment. As the sound waves "bend" around obstructions, they lose a great deal of energy. This phenomenon explains the use of barriers along major highways in urban areas. This also explains why people do not usually hear sounds from sources that are behind hills. The amount of attenuation afforded by an obstruction is a function of the amount of bending of the sound waves. Therefore, the attenuation is greatest close to the source, and is less effective at greater distances.

In addition to environmental attenuation from distance, ground obstructions, trees and other natural features, man-made features can also reduce noise levels. Project buildings, weather enclosures, sound walls, exhaust mufflers and other similar components reduce the amount of noise effects from facilities. Noise-reducing components can be designed (e.g., by adding extra insulation) to reduce noise emissions beyond the reduction that would otherwise result.

Existing Noise Levels

The Deh Cho Bridge project is located in a remote area where ambient sound levels would be expected to be low. Noise would only occur during passing vehicular traffic (ferry, automobiles, boats, maintenance equipment). Although no ambient noise monitoring has been conducted at the Deh Cho Bridge project area, ambient noise monitoring has been performed in other parts of northern Canada that may be considered to be representative of levels at a remote site similar to the project.

Baseline noise monitoring data has been collected as part of the approval process for mining projects in the Northwest Territories. The Diavik Diamond Project EIA indicated that sound levels in rural or wilderness areas range from 25 to 40 dBA (Diavik 1998). Baseline monitoring conducted at the Snap Lake Diamond Project site indicated that hourly sound levels ranged from 23 to 40 dBA with an average sound level of 35 dBA (De Beers 2002). Since both of these sites are in remote locations that are comparable to the Deh Cho Bridge, the ambient noise levels at the project site would likely be in a similar range.

Project Area and Surrounds

Increased noise levels in the area are to be expected if the bridge is constructed. Noise due to construction would cause animals and birds to avoid the area around the bridge and their community. Noise is an issue that is present at all phases of the project but would likely be greatest during construction, which is a relatively short-duration activity. Noise during this period would be related to the amount of heavy equipment operating during construction as well as environmental conditions (see above).

Fish and Wildlife

Issues related to noise and wildlife interactions are provided in our response to J.6 above. Noise impacts and mitigation to fisheries resources is addressed in Golder (2004). Short-term, minimal effects are anticipated during construction. Positive effects due to discontinuation of ferry operations will result (i.e., noise from engine revving, dropping of bow ramp). Significant long-term effects of noise on wildlife and fish are not expected.

Mitigation Measures

The overall impact of the project, particularly during the construction phase, on noise will be minimized by the following mitigation measures:

- limiting activities to non-sensitive time periods (i.e., during peak waterfowl migration times);
- limiting extent of heavy equipment operations; and
- ensuring all equipment is installed with appropriate noise reduction devices.

Noise levels during the operational phase of the project would be related to traffic volume and maintenance operations. Increased amount of commercial traffic associated with the project is 2 to 5% (PROLOG 2002). There are no mitigation measures to address an increase in noise as a result of traffic volumes. Reduction of noise as a result of maintenance activities can include limiting activities to non-sensitive time periods, limiting extent of heavy equipment operations, and ensuring all equipment is installed with appropriate noise reduction devices.

Impact Assessment

Based on the above, and the nature of the project (e.g., effects mainly restricted to the construction phase of the project, implementation of "best management practices"/mitigation), potential long-term net effects to noise levels are expected to be low and not significant (Table J13). This is primarily due to:

- short construction period relative the to life of the project
- elimination of ferry operations and maintenance equipment of the ferry and ice roads, thereby reducing overall noise emissions from vehicles.

J.9 Literature Cited:

De Beers. 2002. Snap Lake Diamond Project Environmental Assessment Report. Prepared by Golder Associates Ltd. for De Beers. Calgary, AB.

Diavik (Diavik Diamond Mines Inc.). 1998. Diavik Diamonds Project Environmental Effects Report, Climate and Air Quality. Prepared by Cirrus Consultants.

GeoNorth. 2003. Aquatic effects study for the ferry crossing near Tsiigehtchic and Ft. McPherson, NT. 2002-2003 Final Report. A project by GeoNorth-Ross-AMEC, prepared for the Department of Transportation, Government of the Northwest Territories. 119 p. + 6 app.

Golder Associates Ltd. 1996. Aquatic environmental impacts and mitigation for the proposed Suncor Bridge crossing of the Athabasca River. Prepared for Suncor Inc, Oil Sand Group. Golder Report No. 952-2307: 29 p. + 1 app.

Golder Associates Ltd. 2002. Environmental scoping for the Deh Cho Bridge crossing at Fort Providence. Prepared for Andrew Gamble and Associates, Yellowknife, NT. Golder Report No. 012-2319: 53 + 1 app.l

Golder Associates Ltd. 2004. Fisheries assessment of the Mackenzie River at Fort Providence, NT – proposed Deh Cho Bridge. Prepared for Jivko Engineering, Yellowknife, NT. Golder Report No. 03-1370-021: 89 p. + 6 app.

PROLOG Canada Inc. 2002. Commercial vehicle traffic forecast, Mackenzie River Crossing, Fort Providence, NWT. Prepared for Department of Transportation, Government of the Northwest Territories.17 p.

RWED (2000a). Information about threatened, vulnerable and endangered species of the Northwest Territories. Pamphlet series. Yellowknife, NT.

RWED (2000b). NWT Species 2000. General status ranks of wild species in the Northwest Territories. Yellowknife, NT.

NWT and Nunavut Bird Checklist Survey Database. Maintained by CWS. Yellowknife, NT. Searched on 6 May 2004.

Trillium Engineering and Hydrographics Inc. 2002. Updated hydrotechnical information for the Mackenzie River bridge at Fort Providence. Prepared for Jivko Engineering, Yellowknife, NT. Trillium Report No. 02-519: 33 p.

Trillium Engineering and Hydrographics Inc. 2004. Ice load and scour analysis for new pier geometry. Prepared for Jivko Engineering, Yellowknife, NT. Trillium Letter Report No. 03-563: 12 p.

Notes to Tables J3 – J13

Impact Assessment Criteria

Assessment criteria are defined as follows:

Impact Measure

Direction	Describes the effect of the impact as **positive**, **neutral** or **negative**.
Magnitude	**Negligible/Low/Medium/High:** Describes the amount of change in a variable relative to the baseline condition. The criteria used to describe the "Magnitude" of an effect are specific to the characteristic being investigated, the methods available to measure the effect, and the availability of quantitative data to measure the effect.
Extent	**Local:** The immediate vicinity of the crossing. **Regional:** Effects realized beyond the immediate vicinity of the crossing. **Territorial:** Effects realized within the Northwest Territories as a whole.
Duration	**Immediate/Short/Medium/Long Term:** Duration refers to the actual length of time over which the environmental effects occur. Categories used here are: immediate term (< 30 days), short term (< 1 year), medium term (between one year and the Project life), and long term (persists beyond the life of the Project).
Frequency	**Low/Medium/High:** Frequency describes how often the effect occurs throughout the Project life, and is classified as low (occurs rarely), medium (occurs intermittently) or high (occurs continuously). Discussions on seasonal considerations are introduced when they are important in the evaluation of the impact.
Confidence	**Low/Medium/High:** This is an indication of the certainty of the predicted impact, taking into account risks, external variables and proposed mitigation measures. The assessment of probability is often based on the availability of project information, and an understanding of the processes that result in the impact.
Reversibility	**Yes/No:** Reversibility is an indicator of the potential for full recovery from an ecological disturbance. In some cases, reversibility and duration are closely tied (e.g., temporary loss of habitat). In other cases, the effect may extend well-beyond the period of the original impact (e.g., a chemical spill might result in longer term effects on plant health).
Significance	**Negligible/Low/Medium/High:** Subjective evaluation of the Project's effects on a given VEC. This rating is based on the mitigation proposed and the level of confidence in the efficacy of that mitigation. In addition, regional and community significance of that VEC are also considered.

Table J3 – Potential Impacts to Air Quality and Climate

Project Activity (duration)	Valued Components	Impacts									
		Direction	Magnitude	Extent	Duration	Frequency	Confidence	Reversibility	Significance	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	Air Quality	-	L	L	S	L	M	Y	L	Increased fugitive dust and vehicle exhaust emissions can be expected during the construction period.	Apply dust control and appropriate vehicle maintenance; see above for more detailed mitigation
Bridge Operations (years 3 to 35+)	Air Quality	+	L	T	L	H	M	Y	N	Overall, air quality will improve due to discontinued use of ferry and ice road operations. Anticipated increase in road traffic is not significant (2-5%).	None; see text for more detail

Direction: '-' = Negative; '+' = Positive. **Magnitude**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High. **Extent**: 'L' = Local; 'R' = Regional; 'T' = Territorial. **Duration**: 'I' = Immediate; 'S' = Short-term; 'M' = Medium-term; 'L' = Long-term. **Frequency**: 'L' = Low; 'M' = Medium; 'H' = High. **Confidence**: 'L' = Low; 'M' = Medium; 'H' = High. **Reversibility**: 'Y' = Yes; 'N' = No. **Significance**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High.

Table J4 – Potential Impacts to Terrain and Soils

Project Activity (duration)	Valued Components	Impacts									
		Direction	Magnitude	Extent	Duration	Frequency	Confidence	Reversibility	Significance	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	Soil capability	-	N	L	S	L	H	Y	N	The physical area of surface disturbance will be minimal; compaction and rutting will be mitigated as much as possible	Minimize footprint; manage topsoil stripping; grading should be minimized; see above for more detailed mitigation
	Soil erosion potential	-	N	L	S	L	H	Y	N	Re-vegetation will occur as soon as possible.	Minimize footprint; slope working surfaces to minimize run-off; progressive reclamation; immediate re-vegetation; see above for more detailed mitigation
Bridge Operations (years 3 to 35+)	Soil capability	-	N	L	L	L	H	Y	N	There will be minimal to no physical disturbance after construction. Footprint areas will result in permanent loss in soil capability; however, the permanent bridge footprint is within the existing footprint for ferry operations so there is no net loss.	same as above
	Soil erosion potential	-	N	L	S	L	H	Y	N	Prompt re-vegetation after construction will mitigate any concerns related to soil erosion.	same as above

Direction: '-' = Negative; '+' = Positive. **Magnitude**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High. **Extent**: 'L' = Local; 'R' = Regional; 'T' = Territorial. **Duration**: 'I' = Immediate; 'S' = Short-term; 'M' = Medium-term; 'L' = Long-term. **Frequency**: 'L' = Low; 'M' = Medium; 'H' = High. **Confidence**: 'L' = Low; 'M' = Medium; 'H' = High. **Reversibility**: 'Y' = Yes; 'N' = No. **Significance**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High.

Table J5 – Potential Impacts to Vegetation and Plant Communities

Project Activity (duration)	Valued Components	Impacts									
		Direction	Magnitude	Extent	Duration	Frequency	Confidence	Reversibility	Significance	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	Native plant communities	-	N	L	S	L	H	Y	N	Majority of disturbed area will be on areas previously disturbed for ferry operations. New clearings are minimal (13.6 ha).	minimize footprint; maximize construction during winter months; dust control measures; immediate reclamation and revegetation
	Rare plant potential	-	N	L	S	L	H	Y	N	Disturbed areas such as shorelines may have high potential for rare ephemeral plant species	minimize footprint in high potential areas; dust control measures
	Commercial forest	-	N	L	S	L	H	Y	N	Majority of disturbed area will be on areas previously disturbed for ferry operations. New clearings are minimal (13.6 ha).	minimize footprint; provide local communities with first opportunity to salvage; immediate reclamation and revegetation
Bridge Operations (years 3 to 35+)	Native plant communities	-	N	L	S	L	H	Y	N	Newly cleared area will be reclaimed after abandonment.	immediate reclamation upon abandonment and dust control measures
	Rare plant potential	-	N	L	S	L	H	Y	N	little to no disturbance along shoreline	ceased ferry operations will minimize disturbance to shoreline
	Commercial forest	-	N	L	S	L	H	Y	N	Newly cleared area will be reclaimed after abandonment and natural vegetation encroachment will likely occur.	immediate reclamation upon abandonment and dust control measures

Direction: '-' = Negative; '+' = Positive. **Magnitude**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High. **Extent**: 'L' = Local; 'R' = Regional; 'T' = Territorial. **Duration**: 'I' = Immediate; 'S' = Short-term; 'M' = Medium-term; 'L' = Long-term. **Frequency**: 'L' = Low; 'M' = Medium; 'H' = High. **Confidence**: 'L' = Low; 'M' = Medium; 'H' = High. **Reversibility**: 'Y' = Yes; 'N' = No. **Significance**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High.

Table J6 Potential water quality impacts on the Mackenzie River due to the proposed Deh Cho Bridge

Project Action	Type of Impact	Rationale/Comments	Mitigation Techniques/Opportunities
1) Modification of North Approach a) Removal of outermost section of causeway (80 m) (i.e., reduced perpendicular extension into channel by 108.5 m (Attachment 8A of Jivko's project description). b) Addition of blasted rock into channel on downstream perimeter of causeway for detour road; removal of same following completion of bridge construction. c) Widening of the bridge approach; involving placement of clean blasted rock into the channel.	Increased suspended sediment	a) Sediment travel into and subsequent deposition within immediate downstream river reaches/habitats. Majority of sediment expected to enter main channel (i.e., bypass nearshore habitats). b) Potential impact on two occasions; removal expected to generate more sediment. c) Material added will have low sediment content; one time only event.	a, b, c) Avoidance of May/ June period (northern pike spawning/ incubation/ early rearing). Sediment monitoring with construction feedback objective.
2) Modification of South Approach a) Linear extension of causeway by 30 m and widening of causeway. Involving placement of clean limestone into the channel. Total area of displacement: 5600 m^2. b) Removal of 11,000 m^3 of granular backfill and 90 m^3 of structural timber from the ferry haul out area. Material to be removed from an area of 9500 m^2, situated immediately downstream of the proposed bridge.	Increased suspended sediment and potential contaminants from ferry haul out area.	a) The rock material added will have low sediment content. The placement is a one time only event and the majority of the fines will likely settle out within 500 m of the construction site. b) Removal of this volume of material will release a considerable volume of sediment, much of which is expected to accumulate in the nearshore zone. The bed material contained in the ferry haul out area may harbor harmful concentrations of hydrocarbons or other contaminants (e.g., creosote).	a, b) Avoidance of construction during pre-spawning movement period for Arctic grayling and northern pike into downstream habitats (e.g., Providence Creek) and spawning/early rearing period for northern pike in downstream nearshore habitats (i.e., May to June). b) The magnitude and severity of this concern will be investigated by the NT government, the current operator of the facility. The NT government will carry out rehabilitation of the site as required.

Table J6 Potential water quality impacts on the Mackenzie River due to the proposed Deh Cho Bridge (continued)

Project Action	Type of Impact	Rationale/Comments	Mitigation Techniques/Opportunities
3) Installation of Instream Piers (n=8) a) Cofferdams (sheet piling driven into riverbed) will be installed at each pier site. The sheet piling will be extracted after the footings are completed, using vibrating equipment. b) After the cofferdams are installed, the bed material will be augured and removed. Dewatering (pumping to river) will then be carried out; this water will contain significant amounts of suspended sediment. c) The riverbed will be excavated to a depth of not less than 2.5 m below the natural level in order to construct the footings. Between 750 and 800 m^3 of material will be excavated at each pier site (i.e., piers 4 and 5 require 800 m^3 and remaining six piers require 750 m^3). Rock aprons (0.5 -1.0 m granite rip rap) will be placed around the perimeter of the footings (±11 m radius) to prevent scour (total volume placed: 4790 m^3).	Increased suspended sediment	a) The amount of sediment released at each of the pier sites is anticipated to be very small, and will be rapidly entrained and diluted due to the large flow volume and high average velocity. Sediment will be generated on two occasions (i.e., during installation and removal). b) The method of disposal of excavated spoil and sediment-laden water will depend on the timing of construction. If in winter, the spoil will be disposed of in a nearby gravel pit and water will be pumped into a confined area on the ice. After freezing the frozen material will be removed and disposed of in a nearby gravel pit. In summer, the spoil will be loaded into a barge and disposed of in the designated gravel pit; the water will be pumped into the river. In either case, the intent will be to minimize sediment input into the river and maintain input at levels not considered to be harmful to aquatic life. c) In winter, the excavated material will be stockpiled on the ice until frozen; it will then be scraped from the ice surface, and trucked to a nearby gravel pit for disposal. In summer, the material will be placed in a barge and then hauled to the gravel pit disposal site. In either case, the intent will be to minimize sediment input into the river (i.e., attempt to maintain at levels not considered harmful to aquatic life).	a) Selection and use of equipment during installation and extraction that will minimize the amount of sediment generated and the duration of the sediment event. Consideration could be given to avoiding construction of the two outside piers during the spring spawning period (May to June); feedback monitoring should be in place during this period. b) If the disposal of the excavated spoil material in areas adjacent to the river was considered to have higher environmental risk than returning it to the river it may be possible to schedule a controlled release of the material into the river. A scheduled, controlled release would take into account the location, and timing of use, of important nearshore habits. It would also incorporate a feedback monitoring component (i.e., rate of release dependent upon results of strategic water sampling). b, c) The benefits and associated adverse effects of placing the material in a land disposal site would have to be weighed against the same for a river material disposal. Given the discharge and velocities in the main channel it is anticipated that the material will be assimilated by the river within a short period of time.

Table J6 Potential water quality impacts on the Mackenzie River due to the proposed Deh Cho Bridge (continued)

Project Action	Type of Impact	Rationale/Comments	Mitigation Techniques/Opportunities
4) Placement of blasted rock in river. a) Blasted rock, with possible ammonia residue and uncertain regulated metal content, will be used in the construction of several of the bridge-related structures within the wetted channel. These include the North Approach detour road (6000 m^3), which will be removed following completion of the bridge, the South Approach extension and the widening of both approaches (22,000 m^3), and the protective aprons around the 8 instream piers (4790 m^3).	Altered water quality (ammonia, regulated metals)	a) The ammonia content of the blasted rock to be used at the site is unknown. Ammonia has a high chronic toxicity to aquatic organisms (e.g., fish and invertebrates). However, it is unlikely to be problematic in the current setting due to the large dilutional capacity at the site (high, sustained hand flows), generally high dissolved oxygen levels (which result in a rapid decline in ammonia levels), relatively cold water temperatures throughout the summer months and the presence neutral to basic pH (which reduce the toxicity). Ammonia toxicity is generally observed in southern latitudes and in situations where there is a constant input of ammonia into a low flow-through setting (e.g., drainage from rock dumps at mining facilities, releases from sewage treatment facilities). The proponent submitted three samples of limestone/bedrock from local quarries to determine geochemistry. It was determined that none of the regulated parameters (arsenic, cadmium, chromium, copper, lead, zinc) exceeded the applicable guidelines (EBA Dec. 2003).	a) The proponent has developed a specific strategy to monitor ammonia levels at the site during and following the placement of blasted rock. Representative samples of blasted rock will be tested to determine ammonia residue content prior to placement in the channel. If significant ammonia residue is detected a water quality monitoring program will be put into place. Particular attention will be paid to tracking ammonia levels in the backwater habitats immediately adjacent to the north and south causeways. A monitoring plan is outlined in Golder (2004). With respect to regulated metal content, it appears that limestone rip rap/fill material should not pose a concern to aquatic life.
5) Placement of concrete in the channel a) Cast in-place concrete flat footings will be installed inside the cofferdams at the 8 instream piers (approx. 3600 m^3 of concrete). Concrete pedestals will be constructed on top of the footings (approx. 2700 m^3 of concrete). During construction, it will likely be necessary to de-water the contained site. Water that has been in contact with fresh concrete (which is typically alkaline) may have exhibit elevated pH levels (relative to river background levels).	Altered water quality (pH)	a) Water with elevated pH levels can be harmful to aquatic and terrestrial life. The contained water will be treated prior to returning to the river (e.g., efforts applied to neutralize the pH).	a) Prior to releasing the affected water, it will be tested and treated as necessary to balance the pH.
6) Chemical spill event during bridge operation a) Contaminants can enter the river from fuel or chemical spills	Altered water quality (contaminants; hydrocarbons)	a) Water with elevated contaminant levels can be harmful to aquatic and terrestrial life.	a) appropriate storage location, methods and handling procedures, ensure appropriate spill response equipment is on site, provide adequate spill response training for personnel and ensure that immediate spill response takes place if an incident occurs.

Table J7 – Summary of Overall Potential Impacts to Water Quality

Project Activity (duration)	Valued Components	Impacts									
		Direction	Magnitude	Extent	Duration	Frequency	Confidence	Reversibility	Significance	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	Water Quality	-	L	L	M	L	M	Y	L	The amount of construction is small and of short duration (few months of construction for each pier/structure) relative to the size of the Mackenzie River. Construction timelines will be staggered, not all structures will affect resources simultaneously. See Table J6 for details.	Bridge construction footprint and schedule minimizes potential for alterations to water quality; overall project construction area is small compared size of river. See Table J4-1 for details.
Bridge Operations (years 3 to 35+)	Water Quality	+	L	L	L	H	H	Y	L	Discontinued use of existing ferry and ice road operations will result in positive effects to water quality (net lowering of overall introduction of sediment, disturbance of sediments, and likelihood of spills). See Table J6 for details.	Have approved emergency spill action plan and mitigation (e.g., catchment basin at bridge run-off sites) in place. See table J4-1 for details.

Note**:** **Direction**: '-' = Negative; '+' = Positive. **Magnitude**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High. **Extent**: 'L' = Local; 'R' = Regional; 'T' = Territorial. **Duration:** 'I' = Immediate; 'S' = Short-term; 'M' = Medium-term; 'L' = Long-term. **Frequency**: 'L' = Low; 'M' = Medium; 'H' = High. **Confidence**: 'L' = Low; 'M' = Medium; 'H' = High. **Reversibility**: 'Y' = Yes; 'N' = No. **Significance**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High. See text for more/detailed mitigation.

Table J8 – Potential Impacts to Water Quantity

Project Activity (duration)	Valued Components	Impacts									
		Direction	Magnitude	Extent	Duration	Frequency	Confidence	Reversibility	Significance	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	River Channel	-	L	L	S	L	M	Y	L	The physical area occupied by temporary instream bridge construction structures is small, and structures will be in place for a short duration (a few months of construction for each pier/structure). Construction will be sequential, so not all structures will affect resources simultaneously.	The bridge construction schedule minimizes the potential for narrowing channel width; overall project construction area is small compared to size of river. Navigation will continue unimpeded during the entire construction period.
	Scour / Erosion	-	L	L	S	L	H	Y	N	As above for river channel. Pier foundations will be cast in place concrete spread footing and pedestals within steel plate cofferdams (i.e., construction areas only slightly larger than final project footprint). Construction of piers will take place over a short time period (four piers will take four months).	As above for river channel.
Bridge Operations (years 3 to 35+)	River Channel	+	L	L	L	H	H	Y	N	There will be a net gain of channel width (>30 m) at the bridge resulting in positive effects to channel form (net lowering of overall water velocities, thus reducing potential for channel erosion). The bridge substructure is designed to resist the impact of a colliding stray vessel.	The bridge deck height is designed to account for 100 year flood levels and allows for continued navigation (navigation channel 185 m wide and at least 22.5 m vertical clearance); minimizes potential for channel blockage by ice jams under severe flood conditions
	Scour / Erosion	-	N	L	L	H	H	Y	N	Bridge design and mitigation minimizes potential for scour due to ice and water flows. Abutments, approaches and piers will be designed to withstand ice collisions. As above for river channel.	Rip rap at piers, abutments and approaches will protect against localized scour due to ice and water flows.

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Table J9 Potential aquatic resources impacts on the Mackenzie River due to the proposed Deh Cho Bridge

Project Action	Type of Impact	Rationale/Comments	Mitigation Techniques/Opportunities
1) Modification of North Approach a) Removal of outermost section of causeway (80 m), resulting in an increase of 4300 m^3 of habitat. b) Addition of blasted rock into channel on downstream perimeter of causeway for detour road; removal of same following completion of bridge construction. c) Widening of the bridge approach; involving placement of clean blasted rock into the channel.	a) Increased sediment and reduced footprint b) Increased sediment c) Increased sediment and footprint	a) Sediment travel into and subsequent deposition within immediate downstream river reaches/habitats. Majority of sediment expected to enter main channel (i.e., bypass nearshore habitats). b) Potential impact on two occasions; removal expected to generate more sediment. c) Material added will have low sediment content; one time only event.	a) Ensure that the restored portion of channel is shaped and formed to a condition resembling the natural channel. The rip rap bank protection that will be employed on the outer perimeter of the abatement should be designed and placed to maximize its value as fish feeding habitat. (a, b, c) Avoidance of May/ June period (northern pike spawning/ incubation/ early rearing). Sediment monitoring with construction feedback objective.
2) Modification of South Approach a) Linear extension of causeway by 30 m and widening of causeway. Involving placement of clean limestone into the channel. Total area of displacement: 5600 m^2. b) Removal of the ferry haul out area will result in the gain of 9500 m^2 of backwater habitat situated immediately downstream of the proposed bridge.	a) Increased sediment and footprint b) Increased sediment, potential contaminants and large reduction in footprint	a) The rock material added will have low sediment content. The placement is a one time only event and the majority of the fines will likely settle out within 500 m of the construction site. b) Removal of this volume of material will increase the availability of nearshore, backwater habitat that will benefit northern pike (spawning, rearing, adult feeding) and other fish species (feeding).	a, b) Avoidance of construction during pre-spawning movement period for Arctic grayling and northern pike into downstream habitats (e.g., Providence Creek) and spawning/early rearing period for northern pike in downstream nearshore habitats (i.e., May to June). b) The morphometry of the restored area adjusted to resemble the conditions in the adjacent backwater.
3) Installation of Instream Piers (n=8) a) Cofferdams (sheet piling driven into riverbed) will be installed at each pier site. The sheet piling will be extracted after the footings are completed, using vibrating equipment. b) After the cofferdams are installed, the bed material will be augured and removed. Dewatering (pumping to river) will then be carried out; this water will contain significant amounts of suspended sediment. c) The riverbed will be excavated to a depth of not less than 2.5 m below the natural level in	a) Increased suspended sediment and deposition b) Sediment and footprint c) Footprint	a) The amount of sediment released at each of the pier sites is anticipated to be very small, and will be rapidly entrained and diluted due to the large flow volume and high average velocity. Sediment will be generated on two occasions (i.e., during installation and removal). b) The method of disposal of excavated spoil and sediment-laden water will depend on the timing of construction. If in winter (see Section J4). c) Difficult to assess use of main channel habitat in large rivers (i.e., due to deep water and high velocities). Likely major use of main channel is for	a) Selection and use of equipment during installation and extraction that will minimize the amount of sediment generated and the duration of the sediment event. Consideration could be given to avoiding construction of the two outside piers during the spring spawning period (May to June); feedback monitoring should be in place during this period. b, c) The benefits and associated adverse effects of placing the material in a land disposal site would have to be weighed against the same for a river material disposal. Given the discharge and velocities in the main

order to construct the footings. Rock aprons (0.5 -1.0 m granite rip rap) will be placed around the perimeter of the footings (±11 m radius) to prevent scour (total volume placed: 4790 m^3).		fish migration and movements. As such, the footprint of the piers will have no adverse impact on spawning, rearing, adult feeding or overwintering.	channel it is anticipated that the material will be assimilated by the river within a short period of time.
4) Placement of blasted rock in river. a) Blasted rock, with possible ammonia residue and uncertain regulated metal content, will be used in the construction of several of the bridge-related structures within the wetted channel.	Altered water quality (ammonia, regulated metals)	a) The ammonia content of the blasted rock to be used at the site is unknown. Ammonia has a high chronic toxicity to aquatic organisms (e.g., fish and invertebrates). However, it is unlikely to be problematic in the current setting due to the large dilutional capacity at the site (high, sustained hand flows), generally high dissolved oxygen levels (which result in a rapid decline in ammonia levels), relatively cold water temperatures throughout the summer months and the presence neutral to basic pH (which reduce the toxicity). See section J4 for details.	a) The proponent has developed a specific strategy to monitor ammonia levels at the site during and following the placement of blasted rock. See Section J4 for details.
5) Placement of concrete in the channel a) Cast in-place concrete flat footings and concrete pedestals will be installed inside the cofferdams at the 8 instream piers. Concrete (which is typically alkaline) may elevated pH levels of surrounding waters. See Section J4 for details	Altered water quality (pH)	a) Water with elevated pH levels can be harmful to aquatic and terrestrial life. The contained water will be treated prior to returning to the river (e.g., efforts applied to neutralize the pH).	a) Prior to releasing the affected water, it will be tested and treated as necessary to balance the pH.
6) Chemical spill event during bridge operation a) Contaminants can enter the river from fuel or chemical spills	Altered water quality (contaminants; hydrocarbons)	a) Water with elevated contaminant levels can be harmful to aquatic and terrestrial life.	a) appropriate storage location, methods and handling procedures, ensure appropriate spill response equipment is on site, provide adequate spill response training for personnel and ensure that immediate spill response takes place if an incident occurs.
7) De-commissioning of Ferry/Ice Crossing a) Discontinued placement of gravel fill (with significant fines content) on an annual basis, to upgrade and maintain the north and south ferry landings. b) Discontinuing the use of the Ice Crossing, resulting in: reduced contamination of ice with silt and oil imported by traveling vehicles, and ending of risks associated with the accidental sinking of vehicles and attendant risks for a major fuel spill.	Decreased suspended sediment and deposition Altered water quality	a) Approximately 1000 m^3 of silty gravel material is placed in the channel at the ferry landings each year (500 m^3 per approach assumed). Habitats most affected by the entrained and deposited sediment are the backwaters located immediately downstream of the causeways b) The type and extent of input of sediment and petroleum products at the Ice Crossing is unknown. However, it is assumed that the amounts added are relatively small.	a) Discontinuing the input of silty gravel on an annual basis is considered to be beneficial to the aquatic environment in the area. b) Discontinuing the use of the Ice Road Crossing and eliminating the risk of a major fuel-spill in the future is considered to be a major benefit of the project.

Table J10 – Summary of Overall Potential Impacts to Aquatic Resources

Project Activity (duration)	Valued Components	Impacts									
		Direction	Magnitude	Extent	Duration	Frequency	Confidence	Reversibility	Significance	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	Aquatic Resources	-	L	L	M	L	M	Y	L	The area affected by instream activity is small relative to the size of the Mackenzie River, and construction events have a short duration. Construction timelines will be staggered; as such, not all structures will affect resources simultaneously. See Table J11 for details.	Instream construction can be scheduled to avoid critical spawning/rearing periods for key fish species (e.g. northern pike). Known or potential critical habitats within the zone of influence of the project will be identified to construction managers. Water quality monitoring will occur during major instream construction phases. The program will include feedback monitoring to allow adjustment of construction rates and scheduling (when practical)..
Bridge Operations (years 3 to 35+)	Aquatic Resources	+	L	L	L	H	M	Y	L	There is a net increase in the availability of aquatic habitat following installation of the bridge. Discontinued use of existing ferry and ice road operations will result in positive changes to water quality regime (reduction in sediment input over medium and long-term and reduced potential for accidental spills). See Table J11 for details.	Use of "best management practices" with respect to maintenance of stable approaches and banks to prevent surface and point-of-contact erosion. Have approved emergency spill action plan and mitigation (e.g., catchment basin at bridge run-off sites) in place. See table J5-1 for details.

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Table J11 – Potential Impacts to Wildlife and Wildlife Habitat

Project Activity (duration)	Valued Components	Direction	Magnitude	Extent	Duration	Frequency	Confidence	Reversibility	Significance	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	wildlife habitat	-	N	L	S	L	H	Y	N	New clearings are minimal (13.6 ha)	minimize footprint; maintain wooded buffers to lessen sensory disturbance.
	wildlife movement	-	N	R	S	L	H	Y	N	Extent of footprint minimized; if movements are affected, potential for regional change, however, this would be short-term.	using wooded buffers to lessen sensory disturbance;
	wildlife abundance	-	N	L	S	L	H	Y	N	Minimal clearing is required, thus reducing potential increase in direct mortality as a result of clearing.	pre-construction surveys for raptor nests and bear dens; maximizing construction opportunities during the winter.
Bridge Operations (years 3 to 35+)	wildlife habitat	-	N	L	S	L	H	Y	N	same as above	prompt revegetation after abandonment..
	wildlife movement	-	N	R	S	L	H	Y	N	Existing ferry operations likely have an effect on wildlife movement;	reduced speed limits may lessen sensory disturbance effects; operation of bridge may be less intrusive than ferry operations.
	wildlife abundance	-	N	L	S	L	H	Y	N	bridge may provide nesting habitat for some species, particularly swallows; increased potential for wildlife-vehicle collisions, however, may not be more than current conditions.	Texas gate installed to prevent mixing of diseased bison; management of maintenance schedule to mitigate effects on nesting birds; reduce speed limits' appropriate bridge marking for aerial wildlife.

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Table J12 – Potential Impacts to SARA-Listed Species

Project Activity (duration)	Valued Components	Impacts									
		Direction	Magnitude	Extent	Duration	Frequency	Confidence	Reversibility	Significance	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	SARA-Listed Species	-	N	L	S	L	H	Y	N	Outlined for wildlife and wildlife habitat in J11.	Outlined for wildlife and wildlife habitat in J.6.
Bridge Operations (years 3 to 35+)	SARA-Listed Species	-	N	L	S	L	H	Y	N	Outlined for wildlife and wildlife habitat in J11.	Outlined for wildlife and wildlife habitat in J.6.

Direction: '-' = Negative; '+' = Positive. **Magnitude**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High. **Extent**: 'L' = Local; 'R' = Regional; 'T' = Territorial. **Duration**: 'I' = Immediate; 'S' = Short-term; 'M' = Medium-term; 'L' = Long-term. **Frequency**: 'L' = Low; 'M' = Medium; 'H' = High. **Confidence**: 'L' = Low; 'M' = Medium; 'H' = High. **Reversibility**: 'Y' = Yes; 'N' = No. **Significance**: 'N' = Negligible; 'L' = Low; 'M' = Medium; 'H' = High.

Table J13 – Potential Impacts to Noise

Project Activity (duration)	Valued Components	Impacts									
		Direction	Magnitude	Extent	Duration	Frequency	Confidence	Reversibility	Significance	Rationale/ Comments	Mitigation
Bridge Construction (2 year duration)	Noise	-	M	L	S	L	M	Y	L	Increased noise emissions can be expected during the construction period.	Apply noise control devices and appropriate vehicle maintenance; see above for more detailed mitigation
Bridge Operations (years 3 to 35+)	Noise	-	L	L	L	H	M	Y	N	Overall, noise may not change considerably due to discontinued use of ferry and ice road operations. Anticipated increase in commercial road traffic is not significant (2%).	None; see text for more detail

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K Cumulative Impacts:

K.1 Cumulative Impacts

Predict the cumulative impacts that might result from the proposed development impacts in combination with other past, present or reasonably foreseeable future developments and activities.

In evaluating cumulative impacts, the construction of the Deh Cho Bridge could be viewed as an incremental part of the overall development of this highway transportation corridor. It can also be considered in the context of long term cumulative local and regional socio-economic and environmental impacts.

K.1.1 Transportation Corridor

Prior to the 1960s, access to Ft. Providence and the communities of the North Slave Region was limited to waterways, winter cat-train roads and air.

In 1968 an all-weather highway, including the ferry at Ft. Providence, was completed from Alberta to Yellowknife via Ft. Providence and Rae. This highway provided a major change to the accessibility of these communities and unprecedented access to the land traversed. The construction and subsequent maintenance and upgrading consumed significant quantities of granular resources, disturbed large areas of land (for the right of way and borrow sources) and altered local drainage systems. This initial construction had by far the greatest environmental and socio-economic impact of the corridor development.

Until the early 1980's, highway traffic was interrupted for 4 to 6 weeks during freeze-up and break-up. At that time, the ferry hull was strengthened and the ferry operations were extended into the fall and winter, operating in the ice, until the ice bridge reached capacity for heavy traffic. This improvement reduce the annual month long interruption of service to spring breakup, with intermittent suspension in the fall. This improvement has resulted in an incremental improvement in accessibility and costs to the region.

Beginning in the mid 1980's, the GNWT undertook to upgrade and pave this highway corridor. This work has been completed from the Alberta border north and only about 60 kilometres remains to be completed between Rae and Yellowknife. This improvement consumed significant quantities of granular materials, in excess of those used for the original construction. Additional land and habitat was disturbed to widen and realign the highway right-of way and to open and expand borrow pits, granular sources and rock quarries. Once completed, this paving has reduced dust emissions, reduced erosion and siltation of roadway embankments and consumption of granular materials for maintenance. It has also eliminated the use of calcium chloride for dust control. The upgraded and highway has provided a higher level of service, including improved safety, reduced cost and time savings.

The construction of the bridge to replace the current ferry operation will result in the consumption of local granular materials and rock and largely temporary disturbance of habitat. Compared to the impacts of the highway construction and reconstruction, the effects are almost insignificant. In the long term the bridge will result in a reduction in local consumption of granular materials and fossil fuels. While the socio/economic/cultural impacts are considered significant (and positive overall), they pale by contrast to the impacts of the initial construction of the highway. The bridge (and all improvements since original highway construction) have provided incremental improvements in access, costs and safety and have the potential to stimulate additional community economic activity. The bridge is not expected to have any significant stimulus (positive or negative) to mineral development in the region. It is expected to result in a small increase in total annual traffic and associated impacts.

Construction of this bridge will complete this highway corridor to current and foreseeable standards. Aside from ongoing maintenance and repair of the road surfaces, right-of way and drainage structures, major work not contemplated. It is unlikely that there will be any need to change the road alignment or width.

In the long term there may be proposals to extend the all weather highway network to other North Slave communities and/or into the active mineral regions of the Slave Province.

Table K1 illustrates the relative contribution of the proposed bridge to cumulative environmental and socio-economic impacts of other highway developments.

Table K1 – Cumulative Transportation Corridor Impacts

Highway Corridor Development	Valued Components	Impacts					
		Extent	Direction	Magnitude	Significance	Confidence	Rationale/ Comments
Initial Highway Construction	Environmental Impacts	R	-	H	H	H	Significant resource consumption, disturbance of habitat and drainage systems. Unprecedented access.
	Socio-economic Impacts	R	+	H	H	H	All weather highway access and significant reduction in costs and isolation. Stimulation of regional economy and mineral development.
Ferry Service extension	Environmental Impacts	L	-	L	L	H	Relatively minor change in operations
	Socio-economic Impacts	R	+	L	L	H	Relatively minor improvement in access
Highway Upgrading & Paving	Environmental Impacts	R	+	L	L	H	Significant resource consumption. Additional disturbance of habitat. Long term reduction in dust, erosion and granular consumption
	Socio-economic Impacts	R	+	M	M	H	Significant improvement in level of service and safety
Bridge Construction	Environmental Impacts	L	+	L	L	H	Net reduction in siltation, fuel consumption and granular consumption. Increased fish habitat
	Socio-economic Impacts	R	+	L	M	H	Improved access and reliability. Reduction in cost, isolation.
Future Highway Extensions	Environmental Impacts	R	-	H	H	L	Would result in significant resource consumption, disturbance of habitat and drainage systems. Unprecedented access.
	Socio-economic Impacts	R	+	H	H	L	Would likely be all weather access to communities and/or mineral developments

Extent: **L**ocal **R**egional **T**erritorial **Direction:** **+** beneficial **-** negative
Magnitude, Significance, Confidence: **L**ow **M**edium **H**igh

K.1.2 Socio-Economic Impacts

The key valued socio-economic components are noted in Section I. While the bridge will have a significant short term regional and local impact, the long term contribution to cumulative impacts will not be significant (measurable) for most components, particularly on a regional level.

Table K2 identifies those cumulative impacts for which the bridge would make a measurable contribution. Areas for which the impact would be so insignificant as to be not measurable are not included (for example regional employment impacts). A cost savings of a fraction of a cent on a litre of fuel is barely significant, when world markets can increase or reduce the price by 10 cents in a few weeks.

Key local impacts would include employment and economic stimulus from reinvestment of investment dividends. This project is considered one of few significant local opportunities in the near future. Dividends are also to be invested in local social and cultural priorities.

On a regional basis, the cost-of-living differential for Yellowknife (compared to Edmonton) has been declining steadily with increased access, market size and competition. The bridge should make a modest additional contribution to this trend. Perhaps the most significant regional impact will be a further contribution to reducing the uncertainty of access and sense of isolation of the region.

Table K2 – Cumulative Socio-Economic Impacts

Valued Components	Impacts					
	Extent	Direction	Magnitude	Significance	Confidence	Rationale/ Comments
Local Employment	L	+	H	H	H	Investment of dividends in local infrastructure and economic development initiatives.
Local economic stimulus	L	+	H	H	H	
Regional economic stimulus	R	+	L	L	H	Increase in reliability of access
Local/Regional cost of living	R	+	L	L	H	Modest net decrease in cost
Local Socio-Cultural	L	+	M	H	H	Investment of dividends in local social and cultural initiatives
Regional Socio-Cultural	R	+	M	H	H	Reduced sense of isolation and uncertainty
Local Land use	L	+	L	L	H	Replacement of ferry with bridge will have small net impact

Extent: **L**ocal **R**egional **T**erritorial **Direction:** **+** beneficial **-** negative
Magnitude, Significance, Confidence: **L**ow **M**edium **H**igh

K.1.3 Physical and Biological Environment

The key valued environmental components (VECs) are noted in Section J. While the bridge will have a significant short term local impact, the long term contribution to cumulative impacts will not be significant (measurable) for most VECs, particularly on a regional level.

Table K3 identifies those cumulative impacts for which the bridge construction would make a measurable contribution. Areas for which the impact would be so insignificant as to be not measurable are not included. This is the case for all VECs at a regional level. At a local level the long term contribution to cumulative impacts in areas such as vegetation and wildlife habitat are also negligible, since disturbed areas a very small (15 ha.) and are to be remediated/reclaimed after construction. For comparison, one kilometer of highway requires permanent clearing of about 10 ha. Increased noise from construction is also temporary.

Cumulative impacts considered include local air quality, permanent disturbance (consumption) of soil, gravel and rock, water quality and aquatic habitat. Of these, the latter two would be considered the most significant and both are positive (beneficial). Replacing the ferry with a bridge will reverse previous negative impacts.

Table K3 – Cumulative Physical and Biological Impacts

Valued Environmental Components	Impacts					
	Extent	**Direction**	**Magnitude**	**Significance**	**Confidence**	**Rationale/ Comments**
Air Quality (fossil fuel emissions)	L	+	L	M	H	Estimate 4.6 million litres fuels consumed for construction Estimated 0.5 million litres per year fuel savings from ferry and shorter trip distance
Soils (consumption)	L	-	L	L	H	Estimated granular consumption for construction Reduction in annual maintenance use for ferry landings
Water Quality	L	+	L	H	H	Small increase in siltation during construction and reduction in siltation from erosion and prop wash. Variation a small fraction of background levels
Aquatic habitat	L	+	L	H	H	Modest net increase in habitat, reduced disturbance from ferry operations

Extent: **L**ocal **R**egional **T**erritorial **Direction:** **+** beneficial **-** negative
Magnitude, Significance, Confidence: **L**ow **M**edium **H**igh