GWICH'IN TRIBAL COUNCIL AND THE
GOVERNMENT OF THE NORTHWEST TERRITORIES

PROJECT DESCRIPTION REPORT FOR THE CONSTRUCTION OF THE MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA, NT

Gwìch'inat Eenjit
Gàdatr'igwijìlcheii Gidilii
Gwich'in Tribal Council

Northwest Territories

MAY 2011
ISSUED FOR USE

MACKENZIE ABORIGINAL CORPORATION

Nehtruh - EBA

ACRONYMS

ARI	Aurora Research Institute
CEA	Cumulative Effects Assessment
CEAA	Canadian Environmental Assessment Act
CWS	Canadian Wildlife Services
DFO	Department of Fisheries and Oceans
DGO	Designated Gwich'in Organization
DOT	Department of Transportation
ENR	Department of Environment and Natural Resources
EIS	Environmental Impact Statement
GCLCA	Gwich'in Comprehensive Land Claim Agreement
GDP	Gross Domestic Product
GLA	Gwich'in Land Administration
GLUP	Gwich'in Land Use Plan
GLUPB	Gwich'in Land Use Planning Board
GLWB	Gwich'in Land and Water Board
GNWT	Government of the Northwest Territories
GRRB	Gwich'in Renewable Resources Board
GSA	Gwich'in Settlement Area
GSCI	Gwich'in Social and Cultural Institute
GSR	Gwich'in Settlement Region
GTC	Gwich'in Tribal Council
HADD	Harmful Alteration, Disruption, or Destruction (of fish habitat)
HSE	Health, Safety, and Environment
INAC	Indian and Northern Affairs Canada
MGP	Mackenzie Gas Project
MOU	Memorandum of Understanding
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVLWB	Mackenzie Valley Land and Water Board
MVRMA	Mackenzie Valley Resource Management Act
NRCAN	Department of Natural Resources Canada
NEB	National Energy Board
NOGAP	Northern Oil and Gas Action Plan
PDR	Project Description Report
PWNHC	Prince of Wales Northern Heritage Centre
RRC	Renewable Resource Council
SSA	Sahtu Settlement Area
VC	Valued Component
NGL	Natural Gas Liquid

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EXECUTIVE SUMMARY

E1.0 INTRODUCTION

The concept of an all-weather highway along the Mackenzie Valley originated in the 1960s. In the 1970s, the federal government, through Public Works Canada, did significant work on highway surveys, geotechnical investigations, environmental studies, bridge and culvert designs, some detailed design and even tender package preparation. Two hundred and ten kilometres of the south part of the Mackenzie Highway, between Fort Simpson and Wrigley, were constructed in the mid-1970s and ended in 1977 just south of Wrigley.

The remaining few kilometres to Wrigley were completed in the mid-1990s, but the plans to construct the more than 800 km of highway between Wrigley and Inuvik were put on hold. With the completion of the Dempster Highway in 1979, an all-weather road through Yukon, it became possible to reach Tsiigehtchic, Fort McPherson and Inuvik by road year-round.

In 1989, the federal government devolved responsibility for the highway system to the Government of the Northwest Territories (GNWT). The same year, the Transportation Engineering Division of the Department of Transportation (DOT) prepared a report entitled "Mackenzie Highway, Wrigley to Inuvik Extension", based primarily on the work done by Public Works Canada in the 1970s, but which changed the parameter for bridges from two-lane to single lane spans. In the early 1990s, a ferry crossing was completed at N'Dulee Crossing (Camsell Bend) and a 210 m two-span bridge was installed at Willow Lake River in 1994. This completed the all-weather road connection from Wrigley to Fort Simpson (DOT GNWT 1989).

DOT updated the Highway strategy in 1999 with three new studies: an engineering study to modify design standards to allow an operating speed of 60 kph to 90 kph depending on local conditions, an environmental scoping study and a benefit/cost analysis. The updated strategy still focused on community-based construction but extended the construction period to more than 10 years.

At the time GNWT took over the highway system, it did not have the financial basis to undertake construction of major infrastructure projects such as the Mackenzie Valley Highway extension. Funding from the federal government was, and still is, required.

In 2010, a Memorandum of Understanding (MOU) was signed between the Gwich'in Tribal Council (GTC) and DOT to set the terms for the completion of a Project Description Report (PDR) for the construction of 181 km of all-weather, graveled highway through the Gwich'in Settlement Area (GSA) from Inuvik south to the southern boundary of the GSA. This agreement, and DOT's decision to form partnerships with each land claimant organization along the proposed route, has revived the idea of building the Mackenzie Valley Highway.

This PDR is the "story" of the Highway through the GSA, based on the nearly five decades of initiatives, studies, consultations and reports, and serves as the guiding document for the Highway development proposal. The PDR is subject to the terms of the *Gwich'in Comprehensive Land Claim Agreement (GCLCA)* and to the extent there is a conflict between the PDR and the *GCLCA*, the provisions of the *GCLCA* shall govern to the extent of the inconsistency.

E2.0 HIGHWAY CONCEPT

In 2010, the highway concept was reviewed by Gwich'in leadership and DOT, resulting in a decision to consider a route that follows the proposed Mackenzie Gas Project (MGP) pipeline corridor rather than the route identified by Public Works Canada in the 1970s.

This decision effectively establishes a common corridor to accommodate transportation (highway), utilities (pipeline), and communication infrastructure (fibre optic cable), which will reduce the overall impact on the land, wildlife, habitat, traditional land use areas and cultural values in the GSA. Much of the information gathered in the past several years for the pipeline project has proven useful for designing and building the Highway and for preparing the PDR.

This PDR is specific to the construction of the Highway within the GSA. The overall Mackenzie Valley Highway from Wrigley to Inuvik has segments through the Deh Cho and the Sahtu Settlement Area (SSA). Similar PDRs for the construction of the segments of the overall Mackenzie Valley Highway are being prepared in these regions. Ultimately the various PDRs will be compiled into an overall PDR for the construction of the Mackenzie Valley Highway that will be submitted to the Mackenzie Valley Land and Water Board (MVLWB).

This PDR builds on the information that is available for the Environmental Impact Assessment (EIS) for the MGP. As the Highway in the GSA is positioned in a common corridor with the MGP, for the most part the Highway has the same terrain, fauna, wildlife, hydrology and other valued components and the construction of the Highway will have similar impacts as the MGP.

E3.0 PARTNERSHIP IN PREPARATION OF THE PROJECT DESCRIPTION REPORT

The partnership for the preparation of the PDR for the Highway in the GSA consists of the GTC and DOT. Decision making for the preliminary design and the development of the PDR is by the Project Steering Committee which is represented by the President of the GTC and the Minister of Transportation, GNWT. The preparation of the preliminary design and the development of the PDR has included input from the GTC, the people of the GSA and DOT.

E4.0 PURPOSE OF THE PROJECT DESCRIPTION REPORT

The purpose of this PDR is to describe the construction of 181 km of all-weather, graveled highway, including an allowance for future installation of fibre optic cable within the highway right-of-way, through the GSA in the Northwest Territories (the Highway). This part of the proposed Mackenzie Valley Highway extension from Wrigley north to Inuvik covers the section from Inuvik south to the southern boundary of the GSA . When completed, this section of the Mackenzie Valley Highway will be operated and maintained as part of the Northwest Territories public highway system.

The detailed design, construction and operation of the Highway will involve:

- refinement of the locations for the Highway alignment, stream crossings, borrow sources, and future installation of a communications fibre optic cable within the Highway right-of-way;
- developing supporting construction and maintenance infrastructure, including, borrow sources (long-term and temporary), temporary winter access roads, camps, and fuel, equipment and materials staging and storage locations;
- connecting existing and proposed highways including the Dempster Highway east/southeast of Inuvik and the Mackenzie Valley Highway at the at the southern boundary of the GSA; and
- de-commissioning and restoring temporary borrow sources and access roads.

The reasons for building the Mackenzie Valley Highway are the same as when first proposed in the 1960s, as follows:

- provide a year-round transportation link connecting the Mackenzie Delta and the Mackenzie Valley with the rest of the Northwest Territories and Canada;
- support resource exploration, development, and production to stimulate the regional economy;
- decrease the cost of living by increasing access to good and services;
- increase access to health care, education, training resources and employment opportunities;
- enable communities and families to share social, cultural, recreational and sports activities;
- develop hospitality and tourism markets and other businesses;
- deliver governments' commitments for Northwest Territories regional economic development;
- reduce the cost of delivering government services; and
- more recently, provide fibre optic cable from southern Canada to the Beaufort Sea to enhance communications and support future development.

E5.0 ECONOMIC BENEFITS AND IMPACTS

E5.1 Economic Benefits

The "Mackenzie Valley All-weather Road Economic Analysis, September 2009" was prepared for DOT, and updated the socio-economic study that was included in the 1999 DOT Highway strategy. This economic analysis looked at the overall Mackenzie Valley Highway (Wrigley to Inuvik) and not just its component parts in the various land claim regions.

The analysis presented in the September 2009 report was based on cost estimates provided by the DOT for the overall Mackenzie Valley Highway. The costs estimated at that time were:

- total construction cost, Wrigley to Inuvik: $1.67 billion, including $1.3 billion for road building, $223 million for bridge construction, and $178 million for engineering;
- construction costs for the GSA section at $369.4 million; and
- maintenance costs, estimated at $13 million/year.

E5.2 Economic Impacts

Economic impacts will be primarily felt in the Northwest Territories, but will also affect the rest of Canada. The September 2009 study noted above indicates that:

- Jobs – from construction and maintenance:
  - 7,785 one-time jobs in the Northwest Territories.
  - 6,297 one-time jobs in the rest of Canada.
  - 128 permanent Northwest Territories jobs for ongoing maintenance.

These estimates are for the overall Mackenzie Valley Highway and the GSA will see a proportion of them.

- Reduction in the cost of living:
  - Inuvik residents can expect to save $15.7 million through reduced transportation costs. All of the 5,110 commercial trucks using the Dempster are expected to use the new Highway, at a cost saving of $3,070/year per transport load. The highway from Edmonton to Inuvik is 745 km, or 23%, shorter than the Dempster.
  - Spin-off benefits for the rest of the Northwest Territories include $5.5 million in gross domestic product (GDP), 41 permanent jobs, $1.1 million increase in revenue for the GNWT (.6 million net).
  - Spin-off benefits for the rest of Canada include $.06 million in GDP, 11 permanents job, and an $88,000 increase in revenue.
- Tourism:
  - Expected to increase by 20%, with a corresponding increase in economic activity of $500,000 and in 10 new jobs.

- Increased average length of stay.
- Tourists can drive "the Loop" formed by the Mackenzie Valley Highway and the Dempster Highway, thereby spending more time in the northern part of Northwest Territories and Yukon.

- MGP:
  - If the Highway is built before the pipeline construction begins, it will likely reduce access costs to the pipeline corridor for construction.
  - Positive structural change to Northwest Territories economy:
  - Facilitate new petroleum exploration and development.
  - Reduce cyclical intensity of economic activity.
  - Potential development of Northwest Territories service and supply businesses for oil and gas sector.
- Impact on oil and gas activity (based on October 2007 Meyers Norris Penny LLP study for Mackenzie Aboriginal Corporation):
  - Highway could extend winter drilling season from 90 to 129 days per year, allowing for a faster pace of exploration and development.
  - Rate of increase from greater oil and gas exploration and development estimated at 43%, or about the equivalent of drilling and producing 500 wells over a 25-year period.
  - Impact over 25 years is expected to be about a $3.4 billion increase in government revenue.
  - A cost reduction of 15%, or an average of $2.25 million per well, for a total cost saving to industry of $1.25 billion, based on 500 wells drilled.

E5.3 Other Benefits

The benefits listed below are difficult to quantify so no dollar value is provided.

- Pollution prevention and spill response in the Beaufort Sea, through cheaper and more effective re-supply to the Coast Guard in Tuktoyaktuk via the Mackenzie Valley Highway.
- Enhance national sovereignty and security in the Arctic.
- Workforce development in the following areas:
  - management of Highway maintenance and operations;
  - land access management (enforcement, wildlife monitors, technical planning);

- tourism and associated community businesses (guides, environmental and wildlife monitors, communications and promotions specialists, business administrators, restaurant workers including owners and managers, expeditors, logistics specialists); and
- resource exploration and development.

There are no communities along the section of the Highway through the GSA. However, all of the GSA communities will benefit from the Highway construction, through business and employment opportunities related to construction, business and employment opportunities related to the operation of the Highway, and once completed, the Highway will provide a shorter and safer transport link to southern Northwest Territories communities, to Alberta cities such as Edmonton and Calgary, and to the rest of Canada. Driving time to Edmonton, for example, is expected to be two-thirds that of what it now takes to drive along the Dempster Highway through Yukon. When all sections are completed, the Mackenzie Valley Highway will allow all Canadians to travel by road from Coast to Coast to Coast.

E6.0 REGULATORY REVIEW AND APPROVALS

E6.1 Screening and Review

In 2010, consultation with regulatory authorities, the GTC, the Designated Gwich'in Organizations (DGO), the Renewable Resource Councils (RRC), and the Bands and Band Councils provided information about what the regulatory review process will likely look like for the project in the GSA.

The Highway within the GSA and the overall Mackenzie Valley Highway is located within the Mackenzie Valley of the Northwest Territories. The main statutes governing the land and resource management in the Mackenzie Valley are:

- the *Mackenzie Valley Resources Management Act (MVRMA)*;
- the *Mackenzie Valley Land Use Regulations*;
- the *Northwest Territories Waters Act*; and
- the *Northwest Territories Waters Regulations*

In addition, the *GCLCA* applies in the GSA.

The *MVRMA* is the governing legislation for both the MVLWB and the Mackenzie Valley Environmental Impact Review Board (MVEIRB). The GSA, SSA and Tlicho each has its own Land and Water Board, set up under provisions of their respective settled land claims and which function as regional panels of the MVLWB. (The Dehcho and Akaitcho regions do not have settled land claims, so the MVLWB manages the *MVRMA* process in those areas.) Part of the MVLWB's mandate is to screen and regulate development projects that cover more than one region, as may prove to be the case for the Highway project.

The MVLWB will screen the Highway project based on a submission for the overall highway from Wrigley to Inuvik. The Gwich'in Land and Water Board will participate in the screening. Preliminary screening will likely find that the Highway project might cause significant adverse environmental or socio-economic effects, and would therefore be referred for an environmental assessment by the MVEIRB (GeoNorth and

Golder Associates 1999). Based on submitted project documentation and public concern about the project, the Review Board could determine whether to conduct an environmental impact assessment or an environmental impact review, a more detailed examination and therefore longer process.

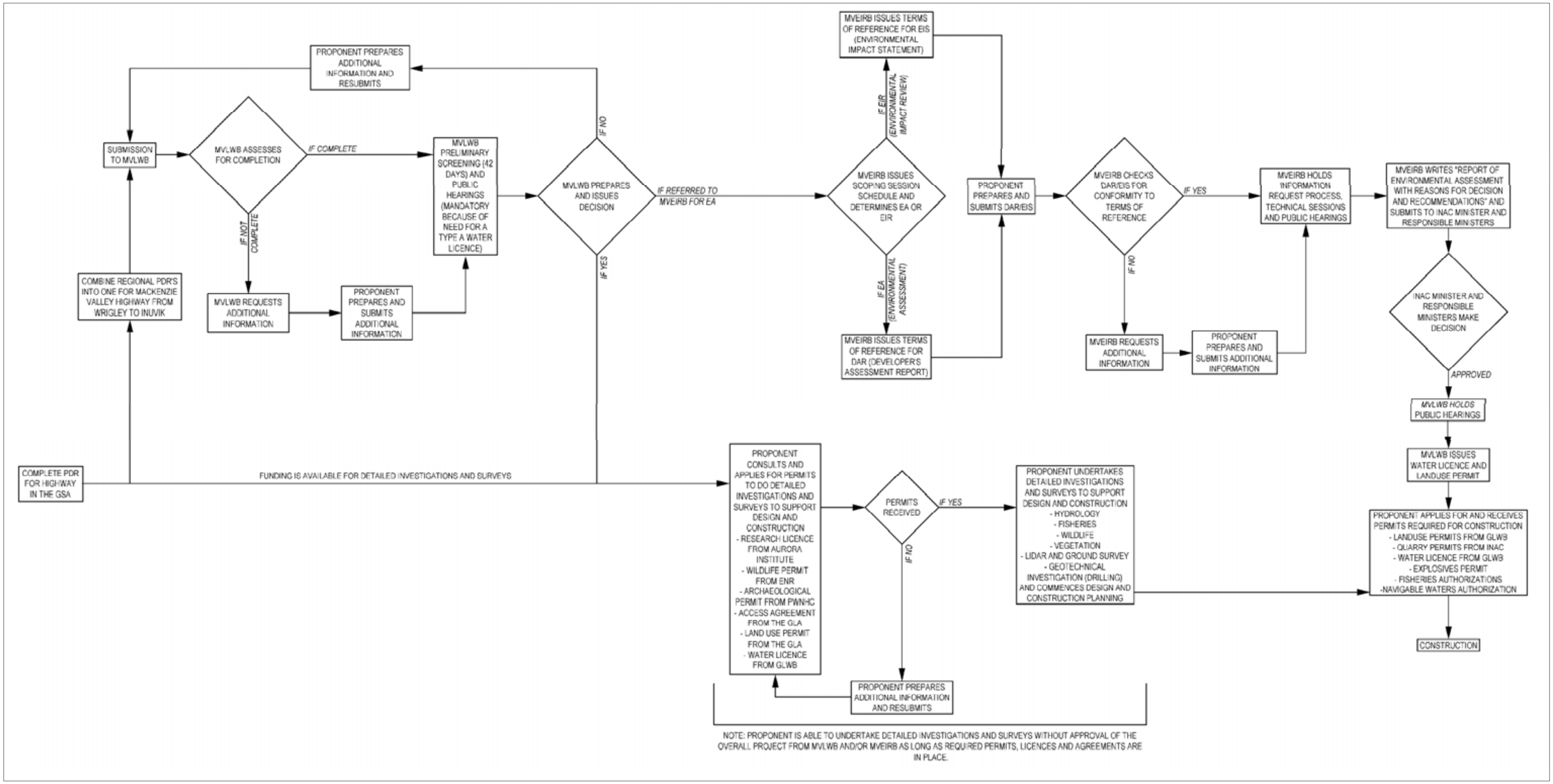
The following table shows the various permits, licences, authorizations or processes needed for construction of the Mackenzie Valley Highway.

Table E6.1-1: Anticipated Authorizations, Permits, Licenses or Other Approvals

Process, Authorization, Permit, License, Approval	Act and/or Regulation	Board, Agency, or Organization
Environmental Impact Assessment Process		
Preliminary Screening	*MVRMA*	To Be Determined – Gwich'in Land and Water Board (GLWB) or MVLWB
Environmental Assessment (if required)	*MVRMA*	MVEIRB
Environmental Impact Review (if required)	*MVRMA*	MVEIRB
Land		
Land Use Permit	*Mackenzie Valley Land Use Regulations*	GLWB
Quarry Permit	*Territorial Quarrying Regulations (Territorial Lands Act)*	Indian and Northern Affairs (INAC)
Explosives Permit	*Explosives Act*	Natural Resources Canada
Water		
Water License	*Northwest Territories Waters Regulations (Northwest Territories Waters Act)*	GLWB
Fisheries Authorization and/or Letter of Advice	*Fisheries Act*	Fisheries and Oceans Canada (DFO)
Navigable Waters Authorization	*Navigable Waters Protection Act*	DFO
Other		
Archaeology Permit	*Northwest Territories Archaeological Sites Regulations (Northwest Territories Act)*	Prince of Wales Northern Heritage Centre (PWNHC)
Research License	*Northwest Territories Scientists Act* and *Northwest Territories Act*	Aurora Research Institute (ARI)
Land Access and Development	*GCLCA*	GTC

Note: Based on GeoNorth Limited and Golder Associates (1999 p. 78).

A flow chart of the estimated permitting process is illustrated on Figure E6.1-1.



MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Regulatory Flow Chart

FILE NO.				
Figure4.1-1-Regularotry_Flowchart.mxd				
PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0
OFFICE	DATE			
EBA-RIV	May 10, 2011			

STATUS
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Figure E6.1-1

E6.2 Gwich'in Land Use and Water Permitting

In addition to the regulatory and assessment bodies listed in the table above, permits and/or authorizations must be obtained from other administrative and co-management bodies, including four others from the GSA, as follows:

- Gwich'in Land Administration (GLA), which manages Gwich'in private lands in the GSA on behalf of the GTC. The GLA issues authorizations for land use activities and includes provisions identifying rights granted, term, condition, reporting requirements, environment, storage, waste, etc. Highway activities that will occur on Gwich'in private lands are:
  - research and investigate for borrow sources, archaeological assessments, fisheries assessments;
  - establishing gravel pits and quarries (borrow sources); and
  - Highway construction and associated infrastructure.

Of the Highway's expected 181 km length, 111.7 km are located on Gwich'in private land. The remaining is on Crown land, but permits would come from the GLWB.

- Gwich'in Land Use Planning Board, (GLUPB) which administers *Nanh' Geenjit Gwitr'it Tigwaa'in, the Gwich'in Land Use Plan (GLUP)* (2003) and the revised draft *GLUP* (2010). The *GLUP* provides for the conservation, development and utilization of land, water and resources and covers all lands in the Gwich'in Settlement Region (GSR) outside of municipal boundaries, an area just under 57,000 km^2. All licences, permits or other authorizations relating to the use of land, water or waste deposit in the GSR must conform to the GLUP.

A possible corridor for the Highway is contemplated in Section 4.6.2(ii) of the 2010 draft revision to the Plan, and is also identified in the *GCLCA*, schedule XVII in Appendix F (volume 2).

- Gwich'in Renewable Resources Board (GRRB), a co-management board established under the *GCLCA* in 1992. This is a public board that is intended to be the "main instrument of wildlife, fish and forest management in the GSA" (GRRB 2011). The Board has an equal number of Gwich'in participants and federal and territorial members, and works to conserve and manage renewable resources through management plans for the above resources. It holds advisory powers for proposed developments that might affect renewable resources. The GRRB works collaboratively with the RRCs in each community.
- Gwich'in Social and Cultural Institute (GSCI) is responsible for cultural and heritage values as established under the *GCLCA.* The GSCI was established in 1993 as a non-profit society with charitable status and a mandate to document, preserve and promote the practice of Gwich'in culture, language, traditional knowledge and values. The GSCI is the cultural and heritage arm of the GTC. The GSCI has contributed project-specific traditional knowledge to this PDR, and will further assist with pre-construction assessments and developing appropriate approaches to the Highway construction.

E7.0 COMMUNITY AND REGULATORY CONSULTATIONS

E7.1 Community Consultations

Community consultations took place in the four GSA communities – Inuvik, Aklavik, Tsiigehtchic and Fort McPherson. The consultations were led by GTC, and present were representatives from the consultant team (Mackenzie Aboriginal Corporation and Nehtruh-EBA Consulting Ltd.) and DOT. The intent of the consultations was to get input from the members of the communities at key stages in the development of the preliminary design and the PDR. Initial consultations were held in May 2010 in Inuvik, Aklavik, and Fort McPherson, and in Tsiigehtchic in July 2010. The second round of consultations was held in all four communities in November 2010, and the third round took place in March 2011.

Table E7.1-1: Consultation Summary

Location	Date	Format and Content of Meeting
Fort McPherson	May 25, 2010 (Elders' Lunch)	Meeting with leadership and Elders. Project presentation and discussion around maps showing the preliminary corridor for the Highway.
	May 25, 2010 (Community Supper)	Community meeting with a project presentation and discussion around maps showing the preliminary corridor for the Highway.
	Nov 26, 2010 (Elders' Lunch)	Meeting with leadership and Elders. Presentation and discussion of the project around large maps showing the preliminary alignment for the Highway. The discussion included updated information about the project, e.g., preliminary alignment, Traditional Knowledge, environmental and socio-economic issues.
	Nov 26, 2010 (Community Supper)	Presentation and discussion of the project around large maps showing the preliminary alignment for the Highway. The discussion included updated information about the project, e.g., preliminary alignment, Traditional Knowledge, environmental and socio-economic issues.
	March 17, 2011 (Community Supper)	Community meeting with a presentation to show how community input was included in the PDR and discussion of the project around large maps.
Aklavik	May 27, 2010 (Elders' Lunch)	Meeting with Elders and project presentation and discussion around maps showing the preliminary corridor for the Highway.
	May 27, 2010 (Afternoon Meeting)	Meeting with Chief and Council and members of the RRC. Project presentation and discussion around maps showing the preliminary corridor for the Highway.
	May 27, 2010 (Community Supper)	Community meeting with a presentation and discussion around maps showing the preliminary corridor for the Highway.
	Nov 23, 2010 (Elders' Lunch)	Meeting with leadership and Elders. Project presentation and discussion of the project around large maps showing the preliminary alignment for the Highway. The discussion included updated information about the project, e.g., preliminary alignment, Traditional Knowledge, environmental and socio-economic issues.
	Nov 23, 2010 (Community Supper)	Community meeting with presentation and discussion of the project around large maps showing the preliminary alignment for the Highway. The discussion included updated information about the project, e.g., preliminary alignment, Traditional Knowledge, environmental and socio-economic issues.
	March 14, 2011 (Community Supper)	Community meeting with a presentation to show how community input was included in the PDR.
Inuvik	May 28, 2010 (Community Supper)	Community meeting with a presentation and discussion around maps showing the preliminary corridor for the Highway.
	Nov 24, 2010 (Community Supper)	Early meeting with Chief Herbert Blake followed by community meeting with a presentation and discussion of the project around large maps showing the preliminary alignment for the Highway. The discussion included updated information about the project, e.g., preliminary alignment, Traditional Knowledge, environmental and socio-economic issues.
	March 16, 2011 (Community Supper)	Community meeting with a presentation to show how community input was included in the PDR.
Tsiigehtchic	July 27, 2010 (Community Supper)	Community meeting with a presentation and discussion around maps showing the preliminary corridor for the Highway.
	Nov 25, 2010 (Community Supper)	Community meeting with a presentation and discussion of the project around large maps showing the preliminary alignment for the Highway. The discussion included updated information about the project, e.g., preliminary alignment, Traditional Knowledge, environmental and socio-economic issues.
	March 15, 2011 (Community Supper)	Community meeting with a presentation to show how community input was included in the PDR.

At the initial consultations, a presentation was given covering the following topics:

- main organizations involved in the project (GTC and DOT)
- introduction of the project team (Mackenzie Aboriginal Corporation and Nehtruh-EBA);
- partnership approach to the project;

- decision-making and timeline for producing the PDR;
- history of Highway development and highlights from the *GCLCA;*
- planned community consultations;
- next steps; and
- possible discussion topics.

The second consultations were held at the midpoint of the project development. The consultations were held to show progress, to gain additional input from the communities and to answer questions. At the third consultations, the completed description of the project was presented and included a discussion and demonstrated how the community input from previous meetings was used or addressed. A short video of the Highway alignment was also shown.

Copies of large maps used during the consultations were left in the communities for reference. At the initial consultations, the maps included an overview of the proposed Highway alignment from Inuvik to Wrigley, and a more detailed view of the preliminary Highway corridor. At the second consultations, the maps showed the preliminary alignment for the Highway, bridge and culvert locations, wildlife and other observations from field programs, traditional land use information from GSCI, and potential borrow source locations. A sampling of comments received can be found in the PDR, Section 9.4 and Section 9.5, and a detailed summary of each of the meetings is included in the appendix of the PDR.

E7.2 Regulatory Consultations

Consultations took place with the following regulators or agencies:

- GLWB, November 25, 2010;
- GLA, May 28, 2010;
- GNWT – Department of Environment and Natural Resources (ENR), July 28, 2010;
- Canada – INAC, June 23, 2010;
- Canada – DFO, June 2010;
- GNWT – PWNHC, May 2010; and
- GSCI, October 2010

Summaries of the discussions held with each organization can be found in the PDR in Section 9.6.1 through to Section 9.6.7.

E8.0 DEVELOPMENT OF THE HIGHWAY

Highway plans of the past estimated construction periods ranging from as few as four years to as many as 20 years in order to utilize local community labour and construction equipment. However, there is greater advantage to putting the Highway into operation sooner rather later. Local communities will benefit more from long-term sustainable management and operations than from the relatively shorter term construction period. The vision of opportunities beyond construction of the Highway are relative to:

a) The management and operation of the Highway (equipment operators, highway patrol, maintenance foreman, expeditors, engineering and technical staff, environmental monitors, etc.).

b) Management of access to the land (enforcement, environmental and wildlife monitors, technical planning staff, etc.).

c) Tourism and associated community based service businesses (environmental and wildlife monitors, professional guides, communications and promotions specialists, business administration professionals, chefs, restaurant managers, expeditors, logistics specialists, etc.).

d) Resource and exploration opportunities and associated community based service business (environmental and wildlife monitors, technical and engineering specialists, camp support staff, expeditors, logistics specialists, business administration professionals, etc.).

E8.1 Combining Design and Construction

In a traditional design and construction approach, the detailed design would be completed for the full 181 km of highway before the construction starts. The design will take a considerable amount of time and could add years to the delivery of the project. Completion of the Highway can be achieved much sooner if large components of the design are completed each year, staying just ahead of construction. The work that has been completed in the development of the preliminary design and PDR provides sufficient information and knowledge about the Highway to be able to proceed with design and construction in this manner. This approach will result in an accelerated delivery schedule as well as advantages and savings from innovations in design, construction, mobilization and staging than a traditional design and public tender construction approach. Significant resources are needed for accelerated design and construction. To the extent possible, all qualified and relevant resources in local communities will be used.

Using this approach, construction of the Highway through the GSA is likely to take three winter seasons. Detailed investigation, engineering and design are necessary in advance of construction of the initial segments of the Highway, but not for the entire 181 km at once. This can be done in advance of starting construction on each segment. Start of construction on the initial segments of the Highway within the GSA is expected in the first winter following regulatory approvals, assuming funding for the Highway in the GSA is available.

E8.2 Project Timetable

The estimated completion date for the Highway project is late 2016. This includes all activities associated with detailed field investigation, design and detailed engineering and permitting that are required before the start of construction.

Table E8.2-1: Proposed Schedule of Activities

Activities	Approximate Dates
Submission to MVLWB for Highway Construction Wrigley to Inuvik	January 2012
MVLWB Preliminary Screening Process	February through September 2012
MVEIRB Environmental Assessment Process	October 2012 through December 2013
Consultation and Permitting Required for Investigation and Survey Activities	October 2012 through May 2013
Investigation and Survey Activities to Support Design and Construction Permitting	June 2013 through March 2014
Additional Permitting Required for Construction	April 2013 through August 2014
Design	Commences April 2013 and is ongoing throughout the duration of the project staying ahead of fabrication and construction requirements.
Construction	December 2013 through late summer 2016
Estimated Opening of the Highway	Late summer 2016

The estimated dates for construction start and completion could be earlier than those shown if the approval is provided through preliminary screening by the MVLWB, and if screening/review is completed earlier. Estimated timelines for permitting and construction activities are shown in Table E8.2-2 and Table E8.2-3.

E8.3 Location and Design

The highway portion in the GSA forms the northern-most segment of the Wrigley to Inuvik Mackenzie Valley Highway extension. It starts at the junction of the Dempster Highway, south of Inuvik, and stretches

181 km to the southern boundary of the GSA and follows approximately the same transportation and infrastructure corridor as that of the proposed MGP pipeline alignment.

The proposed Highway section in the GSA will be located within the Anderson Plain division of the Interior Plains region. The Anderson Plain is predominantly an upland area with topography that is generally 300 m above sea level (Hardy 1986). The terrain includes areas of permafrost, muskeg, massive ground ice, retrogressive thaw flow landslides, thermokarst and thermal erosion features. The Highway corridor passes close to traditionally and environmentally important natural features including Caribou Lake, Travaillant Lake, and Thunder River. Seven major bridges will be needed along the route, along with 135 culverts and/or minor bridges.

With the Proponent's view to establishing a single corridor for transportation, utility and communication infrastructure in mind as the primary objective, initial routing studies identified a preliminary alignment and minor alternatives within the vicinity of the MGP corridor. Two-thirds of the Public Works Canada 1975 alignment did not meet this primary objective, so two-thirds of this new highway alignment has not had previous highway routing studies.

Using topographic maps, air photo imagery, and other available information, an initial desktop routing study was done to define a preliminary highway alignment and minor alternatives, potential stream crossings and potential borrow sources. The development of the initial routing was based on the following constraints:

- avoid ice rich and unstable terrain;
- avoid steep grades and deep valleys;
- find locations to cross major streams to minimize bridge lengths;
- avoid locations with obvious wildlife nesting or denning areas;
- situate the route on or near potential borrow sources to minimize the length of temporary or permanent access roads;
- minimize the need to cross the MGP pipeline; and
- minimize the infrastructure footprint while maintaining a sufficient tree or vegetation screen between the highway and a minimum 50 m from the pipeline alignment.

The initial routing study was the basis for the June 2010 field program and the preliminary design. The outcome of the preliminary design, the preferred Highway alignment, is illustrated on Figure E8.3-1. Potential borrow sources have been identified in the preliminary design and are also shown in the figure. The Highway alignment and the selection of the borrow sources will be refined through more detailed investigation and design in the next stages of the project development. Throughout the consultations, Travaillant Lake has been identified as an important area. Borrow Source 4-060 (shown on the figure) is within the Conservation Zone around Travaillant Lake. Use of this borrow source will be considered only if necessary and critical to the overall development of the Highway, and even then, permit conditions that are specific to seasonal operations, will be followed.

Winter Construction Season No. 1 (See Table 7.0-3 Construction Schedule)

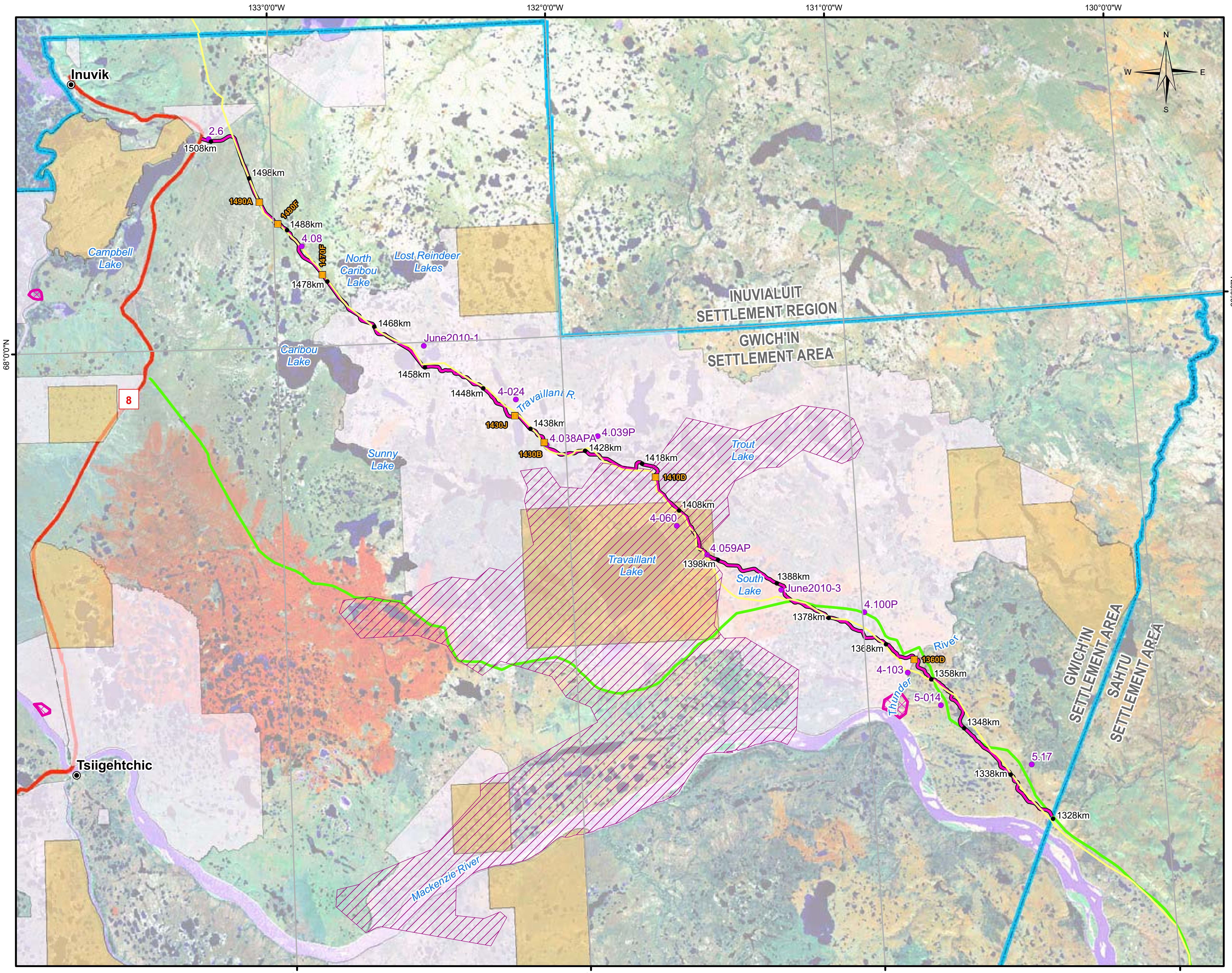
Table E8.2-2 Project Approvals, Investigations and Design Schedule

Activity	2012												2013												2014												2015					
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Submit combined Mackenzie Valley Highway regional PDRs to MVLWB																																										
MVLWB determines: completeness, requests more information if needed, appoints transboundary panel from regional L&WBs, if needed																																										
Proponents submits more information; MVLWB screens application for environmental impact or public concern																																										
MVLWB refers project to MVEIRB																																										
MVEIRB conducts scoping sessions, determines if process will be environmental assessment (EIA) or environmental review (EIR)																																										
MVEIRB issues Terms of Reference for Developer's Assessment Report (DAR) or Environmental Impact Statement (EIS) and Workplan																																										
Proponents submit DAR or EIS; Review Board checks for conformity, requests more information if needed;																																										
Proponents submit requested information; MVEIRB conducts Information Request process																																										
MVEIRB conducts Technical Sessions; Public Hearings																																										
MVEIRB writes Report of Environmental Assessment with Reasons for Decision and Recommendations; submits to INAC Minister & Resp. Ministers																																										
INAC Minister issues approval of MVEIRB recommendations																																										
MVLWB holds Public Hearings																																										
MVLWB issues Water License and Land Use Permits																																										
Plan Winter Construction Access and Pit Management based on Investigation and Survey Activities, Apply for & Receive Permits required for Construction																																										
Consultation and Permitting required for Investigation and Survey Activities																																										
Spring Investigation Activities (Hydrology, Fisheries, Wildlife, Vegetation, Birds)																																										
Late Summer/Fall Investigation Activities (Hydrology, Fisheries, Wildlife, Vegetation, Archaeology Studies)																																										
LiDAR and Ground Survey																																										
Winter Investigation Activities (Geotech and Wildlife Studies)																																										
Highway Design (ongoing through combined design and construction process)																																										
Bridge Design (Initially first three bridges then ongoing through combined design and construction process)																																										
Fabrication of Bridge Components (Initially first three bridges then ongoing through combined design and construction process)																																										
Environmental Monitoring during construction																																										

Table E8.2-3 Construction Schedule

Activity	2014									2015												2016											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Environmental Monitoring during construction	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
Highway Design (ongoing through combined design and construction process)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■												
Bridge Design (Initially first three bridges then ongoing through combined design and construction process)		■	■	■																													
Fabrication of Bridge Components (Initially first three bridges then ongoing through combined design and construction process)					■	■	■	■	■	■																							
Planning for and Mobilization of Equipment via Dempster Hwy to Inuvik and km 1509				■	■	■	■	■	■	■																							
Clearing of ROW and Construction of Winter Road, km 1509 to km 1458									■																								
Material Production and Stockpiling at Source "2.6", "4.08" and "June 2010-1"										■	■	■	■	■	■																		
Embankment Construction, km 1509 to km 1458 (three spreads)										■	■	■																					
Grading, Compaction and Placement of Surfacing, km 1509 to km 1458 (Note 1)																■	■	■															
Mobilize Piling Equipment to Bridge Sites 1490A, 1480F and 1470F										■																							
Piling at Bridge Sites 1490A, 1480F and 1470F											■																						
Erect Piers and Abutments/Backwalls at Bridge Sites 1490A, 1480F and 1470F												■																					
Launch Girders and Deck at Bridge Sites 1490A, 1480F and 1470F																	■	■															
Planning for and Mobilization of Equipment to Little Chicago and prepare staging area		■	■	■	■	■																											
Clearing of ROW and Construction of Winter Road, Little Chicago to km 1360 (Thunder River)									■																								
Material Production and Stockpiling at Source "5.17" and "5-014"										■	■	■	■	■	■																		
Embankment Construction, km 1328 to km 1360 (one spread)										■	■	■																					
Grading, Compaction and Placement of Surfacing, km 1328 to km 1360 (Note 1)																■	■	■															
Construction of Winter Road from Little Chicago to km 1328																					■												
Construction of Ice Crossing at km 1360 (Thunder River)																					■												
Clearing of ROW and Construction of Winter Road, km 1360 to km 1385																					■												
Material Production and Stockpiling at Source "4-103" and "4.100P"																						■	■	■	■	■	■						
Embankment Construction, km 1360 to km 1385 (one spread)																						■	■	■									
Grading, Compaction and Placement of Surfacing, km 1360 to km 1385																												■	■	■			
Mobilize from Dempster Highway to km 1458 via previously constructed Highway																				■	■												
Clearing of ROW and Construction of Winter Road, km 1458 to km 1385																					■												
Material Production and Stockpiling at Source "4-024", "4.038APA", "4.039P", "4-060", "4.059AP", and "June 2010-3".																						■	■	■	■	■	■						
Embankment Construction, km 1458 to km 1385 (three spreads)																						■	■	■									
Grading, Compaction and Placement of Surfacing, km 1458 to km 1385 (Note 1)																												■	■	■			
Mobilize Piling Equipment to Bridge Sites 1430J, 1430B, and 1410D																						■											
Piling at Bridge Sites 1430J, 1430B, and 1410D																							■										
Erect Piers and Abutments/Backwalls at Bridge Sites 1430J, 1430B, and 1410D																								■									
Launch Girders and Deck at Bridges Sites 1430J, 1430B, and 1410D																								■									
Mobilize from Dempster Highway to km 1360 (Thunder River) via winter road																					■												
Piling at Bridge Site 1360D (Thunder River)																						■	■										
Erect Abutments/Backwalls at Bridge Site 1360D (Thunder River)																							■	■									
Launch Girders and Deck at Bridge Site 1360D (Thunder River)																								■									
MACKENZIE VALLEY HIGHWAY, GWICH'IN SETTLEMENT AREA OPENS!																														★			

Notes:
1. Will likely require stockpiling of surfacing material along or adjacent to completed embankment in previous winter.



M:\TRANSPORTATION\NWT_Mackenzie_Highway\V33101053_Gwich'in\Maps\Executive Summary\FigureE8.3-1.mxd modified 5/10/2011 by brittney.aldous

LEGEND

- Preferred Borrow Sources
- Bridge
- KM Post
- Communities
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- PWC 1974 Highway Concept Route
- Mackenzie Gas Project Corridor
- Heritage Conservation Zone
- Conservation Zone
- Settlement Area Boundary

Gwich'in Lands

- Surface and Subsurface Rights
- Surface Rights

NOTES
Base data source: ESRI Base Data
NTS 1:250,000
Alignment is considered preliminary and is subject to change

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Preferred Highway Alignment

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:550,000
10 5 0 10
Kilometres

FILE NO.
FigureE8.3-1.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure E8.3-1

Preliminary highway design incorporated constraints based on operational and safety considerations such as traffic volume (estimated at 50 vehicles per day, with 13% to 15% of that being heavy trucks), the type of vehicle to operate on the Highway, desired operating speed, accommodation and protection of permafrost and ice-rich terrain, avoiding or minimizing impact to sensitive environmental and heritage resource areas, and information gathered during consultations.

Design parameters are based on published and accepted guidelines and best practices for developing infrastructure in the Northwest Territories. DOT has reviewed and accepted the design parameters developed for the Highway. Working within a continuous permafrost region such as is found in the GSA, and considering the potential for impact from climate change on permafrost, extensive consideration of past experience and adaptation of engineering principles and practices is required.

Table E8.3-1: Design Parameters

Design Criteria	
Desired Road Design Speed	90 kph
Minimum Road Design Speed	80 kph
Horizontal Alignment	
Desired Curve Radius	340 m
Minimum Curve Radius	250 m
Desired Sight Distance	n/a
Minimum Sight Distance	n/a
Vertical Alignment	
Minimum Passing Sight Distance	n/a
Minimum Stopping Sight Distance	n/a
Minimum Sag K Value	13
Minimum Crest K Value	25
Minimum Lengths of Vertical Curves	80 m
Desired Maximum Grade	6%
Maximum Grade	8%
Cross-Section	
Desired Finish Top Shoulder Rounding to Shoulder Rounding	9 m
Minimum Finish Top Shoulder Rounding to Shoulder Rounding	8.5 m
Lane Cross Fall	3%
Superelevation	6%
Minimum Side Slopes - All Sections	3:1
Embankment Height	
Dry (ice poor) Till and Outwash Deposits	1.4 m
Wet (ice medium to ice rich) Till and Outwash Deposits	1.4 m to 1.6 m
Wet Silts and Clays (ice rich)	1.6 m to 1.8 m
Thick Organic Peatlands and Ice Rich Permafrost	1.8 m
Thickness of Base Course Gravel	200 mm to 300 mm

A typical cross section for the Highway is illustrated on Figure E8.3-2.

Preliminary bridge design as conceived for this PDR is for six of the seven major bridges to be constructed as single lane structures. The seventh, the Thunder River Bridge, would be a two-lane structure to allow for opposing vehicles to pass, given the limited sight distance on approach.

Final bridge and abutment designs will be determined during the detailed engineering process.

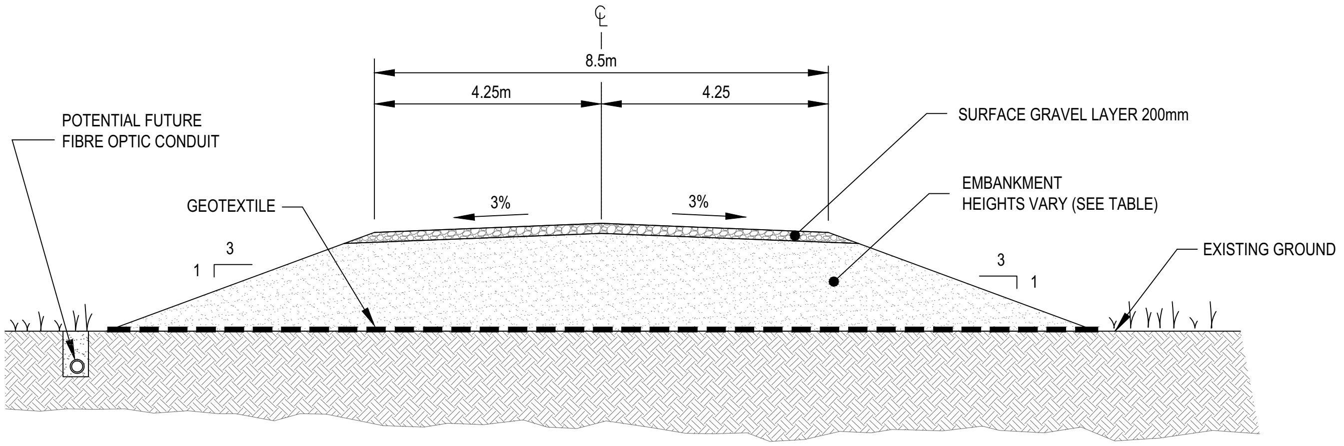
The bridge spans will vary in length from 30 m to 65 m. The proposed structures will include steel plate girders with precast concrete foundation or support structures. This will simplify fabrication and construction and save costs. All steel and precast components can be pre-fabricated off-site to ensure quality of work and to expedite construction.

Other minor stream crossings will use a culvert or a small bridge, depending on ground and soil conditions, availability of fill material, cost and requirements to protect fish habitat. The detailed design will include erosion protection requirements.

Designs for large and small culverts will include requirements for bedding materials, geotextiles and insulation to provide strength in the foundation and to protect the surrounding permafrost and ice-rich soils from thaw. Detailed geotechnical information will be collected during field investigations and detailed design stages will incorporate the bedding and foundation requirements for culverts.

E8.4 Land Tenure

Of the 181 km of the Highway in the GSA, 111.7 km are on Gwich'in settlement lands. As the ultimate goal is to have the 60 m wide highway right-of-way under the authority of the GNWT (surface rights), 111.7 km are to be transferred to the GNWT pursuant to the expropriation procedure set out in Section 23 of the *GCLCA* and as more specifically addressed in Schedule XVII - "Notice of Intent, Expropriation of Gwich'in Lands for the Proposed Mackenzie Highway". As the Highway proceeds through approvals, funding, design and construction, the GTC will work with DOT to give effect to the land transfer pursuant to and subject to the provisions of the *GCLCA*.



TYPICAL HIGHWAY CROSS SECTION

TERRAIN TYPE	DESCRIPTION	EMBANKMENT HEIGHTS
1	DRY (ICE POOR) TILL AND OUTWASH DEPOSITS	1.4 m
2	WET (ICE-MEDIUM TO ICE-RICH) TILL AND OUTWASH DEPOSITS	1.4 to 1.6 m
3	WET SILTS AND CLAYS (ICE-RICH)	1.6 to 1.8 m
4	THICK ORGANIC PEATLANDS AND ICE-RICH PERMAFROST	1.8 m

LEGEND

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Typical Highway Cross Section

PROJECTION | DATUM

Scale 1:150

1 0 1 3m

FILE NO.
V33101053 - Typical section.dwg

PROJECT NO.	DWN	CKD	REV
V33101053	SM	RM	0

OFFICE	DATE
EBA-VANC	JANUARY 13, 2011

Figure E8.3-2

E8.5 Deployment, Staging and Storage

Highway construction through the GSA and within an efficient period of time requires deployment of equipment and crews from both the north and south ends of the project. The north end is accessible from the Dempster Highway, south of Inuvik, and the south end can be accessed from Little Chicago, which is about 30 km south of the southern boundary of the GSA. It is suitable for a barge landing and offloading supplies, a construction staging area, development of a short access road to higher ground, temporary fuel storage and camp facilities. The development of Little Chicago as a deployment area will also be advantageous for the construction of the Highway through the SSA.

With the exception of Little Chicago, temporary camps, likely 150-person facilities, will be situated in borrow sources to minimize the development footprint approximately 50 km apart to ensure a maximum driving distance of 25 km for project workers.

In addition to central staging areas at Inuvik and Little Chicago, stockpile and staging areas will be constructed parallel to the Highway and just ahead of material delivery by truck to work areas. Camp, staging and stockpile areas not identified for post-construction highway maintenance will all be reclaimed in accordance with appropriate guidelines.

Most construction activities will take place in winter, and some can take place year round, depending on access to the Dempster Highway or to completed sections of the Highway. The timing of construction activities will respect the sensitive nature of the management areas and conservation zones and will follow permit conditions. Embankment construction or accessing areas within the right-of-way before the Highway is constructed must be done in the winter to avoid damage to the land. Temporary winter roads will be used to access most borrow sources instead of more costly and permanent all-weather access roads.

Equipment and bridge components can be mobilized to the north end of the project via the Dempster Highway, or by barge from Hay River to Inuvik in July or August, and then by truck south to where it will be used along the Highway; or, if to the south end, by barge to Little Chicago and then by truck over a completed section of the Highway to where it will be used. Where the Highway is not completed, bridge sites can be accessed by winter road.

While winter construction has environmental advantages, there are some disadvantages, including minimal daylight, extreme cold temperatures that are challenging for work crews and equipment, the difficulty in compacting frozen material directly on top of geotextile material placed on natural ground, and drilling and blasting to excavate frozen borrow material. These have been considered in the development of the construction schedule and cost, and in consideration of future maintenance requirements.

E9.0 ARCHAEOLOGY, TRADITIONAL KNOWLEDGE AND LAND USES

E9.1 Archaeology

Evidence for human occupation and use in what is now called the GSA dates back at least 6,000 years to the Middle Prehistoric Period. The Gwichya Gwich'in – "people of the flat lands"- also called "Loucheux" by European fur traders in the 1800s, concentrated in the Travaillant Lake and Travaillant River vicinities and the Thunder River area during trapping seasons, but moved around the region depending on the availability of seasonal resources.

Archaeological investigations began in the early 1950s as part of a search for the routes used by early explorers. In 1973, a number of surveys and studies were conducted including an archeological study of the Mackenzie Valley covering three km (two miles) either side of the river from Fort Providence to Arctic Red River, a survey for a possible highway route between Fort Good Hope and the Dempster Highway, and the first of many archeological studies along potential pipeline corridors. (Clarke and Webster 2005)

In 1985, the Archaeological Survey of Canada began several years of studies in the Mackenzie Valley, and started in the vicinity of Travaillant Lake where more than 90 archeological and historical aboriginal sites were found. Since the mid-1980s, most archeological investigations have related to Mackenzie Valley pipeline proposals. In 2001, a pipeline route examination found 27 new sites in the Travaillant Lake area, most of them south of the current study corridor.

Beginning in 2002, four field seasons of archeological investigations were completed for the MGP pipeline route that passes north of Travaillant Lake and which now is the guiding corridor for the Highway. Three years of these studies focused on high archaeological potential locations within a 1 km pipeline corridor, borrow sources and infrastructure locations. The entire pipeline route was not assessed.

The information publically available from the MGP studies has been used in the development of the Highway project. In addition, a visual archeological overview assessment of the preliminary Highway corridor, using low altitude and slow-flying helicopter overflight, was completed in June, 2010 to assess the archeological potential of the terrain. The thirteen proposed borrow sources were not finalized at the time of this field study and so were not assessed but were rated later by a preliminary desktop study.

The primary locations rated for moderate to high archeological potential are Thunder River valley, South Lake, Travaillant Lake, Woodbridge Lake, Hill Lake, Sitidgi Lake tributary, known locally as Minor Creek, and elevated terrain near the Mackenzie River. The proposed highway alignment generally avoids areas of archeological potential. Further ground reconnaissance will be needed after the Highway alignment is finalized and the boundaries of all associated borrow sources, staging areas, construction camps and access roads have been identified. At that time, modifying the Highway alignment or proposed borrow source will be the mitigative measure to avoid impact to archeological resources.

E9.2 Traditional Knowledge

The GSCI provided access to the Gwich'in Traditional Knowledge Study of the MGP Area (2005) for the development of this PDR. In general terms, traditional knowledge is that body of knowledge generally held by indigenous people about their cultural and physical landscape.

Traditional seasonal activities pertinent to the Highway project are summarized in Table E9.2-1. The Highway may affect seasonal activities by providing people with easier access to the land, or construction activities could temporarily affect traditional pursuits.

Table E9.2-1: Summary of Gwich'in Cultural Activities by Season

	Screendyrt (Spring)	Luu tatjyaa (Break up)	Shın (Summer)	Khaıınts'an' (Fall)	Tadeedıchıh (Freeze Up)	Khaıı (Winter)
Cultural	Story telling at night Sewing Heading to the Delta Carnivals and jamborees Easter	Ice breaking up 24 hour sun	Assemblies and meetings August 15th Story telling at night Sew Barges Canoe races Gatherings July 1st Weddings Picnics Swimming	Storytelling at night School Trap line Making dog harnesses and dog blankets Making ice road Sew Bush Camp Heading up the Mackenzie River Making Dog whips	Fishing under ice Freeze up	Storytelling at night Tracking along the river Skiing and skating New Years Meteor showers (every 33 years) Making snowshoes Christmas Ski-dooing Sew Ice hauling Snowshoeing Bush camps
Animals, Hunting, and Hides	Trapping and shooting muskrats Hunt caribou Dry meat Rat (muskrat) camps Beaver hunting on lake ice Tanning	Trapping and shooting muskrats Tanning	Beaver hunting on the river Tanning	Shooting rabbits along river Hunt moose Hunt caribou Dry meat making Moose calling Tanning	Tanning	Trap wolf and fox Trap marten Bear hunting Hunt caribou Dry meat making Snaring rabbits Trap line Tanning
Birds	Geese and duck hunting Swan and snow geese	Geese and duck hunting Dried geese				
Fish	Fishing under lake ice	Setting loche hooks	Fishing with nets and dry fish Fish camps	Split fish Pit Fish Fishing under river ice Stick fish Egg fish	Jiggling for loche	Fishing under lake ice
Plants and Trees	Spruce gum collecting Wood hauling	Spruce gum collecting Digging for bear roots	Spruce gum collecting Wood hauling Blueberries Yellowberries Raspberries Blackberries Wood hauling on the river Gooseberries Collect birch bark for fire starter	Spruce gum collecting Wood hauling Cranberries Bear roots Yellow leaves Leaves falling Digging for bear roots	Spruce gum collecting	Spruce gum collecting Wood hauling

Source: Gwich'in Traditional Knowledge Study of the Mackenzie Gas Project Area (2005)

Given its proximity to the MGP pipeline corridor, concerns raised during the collection of traditional knowledge for the MGP are relevant to this project. Several concerns refer to environmental disturbance to wildlife, particularly during migration or birthing, plants, fish, birds, key rivers and lakes such as in the area around Travaillant Lake, and permafrost. Other concerns refer to cultural and traditional issues such as burial grounds, modern and archeological camps and cabins, country foods, trails, myths and legends and Gwich'in named places that have importance due to their heritage values.

Traditional knowledge and local knowledge gathered at community consultations has influenced the Highway's preliminary design and the general approach to the project as a whole. Some areas where consultation has influenced the project are:

- Travaillant Lake is an important area for Gwich'in, both traditionally and culturally, and is currently used for harvesting. The Highway will be designed so as to not interfere with the integrity of the lake or the surrounding, interconnected water bodies.
- Research is needed to find dust control products other than calcium chloride or magnesium chloride for use on bridge approaches and the part of the Highway closest to Travaillant Lake.
- Additional maintenance will be needed during the first few years of Highway operation to deal with material settling and compaction, given the initial construction with frozen material.

As the project progresses through the regulatory and assessment processes, further consultation with GSA communities will be required.

E9.3 Land Uses

The *GLUP* identifies several areas deserving of special status, depending on preservation values in each area.

E9.3.1 Gwich'in Conservation Zones

Eleven percent of the GSA has been designated as Gwich'in Conservation Zones, based on the following criteria:

- need year-round protection;
- contain a variety of resources that the Gwich'in have deemed to need protection, such as, current and historical use, heritage resources, wildlife, fish, forests, vegetation and water;
- scientifically-designated core areas containing critical wildlife habitat, outstanding heritage sites, unique land features and ecological processes; and
- five out of six identified eco-regions, and areas that do not unreasonably limit resource development to occur in the GSA.

E9.3.2 Gwich'in Heritage Conservation Zones

Gwich'in Heritage Conservation Zones are defined as "outstanding historical or cultural significance in the GSA." These zones have the same status as Gwich'in Conservation Zones.

The Thunder River Heritage Conservation Zone (Vihtr'ii tshik) is located southwest of the Highway alignment, which passes as close as 4 km. This zone includes a site where the Gwich'in sourced stones to make tools, including arrowheads, scrapers and flint.

E9.3.3 Gwich'in Special Management Zones

GSA special management zones cover 42% of the GSA, and allow land use provided that zone-specific conditions are met and appropriate authorizations are obtained. Those in the vicinity of the proposed Highway alignment include Zone 6 – Campbell Creek (Gwieekajilchit tshik) and Zone 12 – Lakes Around Travaillant Lake (Van Kat Khaii Luk Gwindii).

The Highway passes adjacent to the southern boundary of Campbell Creek Special Management Zone 6, designated as such to protect fish habitat and heritage resources. Conditions for the protection of significant heritage resources, traditional fish harvesting and fish are provided in the *GLUP*. Through the consultations with local Gwich'in organizations and government the potential effects have been identified and appropriate considerations for timing and/or activities have been made in the design and construction approach.

The Highway passes through the Lakes Around Travaillant Lake Special Management Zone 12 for a distance of 101.7 km. This Special Management Zone is established to protect important fishing resources, heritage values, waterfowl staging and breeding areas and the range for barren ground and boreal woodland caribou. Conditions to protect these resources are provided in the *GLUP*, Section 4.5.12 and have been included in the development of this project. To protect waterfowl, specific nesting and staging sites will be identified in the detailed stages of field investigation and a 250 m setback will be observed year round. Aircraft are to maintain a minimum altitude of 650 m when flying over this Zone in June, July and August. As noted in the *GLUP*, "the Planning Board asks that regulators and developers give full consideration to maintaining habitat and limiting disturbance of caribou in this zone" (*GLUP* 2010) until management plans are completed for these species.

Section 4.5.1 of the *GLUP* offers the concept of a Transportation Special Management Zone for protecting resources in the vicinity of the Dempster Highway, and includes elements relating to highway design, construction and operations. This Zoning allows for transportation-related activities for 1,000 m on either side of the Highway. The Zone is divided into three areas to address primary values specific to each area which include wildlife, tourism, granular resource/pit management, water quality, wildfowl and raptors. Wildlife monitors assess activity of wildlife such as caribou, and DOT has been instructed to preserve scenery and tourism values as the Dempster Highway is maintained. Similar zoning will be adopted for the Mackenzie Valley Highway in the GSA.

E9.3.4 Non-traditional Land Use

The most extensive non-traditional land use in the vicinity of the Highway and throughout the GSA has been 2-D and 3-D seismic exploration programs. There have been some limited drilling operations, but none in the vicinity of the Highway. Future non-traditional use includes the MGP, but at the time of preparing this PDR, no firm date has been announced for when, or even if, this will proceed.

E9.3.5 Traditional Land Use

E9.3.5.1 Wildlife

Traditionally, wildlife was harvested for subsistence, survival materials and trade. Wildlife harvesting provided the basics for life, cultural identity and tied the Gwich'in to the land and their heritage.

Traditional hunting for subsistence and trapping continues today. According to the Gwich'in Harvest Study (GRRB, 2001), fish were by far the most harvested wildlife group. The annual wildlife harvest in the GSA includes:

- Barren-ground caribou and woodland caribou of the boreal population are found along the Highway at certain times of the year.
- Moose – found throughout the GSA year-round, but especially near Tsiigehtchic.
- Grizzly and black bears – found throughout the GSA year-round.
- Furbearers, including beaver, muskrat, snowshoe hare, marten, ermine, mink, otter, lynx, red fox, wolf and wolverine.
- Waterfowl, including 12 species of duck and four species of geese. Harvesters from Inuvik hunt waterfowl in May, June, August and September, while those from Tsiigehtchic hunt in May.
- Fish, including Dolly Varden (char), chum salmon, lake whitefish, Arctic grayling, cisco (herring), jackfish, lake trout, burbot (loche), white sucker, broad whitefish and inconnu.

E9.3.5.2 Berries

There is limited information regarding traditional or contemporary berry harvesting sites, but it can be assumed that berries are harvested from the area that will become the future Highway right-of-way, particularly along watercourses, at summer fish camps, and near Inuvik.

Several species of berries are used for food including bearberry, cranberry, blueberry, cloudberry, crowberry, raspberry, and black and red currants. Berry harvesting typically occurs from mid-July to mid-August.

The Highway will provide greater access to the area for harvesting. This is both an advantage and disadvantage. Controlling access to Gwich'in Lands from the Highway will be through the authority in the *GCLCA* and associated legislation, and through policies for education, monitoring and enforcement undertaken by the GTC. DOT has authority only to restrict access to the Highway from adjacent lands.

E10.0 COMMUNITIES AND DEMOGRAPHICS

There are four communities in the GSA, and all are likely to feel the effects of Highway construction due to their proximity to the Highway, the increased connectivity to communities in the southern Northwest Territories and the rest of Canada, as well employment and business opportunities arising from construction and long-term maintenance and operation.

All communities have a mixed population of Gwich'in, Inuvialuit, Metis and non-aboriginals in varying numbers. Aklavik, with 645 residents, is 91.6% Aboriginal, Inuvik, with 3,586 residents is 62.9% Aboriginal, Fort McPherson has 791 people of which 93.3% are Aboriginal, and Tsiigehtchic has 136 people, of which 94.9% are Aboriginal. (GNWT Bureau of Statistics 2010)

Inuvik, Fort McPherson and Tsiigehtchic are accessible year round by the Dempster Highway, except during freeze-up and break-up at river crossings. Aklavik is accessible by winter road, and all are accessible by boat in summer and by air year round.

Employment history in all communities reflects the boom-bust cycle of oil and gas exploration in the Beaufort Sea and the Mackenzie Delta over the last 40 years.

Expected economic impacts from the Highway project are noted in the section "Economic Benefits" in this summary, and more information can be found in the PDR.

E11.0 ENVIRONMENTAL OVERVIEW

The general climate of the GSA, or Lower Mackenzie Valley, is sub-arctic and characterized by long, cold winters, short cool summers and extreme annual temperature variations. Transition between seasons is abrupt, and snow and ice cover typically persists from October to May. Annual precipitation is typically moderate, occurring more frequently in summer than in winter.

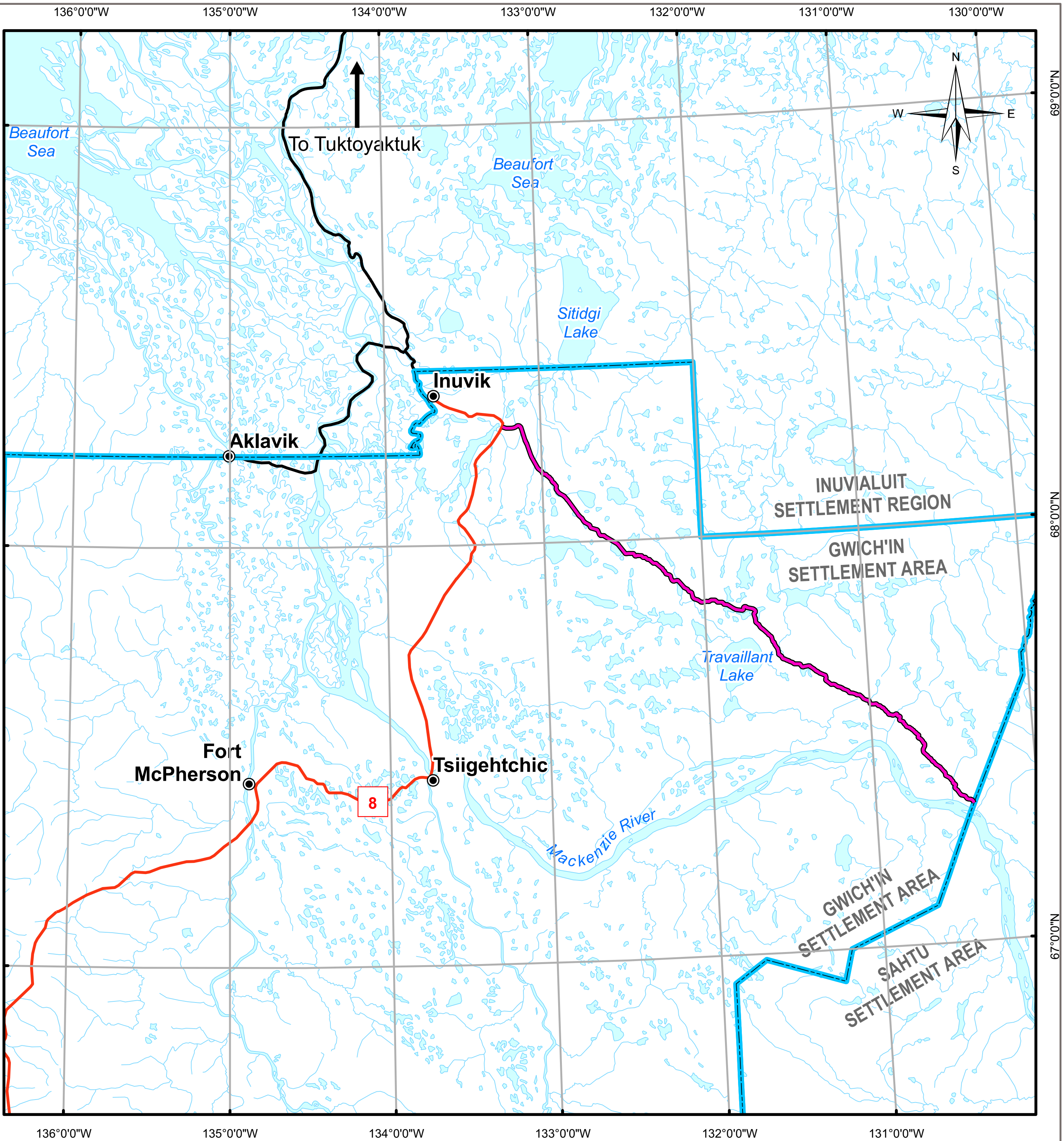
Excluding communities and the Dempster Highway, the GSA is largely undeveloped and has had little in the way of any industrial activity. Beyond subsistence hunting, trapping and fishing, most of the GSA has been largely undisturbed.

The area is classified as Taiga Plains Ecozone by the Canada Committee on Ecological Classification, and is characterized by distinctive regional ecological factors, including climate, physiography, vegetation, soils, water, fauna and land use. The Taiga Plains Ecozone is dominated by the Mackenzie River and its tributaries. The Mackenzie Valley forms one of the North America's most travelled migratory corridors for waterfowl (ducks, geese and swans) breeding along the Arctic coast.

Vegetation in this eco-region consists of white spruce forest, with scrub birch, Alaska paper birch (south part of the region), mountain cranberry, Labrador tea, red bearberry, lichens and mosses. Tree density and heights vary in response to local conditions: shorter trees with less density in the north, taller trees and greater density in the southern region.

Glacio-fluvial deposits in the form of moraines and drumlins are extensive in the Travaillant Lake area and hummocky till uplands are the main landform type in the north part of this region.

As Highway alignment is close to that of the MGP, eco-region data will be quite similar. The PDR has drawn substantial information from the MGP environmental impact statement. Where the Highway alignment deviates from the MGP alignment there is no data available from prior studies, so site-specific vegetation surveys and assessments in the areas that have not previously been studied, must be completed before any disturbance takes place.



M:\TRANSPORTATION\NWT_Mackenzie_Highway\V33101053_Gwich'in\Maps\Executive Summary\FigureE10.0-1.mxd modified 5/10/2011 by brittney.aldous

LEGEND

- Communities
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- Public Winter Road
- Settlement Area Boundary
- Waterbody
- River

NOTES
Base data source: NTS 1:250,000
Alignment is considered preliminary and is subject to change

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA

Communities in the Vicinity of the Proposed Highway

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:1,500,000
20 10 0 20
Kilometres

Northwest Territories
Nehtruh - EBA

FILE NO.				
FigureE10.0-1.mxd				
PROJECT NO.	**DWN**	**CKD**	**APVD**	**REV**
V33101053	BA	MS	RM	0
OFFICE	**DATE**			
EBA-RIV	May 10, 2011			

Figure E10.0-1

E11.1 Anticipated Effects and Mitigation

The Proponents are committed to constructing the Highway, borrow sources and associated winter access roads in a safe and environmentally responsible manner.

The existing framework for environmental management of Highway construction consists of:

- regulatory and other management instruments that define environmental terms and conditions;
- hiring experienced local construction contractors;
- avoidance and protection of sensitive terrain and habitats;
- avoidance of identified heritage and traditional values and archeological sites; and
- hiring environmental and wildlife monitors with experience on the land and local knowledge.

Contractors hired for Highway construction will be required to comply with the following management plans:

- contractor health, safety and environment manuals including general spill contingency and emergency response plans;
- contractor work procedure documents;
- site-specific health and safety plans; and
- site-specific spill contingency plans.

E11.1.1 Air Quality and Noise

Dust, air emissions and noise associated with Highway construction are expected to have limited, localized and temporary impacts in the vicinity of the Highway.

Dust is expected from heavy equipment movements, loading and unloading material, crushing, screening, blasting, erosion from stockpiles and other activities. Dust suppression, using water from nearby lakes as permitted under an Northwest Territories Water License and DFO water withdrawal criteria, will follow the GNWT Guideline for Dust Supression (GNWT 1998).

Noise will be associated with heavy equipment and truck movements and blasting during excavations. The use of heavy equipment, truck movements and explosives will be timed and located to avoid periods when wildlife species are in the area or to avoid potential harm to fish in local water bodies.

Contractors will be directed to maintain their equipment in proper working order, including mufflers, to reduce emissions and noise.

E11.1.2 Construction and Operation Effects and Mitigation

The Highway right-of-way will be 60 m and will be maintained cleared for the full width. The average width of the Highway footprint (from one toe of the embankment to the other) will be 20 m to 28 m along the entire 181 km route, amounting to about 329 ha of terrain and associated vegetation.

Highway construction will be by excavation and end-dumping of aggregate material. Activities that affect terrain directly include removal of overburden at borrow sites, excavation of Highway construction material at borrow sites, Highway construction, and re-contouring of construction sites and associated facilities. Monitors will be on site from the start of construction.

Several indirect effects from construction may occur including the introduction of non-native or invasive plant species, alteration of hydrology conditions and increased erosion or slumping which could also affect plant communities.

Operational activities, including road maintenance and vehicle traffic, have the potential to directly and indirectly have an impact on vegetation.

Borrow sites have been selected to be as close to the Highway as possible to minimize haul distances and will be operated in accordance with INAC quarry permit requirements and existing environmental standards and guidelines. Borrow sites will be accessed by temporary winter roads except in the case of those identified for maintenance and operations once the Highway is completed. All borrow sites will be permanently reclaimed or restored after use in accordance with the applicable reclamation plan.

During operation, the amount of dust produced from the Highway will increase, and is expected to be local and seasonal. Dust along the highway can lead to early snow melt and corresponding early green up. Dust could also lower vegetation cover and change plants assemblages. Dust suppressants such as calcium chloride may also have a negative impact on plants. Products other than calcium and magnesium chloride are being considered for dust control.

Snow removal is necessary during winter operations. The build-up of snow in ditches along the Highway may result in additional vegetation or plant loss, and an increase in forest fires.

Mitigation measures will include:

- minimize project footprint wherever possible to reduce impacts;
- avoiding the two locations of rare plants as identified in the MGP studies;
- design and install appropriate drainage culverts to maintain existing water flow conditions;
- monitor and maintain drainage culverts to ensure proper working order and mitigate standing water or ponding;
- remove snow from the roadway and sideslope to specific storage areas during winter maintenance;
- employ geotextile as an underlay, and use sufficient fill depths over the road bed to protect permafrost;
- minimize the number of borrow sources for the Highway construction and future maintenance requirements;
- reclaim all borrow sources (including re-contouring and re-vegetation) that are not to be kept open for future maintenance requirements;

- restrict construction traffic to the planned Highway footprint; and
- introduce alternatives to calcium and magnesium chloride for dust suppression methods particularly in the area around Travaillant Lake.

E11.1.3 Effects on Wildlife and Mitigation

E11.1.3.1 Wildlife

The Highway may directly or indirectly result in loss of wildlife habitat, fragmented habitats and wildlife mortality. Effects could occur at the individual or population level. Particular species such as grizzlies, wolverines and boreal caribou are more sensitive to human disturbances and may avoid roads, although studies show highway avoidance in areas without hunting are non-existent or short-term. Some species such as herbivores and bears may be attracted to ditches in search of food, especially in spring. Carnivores, including raptors, could be attracted to the ditches to prey on foraging animals or carrion.

Potential direct and indirect wildlife mortality may occur, including wildlife-vehicle collisions, increased predation, hunting, trapping and problem wildlife. Mortality risk from vehicle collisions occurs all along the Highway. The primary wildlife species of concern to the operation of the proposed Highway are caribou, moose, grizzly bears, wolverines, and foxes.

The objectives of wildlife management activities will be to mitigate potentially negative effects on wildlife in the following general ways:

- minimize loss or fragmentation of habitat through project design;
- minimize direct mortality due to collisions with vehicles;
- manage waste at construction camps and implement environmental awareness programs;
- reduce the volume, duration, and frequency of noise producing construction activities;
- time construction activities to avoid critical periods for wildlife;
- conformance with pre-determined setback distances from wildlife habitat along the right-of-way (such as GLUPB's for the Dempster Highway); and
- ensure construction crews have wildlife training and awareness, and understand the applicable regulations for fishing, hunting and land access.

DOT's highway operational policies are designed to mitigate potential impacts on wildlife and wildlife habitat. Applying these measures will potentially localize and limit effects on wildlife and wildlife habitat.

E11.1.3.2 Fish

The potential effects of the Highway on aquatic resources, fish and fish habitat, and the development of effective avoidance or mitigation measures are major components of the Highway's environmental assessment.

There are three categories of streams along the Highway alignment:

- non-fish bearing stream: not used by fish during any part if their life cycles;
- migratory channels: ephemeral and perennial streams, used by fish only for migration or that contribute to downstream habitat quality; and
- spawning/rearing/feeding streams: ephemeral and perennial streams, used for one or more life cycle stages in addition to migration.

Various Highway activities, including design and road bed construction, bridge construction, proper culvert sizing and installation, use of heavy equipment, quarry development, water extraction in winter and summer and public access after construction can have negative effects on water resources and fish. Constructions strategies to minimize impacts and disturbances include:

- erosion and sediment control best practices, including on-going monitoring of culverts after they are installed, to ensure erosion and sediment disturbance are controlled;
- employing DFO protocols for water withdrawal in winter and summer;
- route location to maintain sufficient distances of borrow sources and the Highway alignment from critical habitat, lakes and streams;
- employing DFO protocols for temporary stream crossings and clear span bridges; and
- public education to minimize disturbances from Highway use.

E11.1.3.3 Birds

The Mackenzie River acts as a major flyway for Arctic breeding birds during spring and fall migrations. Numerous species, including waterfowl (swans, geese, ducks, loons and grebes) and waterbirds (cranes, shorebirds, gulls and terns), raptors and other upland birds use the Mackenzie River during the migrations and disband along the route to appropriate breeding habitat. Migration is influenced and governed by weather, as is the speed of the migration which varies among species.

A total of 50 species may be found in the Highway vicinity, many of which migrate, in varying densities, to the area for breeding and summer feeding. Some use the area for staging before continuing with the migration.

The *GLUP* identifies the Lakes Around Travaillant Lake Special Management Zone as an important area for waterfowl staging and breeding. The Khaii luk, Nagwichoonjik, Dachan choo gehnjik Conservation Zone (Travaillant Lake, Mackenzie River and Tree River) is designated as significant waterfowl habitat.

The *GLUP* permits land use for the Highway through the Conservation Zones. Strategies for locating the Highway have and will be used to mitigate effects on waterfowl, water birds, raptors and upland birds, as follows:

- remain as far from lakes and wetlands as possible; *GLUP* recommends a minimum 250 m;
- avoid all known raptor nests by 1 km if possible; *GLUP* recommends a minimum 250 m;

- avoid clearance and construction during nesting and fledgling seasons (March to August) as per *Migratory Birds Convention Act* and *Northwest Territories Wildlife Act*; and
- aircraft must remain at a minimum 650 m altitude when flying over nesting areas.

Section 11.0 of the PDR provides more information include mitigation measures for species at risk.

E11.1.3.4 Cumulative Effects

With the application of proposed mitigation measures summarized here and included in the PDR, the residual effects associated with the construction and operation of the Highway within the GSA are anticipated to be of low magnitude and local in extent.

Individually, no significant residual effects are anticipated. A cumulative effects assessment will consider the potential additive and synergistic effects of overall residual effects, in combination with past, existing or known planned activities in the vicinity of the Highway through the GSA.

E12.0 CONCLUSION

Decades of planning, investigation, and consultation show the construction of the Mackenzie Valley Highway has been a long standing goal of the federal government, the territorial government and the residents of each region in the Northwest Territories.

The Highway will reduce the cost of living, improve access to health care, education and training, provide employment and economic development opportunities and reduce the road travel time to the southern Northwest Territories and Canada.

The section of Highway through the GSA will be a key component of the Northwest Territories transportation system. Completing the Mackenzie Valley Highway will connect Canada from Coast to Coast to Coast and will address Canada's goal of establishing a year round transportation link to the Arctic coastline.

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APPENDICES

1.0 INTRODUCTION

The idea of building an all-weather highway through the Mackenzie Valley originated in the 1960s. In the 1970s the Federal Government, through Public Works Canada did significant work on highway surveys, geotechnical investigations, environmental studies, bridge and culvert designs, some detailed design and tender package preparation. Some 200 km of the south portion of the Mackenzie Valley Highway, between Fort Simpson and Wrigley, were constructed in the mid-1970s, but construction came to an abrupt halt in 1977 short just south of Wrigley. The remaining few kilometres to Wrigley were completed in the mid-1990s, but the plans to construct the more than 800 km of highway between Wrigley and Inuvik were put on hold. With the completion of the Dempster Highway in 1979, an all-weather road through Yukon, it became possible to reach Tsiigehtchic, Fort McPherson and Inuvik by road year-round.

In 1989, the Federal Government devolved the authority over highway system to the Government of the Northwest Territories (GNWT). The Department of Transportation (DOT) prepared the initial Highway Strategy and as part of that strategy, prepared a report entitled "Mackenzie Highway, Wrigley to Inuvik Extension" (DOT GNWT 1989). A decade later, as part of an update to the Highway Strategy, DOT undertook three companion studies to update the Mackenzie Valley Highway initiative. The three studies comprised an engineering update, an environmental scoping study and a benefit/cost analysis. These studies contemplated what it would take to build the Mackenzie Valley Highway and evaluated whether the value of the Mackenzie Valley Highway would be worth the investment.

In 2010, a Memorandum of Understanding (MOU) was signed between the Gwich'in Tribal Council (GTC) and DOT to set the terms for the completion of a Project Description Report (PDR) for the Construction of the Mackenzie Valley Highway (the Highway) in the Gwich'in Settlement Area (GSA). This action and DOT's determination to partner with each respective land claim group in the Mackenzie Valley have re-invigorated the dream of building the Highway. This PDR provides a preliminary Highway design, assesses its effects and identifies appropriate mitigation to enable the Highway to be constructed. The PDR has been prepared specifically for submission to the Mackenzie Valley Land and Water Board (MVLWB) for preliminary screening – the first stage of the regulatory process, moving the Highway closer to becoming a reality.

This PDR marks the culmination of decades of initiatives, studies, consultations, and reports. The list of previous studies is included in the References section of this PDR. The PDR represents the 'project story' for the Highway in the GSA and a guiding document for the development proposal. Following this introduction, Section 2.0 and Section 3.0 identify the project Proponent and present the rationale for constructing the Highway. Next, Section 4.0 introduces the anticipated regulatory process and identifies the approvals that will be required to commence construction. Section 5.0, Section 6.0, and Section 7.0 illustrate the location of the project, summarize the history of the Federal and Territorial efforts toward constructing a highway through the Mackenzie Valley, and use available information from these studies, and pertinent information from the Mackenzie Gas Project (MGP) (Imperial Oil Limited 2004), to propose a preferred Highway alignment, design, and project schedule. The PDR identifies the necessary resources – particularly borrow material – that will be used to construct the Highway.

After putting in place this vision for the project, Section 8.0, Section 9.0, and Section 10.0 set the Highway in the environmental, social, and economic context of the GSA. The PDR describes the 2010 engineering, scientific, and archaeological field program activities and their findings. Of note, these studies did not aim to re-evaluate or update previous assessments nor add to the wealth of available bio-physical data that has been collected in this area. Instead, the field programs focused on filling information gaps and clarifying specific questions that arose from 1999 scoping and the Gwich'in decision to adopt the 2010 highway design described herein.

The PDR relates specific detail from three rounds of consultation held in Aklavik, Fort McPherson, Inuvik, and Tsiigehtchic in 2010 and early 2011. The project's Proponent and its technical team were participants in these meetings, during which they received direct feedback that shaped the concept of the Highway at the beginning, in the middle, and near the end of the preparation of this PDR. As such, this PDR values and integrates knowledge shared by the communities and regulators during consultation and it integrates heritage resource information, traditional land use, and traditional knowledge.

With this understanding of the proposed development and a rich picture of the setting for the development, Section 11.0 and Section 12.0 of the PDR assess the potential environmental, social, and cumulative effects of constructing the Highway. In instances where there exists a potential for negative environmental or social effects to arise, mitigation actions are identified.

In closing, the PDR gives voice to the local, regional, and national desire to build the Highway. It describes the activities that establishment of the Highway and provision for installation of the communications fibre optic cable will entail. This landmark project will establish an envisioned infrastructure corridor through the Mackenzie Valley that will, simply stated, bring people together. The GTC and DOT are confident in the findings presented in the PDR. The GTC and DOT further believe that with the preliminary design for the Highway and the assessment of its potential effects, this project can proceed efficiently through the regulatory process to permitting, construction, and responsible long term operations and maintenance. The PDR is subject to the terms of the *Gwich'in Comprehensive Land Claim Agreement (GCLCA)* and to the extent there is a conflict between the PDR and the *GCLCA*, the provisions of the *GCLCA* shall govern to the extent of the inconsistency.

2.0 CONTACT NAMES AND ADDRESSES

The contacts for the Highway in the GSA are the GTC and DOT. All communication regarding this PDR should be directed to the following contacts:

Ms. Wanda McDonald
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Inuvik, NT X0E 0T0

T. 867-777-7900
F. 867-777-7919
E. wmcdonald@gwichin.nt.ca

Mr. Jim Stevens
Director, Mackenzie Valley Highway
Department of Transportation
Government of Northwest Territories
Highways Building, 2nd Floor
4510 – 50 Avenue
P.O. Box 1320
Yellowknife, NT X1A 2L9

T. 867-920-8771
F. 867-873-0288
E. Jim_Stevens@gov.nt.ca

The information contained in this PDR will be combined with similar information for the other sections of the Mackenzie Valley Highway from the GSA south to Wrigley and submitted as one project to the MVLWB. The regulatory review and approvals process is discussed further in Section 4.0 of this PDR. At the time of submission, DOT will be the proponent for the overall Mackenzie Valley Highway project. The GTC supports the information presented in this PDR and supports the submission of the overall project by DOT to the MVLWB for approval. As the proponent for the Mackenzie Valley Highway project, DOT, with support of the GTC, will take responsibility for mitigation commitments as presented in this PDR.

3.0 PURPOSE OF THE PROPOSED PROJECT

The purpose of this project is to construct 181 km of highway with provision for the installation of fibre optic cable within the GSA, as one component of the proposed Mackenzie Valley Highway Extension from Wrigley to Inuvik (approximately 800 km). On completion, the Highway will be operated and maintained as part of the Northwest Territories Public Highway system. The detailed design, construction and operation of the Highway will involve:

- Refinement of the locations for:
  - the Highway alignment;
  - stream crossings;
  - borrow sources; and
  - future installation of communications fibre optic cable (buried along the toe of the embankment).
- Development of supporting construction and maintenance infrastructure, including:
  - borrow sources – long term and temporary;
  - temporary winter access roads;
  - camps; and
  - fuel, equipment and materials storage locations.
- Construction of the Highway and associated bridge structures and stream crossings to connect with existing and proposed highways:
  - the Dempster Highway east/southeast of Inuvik; and
  - the Mackenzie Valley Highway at the southern boundary of the GSA.
- Decommissioning and restoring temporary borrow sources, construction camps and staging areas.
- Replacement or restoration and abandonment of components of the Highway (i.e., bridges, culverts, maintenance borrow sources, etc.) as they read the end of useful life or as operational needs change (i.e., increased traffic volumes, changes in technology, etc.).

The partnership for the preparation of the PDR for the Highway in the GSA consists of the GTC and DOT. Decision making for the preliminary design and the development of the PDR is by the Project Steering Committee which is represented by the President of the GTC and the Minister of Transportation, GNWT. The preparation of the preliminary design and the development of the PDR has included input from the GTC, the people of the GSA and DOT.

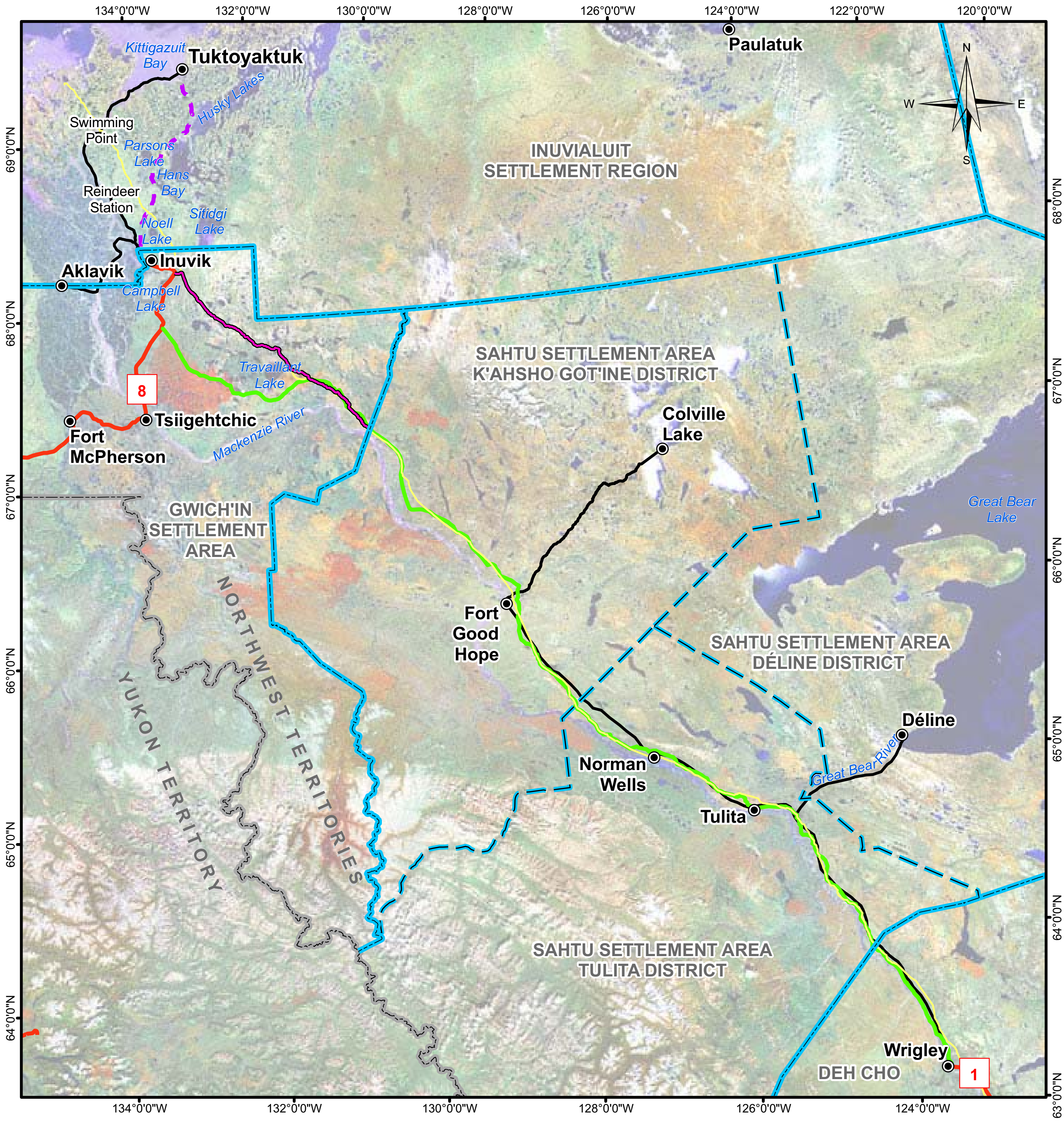
Figure 3.0-1 presents an overview of the proposed route for the Mackenzie Valley Highway between Inuvik and Wrigley and the connection from Inuvik to Tuktoyaktuk. The reasons for constructing a highway through the Mackenzie Valley have been, and continue to include:

- provision of a year round transportation link connecting the Mackenzie Delta and the Mackenzie Valley with the rest of the Northwest Territories and southern Canada;
- supporting resource exploration, development, and production to stimulate the regional economy;
- decreasing the cost of living for residents by increasing access to goods and services;
- increasing access to health care, educational resources, and employment opportunities;
- enabling opportunities for communities and families to interact and share social and cultural connections and participate in recreational and sporting activities;
- creating tourism and hospitality opportunities;
- reducing the cost of delivering government services;
- delivering government's commitment to economic development in the Northwest Territories; and
- more recently, the provision of fibre optic cable from southern Canada to the Arctic Ocean to enhance communications and support future development.

As is discussed further in Section 6.1, over several decades a number of initiatives have been completed and decisions made in support of the Highway. Of paramount importance is the April 1992 signing of the *GCLCA* The *GCLCA* designated a highway corridor within the GSA. It included a Notice of Intent for the Expropriation of Gwich'in Lands was identified in Schedule XVII (17) of the *GCLCA*. Further, *Nanh' Geenjit Gwitr'it Tigwaa'in, the Gwich'in Land Use Plan (GLUP)*, which came into effect in August 2003, includes special consideration to allow for the future construction of the Mackenzie Valley Highway Extension within the GSA. It is evident that there are a number of institutions with more than 10 years of operational experience in the governance of access to and use of lands and resources within the GSA.

In 2010, a MOU was signed between the GTC and DOT to set the terms for the completion of a PDR to construct the section of the Highway that will pass through the GSA. The concept of the Highway underwent review by Gwich'in leadership and DOT, resulting in the decision to consider a route that more closely followed the proposed MGP corridor rather than the route previously identified by Public Works Canada (PWC) in the 1970s.

The preferred alignment, shown on Figure 3.0-2, establishes a common infrastructure or transportation corridor (referred to as a Transportation Corridor) to accommodate transportation, utility, and communication infrastructure (highway, pipeline, fibre optic cable). Consolidating development has the benefit of reducing the overall effect on the land, wildlife, habitat, traditional land use areas, and cultural values in the GSA. As well, the decision to pursue a common Transportation Corridor makes best use of the extensive information gathered during the MGP environmental assessments, consultations, and review. A wealth of recent environmental, social, and economic information and consultation commentary was gathered and closely scrutinized with the prospect of building the pipeline. Much of that information has proven useful for designing and building the Highway and preparing this PDR for the Mackenzie Valley Highway in the GSA.



LEGEND

- Communities
- PWC 1974 Highway Concept Route
- Mackenzie Gas Project Corridor
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- Public Winter Road
- Proposed Inuvik to Tuktoyaktuk Highway (2009)
- Settlement Area Boundary
- District Boundary
- Territorial Boundary

NOTES
Base data source:
J.D. Mollard and Associates Limited. (February 2008).
Location of the Proposed Mackenzie Highway Extension.
NTS 1:250,000

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Mackenzie Valley Highway Overview

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:3,600,000
50 25 0 50
Kilometres

FILE NO.
V33101053_Figure3.0_1.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure 3.0-1

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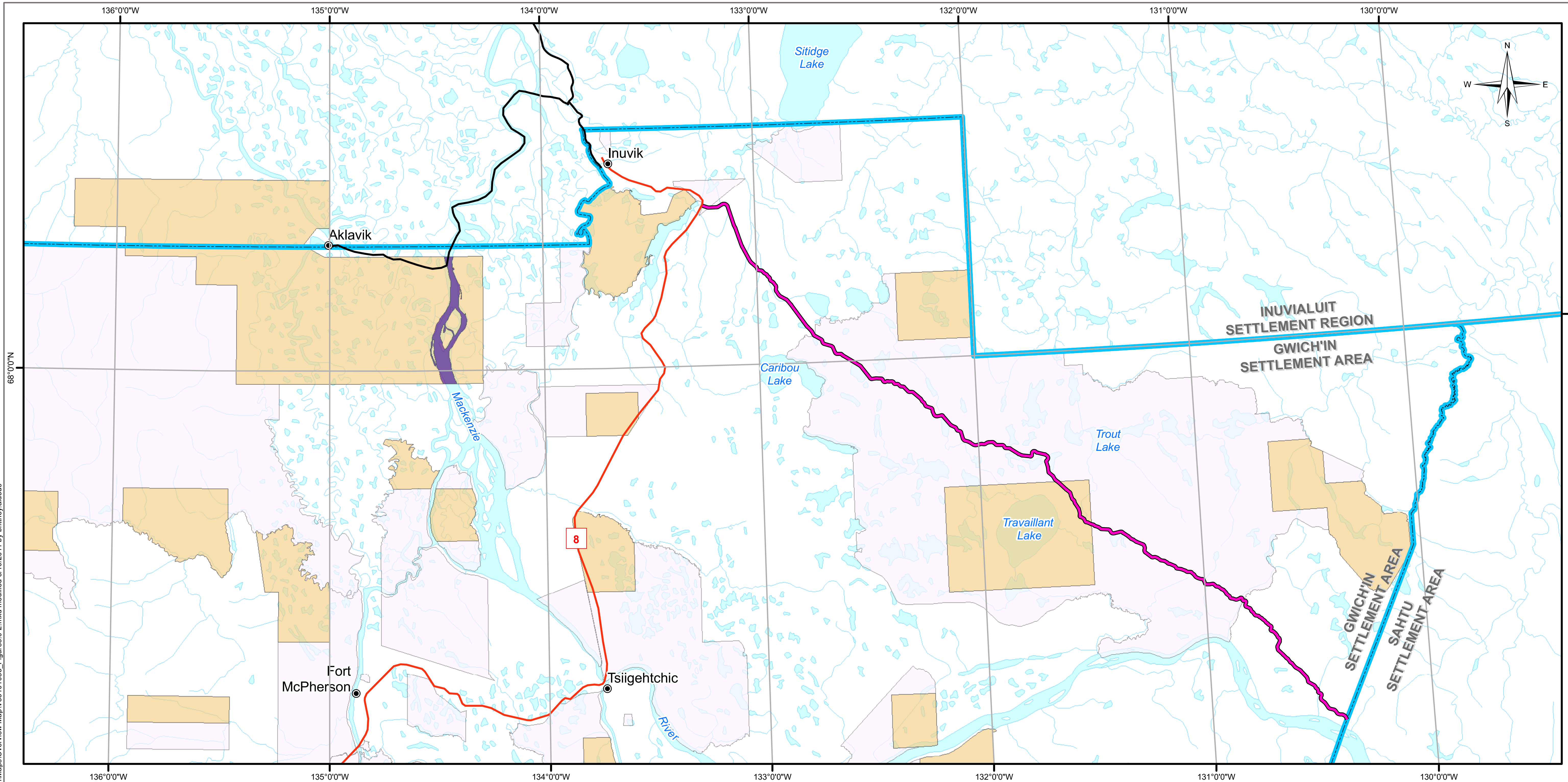


LEGEND

- Communities
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- Public Winter Road
- Settlement Area Boundary
- River
- Waterbody

Gwich'in Lands

- Subsurface Rights
- Surface and Subsurface Rights
- Surface Rights

NOTES

Base data source: NTS 1:250,000
Gwich'in Land Use Planning Board. (April 2010).
Draft Gwich'in Land Use Plan Revisions.
Gwich'in Land Use Planning Board. (August 2003).
Nanh' Geenjit Gwitr'it Tigwaa'in Working for the Land:
Gwich'in Land Use Plan.
Alignment is considered preliminary and is subject to change

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA

General Location of the Highway

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:750,000
10 5 0 10
Kilometres

FILE NO.
V33101053_Figure3.0-2.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Northwest Territories
Nehtruh - EBA

Figure 3.0-2

4.0 REGULATORY REVIEW AND APPROVALS

This section provides an overview of the regulatory processes and approvals that are anticipated for the Highway in the GSA, based on the applicable acts, regulations, guidelines, operational procedures, consultations with regulatory authorities and Gwich'in organizations, and the Mackenzie Valley Highway Extension Environmental Scoping Report (GeoNorth Limited and Golder Associates 1999).

During consultations in 2010 and 2011, the Designated Gwich'in Organizations (DGO), the Renewable Resource Councils (RRC), the Bands and Band Councils and regulatory authorities provided the Proponent with feedback and suggestions about the most likely regulatory review process that will be used for the GSA component of the Mackenzie Valley Highway. Discussions focused on the Highway within the GSA and acknowledged that this is one part of the larger endeavour to create the Mackenzie Valley Highway, an all-weather transportation link between Inuvik and Wrigley.

The Highway within the GSA and the overall Mackenzie Valley Highway is located within the Mackenzie Valley. The main statutes governing land and resource management in the Mackenzie Valley are the *Mackenzie Valley Resource Management Act* (*MVRMA)*, the *Mackenzie Valley Land Use Regulations*, the *Northwest Territories Waters Act*, and the *Northwest Territories Waters Regulations*. The Mackenzie Valley Highway crosses through GSA and the Sahtu Settlement Area (SSA), both of which have settled land claims. Each has its own Land and Water Board to administer the *MVRMA* and screen proposed activities and potential impacts. A third area, the Deh Cho, does not have a settled land claim, so in that area the *MVRMA* is administered by the MVLWB. The MVLWB has the mandate under the *MVRMA* to screen and regulate trans-boundary projects, which may prove to be the case for the Highway. Section 4.1 contains a description of the anticipated environmental impact assessment process and participant organizations, followed by a discussion of specific land, water, and other approvals that will be required. This chapter also identifies Gwich'in organizations and government agencies that have provided input to the development of the Highway, will contribute to regulatory review, and are expected to have ongoing involvement with the project through to its opening as a public highway. Additional communications with GSA organizations and regulatory authorities are provided in Section 9.0.

4.1 Anticipated Authorizations, Permits, Licences, or Other Approvals

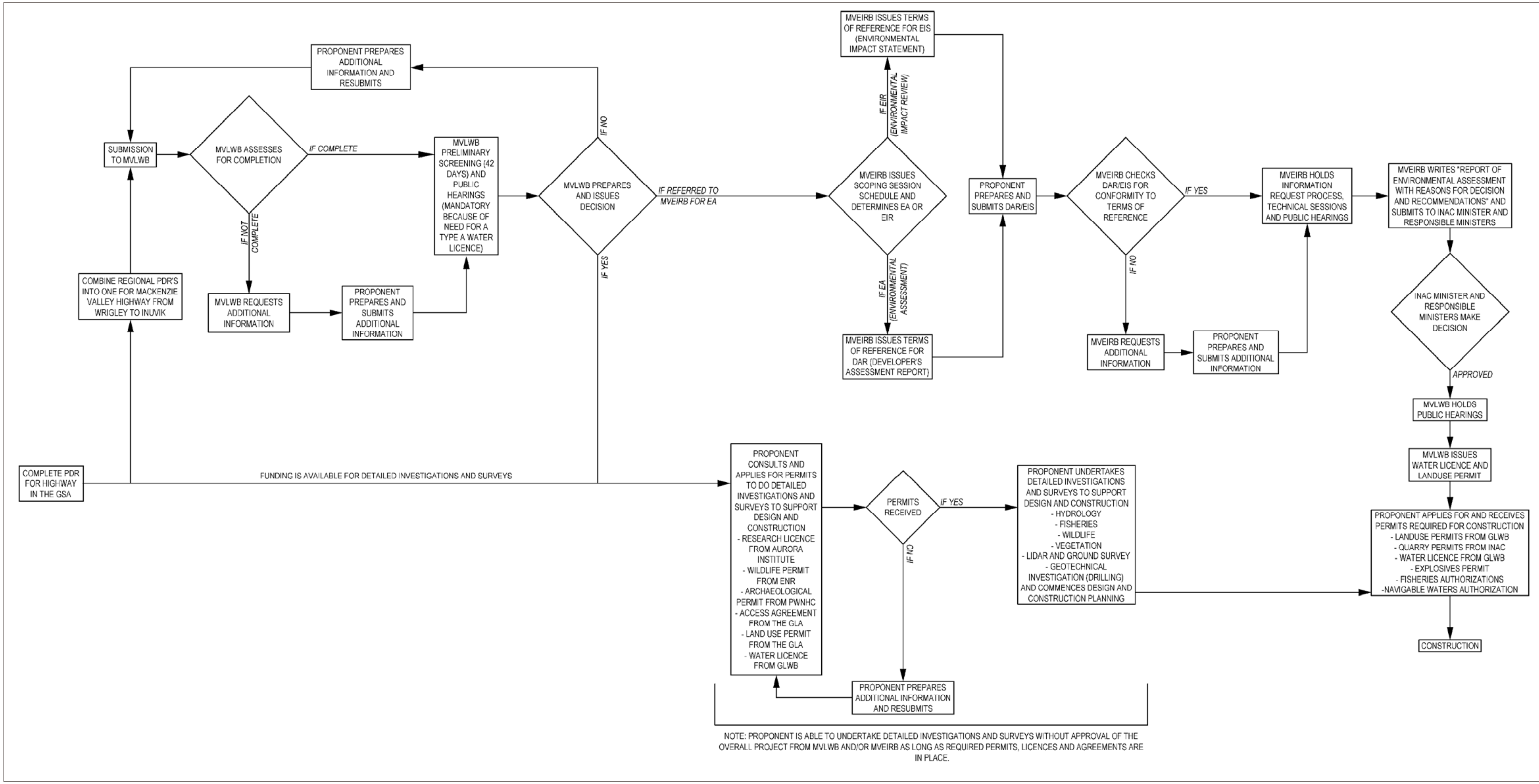
The following permits, licences and other authorizations are anticipated for the construction of the Highway and associated studies and assessments.

Table 4.1-1 Anticipated Authorizations, Permits, Licences or Other Approvals

Process, Authorization, Permit, Licence, Approval	Act and/or Regulation	Board, Agency, or Organization
Environmental Impact Assessment Process		
Preliminary Screening	*MVRMA*	To Be Determined — Gwich'in Land and Water Board (GLWB) or MVLWB
Environmental Assessment (as required)	*MVRMA*	Mackenzie Valley Environmental Impact Review Board (MVEIRB)
Environmental Impact Review (as required)	*MVRMA*	MVEIRB
Land		
Land Use Permit	*Mackenzie Valley Land Use Regulations*	GLWB
Quarry Permit	*Territorial Quarrying Regulations (Territorial Lands Act)*	Indian and Northern Affairs Canada (INAC)
Explosives Permit	*Explosives Act*	Natural Resources Canada (NRCAN)
Water		
Water Licence	*Northwest Territories Waters Regulations (Northwest Territories Waters Act)*	GLWB
Fisheries Authorization and/or Letter of Advice	*Fisheries Act*	Fisheries and Oceans Canada (DFO)
Navigable Waters Authorization	*Navigable Waters Protection Act*	DFO
Other		
Archaeology Permit	*Northwest Territories Archaeological Sites Regulations (Northwest Territories Act)*	Prince of Wales Northern Heritage Centre (PWNHC)
Research Licence	*NWT Scientists Act and Northwest Territories Act*	Aurora Research Institute (ARI)
Land Access and Development	*GCLCA*	GTC

Note: Based on GeoNorth Limited and Golder Associates (1999 p. 78).

The above noted authorizations range in duration from one year to a maximum of five years plus a possible two year extension, i.e., seven years. The order of submissions for various permits is illustrated on Figure 4.1-1



M:\TRANSPORTATION\NWT_Mackenzie_Highway\V33101053_Gwich'in\Maps\Overview Map\Figure4.1-1-Regularotry_Flowchart.mxd modified 5/3/2011 by brittney.aldous

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Regulatory Flow Chart

FILE NO. Figure4.1-1-Regularotry_Flowchart.mxd				
PROJECT NO. V33101053	DWN BA	CKD MS	APVD RM	REV 0
OFFICE EBA-RIV	DATE May 10, 2011			

STATUS
ISSUED FOR USE

Northwest Territories

Nehtruh - EBA

Figure 4.1-1

4.2 Environmental Impact Assessment

4.2.1 Preliminary Screening

The 1999 scoping study listed the following activities that will be required to construct the Highway:

- blasting;
- quarrying;
- use of heavy equipment;
- establishment of construction camps;
- building bridges;
- culvert installations; and
- right-of-way clearing (GeoNorth et al. 1999).

These activities are anticipated in the development of the Highway in the GSA and are discussed further in Section 6.0 of this PDR. These activities trigger preliminary screening under the *MVRMA*. After screening is complete and if the project does not get referred to an environmental assessment or environmental review by the MVEIRB, the delegated boards and agencies will process any applicable authorization, permit, licence, or approval submissions, as described below.

The purpose of preliminary screening is to assess whether the proposed activity, in this case the Highway construction, might have a significant adverse impact on the environment or might be a cause of public concern as defined under the *MVRMA* (s. 125 (1)(a)). To make this determination, the MVLWB will use the PDR submitted by the Proponent, which includes a description of the proposed development and related activities, the environmental context in which the development will be constructed, socio-economic information about the people and communities that might be affected by the development, and a summary of consultations held with communities and any other stakeholders in the area of the development, as provided in this PDR. In addition, the Board will use its knowledge and understanding of the area that could be potentially affected should the development proceed. The MVLWB will make the Proponent's submission available to landowners, stakeholders, regulators, and other organizations for their review and comments, and they may, at their discretion, choose to hold public meetings or hearings (GLWB 2010). The Proponent may be requested to submit supplementary information if requested by the MVLWB. The following sections describe the roles of the GLWB and the MVLWB in preliminary screening.

4.2.1.1 Gwich'in Land and Water Board (GLWB)

The GLWB is a regulatory authority established pursuant to the *GCLCA* and given effect by the *MVRMA* to provide an integrated and coordinated system of land and water management in the Mackenzie Valley of the Northwest Territories, which includes the GSA. The *Act* authorizes the Board to make decisions about the use of land and water by issuing, amending, renewing and suspending Land Use Permits and Water Licences throughout the GSA, which includes Crown land, and Gwich'in private lands (GLWB 2010).

When conducting preliminary screening, the GLWB has the responsibility to involve affected communities, the GTC, co-management Boards, and the appropriate government agencies.

In instances where a project is located solely within the GSA, the GLWB screens the project, renders its decision, and will issue the necessary land use permit(s) and/or water licence(s) and prepare associated terms and conditions. In May 2010, GLWB Executive Director, Mr. Robert Alexie, encouraged the Proponent to discuss the Highway with the MVLWB. Based on the fact that the Highway will ultimately cross more than one settlement area, it was his view that the MVLWB, and not the GLWB, would be the likely authority to conduct preliminary screening. The basis for and implications of MVLWB involvement is discussed in Section 4.2.1.2.

Regardless of which Board screens the project, the GLWB will play a role in issuing water licences and land use permits for the GSA component. While the GLWB issues these water licences and land use permits, the 'right' to access land and construct the Highway will need to be obtained from the Gwich'in Land Administration (GLA) on Gwich'in private lands and from INAC on Crown lands.

4.2.1.2 Mackenzie Valley Land and Water Board (MVLWB)

The MVLWB has three main functions:

- issuing land use permits and water licenses in the unsettled claims area until the balance of the land claims are settled in the Mackenzie Valley;
- processing transboundary land and water use applications in the Mackenzie Valley; and
- ensuring consistency in the application of the legislation throughout the Mackenzie Valley.

The mandate of the MVLWB is to regulate the use of land and waters and the deposit of waste so as to provide for the conservation, development and utilization of land and water resources in a manner that will provide the optimum benefit to the residents of the settlement area and of the Mackenzie Valley and to all Canadians (MVLWB 2011). Under the *MVRMA*, the MVLWB has authority to screen and regulate transboundary projects such as the Mackenzie Valley Highway. In December 2010, Mr. Jim Stevens, Director of the Mackenzie Valley Highway Project, received an informal (verbal) indication from Mr. Zabey Nevitt, Executive Director of the MVLWB, that the land use permit applications and water licence applications would, as per the *MVRMA*, appropriately be filed with the MVLWB. This is expected to be followed by a formal (written) communication closer to the time of submission.

In the sections that follow, the body conducting the preliminary screening will be termed the 'Land and Water Board' to indicate one of the two described in this section.

4.2.1.3 Mackenzie Valley Environmental Impact Review Board (MVEIRB)

Preliminary screening will determine if there is a need to advance the project to the second stage of review, termed 'environmental assessment', based on the potential for significant environmental effects and/or public concern. The MVEIRB will conduct the environmental assessment, and is authorized to do so under s. 126 of the *MVRMA* even if the project is not referred by the MVLWB. The MVEIRB may proceed based on a referral from a government department, agency, First Nation or local government, or on a motion of the MVEIRB.

Environmental impact review is the third possible level of environmental impact assessment under the *MVRMA*, and is a more detailed look at a proposed development project, its related activities and any socio-economic impacts. Impact review would be conducted by a panel of the MVEIRB, the body responsible for the preceding environmental assessment, and is based on the developer's Environmental Impact Statement which provides much more detail about the project development, expected impacts, and proposed mitigations. Because of its nature and the level of detail, an environmental impact review is a much longer process than an environmental impact assessment. If the project were to progress to environmental impact review, the project-specific review process would be defined based on the reviews and assessments that preceded it.

4.3 Land Authorizations

Land use permitting will be done by the Land and Water Board in accordance with the *Mackenzie Valley Land Use Regulations*. Land use permits may be required to conduct the following activities:

- clearing and construction within the Highway right-of-way;
- accessing borrow sources;
- use of explosives;
- borrow source investigations (depending upon equipment used); and
- establishing campsites, fuel and supply storage sites.

The construction of the Highway will require a Class A land use permit, based on the *Mackenzie Valley Land Use Regulations* activity thresholds. A Class A permit is required due to the proposed machinery that will be used to clear land; proposed land clearing that will exceed 1.5 m in width and 4 hectares (ha) in area; the quantities of fuel that may be stored on the alignment (container exceeding fuel capacity of 4,000 L or a fuel storage facility with a capacity of 80,000 L or more); and other project elements. Additional thresholds may apply, but the ones stated above indicate that a Class A land use permit will be required for construction.

While the Land and Water Board issues land use permits and water licences, it is necessary for the Proponent to obtain from INAC and the Gwich'in the 'right' to access Crown lands and Gwich'in private lands, respectively. Agencies and stakeholders are advised that discussions about land tenure, royalties, harvester compensation, and other related matters are ongoing.

4.3.1 Indian and Northern Affairs (INAC)

INAC is responsible for managing and issuing permits for granular resources on Crown lands under the *Territorial Quarrying Regulations*, negotiating access to Crown lands, inspecting and monitoring land use permit and water licence compliance, and providing guidelines for land use in northern Canada. To manage and issue permits for granular resources, INAC must balance the sometimes competing interests between proposed activities, community needs, and anticipated future needs. Any current or potential future competing interests must be identified and managed. Securing the necessary volumes of material will be instrumental to the project moving forward.

This PDR intends to outline for INAC the anticipated borrow material sources and project borrow material requirements to enable INAC's review of the project in the context of total known and estimated granular resources in the GSA (see Section 6.0 for currently available data). Note that the Proponent has yet to assess the planned borrow sources for material quality, quantity, ice content, and other critical characteristics. This information will be submitted to INAC when quarry permit applications are made. Following its review, and assuming the 'right' to the land has been negotiated and a land use permit is obtained, INAC will be the body that issues Quarry Permits for the Highway under the *Territorial Quarrying Regulations*.

As shown on Figure 3.0-2, 69.4 km of the 181 km Highway alignment is located on Crown lands. The Proponent will apply to INAC to conduct further necessary investigations and to construct the Highway across Crown lands.

In the GSA, the permitting and licensing of the proposed Highway will rest with the GLWB. Working with the Board, INAC's second key responsibility is to manage compliance with land or water authorizations under the *Mackenzie Valley Land Use Regulations* and *Northwest Territories Waters Regulations*, respectively. The Proponent will notify INAC in advance of activities on the project. As well, INAC's Operations Branch will conduct inspections of right-of-way clearing, water crossings, borrow sources, and temporary winter access roads to ensure the methods and approach are being applied in accordance with the project-specific terms and conditions.

4.3.2 Gwich'in Land Administration (GLA)

The GLA manages Gwich'in private lands. On behalf of the GTC, the GLA issues authorizations for land use activities (GTC 2011) and includes provisions that identify rights granted, term, conditions reporting requirements, environment, storage and waste, etc. The activities that will occur on Gwich'in private lands as a result of the Highway will include:

- research and investigative activities – borrow sources, archaeological assessments, fisheries assessments;
- establishing gravel pits and quarries (borrow sources); and
- constructing the Highway and associated infrastructure.

As shown on Figure 3.0-2, 111.7 km of 181 km Highway alignment is located on Gwich'in private lands.
The remaining is on Crown land but permits would come from the GLWB.

In May 2010, Ms. Mardy Semmler, Director, Lands and Resources of the GLA noted that when the PDR is submitted, the GLA will likely draft a letter to the Land and Water Board to accompany the document. This would serve the purpose of outlining the GLA's role and expectations going forward.

4.3.3 Gwich'in Land Use Planning Board (GLUPB)

The Gwich'in Land Use Planning Board (GLUPB) was established pursuant to the *GCLCA* in 1992. Soon after the GCLCA was signed, the GLUPB operated as an interim board until it was officially established by the *MVRMA* in 1998. The GLUPB developed and implemented the *GLUP* to which the GTC, the Federal Government and the GNWT are signatories. The *GLUP* provides for the conservation, development, and utilization of land, water, and resources in the Gwich'in Settlement Region (GSR) that are outside of municipal boundaries, an area just under 57,000 km^2. More specific information about Management Areas designated by the *GLUP* is provided in Section 8.4 of this PDR.

All licenses, permits, or other authorizations relating to the use of land, water or the deposit of waste in the GSR must conform to the *GLUP*. The *GLUP* anticipates future requests for development and has some flexibility with respect to conformance because the GLUPB, if requested, will consider making exceptions and amendments.

A possible route for the extension of the Mackenzie Valley Highway is contemplated in Section 4.6.2(ii) of the 2010 Draft Revision to the *GLUP*, which states,

> *A possible corridor for the extension of the Mackenzie Highway is identified in the Gwich'in Land Claim. Schedule XVII in Appendix F (volume 2) of the agreement is a notice of intent for the expropriation of Gwich'in Lands for the proposed Mackenzie Highway…the final alignment will be determined after more engineering studies and subject to consultation and negotiation with the Gwich'in Tribal Council. Even without a specific route, a Mackenzie Highway extension is a permitted use in all zones of the Plan because of this provision in the Gwich'in Land Claim (GLUPB 2010 p. 97).*

After the final route has been determined, the GLUPB will review the *GLUP* to assess the impact of the Highway on other land uses and is expected to propose an amendment to the *GLUP* (GLUPB 2003). Discussions with Ms. Susan McKenzie of the GLUPB in May 2010 confirmed that a request for exemption could be made at any time. This must be attended to in advance of the majority of other authorizations as the Plan states "Regulatory agencies may not issue a licence, permit, or authorization in Gwich'in Special Management Zones unless the proposed use is in conformity with the Gwich'in Land Use Plan" (GLUPB 2010).

4.3.4 Natural Resources Canada (NRCAN)

Explosives are expected to be required to access material at select borrow sources along the Highway alignment. The storage and use of explosives at a work site is administered by NRCAN under the *Explosives Act*. Appropriate approvals will be sought to enable use of explosives when required.

4.4 Water Authorizations

Water licensing for the Highway will be done by the appropriate Land and Water Board in accordance with the *Northwest Territories Waters Regulations*. Water licences will be required for the following project elements:

- major water course crossings;
- direct water use –road construction, dust suppression, winter road construction, etc.;
- water use by camps; and
- deposit of waste by camps.

The specifics of each of these activities will be determined as the project proceeds. The Land and Water Board will make the determination of which type of water licence is appropriate for the project. Based on the principle and ancillary activities involved in constructing the Highway, it will likely be deemed a Miscellaneous Undertaking as defined in the *Northwest Territories Waters Regulations*. The main factor influencing the project's requirement for a Type A or Type B water licence is the volume of 'direct water use' per day. The estimated maximum daily water volumes over the lifespan of the water licence will be 500 m^3 to more than 1,000 m^3 per day at peak usage and encompassing the full range of seasonal activities (see Section 6.0). A Type A licence will be sought to allow for the necessary daily direct water use, deposition of waste, construction of watercourse crossings, and other regulated activities.

4.4.1 Fisheries and Oceans Canada (DFO)

DFO is the regulatory for the *Fisheries Act* in the GSA. The DFO review of the project will focus on the potential effects of construction activities on fish habitat, which is protected under Section 35 of the *Fisheries Act*, as follows:

- Section 35(1) prohibits the Harmful Alteration, Disruption, or Destruction (HADD) of fish habitat; and
- Section 35(2) allows the Minister to authorize a HADD of fish habitat.

The Fisheries Act defines fish habitat to mean "…spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes."

To fulfill its responsibilities under the *Fisheries Act* Section 35, DFO established a Guiding Principle of no net loss of productive capacity of fish habitats to ensure that developments do not result in a diminishment, in quality or quantity, of fish habitats that support fish production. This no net loss principle, however, it does provide discretion to the Minister by allowing for the replacement of habitat losses [authorized under Section 35(2)] through the provision of approved habitat compensation.

DFO does not issue permits for a project. However, DFO is responsible for issuing a Letter of Advice for projects elements that are not expected to result in a HADD, or an Authorization for elements that constitute a potential HADD under Section 35(2). A Letter of Advice typically sets out guidelines and/or mitigation measures that, when followed, would prevent a HADD. An Authorization recognizes that a HADD is likely to occur; therefore, it includes an agreement between the Proponent and DFO for compensation that will achieve no net loss. These documents are intended to assist the Proponent with applying provisions under the *Fisheries Act* to their particular project circumstances, thereby supporting compliance with the Act by following the outlined conditions.

In addition, DFO has developed a series of Operational Statements that provide guidance to the Proponent regarding specific types of projects. Where Operational Statements apply and are followed, the Proponent does not need an approval from DFO. For example, in the Northwest Territories, DFO has published the following Operational Statements of potential applicability to the Mackenzie Valley Highway: clear-span bridges; ice bridges and snow fills; temporary stream crossings; culvert maintenance; and, maintenance of riparian vegetation in existing rights-of-way.

4.4.2 Transport Canada

Transport Canada is responsible for issuing permits under the *Navigable Waters Protection Act*. Under the *Navigable Waters Protection Act and Regulations*, the project will require a permit for the construction of stream crossings (bridges or culverts). The Act requires approvals to be obtained for any structure that may interfere with navigation if it is constructed in, on, over, under, through or across any navigable water bodies. An application will be submitted to Transport Canada after bridge and/or culvert design reaches the necessary level of completeness for the assessment of the proposed structures at each potentially navigable stream crossing. Larger streams crossed by the Highway will constitute navigable waters.

4.5 Other Authorizations and Consultations

4.5.1 Gwich'in Renewable Resources Board (GRRB)

The Gwich'in Renewable Resources Board (GRRB) is a co-management board established under the *GCLCA*. The GRRB is a public board that is intended to be "the main instrument of wildlife, fish and forest management in the GSA" (GRRB 2011). The GRRB works to sustainably conserve and manage these renewable resources in the GSA, in the belief that the people are responsible for using, protecting and conserving the resources working as partners with the GRRB. The GRRB is comprised of a mix of Gwich'in participants and government representatives (territorial and federal). The GRRB works closely with the RRCs in Inuvik, Aklavik, Fort McPherson, and Tsiigehtchic.

The GRRB coordinates management of renewable resources by involving Gwich'in, government, researchers and other management organizations. It funds research about renewable resources in the GSA and has a wealth of information about wildlife, fisheries, forestry, harvesting, and Gwich'in Environmental Knowledge. The GRRB prepares and maintains a number of management plans for the above-noted resources and activities, and set total allowable harvest levels for plants, animals, birds, and fish (GRRB 2010).

The GRRB is called upon by the GLWB, the GLUPB, and the GLA to review and provide feedback regarding the adequacy of the assessment with regard to potential effects on renewable resources in the GSR.

4.5.2 The Aurora Research Institute (ARI)

The ARI is responsible for scientific research licensing in the Northwest Territories under the *Northwest Territories Scientists Act* and the *Northwest Territories Act*.

ARI's purview includes work with the physical, social, and biological sciences as well as indigenous knowledge. Through the research licensing process, information about research work in the Northwest Territories is shared with other researchers and northern residents. Part of the mandate of ARI is to distribute or make available research summaries to community organizations, media, and other researchers. In addition, research information is added to existing and developing scientific databases (ARI 2011). As the Highway project progresses, additional fieldwork is anticipated. The appropriate research licences will be applied for and obtained prior to the conduct of field programs including detailed fisheries assessments at major stream crossings, geotechnical investigations at borrow sources and along the alignment, and studies with sampling and ground-based activities beyond the scope of the helicopter visual reconnaissance that was completed in 2010.

4.5.3 Prince of Wales Northern Heritage Centre (PWNHC)

The PWNHC administers the *Northwest Territories Archaeological Sites Regulations* under the *Northwest Territories Act*. Archaeological permits are required to conduct archaeological studies in the Northwest Territories. This permitting and reporting requirement is in effect at the preliminary reconnaissance stage, as in 2010, and at the pre-construction and construction stages that are yet to come. One aspect of the information sharing involved in Northwest Territories archaeological work is that Highway project archaeologists are given privileged access to information about heritage and archaeological resources in order that they use the information to guide development for the protection of these resources beginning at the planning stage. In this way, the archaeologist's contributions within the project team represent heritage and archaeological values without divulging the specific location or nature of the artifact, feature, or sacred site to see to its protection and preservation.

4.5.4 Gwich'in Social and Cultural Institute (GSCI)

The Gwich'in Social and Cultural Institute (GSCI) is responsible for cultural and heritage values, as established under the *GCLCA*. The GSCI was established in 1993 as a non-profit society with charitable status and a mandate to document, preserve and promote the practice of Gwich'in culture, language, traditional knowledge and values. The GSCI is the cultural and heritage arm of the GTC.

The GSCI and its archaeologists have contributed their knowledge and project-specific traditional knowledge to this PDR. The GSCI's continued involvement will further assist with pre-construction assessments and developing appropriate approaches to the Highway construction project from the perspectives of the land and the people.

4.5.5 Government of Northwest Territories, Department of Environment and Natural Resources (ENR)

Environment and Natural Resources (ENR) is responsible for issuing Wildlife Research Permits under the *Northwest Territories Wildlife Act*. This may include habitat and wildlife species surveys and monitoring associated with more detailed pre-construction assessments (ENR 2011).

4.5.6 Other Organizations, Government Agencies, and the Communities

In addition to those mentioned above, there are several other organizations and government agencies and departments who will receive the Highway PDR and be engaged to supply their comments to the Land and Water Board during preliminary screening.

Ongoing consultations with the Gwich'in Communities, the DGOs, the RRCs and the Bands and Band Councils are fundamental to the Highway project. The Proponent has made a commitment to the communities to welcome inputs and questions as well as facilitate information sharing and participation from project inception through to Highway construction and operations. Summaries of these community consultations are provided in Section 9.0.

5.0 LOCATION

The general location of the Highway is shown on Figure 3.0-2. The Highway is located south of the Town of Inuvik and extends to the eastern boundary of the GSA, Northwest Territories. The Highway is approximately 181 km from the junction of the Dempster Highway to the boundary of the GSA.

The latitude and longitude coordinates for where the Highway meets the Dempster Highway and the boundary of the GSA/Sahtu Settlement Area are provided below:

- Dempster Highway and the Highway: Latitude, Longitude – 133°14,47.18", 68°16'44.97".
- The Highway and the GSA/Sahtu Settlement Area boundary: Latitude, Longitude –130°23'48.13", 67°19'40.64".

The Highway within the GSA forms the northern end of the overall extension of the Mackenzie Highway (NWT Hwy 1) from just south of Inuvik (a junction with the Dempster Highway) to the existing all-weather highway at Wrigley, Northwest Territories.

6.0 DEVELOPMENT SUMMARY

This section presents an overall discussion of the development of the Highway in the GSA. Historical or background information on the earlier work from the 1970s, 1980s, and 1990s is outlined to provide an understanding of the history of development. A discussion of alignment options is presented to demonstrate that the historical work has been useful in the current development of the Highway. Design parameters, a description of the physical infrastructure, quantity and cost estimates, and construction approach are also presented. To summarize:

- The work undertaken in the development of the preliminary design for the Highway and the PDR builds on the previous work that has been undertaken since the early 1970s.
- The physical infrastructure includes an 8.5 m wide gravel driving surface with horizontal and vertical alignment designed to support an operating speed of 80 kph. The design approach is one of fill only for the embankment construction, to avoid cutting into the natural ground and impacting permafrost. There are seven major (greater than 40 m or multi-span) bridge structures (all single lane with the exception of a two lane structure at Thunder River) and 135 smaller stream crossings that have been identified for either culverts or small bridges. Single lane bridges meet the requirements for traffic volumes and safety. A two-lane structure at Thunder River is required because there is insufficient sight distance on approach to see a vehicle ahead crossing the bridge from the opposite direction. The preliminary design also considers the potential for future installation of fibre optic cable. Maintenance camps and emergency shelters will be included. The specific location of these permanent facilities along the Highway will be determined in the detailed design stages of the project development.
- The alignment options considered in the preliminary design include the alignment defined by the Federal Government in the early 1970s, a routing study undertaken in the development of this PDR, and the MGP alignment, with an overall consideration of developing a common Transportation Corridor for linear infrastructure. The preliminary design, location of the Highway, and location of potential borrow sources also consider avoiding areas of heritage value, traditional use, and environmental sensitivity.
- The preliminary estimate for material required for construction of the Highway is over 7 million cubic metres. Thirteen potential borrow sources have been identified along the Highway and ten of these are on Gwich'in lands. All of the potential borrow sources, bridge crossings, and the Highway alignment will require geotechnical investigation and surveys to support the detailed design, borrow source management, and construction planning in the next steps in the project development.
- The preliminary cost estimate for the Highway is over $369 million, and this includes engineering, design, construction administration, environmental monitoring, and construction.
- Most of the embankment and bridge construction will take place in the winter months. Summer activities will include compaction of the embankment, and placing of surfacing gravel. Construction will be from both the north and south limits of the Highway, with access provided from the Dempster Highway and a temporary staging area that will be developed at Little Chicago, approximately 30 km south of the project. Once approvals are in place, construction will be an

accelerated approach with large scale plant and multiple spreads, with design staying just ahead of construction. Construction of the Highway is anticipated to take place at the same time as construction in the other regions. The estimate for overall completion is three and a half years after approvals for construction are in place.

6.1 Historical Development of the Mackenzie Valley Highway

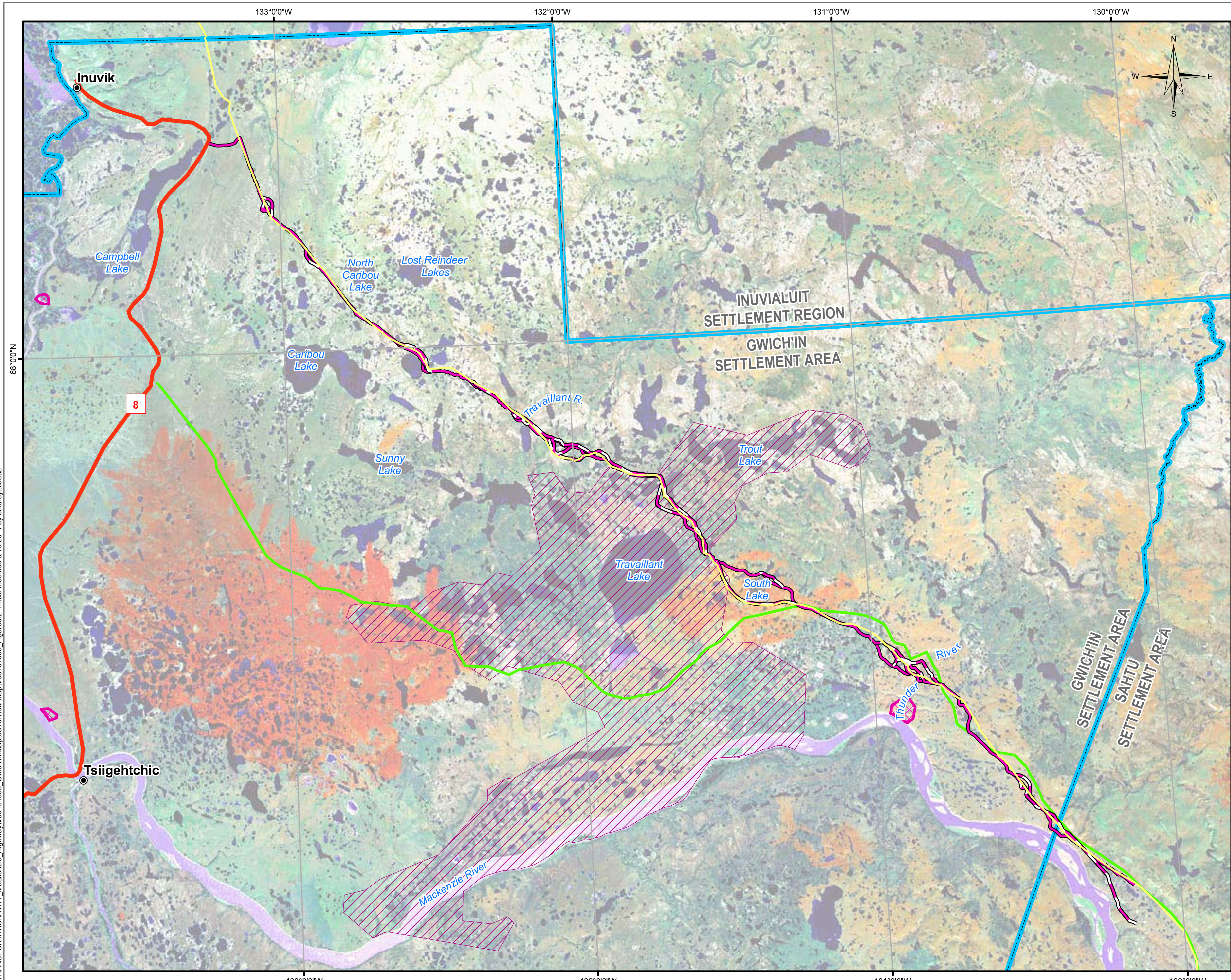
6.1.1 Federal Government and the 1970s

The overall highway concept through the Mackenzie Valley is shown on Figure 3.0-1. In 1972, the Federal Government began steps towards the development of an all-weather highway from Fort Simpson (the terminus of the all weather highway in 1972) to the Dempster Highway. At the time, an ambitious schedule of preliminary engineering, design, and construction being undertaken over a four year period was proposed for the extension of the Highway north from Fort Simpson. Survey, geotechnical investigation, environmental studies, bridge and culvert designs, and for some sections, detailed design and tender package preparation were undertaken, but actual construction of the highway ceased in 1977 just south of Wrigley. Subsequently, only a 210 km section from Fort Simpson to south of Wrigley had been constructed (DOT GNWT 1989).

The highway alignment that was proposed and studied in the 1970s by Public Works Canada (Federal agency responsible at the time) is shown on Figure 6.1.1-1. The highway alignment proposed at the time, within the GSA, runs parallel to the Mackenzie River, south of Travaillant Lake and then turns northwest to intersect with the Dempster Highway approximately 60 km south of Inuvik.

Provisional grading contract packages for grading and concept designs for major bridge structures were developed in the 1970s. Although the desire in the 1970s was a four year period for design and construction, when the grading contract packages were developed, the estimates for construction were eight years for the full highway from Fort Simpson to the Dempster and relied on construction resources from both northern and western Canada.

The basic design parameters that were considered in the 1970s were for a 60 mile per hour (mph) gravel surfaced highway with double lane bridges. The design and construction approach was one of embankment overlay or fill, to avoid cuts in permafrost and ground of high ice content. This is a design and construction approach that is intended to mitigate thawing of unstable ground and is a best practice that is carried forward today.



LEGEND

- Communities
- MVH Concept - June 2010
- MVH Concept - June 2010, Alternative
- Dempster Highway (NWT HWY 8)
- PWC 1974 Highway Concept Route
- Mackenzie Gas Project Corridor
- Heritage Conservation Zone
- Conservation Zone
- Settlement Area Boundary

NOTES
Base data source: ESRI Base Data
NTS 1:250,000

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Alignments Considered in 2010/11

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:550,000
10 5 0 10
Kilometres

FILE NO.
V33101053_Figure6.2-1.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure 6.1.1-1

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6.1.2 Department of Transportation (DOT), Government of the Northwest Territories (GNWT) and 1980s and 1990s

In the early 1980s, still under the authority of the Federal Government, the highway grade was completed to Wrigley, but an all weather connection was still not in place given that Camsell Bend (N'Dulee Crossing) did not have a ferry (winter crossing only) and a major bridge crossing was not in place at Willow Lake River just south of Wrigley (DOT GNWT 1989).

In 1989, the Federal Government devolved the authority over the highway system to the GNWT and an overall Transportation Strategy was developed for the Northwest Territories. The Transportation Strategy set out the priorities for the Northwest Territories in the coming years, including the extension of the Mackenzie Highway. As input to this strategy, the Transportation Engineering Division of DOT prepared a report entitled "Mackenzie Highway, Wrigley to Inuvik Extension" (DOT GNWT 1989). This report outlines the previous work on the highway completed by the Federal Government in the 1970s and provides an updated cost estimate. For the most part, the alignment, design standards, and construction approach for the highway were unchanged with the exception of consideration of single lane bridges (rather than two lane bridges) and a tender/construction approach that shortens the estimated eight years to six or seven years by increasing the number of grading contracts that are underway at any one time, or combining shorter single year contract segments into larger multi-year contract segments. The approach at this time still focused on delivery by available local forces.

At the time of devolution of the highway system and as is still the case, DOT does not have the financial basis to undertake construction of new infrastructure. Federal funding was, and is, still required. The additional development work on the Highway that was completed in this period was the installation of a ferry camp and vessel at N'Dulee Crossing in the early 1990s and the completion of the 210 m, two span Willow Lake River Bridge in 1994. This connected the community of Wrigley to Fort Simpson on an all weather basis, but did not serve to connect the communities in the Sahtu and GSA. During this period, DOT also undertook to review the implementation plan for the Mackenzie Highway Extension and in 1992, published a report entitled "Implementation Plan for the Mackenzie Highway Extension". This report focused on construction by local forces and proposed a 20 year time frame to optimize local economic benefits.

In 1999, as part of an update to the Highway Strategy, DOT undertook three companion studies to update the Mackenzie Valley Highway initiative. The three studies were an engineering update, an environmental scoping study, and a benefit/cost analysis. The engineering update focused on the proposed highway alignment from the 1970s, but proposed a modification to the design standards. For the most part, the highway would be designed to allow an operating speed of 80 kph to 90 kph, but some sections would be designed to only allow for a 60 kph operating speed to compensate for some of the challenges associated with the local relief (DOT GNWT 1999). The 1999 report provided an updated cost estimate but still focused on a community based construction approach over a time period that could likely extend beyond 10 years.

6.1.3 Department of Transportation (DOT), Government of the Northwest Territories (GNWT) and the Gwich'in Tribal Council (GTC)

In 2010, a MOU was signed between the GTC and DOT to set the terms for the completion of a PDR to construct the section of the Highway that goes through the GSA. In launching this new chapter in development of the Highway, the work completed in 1970s and 1990s has been reconsidered by Gwich'in leadership and DOT. The GTC and DOT began the process by looking at route options in 2010 that follow the proposed MGP route. In the long-term view, the 145 km MGP corridor (within the GSA) offers some distinct advantages over the 1970s highway route. Ultimately, the GTC's view is to establish a single Transportation Corridor that reduces the overall environmental impact to the land. This approach results in transportation, utility, and communication infrastructure (highway, pipeline, fibre optic cable) in a single development corridor that protects the land, wildlife habitat, traditional land use, and cultural values. As well, during the MGP studies, a wealth of recent, high quality environmental, social, and economic information was gathered and closely scrutinized with the prospect of building the pipeline. Much of the information that is publically available from the MGP studies is transferrable to the Highway project and has been useful for undertaking the preliminary or conceptual design for the Highway as presented in this PDR.

6.2 Alignments Considered in 2010/2011

The alignment options considered in the preliminary design for the Highway are illustrated on Figure 6.1.1-1. These are:

- Public Works Canada 1970s alignment;
- MGP alignment; and
- alignment options for specific segments identified in the 2010 routing study and field program.

These options and how they are considered in the preliminary design for the Highway are discussed below.

6.2.1 Public Works Canada 1970s Alignment

The Public Works Canada alignment from the 1970s is noted as PWC 1974 Highway Concept Route on Figure 6.1.1-1. As noted above, a considerable amount of survey, geotechnical investigation, and preliminary design was undertaken along this proposed alignment in the period between 1972 and 1976. The idea to intersect the Dempster highway at a point approximately midway between Inuvik and Tsiigehtchic (then Arctic Red River) may be to provide more immediate access to the junction of the two highways from the southern Gwich'in communities, or alternatively, it may have been the most reasonable route from a terrain and topography standpoint to avoid the shores of the Mackenzie River and the high number of waterbodies northeast of Tsiigehtchic.

At the time of the development of the original alignment, the *GLUP* was not yet in place and the Heritage Conservation Zone around Travaillant Lake was not identified. Approximately one third of the PWC 1974 alignment transects the southern portion of the Heritage Conservation Zone between Travaillant Lake and the Mackenzie River.

The southern portion of this alignment in the GSA was one of the two starting alignments that were used in the development of this preliminary design and project description.

6.2.2 Mackenzie Gas Project (MGP) Alignment

The MGP alignment that is currently identified in the available public information is shown on Figure 6.1.1-1. It is accompanied by a 1 km wide pipeline corridor that the pipeline and most of the associated facilities are identified within. The pipeline itself meanders within that 1 km wide corridor. The southern third of the pipeline within the GSA follows a path similar to the PWC 1974 highway alignment but diverges north around Travaillant Lake and heads generally in the northwest direction towards Inuvik. Although the pipeline continues northward approximately 20 km to 25 km east of Inuvik, a 5 km facility access road is proposed to connect to the Dempster Highway approximately 20 km south of Inuvik, near Campbell Lake.

The MGP alignment also transects the north part of the Heritage Conservation Zone around Travaillant Lake. Information received during the consultation sessions for the Highway indicated that initial MGP plans showed the alignment much closer to Travaillant Lake and that through consultation with the community members at the time, the alignment was moved a further distance to the north, away from Travaillant Lake.

The MGP alignment and the available information was the second of the two starting alignments used in the development of this preliminary design and project description.

6.2.3 Transportation Corridor and Initial Routing Study

As noted above in Section 6.1, the GTC's view is to establish a single Transportation Corridor that reduces the overall environmental impact to the land. This approach results in a transportation, utility, and communication infrastructure (highway, pipeline, fibre optic cable) in a single development corridor that protects the land, wildlife habitat, traditional land use, and cultural values. With this in mind, initial routing studies were undertaken to identify a preliminary alignment and minor options that was in the general vicinity of the MGP. Only the southern most third of the PWC 1974 alignment was considered in these initial routing studies. The two thirds of the PWC 1974 alignment that runs south and west of Travaillant Lake was not considered further as it did not meet the primary objective of a common Transportation Corridor for multiple infrastructure developments that minimizes the impact on the land and the environment, and in particular minimizes the footprint of development through the Heritage Conservation Zone that surrounds Travaillant Lake.

Historically, two-thirds of the newly conceived corridor did not have previous highway routing studies. Using available topographic maps, air photo imagery, and other available information, an initial desktop routing study was undertaken to define a preliminary highway alignment and minor alternatives, potential stream crossing locations, and potential material sources. The development of the initial routing was based on the following constraints:

- avoid ice rich and unstable terrain;
- avoid steep grades and deep valleys;

- find locations to cross major streams to minimize bridge lengths;
- avoid locations that are obvious nesting or denning areas for wildlife;
- avoid locations that have obvious cultural or heritage potential;
- situate the route on or near potential borrow sources to minimize the need and/or length of temporary or permanent access roads;
- minimize need to cross the MGP; and
- minimize infrastructure footprint by selecting a route near the MGP while maintaining sufficient tree or vegetation screen between the Highway and the pipeline (minimum 50 m from the pipeline alignment).

The initial routing study was the basis for the June 2010 field program and the preliminary design. The outcome of the routing study was the preliminary highway alignment and minor alternatives that is shown on Figure 6.1.1-1. This information was used as the basis of the initial field program undertaken in June 2010 by environmental, engineering and archaeology specialists. The field program produced observations along the preliminary highway alignment and minor alternatives that were then used for the environmental and heritage resources overviews. These overviews are documented in other sections of this PDR. The overviews, the observations by the engineering specialists on the field program and the information received in the initial consultations were then used to commence the preliminary design and refine the alignment further.

6.3 Design Parameters for the Highway

The preliminary design begins with further development of the constraints outlined above in the initial routing studies into specific design parameters. These are based on operational and safety considerations for the Highway (traffic volumes, types of vehicles expected to use the highway, desired operating speed), accommodation and protection of permafrost and ice rich terrain, avoiding or minimizing impact to areas described as sensitive in the environmental and heritage resources overviews, and respect for questions and comments raised in the consultations.

Design parameters are based on published and accepted guidelines and best practices for developing infrastructure in the Northwest Territories. DOT has reviewed and accepted the design parameters developed for the Highway. Working within a permafrost region such as this, particularly in the face of the impacts of climate change on permafrost, requires extensive consideration of past experience (both good and bad) and adaptation of engineering principles and practices. The specific impacts of climate change and the adaptation in the preliminary design is discussed in a later section of this PDR; however, it is important to note that a recently published guideline entitled "Development and Management of Transportation Infrastructure in Permafrost Regions" (Transportation Association of Canada 2010) was referred to in the development of the preliminary design and construction approach for the Highway in the GSA.

The design parameters considered in this preliminary design are based on estimated traffic volumes and other operational considerations on public highways in the Northwest Territories. The estimated traffic volumes for the Highway are 50 vehicles per day (very low) with an estimated 13% to 15% of those as heavy truck traffic. Using this and the accepted design practices in the Northwest Territories for public highways, the specific design parameters have been obtained from the Geometric Design Guidelines published by the Transportation Association of Canada. The embankment height is specific to the terrain conditions in the Mackenzie Valley and is based on the need to protect permafrost and ice rich soils from degradation under traffic loading and the presence of the highway infrastructure.

The following table presents a summary of the design parameters used in the preliminary design for the Highway.

Table 6.3-1 Design Parameters

Design Criteria	
Desired Road Design Speed	90 kph
Minimum Road Design Speed	80 kph
Horizontal Alignment	
Desired Curve Radius	340 m
Minimum Curve Radius	250 m
Desired Sight Distance	n/a
Minimum Sight Distance	n/a
Vertical Alignment	
Minimum Passing Sight Distance	n/a
Minimum Stopping Sight Distance	n/a
Minimum Sag K Value	13
Minimum Crest K Value	25
Minimum Lengths of Vertical Curves	80 m
Desired Maximum Grade	6%
Maximum Grade	8%
Cross-Section	
Desired Finish Top Shoulder Rounding to Shoulder Rounding	9 m
Minimum Finish Top Shoulder Rounding to Shoulder Rounding	8.5 m
Lane Cross Fall	3%
Superelevation	6%
Minimum Side Slopes – All Sections	3:1
Embankment Height	
Dry (ice poor) Till and Outwash Deposits	1.4 m
Wet (ice medium to ice rich) Till and Outwash Deposits	1.4 m to 1.6 m
Wet Silts and Clays (ice rich)	1.6 m to 1.8 m
Thick Organic Peatlands and Ice Rich Permafrost	1.8 m
Thickness of Base Course Gravel	200 mm to 300 mm

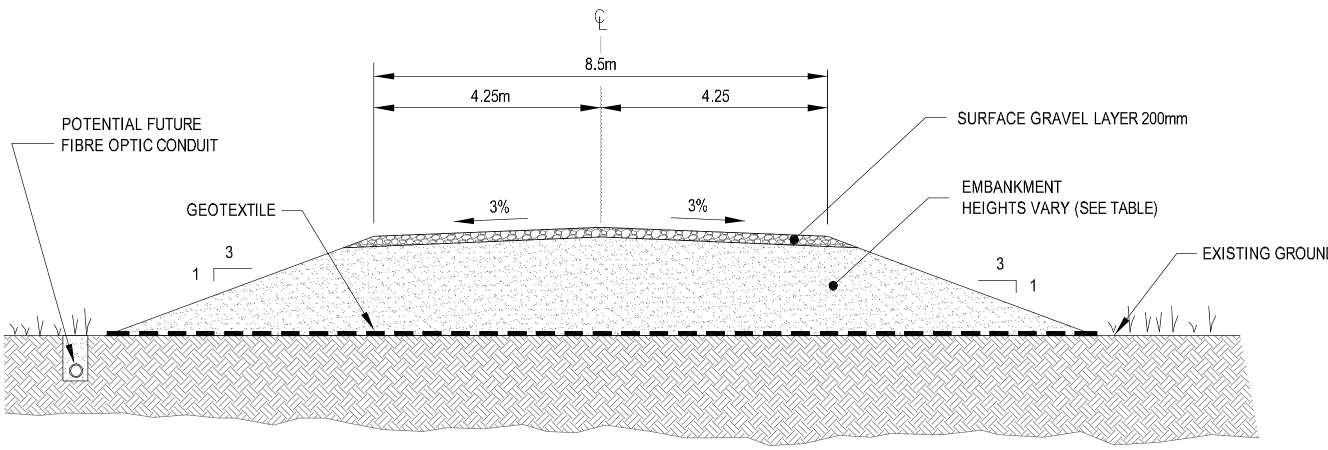
A typical highway cross-section is illustrated on Figure 6.3-1.

These design parameters are recognized as desirable. For the most part, the preliminary design meets or exceeds the design parameters. It is not unusual for there to be design exceptions introduced into a highway design, if it is understood that operational controls can be introduced and reductions in operational level of service over short distances are acceptable. An example of an operational control is a reduced speed limit through a tighter curve and an example of a reduction in operational level of service is a larger vehicle travelling slower over a short but steeper hill. In the current preliminary design, there are design exceptions where the Highway crosses the Thunder River (km 1363, Crossing No. 1360D). The approaches to the bridge (both north and south) are designed with 9% grades and 190 m radius horizontal curves have been introduced that will potentially require a reduction in operating speed to approximately 70 km an hour to comfortably negotiate the curves. It is important to note that these are the only exceptions at the preliminary design stage and when a greater level of information is available through the next steps (field investigation and survey) it is likely that these few design exceptions can be eliminated during the detailed design.

The bridge concepts were developed with consideration given to constructability requirements in remote areas and the utilization of standardized span lengths and substructure components to minimize structural fabrication and erection costs. In addition, the bridge concepts were selected to meet the requirement of minimizing environmental impacts by ensuring that the bridge structures were set back from the edges of the riparian vegetation and banks at the crossing locations. Varying site constraints were also accounted for, including the road alignments and profiles, river and creek alignments and bank widths, embankment fill heights, and existing ground contours.

The Highway will be positioned within a cleared right-of-way that is typically 60 m wide. In some locations, where the height of the Highway to be constructed is quite high relative to the natural ground and the toe of the slope of the embankment extends more than 30 m from the centerline of the Highway on either side, then the right-of-way through these segments will be wider to accommodate the infrastructure. Additional right-of-way will also be required at major bridge crossings, maintenance camps, and in areas where pull-offs and chain up areas are necessary to support safe travel. The total footprint of disturbance will also include temporary access roads and development of borrow sources. Right-of-way and footprint of disturbance will be determined at the detailed design stage. The estimate for right-of-way and footprint of disturbance is approximately 1,300 ha based on the preliminary design undertaken for this PDR. It is not anticipated that the full width of a Transportation Corridor as discussed earlier would be cleared, but it is possible that in the future, rights-of-way for parallel developments (i.e., Highway and pipeline) may overlap within that Transportation Corridor.

Based on a review of the typical road profiles and proposed bridge concept, the bridge crossings were typically selected to provide a maximum 5 m fill height at each bridge abutment. These relatively high approach fills are able to be contained utilizing precast concrete backwalls and return walls designed integral with the bridge superstructure to resist the lateral soil pressures. The proposed bridge design will reduce the overall length of the bridges without requiring a mechanically stabilized earth wall retaining system and associated select granular backfill material. In some cases, the optimal bridge concept may require that the approach fills increase to over 7 m and in these locations, a combined lower retaining wall system utilizing metal bin walls or H-pile retaining walls combined with the typical precast concrete abutment backwalls and return walls. The type of piles (either driven or ad-freeze piles) will be confirmed in the detailed design stage when the geotechnical information at each bridge site is available.



TYPICAL HIGHWAY CROSS SECTION

TERRAIN TYPE	DESCRIPTION	EMBANKMENT HEIGHTS
1	DRY (ICE POOR) TILL AND OUTWASH DEPOSITS	1.4 m
2	WET (ICE-MEDIUM TO ICE-RICH) TILL AND OUTWASH DEPOSITS	1.4 to 1.6 m
3	WET SILTS AND CLAYS (ICE-RICH)	1.6 to 1.8 m
4	THICK ORGANIC PEATLANDS AND ICE-RICH PERMAFROST	1.8 m

LEGEND

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Typical Highway Cross Section

PROJECTION

DATUM

Scale 1:150

1 0 1 3m

FILE NO.
V33101053 - Typical section.dwg

PROJECT NO. V33101053 | DWN SM | CKD RM | REV 0

OFFICE EBA-VANC | DATE JANUARY 13, 2011

Northwest Territories

Nehtruh - EBA

Figure 6.3-1

In addition to minimizing the total lengths of the bridges through the use of relatively high approach fills, the use of common spans and precast elements is proposed to simplify fabrication and construction and to achieve additional cost saving. The proposed bridge superstructures will consist of simply supported steel plate girders with composite precast concrete deck panels and either timber or steel guardrail alternatives. Common superstructure span lengths of 30 m, 40 m, 50 m, and 65 m have been used in the conceptual bridge designs. The proposed substructures consisting of steel pipe pile supporting precast concrete pile caps, precast backwalls, and return walls are typical at the abutments. It is anticipated that all steel and precast components on these bridges shall be prefabricated off site to ensure quality of work and to expedite the construction. The use of common details and geometry shall reduce fabrication costs and provide ease in the procurement process and flexibility in the construction schedule.

The design criteria used in the preliminary design of the seven major bridges is summarized as follows:

- Can/CSA-S6-06 Canadian Highway Bridge Design Code;
- Live Load: CSA CL625, Class C Highway (250 Average Daily Truck Traffic);
- Overload Truck: Permitted Overload Vehicles only;
- Climatic Loads: Site Specific (will be determined in detailed design stage);
- Steel for girder flanges, webs, splice plates, stiffeners, sole plates, and all material welded to girders shall be CSA G40.21M-350 AT Category 3;
- All other steel shall be CSA G40.21M-350A;
- Single lane bridges, with the exception of Thunder River Bridge where two lanes are considered for opposing vehicles to pass given limited sight distance on approach.

Major bridge concepts for specific crossings are presented in later sections of this PDR. Other minor stream crossings will utilize common culvert design and installation or minor bridges. The decision to use a culvert or a minor bridge structure is generally dependent on ground and soil conditions, availability of fill material, cost, and most importantly, requirements to protect fish habitat. Where large diameter culverts (greater than 1,400 mm dia.) are considered for minor crossings, the culverts will be traditional circular or arch culverts with closed bottoms as these are known to have better performance in permafrost regions than open bottom arch culverts. As the cost of shipping large diameter corrugated steel pipe culverts is prohibitive, structural plate corrugated steel pipe culverts will be considered.

Designs for major and minor culverts will include requirements for bedding materials, geotextile, and insulation to provide strength in foundation and to protect the surrounding permafrost and ice-rich soils from thaw. Detailed geotechnical information will be collected in field investigations in the next steps in development of the Highway and detailed design stages will incorporate the bedding and foundation requirements for culverts.

Rip-rap and other erosion protection materials incorporated into bridge and culvert designs are not likely to be readily available in any of the borrow sources. Cost effective pre-manufactured products, such as A-Jacks concrete rip-rap modules and Armorflex articulated concrete block "mats" (both manufactured by Armortec Canada Inc.) will be included in the detailed design stage of the development of the Highway.

In the consultations, the question was asked regarding the practicality of constructing bridge foundations (piling, abutments, and piers) to accommodate widening of the superstructure (girders and deck) to two lanes in the future. This is a practical and cost effective solution to minimize or eliminate instream work in the future should it be necessary to widen the single lane bridges to two lanes. As well, the cost of including this relative to the overall estimated cost of the construction of the Highway is quite small. The need for widening to two lanes will be based on growth in traffic volumes to a point where any delays and waiting times at bridge crossings become intolerable. The estimated traffic volume for the Highway is 50 vehicles per day and growth in that traffic is not anticipated in the foreseeable future. With such low traffic volume, the likelihood of two vehicles travelling in the opposite direction meeting at a bridge structure is very low and the need for two lane bridges is not anticipated in the future. This may not be the case when overweight or over-dimension loads are being hauled on the Highway under permit, or during isolated periods when other construction activities within the corridor are underway (i.e., construction of the MGP), but these are expected to be tolerable given that the conditions are infrequent or temporary in nature. In the preliminary design for this PDR, all bridge structures are considered as single lane, with the exception of Thunder River Bridge. The need to prepare for future two lane structures could be revisited in the detailed design stages of the development of the Highway.

6.4 Comparison of Alignment Options and the Preferred Alignment

Detailed comparison of major alignment options such as the preliminary routing north of Travaillant Lake compared to the PWC 1974 alignment south of Travaillant Lake were not undertaken. Typically, major alignment options would be compared based on community need, constructability, cost, operating conditions, and minimization of impact to the land and the environment. The desire to develop a Transportation Corridor in the vicinity of the currently proposed MGP alignment to minimize development footprint eliminated the need to compare of the PWC 1974 alignment south of Travaillant Lake with the routing developed north of Travaillant Lake.

The preliminary alignment and the minor alignment options prepared in June, based on the initial routing studies, were developed and refined based on the design parameters, the outcomes of the field studies, the outcome of the overview studies, attempts to minimize footprint size and construction material requirements, and suggestions provided in the three rounds of consultation to obtain the preferred alignment.

The preferred alignment for the Highway is shown on Figure 6.4-1. Detailed map sheets at a scale of 1:25,000 are included in Appendix A.

6.5 Terrain and General Topography Along Preferred Alignment

The terrain and general topography along the preferred alignment are discussed in detail in the Section 10, Environmental Overview of this PDR. The key elements that are considered in the preliminary design include:

- The Highway is located in the continuous permafrost zone. Natural ground ranges from dry till and outwash deposits, to thick organic peatlands and ice-rich permafrost. Erosion and slumping due to thawing of the ground ice and permafrost were observed in the 2010 field programs. The embankment thickness is designed to accommodate these differences in terrain type along the

Highway, and the placement of the Highway (the horizontal alignment) considers avoiding the areas of erosion and slumping, as well as areas where there are signs of massive ground-ice potential.

- The topography in the north is generally flat to gently undulating and in the south is more rolling terrain. Vertical alignment in the preliminary design and the fine tuning of the routing of the Highway takes advantage of this topography.

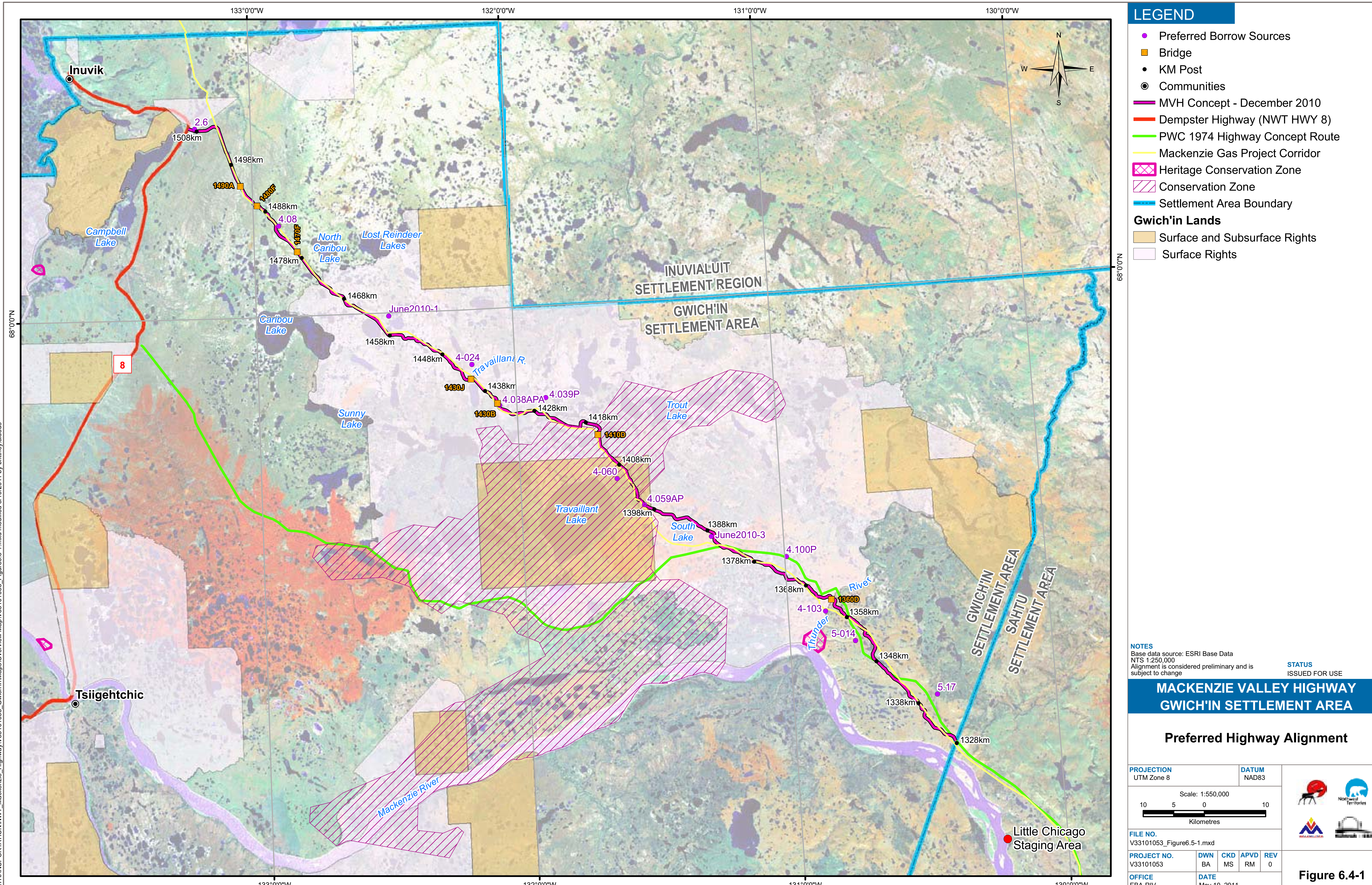
6.6 Bridge and Culvert Structures along the Preferred Alignment

There are seven major bridge structures along the preferred alignment and over 135 culverts or minor bridge crossings identified for what appear to be permanent stream crossings. Additional small diameter culverts will be required to move surface water from one side of the Highway to the other. The number and specific location of these culverts will be identified in later stages of the detailed design for the development of the Highway. Estimates of the number of culverts have been provided in the preliminary design.

The seven major bridge crossings are shown on Figure 6.4-1. These are:

- Thunder River, Water Crossing No. 1360D, km 1362;
- Water Crossing No. 1410D, km 1414;
- Water Crossing No. 1430B, km 1435;
- Travaillant River, Water Crossing No. 1430J, km 1441;
- Water Crossing No. 1470F, km 1479;
- Water Crossing No. 1480F, km 1489;
- Water Crossing No. 1490A, km 1476.

Details including location, description of bridge concept, and crossing constraints are summarized below. Figures for each of the seven bridge crossings are included in the appendix. These conceptual bridge layouts provided in this PDR are based on limited data from field investigation. Specific layouts will be subjected to geotechnical investigation, survey, hydrology studies, detailed design, etc. at later stages in the project development.


LEGEND
Preferred Borrow Sources
Bridge
KM Post
Communities
MVH Concept - December 2010
Dempster Highway (NWT HWY 8)
PWC 1974 Highway Concept Route
Mackenzie Gas Project Corridor
Heritage Conservation Zone
Conservation Zone
Settlement Area Boundary
Gwich'in Lands
Surface and Subsurface Rights
Surface Rights
133°0'0"W
132°0'0"W
131°0'0"W
130°0'0"W
68°0'0"N
N
S
E
W
Inuvik
Tsiigehtchic
Little Chicago Staging Area
Campbell Lake
North Caribou Lake
Lost Reindeer Lakes
Caribou Lake
Sunny Lake
Travaillant R.
Trout Lake
Travaillant Lake
South Lake
Thunder River
Mackenzie River
INUVIALUIT SETTLEMENT REGION
GWICH'IN SETTLEMENT AREA
SAHTU SETTLEMENT AREA
8
2.6
1508km
1498km
1490A
1480F
1488km
4.08
1470F
1478km
1468km
June2010-1
1458km
1448km
4-024
1430J
1438km
1430B
4.038APA
4.039P
1428km
1418km
1410D
1408km
4-060
4.059AP
1398km
1388km
June2010-3
4.100P
1378km
1368km
1360D
4-103
1358km
5-014
1348km
5.17
1338km
1328km
NOTES
Base data source: ESRI Base Data
NTS 1:250,000
Alignment is considered preliminary and is subject to change
STATUS
ISSUED FOR USE
MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA
Preferred Highway Alignment
PROJECTION
UTM Zone 8
DATUM
NAD83
Scale: 1:550,000
10 5 0 10
Kilometres
FILE NO.
V33101053_Figure6.5-1.mxd
PROJECT NO.
V33101053
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M:\TRANSPORTATION\NWT_Mackenzie_Highway\V33101053_Gwich'in\Maps\Overview Map\V33101053_Figure6.5-1.mxd modified 5/10/2011 by brittney.aldous

Figure 6.4-1

6.6.1 Thunder River, Water Crossing No. 1360D – km 1362

The proposed bridge at km 1362 consists of a two-lane, 65 m long single span structure. Each proposed abutment consists of two rows of vertical piles supporting a 1 m deep precast pile cap. The earth retaining components consist of precast backwalls and return walls to retain the top half of the fill and a second retaining structure, either bin walls or H-pile retaining walls, to retain the bottom half of the fill. Approximately 7 m high fills are required to be retained at each abutment.

The constraints at this location were the proposed vertical and horizontal curves in road design. The approaches sightlines were limited due to the horizontal curves, while the roads lead up to the river crossing with greater than 6% grade. Based on the road grades and sightline constraints, it was determined that a two-lane structure will be required to maintain road safety. A short tangent section on the proposed road also restricted the locations of the abutments, where the fills are over 7 m above the existing ground. It was determined that secondary earth retaining walls with granular fills were needed at this crossing location to support part of the fills, to avoid potential stability issues in the abutments, and to reduce the size and lifting weight of the precast abutments components.

6.6.2 Water Crossing No. 1410D – km 1414

The proposed bridge at km 1414 consists of a single-lane, 40 m long single span structure. Each proposed abutment consists of vertical and battered piles supporting a 2 m deep precast pile cap. The earth retaining components consist of precast backwalls and return walls to retain approximately 4.5 m of the fill.

There were no major constraints at this crossing location. The depth of fill behind each abutment and environmental consideration were the primary control parameters in the determination of the bridge layout.

6.6.3 Water Crossing No. 1430B – km 1435

The proposed crossing at km 1435 consists of a 70 m long single-lane bridge, with a 40 m and a 30 m simply supported span. Each proposed abutment consists of vertical and battered piles supporting a 2 m deep precast pile cap, and pier consisting of steel piles supporting a precast pier cap. It was anticipated that the placement of the pier to be outside of the river, and the normal flow is to cross between the pier and the south abutment. The earth retaining components consist of precast backwalls and return walls to retain approximately 5 m of the fill.

The primary constraints at this crossing location were from the meandering river course toward the northwest corner of the bridge and the fill depth at the south abutment. Although the river at this location is only at a slight skew to the proposed road, the river bends rapidly toward the proposed toe of fill at the northwest quadrant of the crossing, eliminating the potential of the placement of an abutment southward. Depth of the fill and river alignment also controlled the placement of the south abutment and the pier, as well as the span length required to clear the river.

6.6.4 Travaillant River, Water Crossing No. 1430J – km 1441

The proposed crossing at km 1441 consists of a 120 m long single-lane bridge, with three 40 m simply supported spans. Each proposed abutment consists of two rows of vertical piles supporting a 1 m deep precast pile cap. The earth retaining components consist of precast backwalls and return walls to retain the top half of the fill and a second retaining structure, either bin walls or H-pile retaining walls, to retain the bottom half of the fill. Total of 7 m fills to be retained at each abutment

The constraints at this bridge layout were the meandering river course, the proposed road design, and the associate fill depth. The river at this location is almost square to the proposed road, and at the northeast and southwest quadrant of the crossing, the river bends toward the proposed toe of fill, eliminated the potential of a single span bridge. The proposed vertical curve at the south end of the crossing and the associate fill depth around the same area, also restricted the placement of the south abutment. With consideration of the stability of the structure and the weight of the precast substructure elements, it was determined that secondary earth retaining walls with granular fills were needed at the south abutment. The north abutment was placed where similar span lengths and substructure components can be utilized throughout the entire bridge.

6.6.5 Water Crossing No. 1470F – km 1479

The proposed bridge at km 1479 consists of a single-lane, 50 m long single span structure. Each proposed abutment consists of vertical and battered piles supporting a 2 m deep precast pile cap. The earth retaining components consist of precast backwalls and return walls to retain approximately 5 m of the fill.

The primary constraint at km 1479 was the depth of fill at the north side of the river, which controlled the placement of the north abutment and the skew in the river toward the southeast corner controlled the placement of the south abutment. Although a 50 m span was not a common span length among all the crossing locations, the benefits from building a shorter structure with increased vertical clearance from the river and the use common precast components outweigh the potential benefits from utilizing the more common 65 m span.

6.6.6 Water Crossing No. 1480F – km 1489

The proposed crossing at km 1489 consists of a 70 m long single-lane bridge, with a 40 m and a 30 m simply supported span. Each proposed abutment consists of vertical and battered piles supporting a 2 m deep precast pile cap and a single row pier pile supporting a precast pier cap. The earth retaining components consist of precast backwalls and return walls to retain approximately 4.5 m of the fill.

The primary constraints at this crossing location were from the meandering river course throughout the propose crossing area. The river bends rapidly toward the northwest quadrant toe of fill and the proposed south abutment, eliminating the potential for a single span bridge. The river alignment also controlled the placement of the pier and the span length required to clear the river between the pier and the south abutment.

6.6.7 Water Crossing No. 1490A – km 1476

The proposed bridge at km 1476 consists of a single-lane, 65 m long single span structure. Each proposed abutment consists of two rows of vertical piles supporting a 1 m deep precast pile cap. The earth retaining components consist of precast backwalls and return walls to retain to top half of the fill and a second retaining structure, either bin walls or H-pile retaining walls, to retain the bottom half of the fill. Total of 7 m fills to be retained at each abutment.

The major constraints at this location were the skew of the river crossing and the vertical curve at the south abutment. The river at this location is at approximately 45 degree skew to the proposed road, which governed the minimum bridge length and eliminated any potential of a pier. The proposed vertical curve at the south end of the crossing also restricted the placement of the south abutment. With consideration of the stability of the structure and weight of the precast substructure elements, it was determined that secondary earth retaining walls with granular fills were needed at the abutments.

6.6.8 Information on Borrow Sources in the Area

General sources of granular material were first identified in the Mackenzie Valley in the 1960s by the Geological Survey of Canada as part of their surficial geology and terrain mapping program. As interest in the development of energy resources in the North grew during the 1970s and 1980s, especially the MGP, comprehensive granular material investigations were undertaken by numerous private industry groups and government agencies, primarily under the direction of INAC. In particular, work carried out by Ripley, Klohn and Leonoff International Ltd. (1973), EBA Engineering Consultants Ltd. (1974), Public Works Canada (1975), Northern Engineering Services Ltd. (1976-77), Techman Ltd. (1976), Hardy Associates (1978) Ltd. (1986), and more recently, by the University of Waterloo (2003), provided confirmation of selected granular material sources and quarry sites in the Mackenzie Valley area.

Field reconnaissance conducted for the development of this PDR in the summer of 2010 provided additional potential borrow sites along the Highway from its junction with the Dempster Highway to southern boundary of the GSA. The 1:25,000 map sheets in Appendix A show the potential borrow sites along the Highway. Figure 6.4-1 shows the borrow sites preferred for the construction of the Highway. These preferred borrow sites are discussed in the next section.

The majority of these borrow locations had been identified and evaluated in previous studies of the area, and four new potential sites were identified during the June 2010 field reconnaissance. The potential borrow location identified as "June 2010-1" has not previously been identified in any of the available literature, but appears, from the field observations to be a potential source given the raised elevation and topography. Confirmation of the availability and use of this area as a potential borrow source is critical in the development the Highway project given that its location presents an optimal haul distance to the segment of the Highway between km 1450 and km 1473 where no other known potential borrow source is in close proximity. The preliminary design and preparation of the PDR has proceeded in the assumption that this and other borrow sources are available for construction. Availability, quantity, and quality of material at these locations will be confirmed in the next steps of investigation and detailed design for the development of the Highway.

Table 6.6.8-1 summarizes the data available for each potential borrow source, including proximity to the proposed alignment, terrain features, material description, estimated volume, and comments regarding development potential.

Of the 46 potential borrow sources along the Highway, 13 have been highlighted as preferred sources. This recommendation has been based on a number of factors, including proximity to the proposed alignment, spacing between sites, as well as environmental, archaeological, and development considerations. These potential or preferred borrow sources have been identified in the preliminary design. The Highway alignment and the selection of the borrow sources will be refined through more detailed investigation and design in the next stages of the project development. Throughout the consultations, Travaillant Lake has been identified as an important area. Borrow Source 4-060 is within the Conservation Zone around Travaillant Lake. Use of this borrow source will be considered only if necessary and critical to the overall development of the Highway, and even then, permit conditions that are specific to seasonal operations, will be followed.

6.7 Preliminary Quantity Estimates for the Preferred Alignment

6.7.1 Total Estimated Length of New Highway Construction

The Preferred Highway Alignment requires 181 km of new highway construction.

6.7.2 Estimate of Embankment (Fill) and Surfacing Material

The preliminary quantity estimates for embankment or fill material and surfacing material are:

- Embankment or fill volume: 6.74 million m^3
- Surfacing gravel: 331,000 m^3

Quantity breakdown by design segment is presented in Table 6.7.2-1. These quantities are presented as compacted material in place, and do not account for "bulking" or swell of material as it is removed from the borrow source and hauled to placement in the Highway. As well, relatively minor amounts of additional fill material will be required at bridge sites, maintenance facilities, staging areas, and other locations.

Table 6.6.8-1 Potential Borrow Sources

Source No.	Preliminary Design Alignment Station	Offset Distance from Align	Direction from alignment	Terrain Features	Description	Estimated Volume (m3)
2.60	1508.2	0.3	N	Glaciofluvial (?) patch within moraine plain (Rampton, 1974)	sand and gravel	250,000
2.57	1504.4	6.1	NE	Fluvial terrace	Alluvium:sand, some gravel	3,500,000
2.59	1504.3	3.5	NE	Glaciofluvial deposit (Rampton, 1974)	sand and silt	15,000,000
4.08	1484.6	0.4	NE	Moraine plain underlain by shallow bedrock	shale	unlimited
2.64B	1481.8	2.8	NE	Moraine plain underlain by shallow bedrock	shale and sandstone	50,000
2.64	1481.3	2	NE	Ice contact glaciofluvial features: hummocks and ridges	sand and gravel	NA
2.064BP	1481.5	2.4	NE	Ice contact glaciofluvial features: hummocks and ridges	sand and gravel	NA
4.04	1480.5	8.5	NE	Terrain data is not available	Clay	NA
4.05	1477	10.8	NE	Terrain data is not available	Gravel	450,000
June 2010-1	1460.3	1.5	NE	Glacial complex: hummocky and ridged till	Boulders, cobble, gravel in silty matrix	NA
4.32B	1457.9	10.4	SW	Slope complex	silt	NA
4.26	1453.3	5.8	NE	Terrain data is not available	sand and gravel	20,000,000
4.026P	1452.3	5.6	NE	Terrain data is not available	sand and gravel	20,000,000
4.28	1449.4	4.1	SW	Ice contact glaciofluvial features: hummocks and ridges	sand and gravel	100,000
4-024	1441.0	2.4	N	Outwash plain	silt and some sand	NA
June 2010-2	1441.9	3.5 to 7.5	S	Ice contact glaciofluvial features: hummocks and ridges	NA	NA
4.023P	1437.5	1.7	NE	Glaciofluvial (outwash) deposits	sand and gravel	4,000,000
4.23	1437.1	2.5	NE	Glaciofluvial (outwash) deposits	sand and gravel	4,000,000
4.038APB	1435.5	2.7	NW	Glaciofluvial (outwash) terrace	sand and gravel	25,000,000
4.038APA	1434.6	1.5	NE	Glaciofluvial (outwash) terrace	sand and gravel	25,000,000
4.35	1434.2	4.5	SW	Outwash plain	sand and gravel	12,000,000
4.36	1432.9	3.3	NE	Till veneer with patches of exposed bedrock	shale	unlimited
4.020P	1427.9	4.2	NNE	Outwash plain	sand and gravel	4,000,000
4.039P	1426.0	2.7	N	Glaciofluvial complex: hummocks and ridges	sand and gravel	1,000,000
4.4	1419.1	4.5	NW	Ice contact glaciofluvial features: hummocks and ridges	sand and gravel	7,500,000
4-060	1405.8	1.8	SW	Glaciofluvial complex: hummocks and ridges	sand and gravel	1,000,000
4.59A	1400.7	0.7	NE	Ice contact glaciofluvial features: hummocks and ridges	sandy gravel	20,000,000
4.059AP	1399.8	0.0		Ice contact glaciofluvial features: hummocks and ridges	sandy gravel	20,000,000
June 2010-3	1387.4	0.8	S	Glaciofluvial deposit (?)	NA	NA
June 2010-4	1382.8	3.0	N	Glaciofluvial complex: hummocks	sand and gravel	NA
4.54	1374.2	4.4	NE	Moraine plain controlled by bedrock	shale	unlimited
4.100P	1374.2	2.5	NE	Moraine plain controlled by bedrock	shale	unlimited
4.102	1366.8	2.0	NE	Hummocky and hilly moraine, underlain by shale bedrock	shale	NA
4.101	1364.7	6.1	NE	Glaciofluvial complex: hummocks and ridges	sand and gravel	6,000,000
4-103	1361.2	3.7	SW	Glaciofluvial (or fluvial ?) terrace; Thunder River valley	sand	5,500,000
4.104	1358.4	4.8	SW	Ice contact glaciofluvial features: hummocks and low hills	sand and gravel	10,000,000
5.12	1358.4	4.7	SW	Ice contact glaciofluvial features: hummocks and low hills	sand and gravel	20,000,000
5.013P	1358.4	5.1	SW	Ice contact glaciofluvial features: hummocks and low hills	sand	2,000,000
5.11	1354.5	9.7	NE	Glaciofluvial deposit within moraine plain	sand and gravel	5,500,000
5-014	1353.4	1.8	SW	Ice contact glaciofluvial features: hummocks and low hills	sand	2,000,000
5.15	1341.5	7.0	NE	Glaciofluvial deposit (?) within hummocky and hilly moraine	sand and gravel	70,000
5.17	1336.3	3.2	NE	Glaciofluvial deposit(?) within till veneer and slope complex	sand and gravel	6,000,000
5.20	1335.1	13.4	SW	Esker within outwash plain	gravel, some sand	3,000,000
5.020P	1334.6	11.1	SW	Outwash plain	gravel, some sand	3,000,000
5.25	1328.3	3.4	NE	Fluvial deposit (alluvium)	sand and gravel	5,500,000
5.23	NE of beginning of align start			Alluvial fan or apron	sand and gravel	40,000,000

Note 1: Distances from alignment were measured at approximate right angles from the centreline.

Note 2: Distances and locations of borrow sites were taken from the approximate centre of the borrow.

Note 3: Estimated volume is based in information in the available literature.

Table 6.7.2-1: Preliminary Quantity Estimates for Embankment and Surfacing Material

Station From	Station To	Length (km)	Fill Volume per km (m^3 – rounded up to the nearest 1,000)	Total Surface Gravel (m^3 – rounded up to the nearest 1,000)	Total Fill Volume (not including Surface Gravel) (m3 – rounded up to the nearest 1,000)
1328.4	1334.0	5.6	35,000	11,000	193,000
1334.0	1339.8	5.8	34,000	11,000	192,000
1339.8	1344.8	5.0	30,000	9,000	147,000
1344.8	1345.2	0.3	30,000	1,000	10,000
1345.2	1351.0	5.8	29,000	11,000	173,000
1351.0	1356.8	5.8	33,000	11,000	189,000
1356.8	1357.3	0.5	48,000	1,000	26,000
1357.3	1363.8	6.5	48,000	12,000	311,000
1363.8	1367.7	3.9	36,000	8,000	139,000
1367.7	1369.6	1.9	36,000	4,000	68,000
1369.6	1375.4	5.8	33,000	11,000	190,000
1375.4	1380.8	5.5	37,000	10,000	200,000
1380.8	1381.0	0.2	37,000	1,000	8,000
1381.0	1386.1	5.1	34,000	10,000	172,000
1386.1	1391.7	5.6	44,000	11,000	242,000
1391.7	1393.6	1.9	38,000	4,000	73,000
1393.6	1397.5	3.9	38,000	8,000	148,000
1397.5	1402.5	5.0	46,000	10,000	230,000
1402.5	1408.1	5.6	58,000	10,000	323,000
1408.1	1413.0	4.9	34,000	9,000	165,000
1413.0	1415.9	2.9	28,000	6,000	81,000
1415.9	1417.0	1.1	28,000	2,000	31,000
1417.0	1422.8	5.8	26,000	11,000	151,000
1422.8	1426.8	4.0	41,000	8,000	162,000
1426.8	1430.3	3.5	54,000	7,000	187,000
1430.3	1437.8	7.5	54,000	14,000	401,000
1437.8	1439.4	1.6	54,000	3,000	86,000
1439.4	1450.7	11.3	32,000	21,000	358,000
1450.7	1452.8	2.1	32,000	4,000	69,000
1452.8	1465.0	12.2	41,000	23,000	489,000
1465.0	1472.5	7.5	29,000	14,000	217,000
1472.5	1479.7	7.3	29,000	14,000	211,000
1479.7	1496.2	16.5	35,000	31,000	571,000
1496.2	1509.4	13.2	41,000	25,000	541,000
Total Volume (m^3)				**346,000**	**6,754,000**

6.7.3 Major Bridge Structures

There are seven major bridge structures. The estimates in terms of span, length, width, and total deck area are presented in Table 6.7.3-1.

Table 6.7.3-1: Major Bridge Structures

Water Crossing Number	Station (km)	Number of Spans	Width (m)	Total Bridge Length (m)	Total Deck Area (m^2)
1360D (Thunder River)	1362	1	8.3	69.5	577
1410D	1414	1	5	44.5	223
1430B	1435	2	5	74.5	373
1430J (Travaillant River)	1441	3	5	124.5	623
1470F	1479	1	5	54.5	273
1480F	1489	2	5	74.5	373
1490J	1476	1	5	69.5	348

6.7.4 Culverts

In addition to the major bridge structures, there will be requirements for culverts at many smaller stream crossings. One hundred and thirty-five stream crossings have been identified through the field observations and the preliminary designs. Detailed hydrology and drainage studies to support culvert design and sizing will be done during later detailed design stages in the development of the project. At that time, decisions will also be made as to whether some of these minor crossings would be served better with a small bridge structure (10 m to 15 m span). A nominal size of 1,200 mm and nominal length of 30 m is estimated at this preliminary stage in the development of the project. Smaller diametre centreline or equalization culverts may also be required. A nominal size of 900 mm, nominal length of 30 m, and estimated frequency of 2 per km is estimated. The summary of estimated culvert quantities is presented in Table 6.7.4-1.

Table 6.7.4-1: Culverts

Culvert Diameter (mm)	Culvert Length (m)	Number of Culverts	Total Estimated Length (m)
1,200	30	135	4,050
900	30	362	10,860

6.7.5 Quantity Estimates from Each Potential Borrow Source

The estimated quantities for embankment (fill) and surfacing material are provided in Section 6.8. The estimate of the material required from each of the 13 preferred borrow sources are summarized in Table 6.7.5-1.

Table 6.7.5-1: Estimated Quantities from Individual Borrow Sources

Borrow Source Number	Alignment Station	Offset Distance from Alignment	Direction from Alignment	Estimated Available Volume (m^3)	Highway Section Served	Estimated Quantity Required from Source (m^3 – rounded up to the nearest 1,000)
5.17	1336.3	3.2	NE	6,000,000	1328.4 to 1344.85	562,000
5-014	1353.4	1.7	SW	2,000,000	1344.85 to 1357.3	420,000
4-103	1361.2	2.0	SW	5,500,000	1357.3 to 1367.7	469,000
4.100P	1374.2	2.5	NE	unlimited	1367.7 to 1380.8	489,000
June 2010-3	1387.4	0.7	S	NA	1380.8 to 1393.6	508,000
4.059AP	1399.8	0.0		20,000,000	1393.6 to 1402.8	394,000
4-060*	1405.8	1.8	SW	1,000,000	1402.8 to 1415.9	593,000
4.039P	1426	2.7	N	1,000,000	1415.9 to 1430.3	556,000
4.038APA	1434.6	1.5	NE	25,000,000	1430.3 to 1437.8	415,000
4-024	1441	2.4	N	NA	1437.8 to 1450.65	467,000
June 2010-1	1460.3	1.5	NE	NA	1450.65 to 1472.45	813,000
4.08	1484.6	0.4	NE	unlimited	1472.45 to 1496.4	825,000
2.6	1508.2	0.3	N	250,000	1496.4 to Dempster	565,000
Total Volume (m^3 – rounded up to the nearest 100,000)						7,100,000

*Note: see Section 6.6.8

The land tenure for the 13 preferred borrow sources are as follows:

- Gwich'in Lands, Surface and Subsurface Rights – 4.059AP and 4-060.
- Gwich'in Lands, Surface Rights – 4-103, 4.100P, June 2010-3, 4.039P, 4.038APA, 4-024, June 2010-1, and 2.6.
- Public Lands – 5.17, 5-014, and 4.08.

6.8 Highway Construction

6.8.1 Combining Design and Construction

As noted above in Section 6.1, the historical implementation plans for the Highway have included both "accelerated design and construction approaches over a short term" and "extended construction time frames building short sections each year with local forces". Economic benefits of the Highway are discussed in later sections of this PDR, but it is relevant to note here that the greater economic benefits to the people of the local communities come from the long-term sustainable management and operation of the Highway over any benefits achieved from the initial construction. There is greater advantage to put the Highway into operation sooner rather than later and an approach that accelerates design and construction over a short term is necessary.

In a traditional design and construction approach, the detailed design would be completed for the full 181 km of highway before the construction starts. The design will take a considerable amount of time and could add years to the delivery of the project. Completion of the Highway can be achieved much sooner if large components of the design are completed each year, staying just ahead of construction. The work that has been completed in the development of the preliminary design and PDR provides sufficient information and knowledge about the Highway to be able to proceed with design and construction in this manner. This approach will result in an accelerated delivery schedule, as well as advantages and savings from innovations in design, construction, mobilization, and staging than a traditional design and public tender construction approach. Significant resources are needed for accelerated design and construction. To the extent possible, all qualified and relevant resources in local communities will be used.

Using this approach, construction of the Highway through the GSA is likely to take three winter seasons. Detailed investigation, engineering, and design are necessary in advance of construction of the initial segments of the Highway, but not for the entire 181 km at once. This can be done in advance of starting construction on each segment. Start of construction on the initial segments of the Highway within the GSA is expected in the first winter following regulatory approvals, assuming funding for the Highway within the GSA is available. .

6.8.2 Construction Activities and Assumptions

6.8.2.1 Reliance on Construction of Southern Segments of the Highway

The Highway is located in remote and undeveloped areas; however, the north end is accessible from the Dempster Highway. The south end of the Highway is at the southern boundary of the GSA. This development summary and construction plan is not reliant on the timing of construction of the remainder of the highway south to Fort Good Hope, and since Fort Good Hope is approximately 180 km to the south, winter road access to the starting point of the Highway within the GSA is not an efficient construction approach. Construction of the Highway within the GSA in an efficient period of time requires deployment of equipment and crews from both the north and the south end; therefore, a mobilization and staging location near the south end of the Highway is required.

6.8.2.2 Staging Locations

Approximately 30 km south of the start of the Highway within the GSA is an area referred to as "Little Chicago" that is suitable for development of a barge landing, construction staging area, and the start of winter road access to the southern starting point of the Highway within the GSA. This location is shown on Figure 6.4-1. Activities at this location include:

- housing of workers;
- storage and maintenance of equipment;
- storage of fuel; and
- receipt of supplies, equipment, and materials by barge.

Temporary facilities at this location include:

- camp and maintenance buildings;
- equipment and material storage areas;
- fuel storage facilities;
- staging area;
- helicopter landing area;
- barge landing area;
- access road from shore; and
- waste containment facilities.

To be used as a deployment point, Little Chicago will require minor grading at or near the shore to provide a suitable area for barge landing and off loading, development of a short access road to higher ground, and site preparation for a staging area. Erection of temporary fuel storage and camp facilities will be required. The development of Little Chicago as a deployment point will also be advantageous for construction of the Highway segment within the SSA.

The construction plan for the Highway within the GSA that is presented in this and the following sections assumes that the main access and deployment locations will be at the north end via the Dempster Highway and at the south end via winter access road from Little Chicago. Similar camp and staging areas will be developed at selected borrow source locations along the alignment. The specific location of these will be determined during the detailed design and construction planning phase.

6.8.2.3 Winter Approach to Embankment Construction

A fundamental concept of the construction methodology is to utilize winter construction techniques for building the embankment or accessing areas within the right-of-way before the Highway is constructed, rather than more typical summer construction as used in southern parts of Canada.

The advantages of winter construction are as follows:

- Winter construction allows the use of temporary winter access to borrow sources without the need to construct costly all-weather access roads.
- Winter construction allows the placement of construction material directly on to frozen ground. This approach enables the establishment of a frozen core for the Highway and helps protect sensitive and ice-rich terrain.
- Winter construction minimizes potential effects on vegetation and soils adjacent to the actual roadway that might occur if working under snow-free or wet conditions.
- Winter construction promotes initial stability of the Highway through the placement of frozen borrow material directly onto frozen ground (with geotextile separation layer). In the first construction year, it is anticipated that the majority of construction settlements will occur in the top layers of the

constructed embankment as it thaws, dries, and consolidates. The lower layers are not expected to thaw much, if at all, in the first years, leading to greater stability than has been the case with the placement of warm fill on thawed ground in summer construction. This will reduce maintenance problems in the future.

Winter construction does have disadvantages, including the following:

- Work is difficult, with extreme cold temperatures common at the beginning of the construction season in late December and early January. This is challenging for both personnel and equipment.
- Operations are conducted in periods of minimal daylight.
- Excavation of frozen material in borrow sources will likely require the use of drill and blast methods to be able to source the required volumes of material for construction.
- Excavating and placing frozen material directly on top of geotextile placed on the natural ground makes it more difficult to achieve compaction of the embankment layers.

6.8.2.4 Summary of Activities by Season

When specific components of the work can be done is largely based on the season as moving equipment on the native ground is limited to the winter months when the ground is frozen. Other activities can take place during the spring, summer, and fall of any given year provided that access over land to the particular area is not required, or that access can be achieved over a portion of the Highway that has previously been constructed. The timing of construction activities will respect the sensitive nature of the management areas and conservation zones and will follow permit conditions.

The construction schedule presented in the next section is based on the following basic factors for construction in the area:

- Equipment and bridge components can be mobilized to the north end of the project at most times of the year given only minor seasonal limitations to travel on the Dempster Highway. Mobilization of large bridge components (i.e., girders) or large amounts of equipment may even be more efficient by rail to Hay River, barge to Inuvik then by road to the north end of the Highway.
- Equipment and bridge components can be mobilized to Little Chicago by barge from either Hay River or Fort Simpson as early as June or July, provided the equipment and bridge components are arrive in Hay River or Fort Simpson in May.
- Where construction of the Highway is not yet complete, bridge sites and borrow sources will be accessed via winter road. Clearing of the right-of-way and winter road construction could start in December, but the actual full operation of the winter road for the purpose of moving equipment, hauling material, and construction of the embankment would not start in earnest until January.
- Although overland access to borrow sources to move equipment to them is by winter road, once equipment is positioned in a borrow source, material production and stockpiling can be undertaken all year long.

- In some cases it will be necessary to construct all-weather access roads to selected borrow sources as they may be used for significant volumes of material during construction, or for ongoing long-term use into the operation of the Highway.

Any given construction year on the Highway can be broken down into the following time periods and activities:

- December – Clearing of right-of-way and construction of winter roads;
- January/February/March – Hauling and placing of embankment material; mobilization to bridge sites and piling for bridge abutments; erection of bridge piers and abutments;
- April/May/June – No activities other than production and stockpiling of material assuming equipment has been mobilized to the particular borrow source;
- July/August/September – Finishing and compaction of previously constructed embankment and placement of surfacing material;
- August/September – Launching of bridge girders and deck components;
- October/November – Any activity that does not require overland access or can be accessed by previously constructed segments of the Highway.

6.8.3 Construction Schedule

Construction of the Highway within the GSA is estimated to take three to three and a half years from approval. Detailed investigation, engineering, and design are necessary in advance of construction, but in a combined design and construction approach, it is not necessary to complete this for the entire 181 km of highway in advance of starting construction. The investigation, engineering, and design components need only to stay in advance of the next segment or bridge to be constructed. The initial start of construction will begin in the first winter directly following approvals and funding being available. Assuming funding is available, the first stage of design then would begin in the preceding spring.

A more detailed discussion and presentation of the construction schedule is included in Section 7.0, Project Timetable and Construction Schedule.

6.9 Discussion of Elements Related to Construction

Basic factors for construction in the area are presented above in Section 6.8.2.4. The following provides a further discussion of some key elements related to construction of the Highway. These are also discussed in greater detail in Section 10.0, Environmental Overview and Section 11.0, Potential Environmental and Social Effects and Mitigation of this PDR.

6.9.1 Anticipated Equipment and Personnel

In any given winter, construction season for four spreads will be in operation for embankment construction.

Typical equipment is listed in Table 6.9.1-1.

Table 6.9.1-1: Typical Equipment

Equipment	Typical Equipment Type
Typical Equipment in Each Spread	Compactors, Dozers, Drills, Cranes, Excavators, Graders, Haul Trucks, Mulchers, Wheel Loaders
Support Equipment	Deck Trucks, Fuel Trucks, Service Trucks, Vacuum Trucks, Water Trucks
Summer Operations	Wheel Loaders, Compactors, Graders, Water Trucks

Opportunities for training and employment of personnel are discussed in Section 12.0 of this PDR. Personnel that will be required will include equipment operators, carpenters and labourers for bridge construction and culvert installation, and engineering/survey/environmental monitoring staff. It is currently estimated that there will be four spreads working at peak times in the construction of the Highway and each spread would likely require 150 to 180 people. This is a substantial workforce. Delivery of the project will initially look to the local work force for qualified and relevant personnel, but will also need to look to other communities in the Northwest Territories, then Yukon and Nunavut, followed by southern Canada.

6.9.2 Camp and Stockpile Areas

Areas will be required for construction camps and stockpile or staging of equipment and materials (e.g., culverts, geotextiles, bridge component). With the exception of Little Chicago, temporary construction camps will be situated in the borrow sources to minimize development footprint. They will be spaced no more than 50 km apart, allowing a maximum driving distance of approximately 25 km for project workers. Individual camp sizes are likely to be 150 person, but will be temporary in set up. They may need to be mobilized ahead of the construction on winter trails.

Stockpile sites and staging areas will be constructed parallel to the Highway and just ahead of material delivery to work areas by truck. Materials will also need to be staged in central areas such as Inuvik and Little Chicago prior to delivery to the project.

Camp and stockpile or staging areas that are not identified for the ongoing operation of the Highway will be reclaimed in accordance with the appropriate guidelines and permit conditions

6.9.3 Access/Haul Roads and Borrow Sources

Roads for access and hauling as noted in the schedule will be constructed along the alignment and to the preferred borrow sources. In most cases, access will be by winter road or over the constructed portion of the Highway. The exception would be access to borrow sources that are selected for permanent or long-term use in the future operation of the Highway. In those cases, permanent all-weather access roads will be constructed. The specific alignment and type of all access roads will be confirmed in the early stages of detailed design in the development of the Highway project.

The driving surface width of any access or haul road will likely be 10 m to 11 m. The cleared width required would be approximately 50 m.

Borrow site or pit management plans will be developed by the Proponent for each selected source when the next stages of investigation are complete and as a requirement for land use and quarry permit applications for construction. The management plans will be in accordance with the appropriate guidelines, as noted in previous sections. Generally, borrow sources will include a minimum of 10 m cleared area beyond the edge of the excavation and stockpile areas, and there will be allowance for areas to be used for staging equipment, storage, stockpiles of organic materials, and wasting of ice-rich materials.

6.9.4 Construction Access Along the Highway

Construction access along and ahead of the Highway will be by winter road along the embankment and within the right-of-way. These winter roads will be constructed during the initial clearing operations in December of each construction year. At small stream crossings, snow bridges will be used to cross the stream valleys, while at larger river crossing, ice bridges will be constructed. For larger river crossings with steeper banks, construction of shoo-flies may be required to reduce the grade from the top of the river bank to the ice crossing. Plans for and design of these shoo-flies, if required, will be undertaken at the detailed design stage.

Winter roads and ice crossings will be constructed and operated in accordance with applicable guidelines. Two such guidelines are:

- A Field Guide to Ice Construction Safety, Department of Transportation, GNWT, 2007; and
- Best Practice for Building and Working Safely on Ice Covers in Alberta, Government of Alberta, 2009.

The Transportation Association of Canada will also be publishing an applicable guide later in 2011 entitled "Best Practices for Operation and Construction of Winter Roads".

6.9.5 Waste Management

The waste generated during construction will include sanitary waste, grey water, kitchen and paper waste, used oils, hazardous waste (i.e., batteries), recyclable metals, used oil from equipment, and other. Temporary maintenance shop facilities at construction camps will have incinerators in which used oil can be burned to produce heat for shop and camp facilities. Camps will have on-site treatment plants that process wastewater that can then be used to supplement the water use as discussed in the next section. Kitchen waste, cardboard, and paper will be incinerated on site and recyclable metals and hazardous wastes will be hauled to commercial waste disposal sites, likely in the south.

6.9.6 Water Use

Overall daily water use for winter road construction is expected to range from at least 500 m^3/day to more than 1,000 m^3/day. Water will also be required during the later summer and fall months to place on the road in support of compaction of the base course and surfacing material. The volume is estimated at 500 m^3/day. The estimates for water use are based on the experience obtained from similar construction projects. Camp operations will require approximately 200 L/person/day. A 150 person camp would, therefore, require approximately 30,000 L or 30 m^3/day.

6.9.7 Fuel Delivery, Storage, and Use

The estimated fuel requirements for construction of the Highway are in the order of 25M to 30M litres. Fuel storage requirements at an individual camp facility will be determined when detailed design and construction planning steps are undertaken at later stages of the project. Major fuel suppliers will likely require advance notice and financial commitment to stockpile fuel at regional fuel hubs of Hay River, Norman Wells, and Inuvik prior to commencement of the construction. This will be necessary as demands for fuel for this project will compete with other significant operations in the Northwest Territories (i.e., community and mining requirements).

Fuel will be delivered in the winter from regional storage hubs to fuel tanks situated along the Highway in the staging and storage areas, in the borrow sources, and in the camps. Fuel resupply to the staging area at Little Chicago will be delivered by barge.

Fuel storage and handling is discussed in Section 11.0 of this PDR.

6.9.8 Health, Safety, and Environment (HSE)

Delivering the construction in a safe manner to protect health of the project workers and to protect the environment will be paramount during the construction operations. The components of the Health, Safety and Environment (HSE) requirements include:

- First Aid requirements;
- spill prevention; and
- erosion control.

The personnel and facilities for the construction of the Highway will include the following First Aid services:

- personnel trained and qualified as Advanced First Aiders;
- personnel trained and qualified as Emergency Medical Technician Paramedics;
- mobile treatment centre; and
- First Aid room at each camp facility.

Spill prevention requirements are discussed in Section 11 of this PDR and include:

- double walled fuel storage tanks;
- minor size spill kits on each vehicle;
- major size spill kits at fuel storage areas;
- major size spill kits at re-fuelling areas; and
- spill response trailer for the work area.

Sediment and erosion control requirements are discussed in Section 11 of this PDR. Erosion Control requirements as a key element of HSE include:

- silt fencing at temporary storage areas and borrow areas;
- silt fencing at inlet and outlets of minor culverts;
- sediment and silt ponds at borrow sources;

- erosion control matting at major water crossings; and
- pre-fabricated rip-rap at major water crossings.

6.9.9 Temporary Airstrips and Helipads

Temporary airstrips and helipads will be required during construction for light fixed wing aircraft (Twin Otter, Cessna) and helicopters. Evacuation of personnel for medical emergencies is preferred by helicopter, but during inclement weather and non-daylight conditions, accessibility by fixed wing aircraft will provide greater reliability. Fixed wing aircraft or helicopter will also be used for resupply of consumables (food, small parts, etc.) and rotation of personnel to the more isolated sections of the project (borrow sources during summer and late fall).

Temporary airstrips during construction could consist of:

- winter strips constructed on frozen lakes and/or cleared sections of the right-of-way; and
- summer strips constructed on tangent sections of the Highway embankment.

Approximately 9 km south (east of the mouth of Thunder River near the Mackenzie River) of where the Highway is currently proposed to cross the Thunder River, there is an airstrip that had been in use some time ago but is now abandoned. Access to the Highway from this location is not ideal because of the distance overland. Specific details of temporary airstrips and helipads will be confirmed at the detailed design stage of the project development.

6.9.10 Explosives

Drilling and blasting operations in the borrow sources will be required as the material will be frozen. Explosives used will be primarily ammonium nitrate and diesel fuel (ANFO) with commercial products for "wet" holes. Storage of ammonium nitrate prills will be on site in a secured location and in accordance to the appropriate legislation and guidelines.

Timing and control of drilling and blasting operations relative to local fisheries, wildlife, and the environment are discussed in Section 10.0 and Section 11.0 of this PDR.

6.9.11 Mobilization

Timing of mobilization to the project area has seasonal and modal restrictions. Staging of camps, equipment, and fuel will be required and the selection or limitation of mobilization route or mode will increase costs as equipment could become stranded during the mobilization period.

The construction schedule presented in this section and the project time table presented in Section 7.0 are based on an estimated timing of issuance of approvals such that mobilization can be undertaken and not delay project start up. Key seasonal and modal factors to consider in mobilization to the project area are as follows:

- The 10-year average of opening and closing dates for the Mackenzie Valley Winter Road (NWT Hwy 1) from Norman Wells to Fort Good Hope is January 1 to March 30 (DOT Website 2010). Although it is not likely that access to the project area in the GSA will be via the Mackenzie Valley Winter Road and construction of a winter road north of Fort Good Hope, the time frame presented gives an indication of when a winter road could be in operation from Little Chicago north to the start of construction in the GSA and the overall operation via winter road for construction in the GSA.

- The 10-year average of opening and closing dates for the river crossings on the Dempster Highway are shown in Table 6.9.11-1.

Table 6.9.11-1: Opening and Closing Dates for River Crossings on the Dempster Highway (10-year average) (DOT Website)

Mode	Mackenzie River Near Tsiigehtchic		Peel River Near Fort McPherson	
	Opening	Closing	Opening	Closing
Ferry	June 2	October 24	June 1	October 24
Ice Bridge	November 21	May 3	November 11	May 5

- Available sailing season for barges on the Mackenzie River from Hay River is generally from May to September.
- Seasonal weight limits (i.e., Spring Weight Restrictions) on Provincial and Territorial Highways can limit the hauling of heavier loads (i.e., large equipment and/or bridge components). This is a limitation to be considered when hauling to Inuvik and the north end of the Highway and to Hay River to meet a barge sailing. Spring Weight Restrictions in Alberta, British Columbia, Yukon and the Northwest Territories are condition based (i.e., they start when the temperature conditions have been such to forecast the timing of when the frost is starting to come out of the highway embankment), but generally start in March in Alberta, April/May in northern British Columbia, May in the Northwest Territories, and May/June in Yukon.

6.9.12 Borrow Source Evaluation and Site Development Plans

The preferred material sources have been selected based on available information about the source and the proximity to the preferred alignment. The selections and the estimate of the materials to be used from this source are preliminary at this stage. Further evaluation of the preferred borrow sources will be required at the detailed design stage and will include geotechnical investigation to confirm quantity and quality of material available.

6.9.13 Site Development Plans or Pit Management Plans

Selection of materials and development of borrow sources is of high importance in permafrost regions. On one hand, it is important to select materials that are suitable for the development of infrastructure over frozen and thaw sensitive ground. On the other hand, it is important to select and develop borrow sources with minimal or no impact to historical resources, traditional use areas, and the environment.

In the next stages of the project development, borrow sites will be investigated with techniques that minimize impact. These include winter only access to the sites, and the use of advanced and non-destructive technologies, such as Ground Penetrating Radar in initial investigations to allow for a well planned and selected drilling program.

Site development and operation will be effectively organized while minimizing the impact on the environment and the permafrost. Considerations will include:

- minimizing the use of valuable non-renewable resources;
- minimizing the footprint around the borrow site;
- minimizing the impact of the operation on the permafrost, and on all waterbodies and watercourses;
- adapting the site operations and selecting equipment that is appropriate to frozen ground conditions; and
- minimizing the impact of the exploration and operational activities on the landscape, traditional activities, and archaeological sites.

Most of the sites will be temporary sites for construction only. However, during the detailed design stage, approximately three of the sites will be selected based on location relative to permanent maintenance facilities and volume, quality, and type of material available to remain as permanent or at least, long-term borrow sources for future maintenance and preservation requirements for the Highway. These sources may be considered for development of other future infrastructure as well, and during the next stages of the Highway project development will include all-weather access to these few selected sources.

Whether a borrow source is considered for construction only, or for long-term use, a development plan for each site is an effective tool to manage the source. Site development plans will be prepared in accordance with local environmental guidelines and policies, as well as local experience and best practices. The most relevant guidelines to the Highway are:

- "Environmental Guidelines, Pits and Quarries", Land Resources, Northern Affairs Program, INAC 1982; and
- "Guidelines for Development and Management of Transportation Infrastructure in Permafrost Regions", Transportation Association of Canada 2010.

6.10 Design/Construction Costs

The estimated design and construction costs for the Highway are presented in Table 6.10-1 and are based on a combined design and construction approach, the construction schedule discussed in detailed in Section 7, and general knowledge and experience from the construction industry. Estimates are budgetary or planning level cost estimates.

Table 6.10-1: Estimated Design/Construction Costs

Item	Quantity	Subtotal
Highway Construction (including mobilization, winter road construction, camp operation, bridges, etc.)	7.1M m^3 Embankment and Surfacing Material 7 Major Bridge Structures 135 Culverts or Minor Bridges Structures Minor Culverts Maintenance Facilities	$353.5M
Engineering, Design, Construction Administration at 4.5% of Estimated Construction Cost		$15.9M
Total Estimated Design and Construction Costs		**$369.4M**

The estimated costs included in the above table do not include royalties or administrative fees associated with granular and embankment materials taken from sources that are on Gwich'in private lands. These royalties or administrative fees are to be negotiated between the GTC and DOT.

6.11 Operation and Maintenance

This PDR is intended to focus on the construction of the Highway, but questions regarding the future operation and in particular dust control, were raised during the consultations. Operation and maintenance of the Highway will require maintenance camps or facilities located at approximately 100 km intervals along the Highway. Specific locations for the facilities will be confirmed during the detailed design phases of the development of the Highway and will be dependent on the final design alignment, the location of material sources, and other factors. These will be permanent facilities, operated all year long. There are expected to be three maintenance facilities in the GSA. Maintenance facilities are anticipated to include a small camp, a shop, fuel and other storage facilities, waste disposal facilities, and a small staging area. The maintenance facilities will be part of the Highway infrastructure and be operated under the authority of DOT.

Winter maintenance activities will include ploughing and ice control. Summer maintenance activities will include grading, blading, replacement of surface gravel, and dust control at selected locations where sight distance may be limited.

Chemicals commonly used for dust control on gravel highways include calcium and magnesium chloride or road salts. When stored and used properly, these road salts have minimal impact on the surrounding environment. However, other cost effective materials and technologies for roadway surfacing are being marketed and tested in northern environments. Some of these include polymer modified cold mix materials that are reported to withstand colder temperatures without ravelling, and are not a chemical that can become water or airborne after application on the road surface. An example of such is "E Z Street" which the vendors report to have used in other cold climate countries and is currently being tested in the Yellowknife area. Another example is "InfraCrete" which is an enhanced soil cement made with natural minerals and used in stabilizing road surfaces. At the present time, there are few practical applications in northern environments, but vendors report that test applications are underway. These types of surfacing materials will be further reviewed for application and effectiveness in the next stages of development of the project.

6.12 Land Tenure

Of the 181 km of the Highway in the GSA, 111.7 km are on Gwich'in settlement lands. As the ultimate goal is to have the 60 m wide highway right-of-way under the authority of the GNWT (surface rights), 111.7. km are to be transferred to the GNWT pursuant to the expropriation procedure set out in Section 23 of the *GCLCA* and as more specifically addressed in Schedule XVII – "Notice of Intent, Expropriation of Gwich'in Lands for the Proposed Mackenzie Highway." As the Highway proceeds through approvals, funding, design and construction, the GTC will work with DOT to give effect to the land transfer pursuant to and subject to the provisions of the *GCLCA*.

6.13 Access Management

The Highway will be under the authority and management of DOT. DOT only has authority to limit or control access to the Highway from adjacent lands (i.e., approval of driveway development to access the Highway). Control of access to adjacent lands will be under the authority of the landowners. To ensure that travellers along the Highway are aware of restrictions and requirements for accessing adjacent lands, non-typical information signs that identify land ownership, the necessity to gain permission to access, and contact information will be included in the typical highway signing.

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7.0 PROJECT TIMETABLE

The summary of overall project activities through permitting, investigation, design, and construction is presented in the table and discussion below. The detailed schedule for activities leading up to construction (detailed field investigation, design, and permitting) and the construction schedule for the Highway is presented in Table 7.0-2 and Table 7.0-3.

Table 7.0-1: Proposed Schedule of Activities

Activities	Approximate Dates
Submission to MVLWB for Highway Construction Wrigley to Inuvik (See Section 7.1)	January 2012
MVLWB Preliminary Screening Process (See Section 7.2)	February 2012 through September 2012
MVEIRB Environmental Assessment Process (See Section 7.3)	October 2012 through December 2013
Consultation and Permitting Required for Investigation and Survey Activities (See Section 7.4)	October 2012 through May 2013
Investigation and Survey Activities to Support Design and Construction Permitting (See Section 7.5)	June 2013 through March 2014
Additional Permitting Required for Construction (See Section 7.6)	April 2014 through August 2014
Design	Commences April 2014 and is ongoing throughout the duration of the project, staying ahead of fabrication and construction requirements.
Construction	December 2012 through Fall 2016
Estimated Opening of the Highway	Fall 2016

7.1 Submission to Mackenzie Valley Land and Water Board (MVLWB)

DOT will prepare an overall PDR for the Mackenzie Valley Highway from Wrigley to Inuvik using information in this PDR and similar PDRs prepared for the other highway segments. Then DOT will submit the overall PDR for approval to the MVLWB. The estimated submission date and the overall schedule is based on the assumption that the work completed to date and the information presented in this PDR is sufficient for purposes of the MVLWB Preliminary Screening, and that additional field investigations (engineering and environmental) and a more fully developed design are not required at this stage.

7.2 Time Estimated for the Preliminary Screening Process

The schedule provides an estimate of time that may be required for the:

- the MVLWB to assess the submission for completeness;
- the MVLWB to request the Proponent to provide additional information;
- the Proponent to prepare and submit additional information;
- the MVLWB to conduct preliminary screening, which could take a minimum of 42 days, (the MVLWB could request longer in accordance with the *MVRMA*);

- the MVLWB to conduct public hearings that are mandatory because of the need for a Type A Water Licence and the timing of which includes a required 35 days of public notice of the hearings; and
- the MVLWB to prepare and issue a decision.

In estimating the schedule, the assumption with this step is that the request for additional information will be relative to clarification of information presented in this PDR, that the additional information can be readily prepared from data already available in the project files, and that additional field investigations (engineering and environmental) and design work will not be required at this stage.

7.3 Time Estimated for Environmental Assessment Process

If the decision made by the MVLWB is to refer the project to the MVEIRB, then the schedule shows the estimated time required for the Environmental Assessment Process and specifically for:

- the MVEIRB to hold community scoping sessions, develop the terms of reference, work plan, for the environmental impact statement (EIS);
- the Proponent to prepare the EIS;
- the MVEIRB to conduct the conformance review of the EIS and to request the Proponent to provide additional information, if needed;
- the Proponent to provide additional information; MVEIRB to hold Information Request process for parties to the assessment;
- the MVEIRB to hold technical sessions and public hearings for the environmental assessment process; and
- the MVEIRB to prepare and issue a recommendation to the Minister for INAC; Minister to make the decision.

In estimating the schedule, the assumptions at this stage are that preparing the EIS and responding to requests for additional information will be undertaken based on data already available in the project files and additional field investigations and design will not be required to support the preparation of the EIS.

7.4 Time Estimated for Consultations and Permitting Required for Investigations and Survey Activities

While the preliminary screening and environmental assessment are underway, the next steps of field investigation and survey activities can be undertaken to support design and construction requirements once the overall project is approved. Consultation within the GSA will likely be required at this stage which includes the GTC, the DGOs, the RRCs, the GSCI and the Bands and Band Councils. The detailed discussion of permitting and the associated authorities is discussed in Section 4. The Permits that will be required include:

- Research Licence from the Aurora Research Institute;
- Wildlife Permit from ENR;
- Archaeological Permit from the PWNHC;
- Access Agreement from the GLA;
- Land Use Permit from the GLWB; and
- Water Licence from the GLWB.

Time estimated in the schedule considers consultations, meetings, and preparation of individual permit applications, as well as time for the appropriate agencies to process the application.

7.5 Investigations and Survey Activities to Support Design and Construction

The intensive investigations and survey activities required to support design and construction are seasonally restricted but can be undertaken while preliminary screening and environmental assessment are underway. These activities are identified on the project schedule and include:

- spring investigations for hydrology, fisheries, wildlife, vegetation, and birds;
- late summer/fall investigations for hydrology, fisheries, wildlife, vegetation, and archaeology;
- LiDAR and ground survey; and
- winter investigations for geotechnical (highway alignment and borrow sources, including construction of winter access trails) and wildlife.

7.6 Additional Permitting Required for Construction

Additional permitting will be required subsequent to the Minister's decision for approval. Details of the permitting and the authorities are discussed in Section 4. The permits that will be required include:

- Land Use Permit from the GLWB;
- Quarry Permits from INAC;
- Water Licence from the GLWB;
- Explosives Permit;

- Fisheries Authorizations; and
- Navigable Waters Authorizations.

Preparation of the necessary applications will require the completion of the investigations and survey activities noted above and the design/planning requirements for winter construction access and pit management.

7.7 Construction Schedule

The approach to construction and the seasonality of specific activities is discussed in Section 6. The construction schedule is presented in Table 7.0-3.

Table 7.0-2 Project Approvals, Investigations and Design Schedule

Winter Construction Season No. 1
(See Table 7.0-3 Construction Schedule)

Activity	2012												2013												2014												2015					
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Submit combined Mackenzie Valley Highway regional PDRs to MVLWB																																										
MVLWB determines: completeness, requests more information if needed, appoints transboundary panel from regional L&WBs, if needed																																										
Proponents submits more information; MVLWB screens application for environmental impact or public concern																																										
MVLWB refers project to MVEIRB																																										
MVEIRB conducts scoping sessions, determines if process will be environmental assessment (EIA) or environmental review (EIR)																																										
MVEIRB issues Terms of Reference for Developer's Assessment Report (DAR) or Environmental Impact Statement (EIS) and Workplan																																										
Proponents submit DAR or EIS; Review Board checks for conformity, requests more information if needed;																																										
Proponents submit requested information; MVEIRB conducts Information Request process																																										
MVEIRB conducts Technical Sessions; Public Hearings																																										
MVEIRB writes Report of Environmental Assessment with Reasons for Decision and Recommendations; submits to INAC Minister & Resp. Ministers																																										
INAC Minister issues approval of MVEIRB recommendations																																										
MVLWB holds Public Hearings																																										
MVLWB issues Water License and Land Use Permits																																										
Plan Winter Construction Access and Pit Management based on Investigation and Survey Activities, Apply for & Receive Permits required for Construction																																										
Consultation and Permitting required for Investigation and Survey Activities																																										
Spring Investigation Activities (Hydrology, Fisheries, Wildlife, Vegetation, Birds)																																										
Late Summer/Fall Investigation Activities (Hydrology, Fisheries, Wildlife, Vegetation, Archaeology Studies)																																										
LiDAR and Ground Survey																																										
Winter Investigation Activities (Geotech and Wildlife Studies)																																										
Highway Design (ongoing through combined design and construction process)																																										
Bridge Design (Initially first three bridges then ongoing through combined design and construction process)																																										
Fabrication of Bridge Components (Initially first three bridges then ongoing through combined design and construction process)																																										
Environmental Monitoring during construction																																										

Table 7.0-3 Construction Schedule

Activity	2014									2015												2016											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Environmental Monitoring during construction	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
Highway Design (ongoing through combined design and construction process)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■												
Bridge Design (Initially first three bridges then ongoing through combined design and construction process)		■	■	■																													
Fabrication of Bridge Components (Initially first three bridges then ongoing through combined design and construction process)					■	■	■	■	■	■																							
Planning for and Mobilization of Equipment via Dempster Hwy to Inuvik and km 1509				■	■	■	■	■	■	■																							
Clearing of ROW and Construction of Winter Road, km 1509 to km 1458									■																								
Material Production and Stockpiling at Source "2.6", "4.08" and "June 2010-1"										■	■	■	■	■	■																		
Embankment Construction, km 1509 to km 1458 (three spreads)										■	■	■																					
Grading, Compaction and Placement of Surfacing, km 1509 to km 1458 (Note 1)																■	■	■															
Mobilize Piling Equipment to Bridge Sites 1490A, 1480F and 1470F										■																							
Piling at Bridge Sites 1490A, 1480F and 1470F											■																						
Erect Piers and Abutments/Backwalls at Bridge Sites 1490A, 1480F and 1470F												■																					
Launch Girders and Deck at Bridge Sites 1490A, 1480F and 1470F																	■	■															
Planning for and Mobilization of Equipment to Little Chicago and prepare staging area		■	■	■	■	■																											
Clearing of ROW and Construction of Winter Road, Little Chicago to km 1360 (Thunder River)									■																								
Material Production and Stockpiling at Source "5.17" and "5-014"										■	■	■	■	■	■																		
Embankment Construction, km 1328 to km 1360 (one spread)										■	■	■																					
Grading, Compaction and Placement of Surfacing, km 1328 to km 1360 (Note 1)																■	■	■															
Construction of Winter Road from Little Chicago to km 1328																					■												
Construction of Ice Crossing at km 1360 (Thunder River)																					■												
Clearing of ROW and Construction of Winter Road, km 1360 to km 1385																					■												
Material Production and Stockpiling at Source "4-103" and "4.100P"																						■	■	■	■	■	■						
Embankment Construction, km 1360 to km 1385 (one spread)																						■	■	■									
Grading, Compaction and Placement of Surfacing, km 1360 to km 1385																												■	■	■			
Mobilize from Dempster Highway to km 1458 via previously constructed Highway																				■	■												
Clearing of ROW and Construction of Winter Road, km 1458 to km 1385																					■												
Material Production and Stockpiling at Source "4-024", "4.038APA", "4.039P", "4-060", "4.059AP", and "June 2010-3".																						■	■	■	■	■	■						
Embankment Construction, km 1458 to km 1385 (three spreads)																						■	■	■									
Grading, Compaction and Placement of Surfacing, km 1458 to km 1385 (Note 1)																												■	■	■			
Mobilize Piling Equipment to Bridge Sites 1430J, 1430B, and 1410D																						■											
Piling at Bridge Sites 1430J, 1430B, and 1410D																							■										
Erect Piers and Abutments/Backwalls at Bridge Sites 1430J, 1430B, and 1410D																								■									
Launch Girders and Deck at Bridges Sites 1430J, 1430B, and 1410D																								■									
Mobilize from Dempster Highway to km 1360 (Thunder River) via winter road																					■												
Piling at Bridge Site 1360D (Thunder River)																						■	■										
Erect Abutments/Backwalls at Bridge Site 1360D (Thunder River)																							■	■									
Launch Girders and Deck at Bridge Site 1360D (Thunder River)																								■									
MACKENZIE VALLEY HIGHWAY, GWICH'IN SETTLEMENT AREA OPENS!																														☆			

Notes:

1. Will likely require stockpiling of surfacing material along or adjacent to completed embankment in previous winter.

8.0 TRADITIONAL AND OTHER LAND USES

8.1 Introduction

Evidence of human occupation and use of the GSA dates back at least 6,000 years (the Middle Prehistoric Period). This section presents information that relates to the use of the land and draws upon information compiled through previous archaeological studies and a field reconnaissance completed in June 2010. It also covers traditional knowledge that has been made available by the GSCI. The importance and content of the *GLUP* is summarized and information on how the land has been used for infrastructure in the past and present is also provided, along with potential ways the land may be used in the future. Information that is available on the harvesting of animals in the area is also summarized.

8.2 Heritage and Archaeological Resources

Heritage resources are non-renewable and finite. They are important sources of historical knowledge and cultural identity. They are considered of value to local communities, scientists, and the Governments of the Northwest Territories and Canada. Consequently, they are protected by legislation. It is illegal to disturb an archaeological site, burial, or artifact, and no land use activity is permitted within 30 m of a known or suspected heritage site. By definition, archaeological sites must have physical remains, while traditional or cultural sites do not need physical evidence. According to *Northwest Territories Regulations*, for remains to be considered archaeological, they must be greater than 50 years old. All these types of cultural sites can be included within the heritage resources classification.

8.2.1 Human History Summary

The following summary is based on extensive research of documentary data. Sources that were consulted include: archaeological site inventory records held by the GNWT, early fur trader/explorer accounts, ethnographic/anthropological studies, available traditional knowledge studies, and reports on past archaeological studies. Pertinent topographic, palaeogeological, and paleoenvironmental information will be incorporated to form a detailed knowledge base in order to assess the potential for heritage resources.

The Regional Study Area for background information research is necessarily large to place the specific project area study results in proper context. Past people used the project study area as part of a larger regional exploitation pattern. Therefore, for this overview, the Regional Study Area is that portion of the GSA bordered by the Mackenzie Delta on the west, the Mackenzie River on the south, and the GSA boundaries on the east and north sides that represent normal traditional range limits.

8.2.1.1 Prehistory

Archaeological investigations in northwest North America have long been focused on trying to determine timing and travel routes for the first people entering North America. The Mackenzie Valley was thought by some to be one of the possible routes used (Clark 1981) to populate the continent from Alaska and Yukon; however, no very early sites have yet been found.

The Paleoarctic Tradition has been dated as early as 11,000 years B.P. (before present) in Yukon and Alaska west of the Mackenzie to as late as 4,500 years B.P. in some areas. There are as yet no dated sites that have been assigned to this Tradition in the Mackenzie Valley.

The Middle Prehistoric Period (6,000 years B.P. to 2,000 years B.P.) is characterized by blending of Northern Cordilleran lanceolate point technology from the south with Paleoarctic microblade technology from the west. This has been termed Northwest Microblade Tradition (Clark 1991). Within the present study area, Whirl Lake revealed this blended microblade culture.

In 1987, the Northern Oil and Gas Action Plan (NOGAP) project excavated several sites in the Tenlen Lake area, close to the present project study area. Some evidence discovered suggested Middle Prehistoric Period occupation, including a lanceolate point base (Pilon 1988). Arctic Small Tool Tradition was identified at a site on Tenlen Lake (Pilon 1992), and microblades were also found at that same site, suggesting occupation between 2,000 and 5,000 years ago.

The Late Prehistoric Period (1,500 years B.P. to 200 years B.P.) is represented in the Mackenzie region by an area called Spence River, first identified in a site on the upper Mackenzie. Artifacts characteristic of this assemblage are small, triangular, and leaf shaped side- to corner-notched points (Clark 1991). Microblades are typically absent. The small notched points suggest the appearance in the north of the bow and arrow hunting method (Morrison 1984). A semi-subterranean dwelling found at Whirl Lake was assigned to this time period, indicating a considerable time depth to this dwelling type. Most of the prehistoric sites recorded in the Mackenzie Valley thus far appear to date to Late Prehistoric times.

8.2.1.2 Historic Period

A number of explorers, fur traders, and adventurers travelled the Mackenzie River and recorded observations of the environment and of their encounters with aboriginal people. First was Sir Alexander Mackenzie in 1789. He was followed by Sir John Franklin in 1826, Thomas Simpson in 1836, and Sir John Richardson in 1850. Although they all provided some descriptions of the people they encountered, these early explorers essentially did not venture far from the banks of this portion of the Mackenzie River, as was also the case for later travellers and adventurers, e.g., Russell (1894) and Waldo (1922). Fur traders and missionaries who actually lived in the region explored more of the country and had more contact with aboriginal inhabitants. This focus on the Mackenzie River valley continued throughout the historic period.

The fur trade in the Mackenzie Valley began shortly after Sir Alexander Mackenzie's historic voyage in 1789. Posts were established at strategic locations to intercept the First Nations people. Fort Good Hope, first established in 1804 (Voorhis 1930), was moved upstream twice after 1821 to provide easier access for the "Loucheux" people (Gwichya Gwich'in). Within the current study area, there were short-lived posts at the mouths of the Travaillant River and Thunder River. Opposite the mouth of the Thunder River, the Hudson's Bay Company operated Fort Good Hope between 1823 and 1836 (Robinson and Robinson 1946), after which it was moved permanently to its present location further south. Several independent traders operated a post at the mouth of Thunder River for four to five year periods between 1933 and 1956, and other traders opened posts at the mouth of the Travaillant River between 1927 and 1939 and possibly 1939 and 1942 (Usher 1971).

In the 1850s, missionaries arrived in the Mackenzie District. One of the most well travelled and observant of the missionaries was Father Emile Petitot who was stationed at Fort Good Hope in the 1860s and travelled overland across the Anderson Plain extensively, making geographic notes and recording his experiences with and observations of aboriginal people of the region. He also published prolifically on his travels and his observations (e.g., Petitot 1970). Steamboats began to travel up and down the Mackenzie River in 1887. The RCMP arrived in the Mackenzie region in 1903 (Robinson and Robinson 1946) and established a post at Arctic Red River.

8.2.2 Ethnography

There are several excellent sources available on Gwich'in traditional knowledge published by the GSCI. The information below is summarized from these and several ethnographic and historic sources, principally, Andre and Kritsch (1992), Heine et al. (2001), Osgood (1936), and Slobodin (1981).

The main part of the study area was occupied at the time of contact by an eastern group of Kutchin speakers, an Athapaskan language group. The subgroup labelled by ethnographers as Arctic Red River Kutchin used the area from the Mackenzie Delta, south along the Arctic Red River, and east along the Mackenzie River to Thunder River and areas to the north (Slobodin 1981). This subgroup of people was also referred to as Loucheux by early fur traders, missionaries, and explorers. The people themselves never used either designation – they have called themselves Gwichya Gwich'in "people of the flat lands" (Heine et al. 2001). The designation "Gwich'in" will be used in this section (Section 8.2.2) to refer to the Gwichya Gwich'in people.

Gwich'in people were hunters and gatherers who were intimately familiar with all animal and plant resources found in the Mackenzie region and used most of them. As hunters and gatherers, the people necessarily travelled throughout the region to obtain required resources. Food pursuits followed a roughly regular seasonal travel pattern, based on comprehensive knowledge of when and where key resources were available. Most of the summer, people would congregate on the flats in the vicinity of the confluence of the Arctic Red River with the Mackenzie. There people would fish, dry the fish, and pick berries. Since this was the primary yearly gathering together of people, trading, dancing, and gaming were also major activities (Andre and Kritsch 1992). In the fall, people dispersed in smaller family groups. Some people would travel to Travaillant Lake where they would remain as long as their food stores lasted into the winter. During winter, fishnets could be set in the middle of the lake; at the south end of the lake, people camped near an area that usually had open water most of the year, permitting netting of fish (Ibid.).

In the spring, people would travel to lakes that were good for hunting migratory waterfowl and muskrats. One of the areas used was a group of small lakes (one of which is Rat Lake) on the north side of the Mackenzie River, just southwest of Andrew Lake, but also said to be good for ratting were the small lakes south of Andrew Lake, Whirl Lake, and Crossing Creek Lake (Ibid.).

The primary food pursuits of the Gwich'in people were fishing and hunting caribou and moose. Other large mammals hunted included sheep and bear. Not only were these animals important sources of food, but their hides were essential for clothing, tents/shelters and canoe/boat coverings; bones and antlers were used for making tools. Before the coming of fur traders with guns, hunting of large mammals was done mainly with bows and arrows; caribou were often trapped and surrounded using caribou fences. Deadfall traps were used for medium-sized mammals.

Fishing was carried out in all seasons. Fish such as char and herring were caught in the Mackenzie River using weirs and basket fish traps. Freshwater fish including whitefish, trout, pike, inconnu, grayling, and burbot were caught by bone hooks, traps, and gill nets. "Fish traps were set at narrows or where creeks flowed in and out of lakes" (Andre and Kritsch 1992). Small mammals such as hare, beaver, muskrats, and squirrels were taken by deadfalls or snares throughout the region in all seasons. Migratory waterfowl, primarily ducks, were hunted as soon as they arrived in the spring, and often saved the people from starvation after a difficult winter season (Osgood 1936). Ducks were shot with blunt arrows. Grouse and ptarmigan were generally taken with snares all year round. Caribou were most frequently hunted in the fall and early winter throughout the region. Spring and fall fishing camps were located on larger lakes, such as Travaillant Lake (Andre and Kritsch 1992). Most of the fish caught in the fall were dried for winter consumption.

Plants served not only as food, but also as medicinal sources and tool components. Spruce, alder, willow, birch, juniper, and wild rose provided important medicines. Spruce root fibres could be used as cords. Licorice root, ground pine, wild parsnip, and various berries such as blueberries and cranberries were significant food components (Heine et al. 2001).

Travel methods included birchbark canoe, moose skin boat, on foot, and with snowshoes made of birch, spruce, and willow. Belongings were carried in packs or on sleds pulled by women or dogs, when available (Osgood 1936).

Prior to contact with fur traders, tools were made of combinations of wood, bone, antler, and stone. Parts of tools were bound together with sinew or babiche. Blades and points were made of stone and bone. The tool kit included grooved stone adzes, hide scrapers made of bone or stone, bone awls and knives with bone or wood handles, and stone blades. Dishes were made mainly of bark, some containers of wood, and spoons were made of horn or spruce roots.

Meat was preferred boiled with hot stones. Smaller quantities were prepared in a bark container, larger amounts in boiling pits. Often boiling pits were up to three feet in diameter, lined with a moose hide, filled with water and hot stones were added. Only rocks that would not explode when heated could be used as cooking rocks; thus, they were very valuable. Thunder River was one of only two places where they were said to be collected (Andre and Kritsch 1992). It was reported that flint for fire starting was obtained from the Thunder River shale deposits (Ibid.). To store food, pits were often dug in the ground and food was covered with spruce bark topped with heavy logs, or food was hung in trees.

The most common type of house used was a dome shaped moss covered structure built wherever resources permitted people to stay for longer periods of time. These were most often built in the fall and occupied as long into the winter as the residents had sufficient food (Heine et al. 2001; Osgood 1936). Other types of dwellings reported were willow houses, semi-subterranean houses, rectangular spruce bark covered houses, and skin tents; the latter used during periods of more frequent travel (Ibid). For one night stops, spruce or willow brush shelters were often made (Heine et al. 2001).

Other smaller structures that were often built included smokehouses, menstrual lodges, and sweat lodges (Osgood 1936). Prior to Christianization, bodies of the dead were typically left behind in the bush, often covered by logs, or sometimes placed in abandoned lodges or on elevated platforms with the bodies either wrapped in skins, or covered with logs (Osgood 1936).

The Gwichya Gwich'in reports that at least six major travel routes were used to access Travaillant Lake from the west (Andre and Kritsch 1992). One from the Delta area went by Campbell Lake, Caribou Lake, Sandy Lake, and on to Travaillant Lake, roughly paralleling part of this proposed road route and possibly being crossed by it. Travel routes from Arctic Red River generally followed drainage systems further south, closer to the Mackenzie River; a couple of routes followed the Bathing, Deep, and Jiggles series of lakes (Heine et al. 2001).

The camp at the north end of Travaillant Lake where people congregated in the fall to catch whitefish was known as Teelaii (Andre and Kritsch 1992). People would stay there as long as possible, well into the winter. From those traditional fall campsites, travel to the Thunder River often followed the small lakes to the north and then east along Trout and Tenlen lakes. Also from Teelaii, a trail to go caribou hunting went along David Lake, Woodbridge Lake, Fish Trap Lake, Hill Lake to Caribou Lake, and then back to Teelaii via Sunny-Point-Sandy-Tregnantchiez lakes (Ibid.). From fishing camps on the south end of Travaillant Lake, people travelled along the river to the Mackenzie and then on to the mouth of the Thunder River to the east, or toward the Flats at Arctic Red River to the west.

8.2.3 Previous Archaeological Studies

Archaeological investigations in the Mackenzie Valley began in the early 1950s (e.g., MacNeish 1953) as part of a search for the routes used by early colonizers of North America. In 1973, an extensive archaeological research study of the Mackenzie Valley two miles to either side of the river between Fort Providence and Arctic Red River found 376 "occupations" (Millar and Short 1973); six sites were recorded at Thunder River and three at Travaillant River, in both cases near the mouths. That same year, Millar led a survey of the PWC 1974 route between Wrigley and Inuvik (Millar and Fedirchuk 1973). Within the northern section, between Fort Good Hope and the Dempster Highway, this survey recorded 41 archaeological sites along the proposed route. Unfortunately, the route surveyed was not shown on report maps at a scale that is at all informative; however, the route ran south of Travaillant Lake and is only close to the currently proposed route in the section east of South Lake. The Thunder River crossing was identified as a key area of concern (Millar and Fedirchuk 1973).

Also in 1973, the first of a number of archaeological studies of potential pipeline corridors in the Mackenzie Valley was completed (Losey 1973), although this investigation was south of the present study area. Beginning in 1985, the Archaeological Survey of Canada began several years of research in the Mackenzie Valley under a program known as NOGAP prompted by anticipation of heavy oil and gas exploration and development activities (Pilon 1985, 1988, 1992). The study focus in 1985 was the vicinity of Travaillant Lake, in particular, lakes to the northeast (Tenlen and Trout lakes) and, to a lesser degree, lakes to the west (Point and Deep lakes). A total of 40 archaeological and historic aboriginal sites were recorded, of which 26 were on the Tenlen-Trout lakes drainage system and 7 were recorded on Point-Sandy lakes and Deep Lake. In 1987, 26 new archaeological sites were recorded and of these, 14 were found on Tenlen and Trout lakes. Excavations focused on investigation of some large pits to determine if they represented caches or semi-subterranean houses. In 1991, 5 more sites were recorded on Trout Lake, 12 on Lure Lake to the north of Travaillant Lake, and 11 sites were recorded at the south end of Travaillant Lake and around Andrew Lake.

Most archaeological investigations since the mid-1980s have related to Mackenzie Valley oil and gas pipeline proposals. These studies were predominantly surveys to locate sites and provide recommendations for avoidance or mitigation excavations. Thus far, these studies have contributed a substantial body of data relating to the early human settlement patterns in the Mackenzie region. No detailed site-specific investigations have been completed relative to these projects to date.

A gas pipeline route examined in 2001 (Thomson and Stoddart 2001) was essentially paralleling the Mackenzie River and passed south of Travaillant and Andrew lakes, as well as the chain of Bathing and Jiggle lakes. Twenty-seven new sites were recorded in the GSA, most of them south of the current study corridor. Seven of these sites were identified as prehistoric; the remainders were classified as indigenous historic, historic, and contemporary.

Beginning in 2002, four field seasons of archaeological investigations were completed for the MGP (Clarke et al. 2003; Clarke et al. 2004; Clarke and Webster 2005; Webster et al. 2007). This is the pipeline routing passing north of Travaillant Lake that provides the corridor guiding the location of the current Highway route. The first three years of these studies selected high archaeological potential portions of a 1 km wide pipeline corridor, as well, specific borrow sources and infrastructure locations were examined. The entire pipeline routing was not assessed. The 2006 season focused mainly on revised borrow and infrastructure locations. These studies resulted in 41 new sites being recorded within the GSA, some prehistoric, but most were indigenous historic or contemporary. Numerous previously recorded sites were also revisited over the four field seasons.

In summary, previous regional archaeological studies specific to the MGP corridor focused on high potential terrain features, that is, the Mackenzie River terraces, mouths of major rivers, several large lakes, and, outside of these areas, specific development zones. This information, and the observations made along the Highway alignment alternatives in the June 2010 field program, was used in the preliminary design to locate the Highway and borrow sources away from known and potential archaeological resources. In the next stages of development of the Highway, which include detailed design and geotechnical investigation, more precise locations of the Highway and the borrow sources will be determined and additional and specific archaeological investigations will be undertaken to include areas that had not previously been investigated.

8.2.4 Recorded Heritage Resources

There are 20 previously recorded sites within the project corridor (Table 8.2.4-1). Five of these occur within the Thunder River valley. Three sites are associated with the drainage at the north end of South Lake, two occur on lakes that are part of the Travaillant drainage system north of Travaillant Lake, three occur along the Travaillant River north of Woodbridge Lake, and one is situated on a high knoll that may be a possible borrow source.

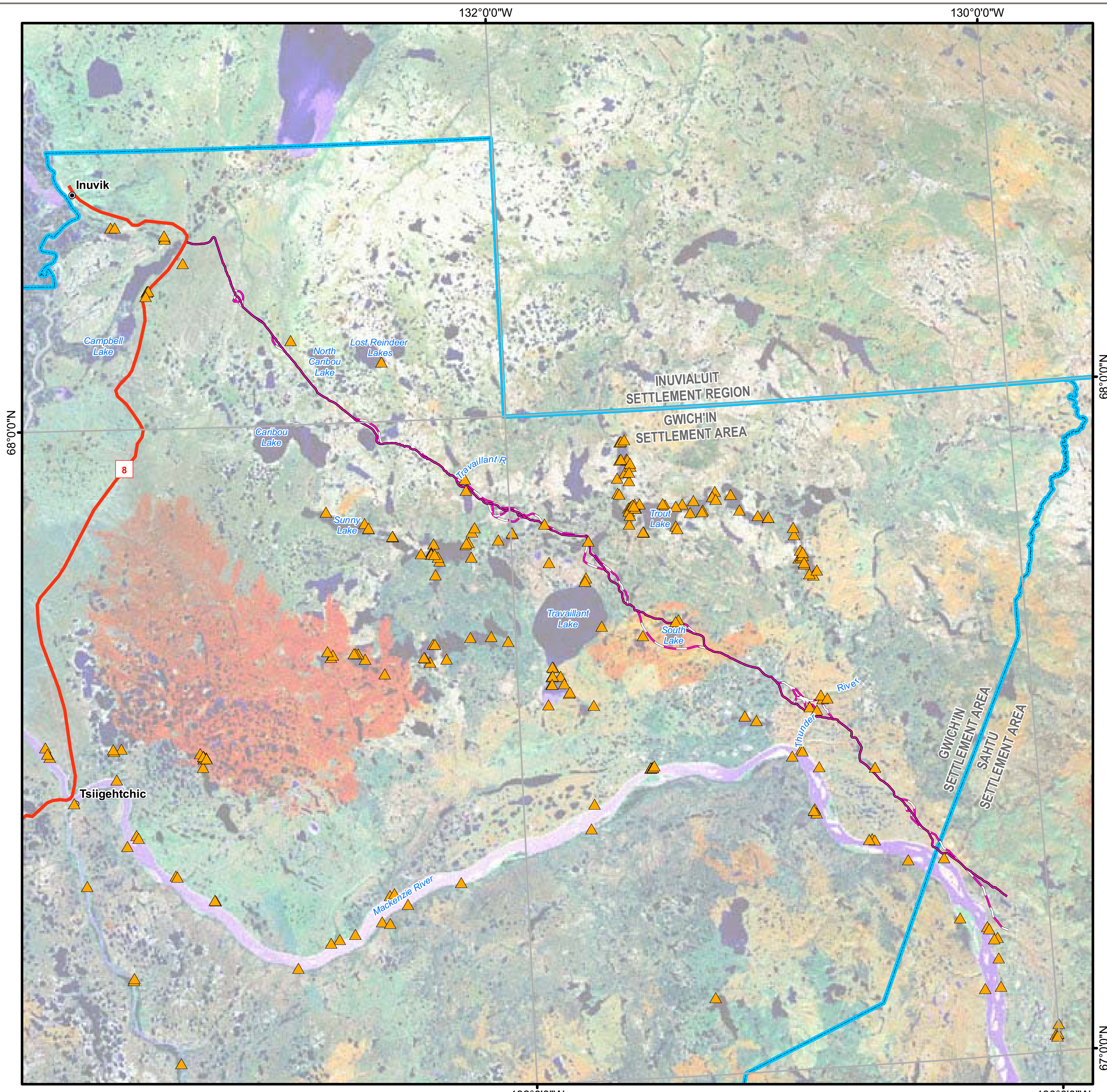
Within the regional study area defined by that portion of the GSA north of the Mackenzie River and east of the Delta, upwards of 150 archaeological and historical sites have been recorded (Figure 8.2.4-1). A large number of archaeological sites (approximately 51) have been found and several have been excavated on Trout (Vidi chu') and Tenlen lakes northeast of Travaillant Lake. Some of these sites are as close as 5 km to the currently proposed Highway. In addition, a concentration of sites occurs at the south end of Travaillant Lake and Andrew Lake. At the mouth of the Travaillant River on the Mackenzie, three fairly recent sites were recorded; six sites recorded near the mouth of the Thunder River include both prehistoric lithic remains and more recent camp remains (Miller and Short 1973). Thunder River was traditionally known as "Flint Creek" (GSCI 1997). Outcrops of siliceous argillite are present, which is a type of rock that is suitable for making stone tools; therefore, several sites containing remains of stone tool making have been found at Thunder River. These sites are approximately 7 km from the currently proposed crossing location.

Table 8.2.4-1: Recorded Sites in Close Vicinity to Road Route

National Inventory Site No.	Location	Component/Distance	Type
MhTh-2	Mackenzie R.	Road route/~500 m	Indigenous historic camp
MjTi-1	Thunder R.	Road route/~300 m	Prehistoric lithic
MjTi-2	Thunder R.	Road route/~400 m	Lithic scatter
MjTi-3	Thunder R.	Road route/~1,100 m	Camp remains
MjTi-4	Thunder R.	Road route/~700 m	Lithic scatter
MjTi-5	Thunder R.	Road route/~1,100 m	Prehistoric lithic
MjTk-1	Travaillant L. East	Road route alt/~800 m	Indigenous historic cabin
MkTk-2	South L. North trib.	Road route/within 100 m	Prehistoric lithic
MkTk-3	South L. North trib.	Road route/~600 m	Prehistoric lithic
MkTk-4	South L. Shore	Road route/within 100 m	Lithic scatter
MkTl-1	N. Travaillant Lake	~4 km/possibly crossed by road	Historic trail
MkTl-3	Crossing Creek Lake	Road route/within 1,000 m	Contemporary indigenous
MkTl-4	Crossing Creek Lake	Road route/within 1,000 m	Indigenous trap
MkTl-5	N. Travaillant trib	~2 km/possibly crossed by road	Historic trail
MkTl-6	N. Travaillant trib	Road route/within 200 m	Prehistoric camp
MlTl-1	N. Travaillant-Trout L.	Road route/within 100 m	Indigenous historic trail/trap
MlTm-1	Travaillant R. north	Crossed by road	Indigenous historic trail
MlTm-2	Woodbridge lakeshore	Road route/~600 m	Indigenous historic camp
NaTo-1	North Caribou Lake	MGP borrow/within 100 m	Prehistoric lithic
NbTp-3	Campbell Lake trib.	Road route-borrow/2.5 km	Prehistoric lithic

The known types of archaeological sites within the regional site assemblage are representative of the full range of cultural history postulated for this Mackenzie region. Some contain stone tool making evidence, some of which are tentatively assigned to the Middle and Late Prehistoric periods. The Middle Prehistoric Period is represented by at least one site on Trout Lake (Pilon 1988), lithic remains found at the mouth of the Thunder River (Pokotylo 1994), and at Whirl Lake (Gordon and Savage 1974). The Late Prehistoric Period is represented by quite a number of sites throughout the study area, in particular, several sites on Trout, Tenlen, and Lure lakes (Pilon 1985), as well as Thunder River. More recent trail, trap, and camp remains were recorded on Travaillant Lake; Travaillant River both north and south of the lake; lakes associated with the river such as Andrew, Crossing Creek, and David lakes; and Woodbridge and Fishtrap lakes.

Archaeological investigations at various sites throughout the region have identified approximately three dozen large pits that most likely represent semi-subterranean dwellings, based on excavations of several (Pilon 1988). Smaller pits have been identified as caches.



LEGEND

- Recorded Archaeological Site
- Communities
- MVH Concept - June 2010
- MVH Concept - June 2010, Alternative
- Settlement Area Boundary
- Dempster Highway (NWT HWY 8)

NOTES

Base data source: ESRI Base Data

STATUS

ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA

Previously Recorded Archaeological Sites

PROJECTION	DATUM
UTM 8	NAD83

10 5 0 10
Kilometres

FILE NO.
V33101053_Arcaelogical_Figure8.2.4-1.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	GP	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure 8.2.4-1

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8.2.5 Archaeological Overview Assessment

An archaeological overview assessment of the preliminary corridor for the Highway and selected borrow sources was completed in June 2010. The main goal was to assess the archaeological potential of terrain to be affected by this project. The primary method used to rate archaeological potential was visual assessment by low and slow helicopter overflight following the proposed alignment using global positioning system (GPS) coordinates. The route was depicted on topographic maps at a scale of 1:25,000. It must be emphasized that borrow sources were not finalized at the time of the field visit; therefore, they were not specifically assessed in the field. The project team later identified some preferred borrow sources and these are assessed here on the basis of the background data results and topographic map interpretation. Data gathered during the overview assessment will be used to identify specific portions of project components that will require ground reconnaissance surveys during the next phase of study.

8.2.5.1 Terrain Assessment

Much of the western 60 km of the Highway crosses more or less level muskeg and spruce bog. This type of terrain is considered generally low potential for archaeological remains, except where there is some focal point such as a slightly elevated lake shore or watercourse edge. In the next section east from the area of Fishtrap Lake, terrain crossed by the Highway becomes more irregular and overall, is somewhat more elevated. Smaller sections of muskeg are interspersed with knolls of various heights and sizes, and small ridges. Several clusters of these elevated terrain features, particularly where they are situated near waterbodies, have been rated as moderate archaeological potential. Level and dry terraces at larger water crossings and elevated terrain in the vicinities of larger lakes are considered high archaeological potential (Figure 8.2.5.1-1 and Figure 8.2.5.1-2).

The primary locations that have been rated as moderate to high archaeological potential are:

- Thunder River valley;
- South Lake;
- Travaillant Lake;
- Travaillant River;
- Woodbridge Lake;
- Hill Lake;
- Sitidgi Lake tributary locally known as Minor Creek; and
- elevated terrain near Mackenzie River.

With regard to the identified borrow sources, the 13 preferred sources were not specifically viewed in the field, with 1 exception noted in Table 8.2.5.1-1, below. Where the proposed source is close to the corridor, the general terrain assessment could be applied. The specific borrow locations, however, were largely rated by a desktop study. Consequently, these ratings should be considered preliminary.

Table 8.2.5.1-1: Preliminary Archaeological Assessment of Preferred Borrow Sources

Identifier	Location Description	Assessment	Archaeological Potential Rating
2.6	E of Campbell L.	Low ground, muskeg	Low
4.08	N of N Caribou L.	Spruce bog, open tundra	Low, IF not elevated
June2010-1	N of Hill Lake	Elevated knoll among lakes	High
4-024	Woodbridge-Fishtrap L	Terrain unknown; historic use	High: may impact recorded historic trail
4.038APA	Travaillant R. drainage	Lake shore and creek, visible trails	Moderate-high
4.039P	Travaillant L	Drainage elevated, major lakes system	Moderate-high
4-060*	Travaillant L	Drainage terrain not viewed, close to lake	Moderate-high IF elevated
4.059AP	Travaillant-Tenlen lakes	Slightly elevated, spruce	Moderate
June2010-3	Trav-Tenlen L systems	Elevated, burned spruce forest	Low-moderate
4.100P	W of Thunder River	Hill – not viewed	Moderate
4-103	Thunder River valley	River terrace	High – NOT REC**
5-014	Thunder River trib.	Terrain not viewed	Moderate-high
5.17	N Mackenzie R trib.	Terrain not viewed	Moderate

Notes:
*see Section 6.6.8

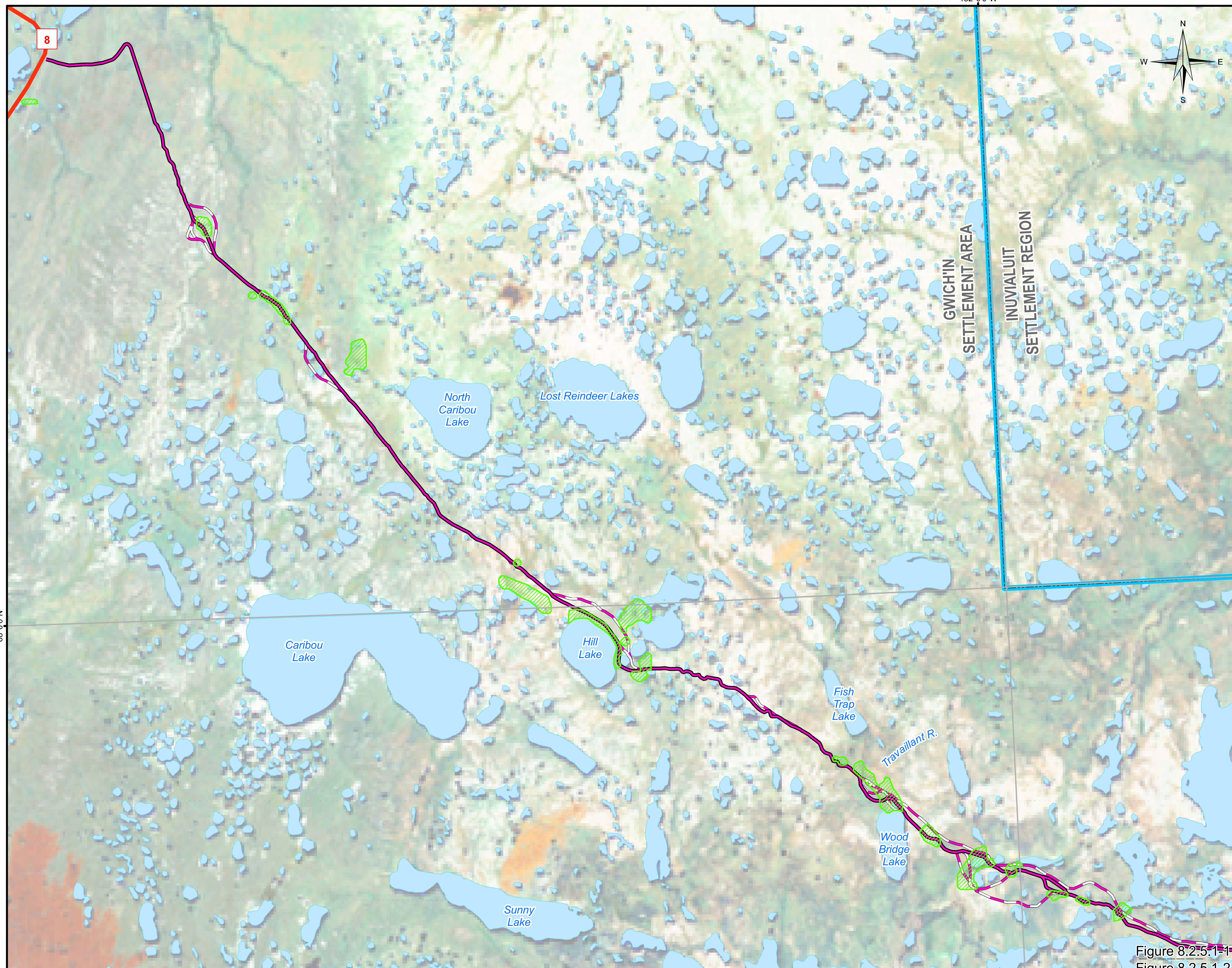
**A borrow source in the Thunder River valley is not recommended. If any ground disturbing geotechnical testing is proposed on terraces associated with Thunder River, it is recommended that archaeological investigations precede such activities. This will be included in later stages of the project development.

8.2.5.2 Recorded Site Proximities

The location of the Highway within the area examined was not finalized and the routing is preliminary. As a result of this, together with the fact that no on-ground site relocation was conducted, it is not yet certain whether any of the recorded archaeological sites are within the Highway right-of-way. However, it is likely that three recorded historic trails will be crossed, since they cross the preliminary corridor for the Highway. Five additional sites are less than 400 m from the approximated route that was examined and one is very close to a proposed borrow site. Consequently, these sites could be at risk of direct or indirect effects. A total of 20 sites are within approximately 1 km of currently proposed Highway. It is likely that investigation of potential borrow source infrastructure, such as construction camps, staging areas, and associated access roads, will provide additional archaeological resources.

Although the north end of Travaillant Lake was identified as an important fall fish camp for Gwich'in people, there are only two sites recorded there. One is a trail that heads north, probably to Trout Lake, and the other is a fairly recent trap. More camp remains should be present. This recorded trail would undoubtedly be crossed by the Highway.

A couple of well-defined trails were observed during the helicopter overflight along the Travaillant River north of Woodbridge Lake. There is a previously recorded trail in this area so one of the ones observed from the air most likely represents the traditional trail between Woodbridge and Fishtrap lakes. This trail will be crossed by the currently proposed corridor for the Highway.



LEGEND

- Archaeological Potential
- Communities
- MVH Concept - June 2010
- MVH Concept - June 2010, Alternative
- Dempster Highway (NWT HWY 8)
- Settlement Area Boundary
- Waterbody

NOTES
Base data source: ESRI Base Data

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Archaeological Terrain Assessment

PROJECTION: UTM 8
DATUM: NAD83

Scale: 1:210,000
4 2 0 4
Kilometres

FILE NO.: V33101053_Arcaeological_Figure8.2.5.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	GP	0

OFFICE: EBA-RIV
DATE: May 10, 2011

Figure 8.2.5.1-1

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LEGEND

- Archaeological Potential
- Communities
- MVH Concept - June 2010
- MVH Concept - June 2010, Alternative
- Dempster Highway (NWT HWY 8)
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NOTES
Base data source: ESRI Base Data

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Archaeological Terrain Assessment

PROJECTION	DATUM
UTM 8	NAD83

Scale: 1:210,000
4 2 0 4
Kilometres

FILE NO.
V33101053_Arcaeological_Figure8.2.5.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	GP	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure 8.2.5.1-2

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8.2.6 Expected Heritage Site Locations and Types

The Mackenzie Valley understandably has a large number of recorded archaeological sites and more can be expected. Potential for archaeological resources generally decreases as one moves away from the river, except along specific drainage systems, such as the Thunder River, the Travaillant River, and the associated network of connected lakes. Based on the distribution of recorded archaeological sites, as well as traditional knowledge and ethnographic research, sites can be expected on well defined terraces along these two river systems, and on elevated landforms near larger lakes in the vicinity of Travaillant Lake, Woodbridge Lake, and South Lake.

Background research indicates that the types of sites to be expected could include various types of structural remains, stone tools and flakes, a variety of bone and wood artifacts, and bone concentrations. Depending on their size, pits could represent semi-subterranean houses or caches for food or belongings or for cooking. Because of the rapid deterioration of wood remains in this region, only more recent sites may be represented by wooden traps, snares, platforms, or structural remains. Historic trails may be identified by cut blazes on trees or lobsticks (a tall tree with most branches removed, leaving only the top branches and that is visible for some distance).

8.2.7 Heritage Resources Conclusions

The combination of background documentary data, traditional knowledge, and overview terrain assessment for potential archaeological remains has resulted in the identification of key areas where the likelihood of encountering heritage remains is judged to be high. Such areas include the crossing of the Travaillant River and Thunder River, as well as close proximity to the larger lakes in the Woodbridge-Travaillant-South lakes areas. Specific areas have been identified that are suggestive of sufficient potential for archaeological resources so that ground reconnaissance is recommended. This will be undertaken in later stages of the project development, when the Highway alignment is finalized and boundaries of all associated components, such as borrow sources, work staging areas, construction camps, and access roads, have been identified. Due to dense ground cover typical over most of the project footprint and the buried nature of some types of archaeological resources in this area, intensive systematic subsurface testing will be required in most areas judged to be suggestive of good archaeological potential.

Overall, there is the potential for archaeological remains to be affected by the Highway, but this can be mitigated through effective design and construction. Potential mitigation measures are covered in Section 11 of this PDR.

8.3 Traditional Land Use and Traditional Knowledge

This section covers traditional use of the land that is located along the Highway and the surrounding area, and the traditional knowledge associated with the land.

GSCI provided access to the Gwich'in Traditional Knowledge Study of the Mackenzie Gas Project Area (2005) for the development of this PDR. Each of the GSA communities contributed to the 2005 report through the relevant RRC in each community plus additional workshops and interviews with community members. The Highway and the proposed MGP are in the same vicinity and intended to be developed in a common Transportation Corridor. The information contained in the 2005 report was, therefore, applicable to the development of the Highway to this stage. The traditional knowledge information in the report has been reviewed as part of the preliminary design of the Highway so that potentially affected cultural sites, important natural areas, and species can be protected when the Highway is constructed and operated. Traditional knowledge, along with information on current and historical land uses, is important information to review for a linear development such as this Highway that will pass across undeveloped land.

8.3.1 Seasonal Land Use

Traditional seasonal activities within the GSA are summarized in Table 8.3.1-1. The Highway may affect seasonal activities in the area due to people having easier access to the land, or construction activities temporarily affecting traditional pursuits. The information comes from literature reviews, interviews, and workshops involving people from Inuvik, Aklavik, Tsiigehtchic, Fort McPherson, and Fort Good Hope. The interviews involved 51 people and were held between November 2004 and January 2005. The information collected at the workshops and during the interviews culminated in the MGP report issued in July 2005.

Table 8.3.1-1: Summary of Gwich'in Cultural Activities by Season

	Screendyrt (Spring)	Luu tatjyaa (Break up)	Shın (Summer)	Khaıınts'an' (Fall)	Tadeedıchıh (Freeze Up)	Khaıı (Winter)
Cultural	Story telling at night Sewing Heading to the Delta Carnivals and jamborees Easter	Ice breaking up 24 hour sun	Assemblies and meetings August 15th Story telling at night Sew Barges Canoe races Gatherings July 1st Weddings Picnics Swimming	Storytelling at night School Trap line Making dog harnesss and dog blankets Making ice road Sew Bush Camp Heading up the Mackenzie River Making dog whips	Fishing under ice Freeze up	Storytelling at night Tracking along the river Skiing and skating New Years Meteor showers (every 33 years) Making snowshoes Christmas Ski-dooing Sew Ice hauling Snowshoeing Bush camps
Animals, Hunting, and Hides	Trapping and shooting muskrats Hunt caribou Dry meat Rat (muskrat) camps Beaver hunting on lake ice Tanning	Trapping and shooting muskrats Tanning	Beaver hunting on the river Tanning	Shooting rabbits along river Hunt moose Hunt caribou Dry meat making Moose calling Tanning	Tanning	Trap wolf and fox Trap marten Bear hunting Hunt caribou Dry meat making Snaring rabbits Trap line Tanning
Birds	Geese and duck hunting Swan and snow geese	Geese and duck hunting Dried geese				
Fish	Fishing under lake ice	Setting loche hooks	Fishing with nets and dry fish Fish camps	Split fish Pit Fish Fishing under river ice Stick fish Egg fish	Jiggling for loche	Fishing under lake ice

Table 8.3.1-1: Summary of Gwich'in Cultural Activities by Season

	Screendyrt (Spring)	Luu tatjyaa (Break up)	Shın (Summer)	Khaıınts'an' (Fall)	Tadeedıchıh (Freeze Up)	Khaıı (Winter)
Plants and Trees	Spruce gum collecting Wood hauling	Spruce gum collecting Digging for bear roots	Spruce gum collecting Wood hauling Blueberries Yellowberries Raspberries Blackberries Wood hauling on the river Gooseberries Collect birch bark for fire starter	Spruce gum collecting Wood hauling Cranberries Bear roots Yellow leaves Leaves falling Digging for bear roots	Spruce gum collecting	Spruce gum collecting Wood hauling

Source: Gwich'in Traditional Knowledge Study of the Mackenzie Gas Project Area (2005)

8.3.2 Traditional Knowledge

Traditional knowledge is defined by the GSCI as, "…that body of knowledge, values, beliefs and practices passed from one generation to another by oral means or through learned experienced, observation and spiritual teachings, and pertains to the identity, culture and heritage of the Gwich'in. This body of knowledge reflects many millennia of living on the land. It is a system of classification, a set of empirical observations about the local environment and a system of self-management that governs the use of resources and defines the relationship of living beings with one another and with their environment." (GSCI 2005). In general terms, it is that body of knowledge generally held by indigenous people about their cultural and physical landscape (GSCI 2005). The Proponents acknowledge the GSCI for providing the Cultural Resource Spatial Data that was used for the preparation of the map included in this PDR. This data is the property of the GSCI. Figure 8.3.2-1, prepared with permission from the GSCI, presents the Highway and examples of Traditional Values along the Highway. More detailed and specific information on Traditional Values was provided by the GSCI and used in the preliminary design for the Highway. It is also recognized that there are many trails and traditional travel routes that cross, or are adjacent to the Highway. The trails are not shown on Figure 8.3.2-1 because many of the trails lead to areas traditionally used for harvesting animals and, as mentioned above, it is accepted practice to avoid drawing attention to these areas in a public document.

Burial Grounds

There are no known burial grounds in the vicinity of the Highway.

8.3.2.1 Traditional Knowledge and the Community Consultations

All of the comments and questions recorded at the community consultations for the Highway are referenced in Section 9.0 and included in Appendix D of this PDR. However, some of the comments recorded at the consultation meetings make reference to the importance of the land and cultural values of the areas and examples are presented below because of their relevance to traditional land use.

Selected Comments from Fort McPherson:

- *"The water has to continue to flow to allow the fish to survive. Stream crossings must be done right."*
- *"The area around Travaillant Lake is protected land (see "Working for the Land. Gwich'in Land Use Plan"). The proposed highway and pipeline cross an area designated as conservation land in the Gwich'in Land Use Plan."*

Selected comments from Aklavik:

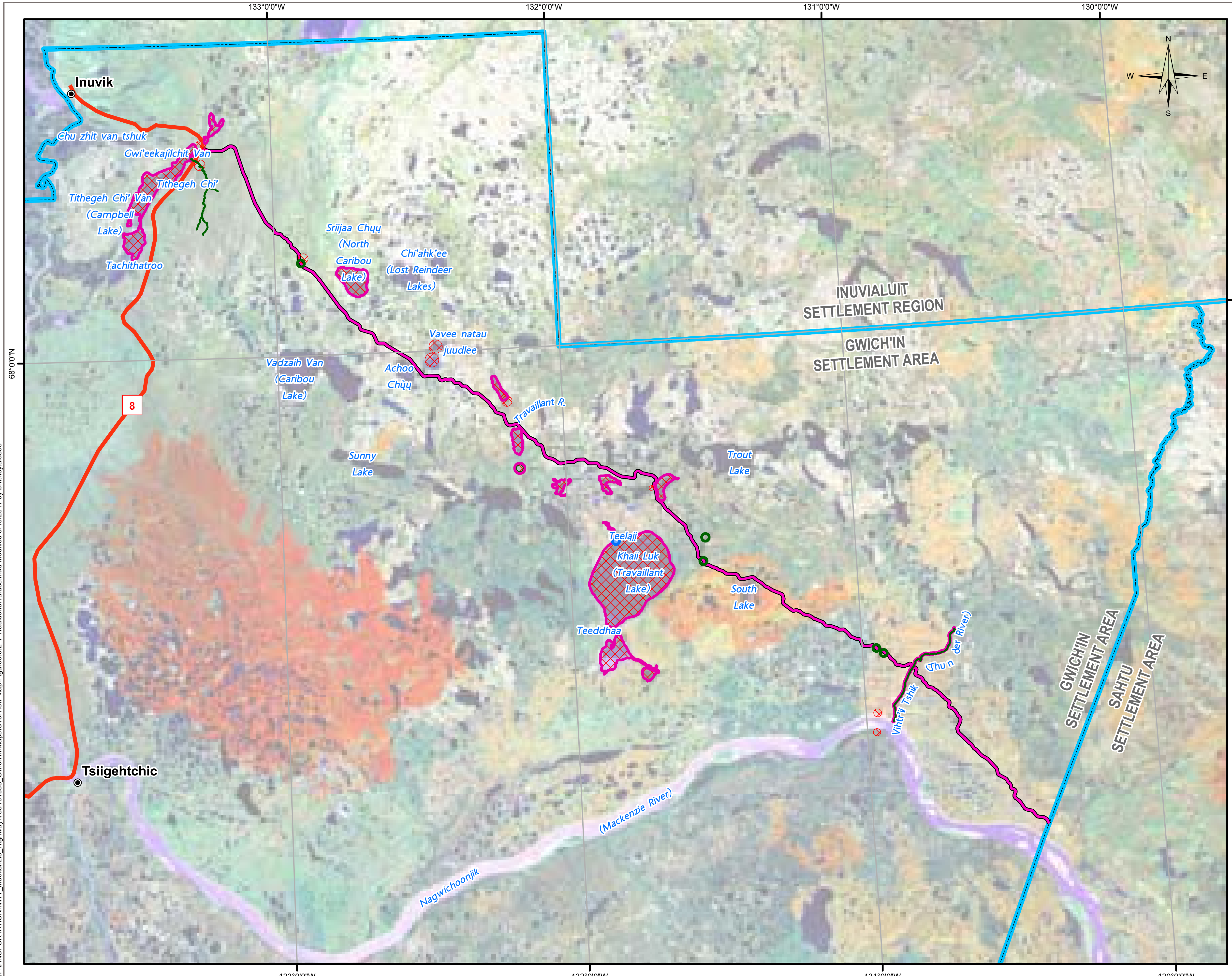
- *"Gwich'in people have registered trap lines and cabins along the proposed highway route."*
- *"Heritage values would have to be negotiated, and may result in re-routing of the proposed highway."*

Selected comments from Inuvik:

- *"Will you measure "before" water quality conditions so contamination of any water can be identified after construction, for example, through using calcium on the road (calcium chloride for dust control)?"*
- *"Are the streams that are crossed fish bearing?"*

Selected comments from Tsiigehtchic:

- *"The Gwich'in Land Use Planning Board are the people to be contacted about all things connected with the land. The land use plan is there to provide protection of the land, when and where it is required. The revised Plan will speak more to conservation, special management areas and to where people can and cannot go on the land."*
- *"It will be easier and perhaps more cost effective to pursue traditional activities in the corridor area with a highway in place."*
- *"There will be negative cultural and social impacts. There needs to be good management of the land by the people."*



LEGEND

- Communities
- Vegetation Along Waterways
- Vegetation area
- Fish Along Waterways
- Fish
- Birds
- Heritage Value Sites
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- Settlement Area Boundary

NOTES
Base data source: ESRI Base Data
NTS 1:250,000
Cultural Resource Spatial Data provided by the Gwich'in Social and Cultural Institute (GSCI): © GSCI.
This is a selection of only some of the Traditional Values found along the Highway Corridor, based on information received from GSCI. For more information on wildlife, see Figure 8.4-1, and all maps in Section 10.
Alignment is considered preliminary and is subject to change

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA

Examples of Traditional Values Along the Highway Corridor

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:550,000
10 5 0 10
Kilometres

FILE NO.
Figure8.3.2-1-TraditionalValues.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure 8.3.2-1

M:\TRANSPORTATION\NWT_Mackenzie_Highway\V33101053_Gwich'in\Maps\Overview Map\Figure8.3.2-1-TraditionalValues.mxd modified 5/10/2011 by brittney.aldous

8.3.3 Development Concerns

As part of the project to collect and collate traditional knowledge connected with the MGP, questions were asked of interviewees and workshop participants about their concerns regarding the proposed pipeline development. It is believed that many of these concerns would also be relevant to the Highway due to the shared corridor of both projects and will be applied to the Highway where reasonably practical. A summary of the concerns identified in the Gwich'in Traditional Knowledge Study of the Mackenzie Gas Project Area (GSCI 2005) has been provided below under key headings. Specific questions and comments raised as part of the Highway consultations can be found in Section 9.0 of this report.

Cabins and Camps (Modern and Archaeological)

Camps and cabins should be left for the Gwich'in to use and archaeological and cultural remains should be avoided. Workers' camps should not be placed in these locations. If treeless helipad alternatives are available, helipads should not be built where trees need to be cut.

Country Foods

Gwich'in employees should have the opportunity to hunt and fish at appropriate times without penalty. Camps should purchase country foods from local sources consistent with the regulations when possible, or hire hunters/fishers to supply camps.

General Environment

Development must have an appropriate plan for decommissioning that includes dealing with cumulative impacts to the land. The developers should facilitate the proper cleanup of the land. When stockpiling fuel or other potentially polluting substances, it should be on a level area and on high ground, above the flood line. Leaking barrels and improper storage are not acceptable.

Raw sewage and dry sewage at developers' camps should be carefully dealt with. Developers should be made responsible for cleaning up their own mess, and must investigate each claim of dumping.

All land should be considered animal, bird, and fish habitat and best practices should be used when handling waste and for construction. Developers should not be allowed to contribute to global climate change.

Myths and Legends

Camp workers near lakes with legends about giant creatures should be made aware of these myths to encourage respect for these places.

Giving Something Back When Taking From the Land

Developers should consult Gwich'in Elders to choose an appropriate gift to the land when construction is underway.

Gwich'in Named Places

Places with Gwich'in names typically mark locations that are known for their heritage value, such as good for hunting, fishing, or other resource use, or associated with myths. Development has the potential to affect these areas. Attempts should be made to use the Gwich'in names on maps to encourage their continued use.

Trails

Traditional trails should be avoided during construction. If trails will be impacted they should be recorded with a GPS for 100 m on either side of the proposed route and kept usable. Exact locations of the trails should be forwarded as geographic information system (GIS) files to the archaeologists and the GSCI.

Khaıı luk Area (Travaillant Lake)

This area and the area north of the lake are very important for hunting and fishing with high caribou and other animal populations. There is a lot of diversity in the area. The proposed gas pipeline and highway corridors pass by the lake in an ecologically delicate area. Best practices for all planned development should occur in this area.

Animals Giving Birth in the Summer

Work in the summer should avoid birthing and rearing areas, such as wooded hillsides.

Wildlife

Vehicles, planes, helicopters, and workers should not disturb wildlife and the pipeline (and highway) should not impact the migration or normal behaviour of animals, e.g., caribou, moose. Populations of key species such as caribou and grizzly bear should be monitored. When assessing beaver numbers don't just count lodges, also count fresh piles of beaver feed.

Plants

Good berry picking and other plant harvesting areas should be avoided. Disturbance of the surface vegetation should be avoided. Stands of spruce that are good for construction should be avoided. During dry seasons, efforts should be made to protect forests against fires. Slashed material should be disposed of carefully.

Fish

Fish populations should be monitored to ensure any impact to them is minimized. Fish lakes and eddies on larger rivers should be avoided and protected. Gwich'in harvesters should participate in identifying fish populations and eddies and the creation of a monitoring plan. Portions of lakes and creeks that stay open late and are fish bearing should be avoided.

Key Rivers and Lakes

Baseline data about water flow, watersheds, and water quality should be gathered. Waterways should be monitored for changes during and after the project. Developers need to be aware of rising water, not just in the spring. Best practices should be used when crossing streams and creeks. Crossings should be monitored for possible impacts, particularly during construction.

Birds

All areas identified as nesting and staging areas should be protected. Populations and bird health should be monitored, in particular black duck, geese, and swans. Ravens should not be killed. New birds should be identified.

Permafrost

Permafrost should be measured and monitored.

8.3.4 Traditional Knowledge, Land Use and the Proposed Highway

The traditional knowledge described above and the local knowledge demonstrated at the community consultation meetings has influenced the preliminary design of the Highway and the general approach to the project as a whole. As the project progresses through the regulatory process, further consultation with the GSA communities will be required. However, examples of where information collected to date has influenced the project are provided below:

Travaillant Lake is a traditionally and culturally important area for the Gwich'in and is currently used for harvesting. The Highway will be designed in such as way that it does not interfere with the integrity of the lake or the surrounding interconnected waterbodies.

Research on dust control products other than calcium chloride or magnesium chloride will be completed, particularly for bridge approaches and for use on the portion of the Highway that is closest to Travaillant Lake.

Additional maintenance efforts will be considered for the first year or two after construction to deal with settling and compaction of materials, given the initial construction with frozen material.

8.3.5 Traditional Knowledge and Land Use Conclusions

Through a review of the traditional knowledge and land use information prepared by the GSCI for the MGP, some traditional land use sites can be found within close proximity to the proposed highway alignment. The alignment passes through areas used seasonally for traditional pursuits by the Gwich'in; however, the alignment for the Highway is preliminary and future detailed design will help identify any potential effects on traditional knowledge and traditional land use sites with more certainty. Traditional and local knowledge collected to date has influenced the preliminary design of the highway and the general approach to the project. Mitigation measures to minimize potential effects on traditional land use sites are discussed further in Section 11.0 of this PDR.

8.4 Management Areas, Conservations Zones, and Heritage Conservations Zones

Management Areas, Conservation Zones, and Heritage Conservations Zones are defined under the *GLUP*. These zones are illustrated on Figure 8.4-1 and discussed in further detail below.

8.4.1 The Gwich'in Land Use Plan (GLUP)

Under the authority of the *GCLCA* and the *Mackenzie Valley Resource Management Act*, the Gwich'in developed and approved the *GLUP*. The *GLUP* acts as "one tool for taking care of the land and people of the GSA today and in the future." (GLUPB 2003).

The *GLUP* was brought into effect in August 2003 and has been used to assess proposed activities and developments since that time. In April 2010, the GLUPB issued the Draft *GLUP* Revisions for review. In January 2011, Ms. Susan McKenzie of the GLUPB indicated that the draft revisions are expected to be finalized in the spring of 2011 (pers. comm. January 10, 2011). For the purposes of the PDR, both the 2003 approved plan and the 2010 draft revision have been referenced in order to represent the most up to date information concerning land use in the GSA.

8.4.2 Management Areas

The Highway passes through, or is adjacent to the following Management Areas:

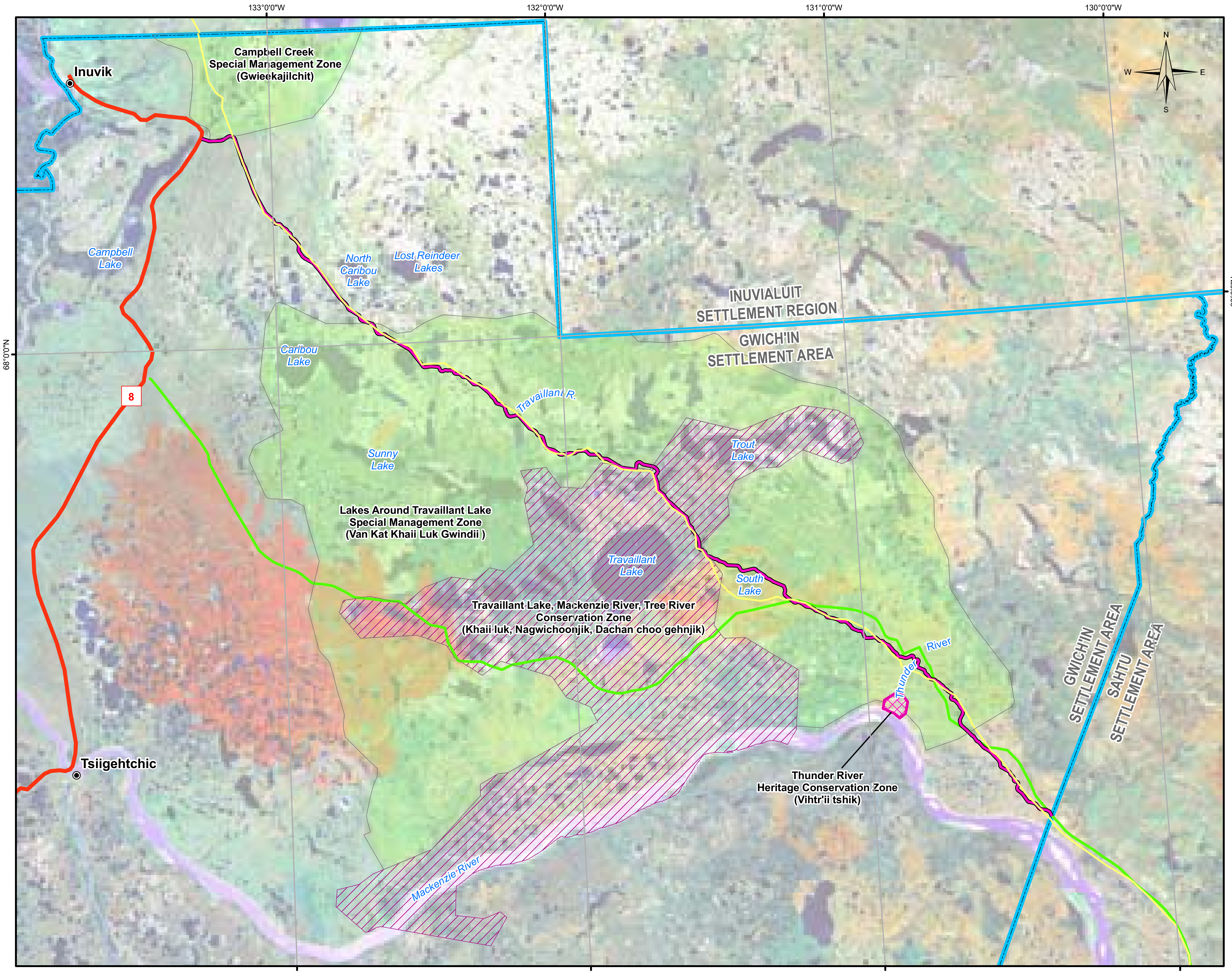
- Gwich'in Conservation Zone C: Kaii luk, Nagwichoonjik, Dachan choo gehnjik (Travaillant Lake, Mackenzie River, and Tree River), for a distance of 20.1 km.
- Gwich'in Conservation Heritage Conservation Zone H03: Vihtr'ii tshik (Thunder River), located southwest of the Highway alignment. The closest approach is 4 km.
- Gwich'in Special Management Zone 6: Gwieekajilchit tshik (Campbell Creek). The Highway passes adjacent to the southern boundary.
- Gwich'in Special Management Zone 12: Van Kat Khaii Luk Gwindii (Lakes Around Travaillant Lake). The Highway goes through Zone 12 for a distance of 101.7 km.

These zones are described in more detail below.

Gwich'in Conservation Zones

The 2010 Draft Revision to the *GLUP* (GLUPB 2010) identifies 11% of the GSA being designated as Gwich'in Conservation Zones. These areas represent:

- Core areas communities would like to see protected based on a variety of values ranging from current and historical use, heritage resources, wildlife, fish, forests, vegetation, and water resources.
- Core areas the scientific community would like to see protected based on critical wildlife habitat and populations, outstanding heritage sites, unique land features, and ecological processes.



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LEGEND

- Communities
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- PWC 1974 Highway Concept Route
- Mackenzie Gas Project Corridor
- Settlement Area Boundary
- Heritage Conservation Zone
- Conservation Zone
- Special Management Zone

NOTES
Base data source: ESRI Base Data
NTS 1:250,000
Gwich'in Land Use Planning Board (2010)
Alignment is considered preliminary and is subject to change

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA

Management Areas

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:550,000
10 5 0 10
Kilometres

FILE NO.
V33101053_Figure8.4-1.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure 8.4-1

- Five out of the six ecoregions of the GSA, and areas that do not unreasonably limit the ability of resource development to occur in the GSA (GLUPB 2010).
- The status of Conservation Zones is such that they require year round protection. Section 4.6.1 of the *GLUP* Draft Revision (2010) identifies activities, mostly industrial and commercial, that are not permitted within Conservation Zones.

Gwich'in Heritage Conservation Zones

Gwich'in Heritage Conservation Zones are areas of "outstanding historical or cultural significance" in the GSA. They hold the same status as Gwich'in Conservation Zones.

Gwich'in Special Management Zones

Gwich'in Special Management Zones comprise approximately 42% of the GSA (GLUPB 2010). Special management zones allow all land uses provided that the zone-specific conditions are met and appropriate regulatory authorizations are obtained. There are no restrictions on traditional land use in Special Management Zones.

Special Considerations for Highway Extension

The *GLUP* provides special consideration for the extension of the Mackenzie Highway, stating that "Schedule XVII in Appendix F (volume 2) of the [Gwich'in Land Claim] agreement is a notice of intent for the expropriation of Gwich'in lands for the proposed Mackenzie Highway." (GLUPB 2010 p. 97). The *GLUP* allows flexibility for additional studies and consultation to be done prior to a final route being selected. It urges the likely Proponent, GNWT DOT, to consider a combined Transportation Corridor for potential linear infrastructure developments, namely a highway, a fibre optic cable and a pipeline.

The *GLUP* informs GNWT DOT that after the Highway route has been selected, the GLUPB will review the proposal against the *GLUP* to assess the potential effect of the Highway on other land uses. The Board advises that it "may propose amendments" (GLUPB 2010 p. 98) in response to the Highway proposal.

8.4.3 Conservation Zone

Gwich'in Conservation Zone C: Kaii luk, Nagwichoonjik, Dachan choo gehnjik (Travaillant Lake, Mackenzie River, Tree River)

The proposed Highway travels through the Travaillant Lake, Mackenzie River, Tree River Conservation Zone for a distance of 20.1 km, see Figure 8.4-1.

The area encompassed by the Travaillant Lake, Mackenzie River, Tree River Conservation Zone has received protective status primarily because of its value to the Gwichya Gwich'in of Tsiigehtchic. Cultural and environmental values in this zone include: significant heritage sites, campsites, cabins and stages, trails, traditional activities and traditional land use features, key wildlife, and waterfowl habitat.

The *GLUP* states that, "The Planning Board acknowledges the Mackenzie Highway extension and the land use plan allows it as a land use through the Gwich'in Conservation Zone" (GLUPB 2010 p. 108).

8.4.4 Heritage Conservation Zone

Gwich'in Heritage Conservation Zone H03: Vihtr'ii tshik (Thunder River)

The Thunder River Heritage Conservation Zone (Vihtr'ii tshik) is located southwest of the proposed Highway alignment (see Figure 8.4-1). The Highway's closest approach to this Heritage Conservation Zone is 4 km.

Vihtr'ii tshik is a site where Gwichya Gwich'in ancestors sourced stones to make tools. Stone tools included arrowheads, scrapers and flint. People would travel up the Mackenzie River to Vihtr'ii tshik for the purpose of gathering stone. In accordance with tradition, the Gwich'in would leave a small item as a token of gratitude for the stone they collected there (GLUPB 2010).

8.4.5 Special Management Zones

Gwich'in Special Management Zone 6: Gwieekajilchit tshik (Campbell Creek)

The Highway passes adjacent the southern boundary of the Campbell Creek Special Management Zone as it approaches the intersection with the Dempster Highway (Figure 8.4-1).

The Campbell Creek area has been designated a Special Management Zone to protect fish and fish habitat and heritage resources. The area supports many fish species, and in particular, provides important rearing and feeding habitat. Sport fishing and traditional harvesting take place here. The key heritage resource in the Campbell Creek area is a traditional trail between Campbell Lake and Sitidgi Lake (GLUPB 2010).

Conditions to protect significant heritage resources, traditional fish harvesting, and fish are provided in *GLUP* Section 4.5.6 (GLUPB 2010). The conditions that are relevant to the design, construction, and operation of the Highway identify the importance of conducting assessments to understand the potential effects on known heritage resources in the area. In regard to environmental concerns, since the Campbell Creek Special Management Zone is adjacent to the Highway, consultation with the local Gwich'in organizations and government agencies has been initiated to identify potential effects on fish and fish habitat and develop appropriate timing and/or activity considerations in the construction design.

Gwich'in Special Management Zone 12: Van Kat Khaii Luk Gwindii (Lakes Around Travaillant Lake)

The proposed Highway travels through the Lakes Around Travaillant Lake Special Management Zone for a distance of 101.7 km (Figure 8.4-1).

The goals of the Lakes Around Travaillant Lake Special Management Zone is to protect important fishing resources, heritage values, waterfowl staging and breeding areas, and the range for barren-ground and boreal woodland caribou.

Conditions to protect significant heritage resources, traditional fish harvesting, fish, and waterfowl are provided in *GLUP* Section 4.5.12 (GLUPB 2010). The conditions for the Lakes Around Travaillant Lake that are relevant to the design, construction, and operation of the Highway identify the importance of conducting assessments to understand the potential effects on known heritage resources in the area. In regard to environmental concerns, since the Campbell Creek Special Management Zone is adjacent to the

Highway, consultation with the local Gwich'in organizations and government agencies has been initiated to identify potential effects on fish and fish habitat and develop appropriate timing and/or activity considerations in the construction design. To protect waterfowl, nesting and staging sites should be identified and a 250 m setback observed year round (GLUPB 2010). Aircraft are to maintain a minimum flight altitude of 650 m when flying over this Zone in June, July, and August (GLUPB 2010). Finally, as noted in the *GLUP*, "the Planning Board asks that regulators and developers give full consideration to maintaining habitat and limiting disturbance of caribou in this zone" (GLUPB 2010) until management plans are completed for these species.

Precedent for Transportation Special Management Zone

This section provides a brief mention of the Gwich'in Transportation Special Management Zone, as presented in Section 4.5.1 of the *GLUP* (2010). The Transportation Special Management Zone concept illustrates one possible approach for protecting resource values in the vicinity of a highway. It is conceivable that a similar approach may eventually be developed and implemented for the Highway.

The Transportation Special Management Zone for the Dempster Highway allows for activities 1,000 m on either side of the right-of-way, such as access from the Dempster Highway for permitted hunting or harvesting, or access to granular sources. The zone is partitioned into three areas to address primary values specific to each area, which, spanning the length of the Dempster Highway in the GSA, include: Porcupine caribou; tourism; granular resource/pit management; waterfowl; water quality and quantity; and peregrine falcons and other raptors. Management activities include examples such as assigning monitors to assess the presence of migrating caribou, and instructing DOT to preserve scenery and tourism values as they maintain and operate the highway. In this way, the *GLUP* contains elements that provide for the responsible design, construction, and operation of current and future highways in the GSA.

8.5 Past and Existing Land Uses

The land between Inuvik and the Gwich'in-Sahtu boundary is accessed by traditional land users. Figure 8.4-1 identifies the location of the Highway in the context of current land use.

8.5.1 Winter Access Trails

Since the introduction of snow machines, winter access trails have been developed each winter as needed to allow the Gwich'in to pursue their traditional hunting, trapping, recreational, and other activities on the land, including the general area of the Highway. At consultations held in May 2010, July 2010, and November 2010, residents and agencies confirmed that several families have camps in the vicinity of the Highway, and use access trails to go to these camps in the winter.

8.5.2 Travaillant Lake

As discussed in Section 8.4.3 and Section 8.4.5, Travaillant Lake and the Lakes Around Travaillant Lake are considered by the Gwich'in to be very important. The area encompasses cultural and environmental values including: campsites, cabins and stages, trails, burial sites, and significant heritage sites. In this area, the Gwich'in take part in traditional activities, harvesting, and spending time on the land. The Travaillant Lake area provides key wildlife habitat, important fishing resources, waterfowl staging and breeding areas, and is part of the range for barren-ground and boreal woodland caribou.

8.5.3 Oil and Gas Exploration

Seismic

Since the 1960s the most extensive non-traditional land use that has occurred in the Mackenzie Delta, including the area in the vicinity of the Highway, has been 2D (linear) and 3D (grid) seismic exploration programs. Although from the air the vegetation along the seismic cutlines sometimes appears to have a different colour, on the ground, little physical evidence remains of these historical seismic programs. Often, in permafrost environments, the groundcover and permafrost disturbance of the old-style cat cut seismic lines stimulates vigorous vegetation regeneration. Recently, low-impact and heli-portable seismic methods have all but eliminated evidence of seismic programs.

Drilling

A few exploratory oil and gas wells have been drilled in the GSA. Drilling has historically taken place near Aklavik and Tsiigehtchic. Publicly available data sources do not identify any drilling locations in the immediate vicinity of the Highway.

8.6 Proposed Future Land Uses

Figure 3.0-2 identifies the location of known proposed future projects that may be developed in the region, the proposed MGP and the Highway. Other than the Highway, the MGP is the most significant proposed future land use envisioned within the GSA in the short to medium term. There exists a strong possibility for spin-off development in the form of oil and gas exploration – seismic and drilling activities, to be stimulated by the MGP.

8.6.1 Mackenzie Gas Project (MGP)

Developing a natural gas pipeline from the Mackenzie Delta through the Northwest Territories to southern markets has been contemplated for many years. Various pipeline projects have been proposed during the last 30 years that consider economics, regulatory requirements, socio-economic and environmental conditions, and engineering and geotechnical issues in the decision-making process (IOL et al. 2004).

The proponents of the proposed MGP include Imperial Oil Resources Ventures Limited Partnership (IOL), ConocoPhillips Canada (North) Limited (ConocoPhillips), ExxonMobil Canada Properties (ExxonMobil), Shell Canada Limited (Shell), and Mackenzie Valley Aboriginal Pipeline Limited (MVAPL) partnership.

The purpose of the proposed project is to develop three onshore natural gas fields (anchor gas fields) in the Mackenzie Delta and to transport natural gas and natural gas liquids (NGLs) by pipeline to market.

8.6.2 Oil and Gas Exploration

The GTC has an oil and gas rights issuance policy for Gwich'in private lands. In the future, the all-weather Highway is expected to encourage exploration of those parcels of land by significantly decreasing logistical costs for seismic and drilling programs in the GSA.

8.7 Natural Resources Harvesting

Diverse assemblages of wildlife and plant species occur within the study area. Many of these species may be harvested for subsistence and commercial purposes.

Residents from Inuvik and Tsiigehtchic are considered the primary users of the study area (Mackenzie Delta–Beaufort Sea Regional Land Use Planning Commission 1991). In 2008, 40.8% of the resident population (15 years or older) in Inuvik participated in hunting or fishing activities; whereas, 7.9% participated in trapping (NWT Bureau of Statistics 2009). Similarly in Tsiigehtchic, 42.9% of the population hunts and fish, and 12.2% trap (NWT Bureau of Statistics 2009).

The Gwich'in Harvest Study (GRRB 2009) summarizes harvest data from hunting, fishing, and trapping activities throughout the GSA. Harvest data presented in that study was collected from hunters from all four GSA communities. Data collected from Inuvik and Tsiigehtchic hunters may represent harvests from within the Highway study area, depending on the hunters' range of activities, but will also be indicative of the harvest from the larger area surrounding these two communities.

8.7.1 Wildlife

Traditionally, people harvested wildlife for subsistence, survival materials, and trade. This not only provided basic life requisites, but also helped maintain their cultural identity and tied them to the land and their heritage. Traditional based hunting for subsistence (principally for food and clothing) and trapping continues today. As indicated in the *GLUP*, the Khaii luk, Nagwichoonjik, Dachan choo gehnjik (Travaillant Lake, Mackenzie River, Tree River) Conservation Zone is reported as an important harvesting area for moose, caribou, waterfowl, furbearers (including marten, beaver, muskrat, otter, mink, lynx, wolverine, fox, and wolf), and fish. However, many Tsiigehtchic residents report a significant decline in the number of harvesters using the Travaillant area over the last 20 years due to changing socio-economic factors and the forest fires that occurred in the area approximately 20 years ago (Winbourne 2004). Although users of the Travaillant Lake area may be declining, Winbourne (2004) reported hunting and trapping has increased near North Caribou Lake as a result of an enhanced access route from Inuvik.

According to the Gwich'in Harvest Study (GRRB 2009) data from 1995 to 2001, fish were by far the most harvested wildlife group. In Inuvik, muskrat, geese, ducks, and snowshoe hare were also highly sought harvest species. In Tsiigehtchic, marten, ducks, and snowshoe hare were the most harvested species (GRRB 2009).

8.7.1.1 Caribou

Three caribou groups, Bluenose, Porcupine, and Boreal Woodland caribou are harvested by residents of Inuvik and Tsiigehtchic. Based on the Gwich'in Harvest Study data, the Porcupine Caribou herd is the most harvested group by residents of both Inuvik and Tsiigehtchic, followed by caribou from the Bluenose herd (Table 8.7.1.1-1). Since the known annual range of the Porcupine caribou herd is located west of the Mackenzie River (outside the study area) (Government of Yukon 2010), residents of Inuvik and Tsiigehtchic are assumed to access this herd's winter range primarily via the Dempster Highway. The Bluenose and woodland caribou are expected to occur within the study area; the Bluenose herd only during the winter and the woodland caribou year round. ENR (2010a) indicates residents of Tsiigehtchic harvest caribou from the Bluenose herd mostly when access to the Porcupine herd is restricted.

Table 8.7.1.1-1: Inuvik and Tsiigehtchic Caribou Harvest Data, 1995 to 2001

Caribou	Reported Harvests (1995 to 2001)		
	Inuvik	Tsiigehtchic	Total
Bluenose	514	39	553
Porcupine	822	747	1,569
Woodland	0	6	6

Source: Gwich'in Renewable Resources Board (2009).

Caribou from the Porcupine herd are generally harvested from August to April, and those from the Bluenose herd are harvested from September to May (GRRB 2009). Six woodland caribou were harvested in November from a resident(s) of Tsiigehtchic (GRRB 2009).

8.7.1.2 Moose

Although caribou are the most sought, moose are also an important subsistence species. Moose occur in the region year round and are harvested opportunistically most of the year (principally from August to April) (GRRB 2009). Residents from Tsiigehtchic reported harvesting more moose than residents of Inuvik during the 1995 to 2001 study period (Table 8.7.1.2-1).

Table 8.7.1.2-1: Inuvik and Tsiigehtchic Moose Harvest Data, 1995 to 2001

Moose	Reported Harvests (1995 to 2001)		
	Inuvik	Tsiigehtchic	Total
Moose	54	73	127

Source: Gwich'in Renewable Resources Board (2009).

8.7.1.3 Bears

Both grizzly and black bears occupy the region; however, harvest data from 1995 to 2001 indicate bears are not an important harvest species (Table 8.7.1.3-1). In the six years of data, a total of nine black bears and one grizzly bear were reported harvested (GRRB 2009). This data may not include defence or property damage kills.

Table 8.7.1.3-1: Inuvik and Tsiigehtchic Bear Harvest Data, 1995 to 2001

Bear	Reported Harvests (1995 to 2001)		
	Inuvik	Tsiigehtchic	Total
Grizzly Bear	1	0	1
Black Bear	1	8	9

Source: Gwich'in Renewable Resources Board (2009).

8.7.1.4 Furbearers

For the purposes of this report, the term furbearer applies to small mammal species that have been trapped or hunted for their fur, or are species important for the local economy. These include beaver, muskrat, snowshoe hare, marten, ermine, mink, otter, lynx, red fox, wolf, and wolverine.

Trapping was historically a major economic resource for the Gwich'in. Wildlife species were trapped for subsistence (for example hare, beaver, and muskrat), and pelts were sold or traded. Trapping continues today, for both subsistence and fur trade purposes. Furbearers are commonly harvested along designated traplines in the region. However, the location and number of traplines present within the study area are unknown. Based on the Gwich'in Harvest Study data, the majority of furbearers are harvested between November and February, with some years extending until June (GRRB 2009).

Inuvik residents reported harvesting 7,303 furbearers from 1995 to 2001 (Table 9.7-4). Muskrat represented 52% of the total furbearers harvested by Inuvik residents, followed by snowshoe hare (21% total furbearers), and marten (17% total furbearers). Red fox, beaver, lynx, mink, wolf, wolverine, and ermine make up the remaining harvest total (GRRB 2009).

In contrast, residents in Tsiigehtchic reported harvesting a total of 3,239 furbearers from 1995 to 2001 (Table 8.7.1.4-1). Marten represented 41% of the total furbearers harvested by Tsiigehtchic residents, followed by snowshoe hare (28% total furbearers), and muskrat (22% total furbearers). Beaver, ermine, lynx, mink, red fox, wolf, and wolverine were harvested to a lesser extent.

Table 8.7.1.4-1: Inuvik and Tsiigehtchic Furbearer Harvest Data, 1995 to 2001

Furbearer	Reported Harvests (1995 to 2001)		
	Inuvik	Tsiigehtchic	Total
Beaver	103	162	265
Ermine	28	7	35
Lynx	208	24	232
Marten	1,243	1,320	2,563
Mink	146	30	176
Muskrat	3769	719	4,488
Red Fox	179	55	234
Wolf	63	4	67
Wolverine	30	14	44
Snowshoe Hare	1,534	904	2,438
Total	**7,303**	**3,239**	**10,542**

Source: Gwich'in Renewable Resources Board (2009).

8.7.1.5 Waterfowl

Twelve species of duck, four species of goose, and one species of swan are included in the Gwich'in Harvest data (GRRB 2009). Inuvik residents reported harvesting 3,361 waterfowl, whereas Tsiigehtchic residents reported harvesting 1,869 (Table 8.7.1.5-1) (GRRB 2009).

Although a number of waterfowl species are harvested, scoter species (also referred to as black ducks) were the most targeted duck, whereas, Canada Goose was the most harvested goose species. Harvesters from Inuvik reported harvesting waterfowl primarily in May, June, August, and September, and those from Tsiigehtchic primarily harvest waterfowl in May (GRRB 2009).

Table 8.7.1.5-1: Inuvik and Tsiigehtchic Waterfowl Harvest Data, 1995 to 2001

Waterfowl	Reported Harvests (1995 to 2001)		
	Inuvik	Tsiigehtchic	Total
Ducks			
Scoter species (black duck)	568	830	1,398
Blue-winged Teal	11	0	11
Canvasback	84	4	88
Goldeneye	83	0	83
Green-winged Teal	16	0	16
Long-tailed Duck	8	25	33
Mallard	375	41	416
Pintail	82	0	82
Ring-necked Duck	3	0	3
Scaup species	52	0	52
Shoveler	19	0	19
Wigeon	202	6	208
Unknown Duck species	202	184	386
Geese			
Brant	0	30	30
Canada Goose	331	112	1,841
Greater White-fronted Goose	300	0	300
Snow Goose	1,163	118	1,281
Unknown Goose species	4	321	325
Swans			
Tundra Swan	128	198	326
Total Waterfowl	**3,631**	**1,869**	**5,500**

Source: Gwich'in Renewable Resources Board (2009)

8.7.1.6 Fish

Fish harvest sites within the study area are unknown; however, it is assumed subsistence fishing traditionally occurred throughout the entire study area wherever appropriate fish habitat occurred. Traditionally, fish were netted during the winter months in lakes, and in the spring and summer along rivers and streams principally near camp sites. It is assumed similar fish harvesting practices occur today.

Harvest data indicates fish are mainly harvested from August to November, then again from June to July (GRRB 2009).

Based on Gwich'in Harvest Study data from 1995 to 2001, Inuvik residents reported harvesting 34,759 fish and Tsiigehtchic residents reported harvesting 109,919 fish (GRRB 2009). During this time, broad whitefish were by far the most common fish species harvested by residents of Inuvik and Tsiigehtchic (Table 8.7.1.6-1) (GRRB 2009). In addition, lake whitefish, inconnu, and jackfish were also commonly harvested (Table 8.7.1.6-1). Additional fish species were likely harvested opportunistically.

Table 8.7.1.6-1: Inuvik and Tsiigehtchic Fish Harvest Data, 1995 to 2001

Fish species (Gwich'in Harvest data name)	Reported Harvests (1995 to 2001)		
	Inuvik	Tsiigehtchic	Total
Dolly Varden (char)	144	2	146
Chum Salmon	4	19	23
Inconnu (coney)	2,785	1,3943	16,608
Lake Whitefish (crookedback)	5,346	2,4777	30,123
Arctic Grayling	0	5	5
Cisco species (herring)	60	362	422
Jackfish	2,180	992	3,172
Lake Trout	660	251	911
Burbot (loche)	1,020	836	1,856
White Sucker (sucker)	0	22	22
Walleye	0	7	7
Broad Whitefish (whitefish)	22,541	66,561	89,102
Fish species	19	2,142	2,161
Total	**34,759**	**109,919**	**144,558**

Source: Gwich'in Renewable Resources Board (2009).

8.7.2 Berries

Limited information exists regarding traditional or contemporary berry harvesting sites; however, it is assumed berries are harvested from the study area. Although there is no published information on harvest sites within the study area, berry harvesting is assumed to occur particularly along watercourses, at summer fish camps (Murray et al. 2005), and near Inuvik. Outside the study area, berry picking commonly occurs along the Dempster Highway (Murray et al. 2005).

Several types of berries, such as bearberry, cranberry, blueberry, cloudberry, crowberry, raspberry, and black and red currants are used for food (Gwich'in Social and Cultural Institute and Aurora Research Institute 1997), and are expected to occur throughout the study area in both upland and lowland habitats. Berry harvesting likely occurs when berries are ripe, typically between mid-July and mid-August.

Based on 50 households surveyed in the GSA, cloudberries, cranberries, and blueberries were by far the most common berry collected (Murray et al. 2005). In 2000, residents of Inuvik reported collecting a total of 38 L of berries per household (cranberry, blueberry, and cloudberry), whereas Tsiigehtchic residents reported harvesting 19 L (Murray et al. 2005).

In the GSA, lowland areas dominated by forested peatlands and black spruce support the greatest cover of cranberry, blueberry, cloudberry, and crowberry (Murray et al. 2005). Upland habitats dominated by white spruce and paper birch had the least cover of berry-producing plants (Murray et al. 2005). Both these upland and lowland habitat types exist within the study area.

The Highway will provide greater access to the area for harvesting. This is both an advantage and a disadvantage. Controlling access to Gwich'in lands from the Highway will be through the authority of the *GCLCA* and associated legislation, and through policies for education, monitoring and enforcement undertaken by the GTC. DOT has authority only to restrict access to the Highway from adjacent lands.

9.0 COMMUNITY AND REGULATORY CONSULTATION

9.1 Introduction

This section provides information on the community consultations and meetings with regulatory agencies that have taken place to date regarding the proposed Mackenzie Valley Highway. The section includes information on meeting dates, meeting format, the comments and questions received at the meetings, and a summary of the comment similarities and differences that were heard in the communities of Inuvik, Aklavik, Tsiigehtchic, and Fort McPherson.

Consultations were led by the GTC, supported by members from the consultant team (Mackenzie Aboriginal Corporation and Nehtruh-EBA Consulting Ltd.) and DOT. The intent of the consultations was to get input from the members of the communities at key stages in the development of the preliminary design and the PDR. Consultations were conducted at the start of the undertaking to share the process and gather initial information; at the midpoint of the development of the PDR to show progress, confirm some decisions about the alignment, and the gather further information; and near the end of the development of the PDR to present the description of the project.

The main purpose of the community meetings was to receive comments, views, and questions that would directly inform and influence the development of the Highway. Topics such as the alignment of the Highway, its effects on the environment, economy, and areas of cultural value, and the benefits of the development of the Highway were discussed at the consultations.

9.2 Identification of Parties Consulted

Meetings were held in the four Gwich'in communities of Fort McPherson, Aklavik, Inuvik, and Tsiigehtchic. In addition, meetings were held, or contact was made, with the following regulatory bodies and agencies:

- GLWB;
- GLA;
- INAC;
- DFO;
- ENR, GNWT;
- PWNHC; and
- GSCI.

9.3 Community Consultation Dates and Format

Initial consultations were held in May 2010, in the communities of Inuvik, Fort McPherson, and Aklavik. Other activities were underway in the community of Tsiigehtchic at the time, and the initial consultation in this community was held in July 2010. The midpoint round of consultations was held for all four communities in November 2010, and the third round of consultation in March 2011.

The meetings typically took place at the Band office, in a community hall, or recreation centre within each of the communities. The dates and general format of each meeting are summarized in Table 9.3-1. The consultation documents, including backgrounders and notices that were distributed prior to the meetings, attendance sheets, and presentations are included in Appendix C.

Table 9.3-1: Consultation Summary

Consultation Location	Date	Format and Content of Meeting
Fort McPherson	May 25, 2010 (Elders' Lunch)	Meeting with leadership and Elders. Project presentation and discussion around maps showing the preliminary corridor for the Highway.
	May 25, 2010 (Community Supper)	Community meeting with a project presentation and discussion around maps showing the preliminary corridor for the Highway.
	November 26, 2010 (Elders' Lunch)	Meeting with leadership and Elders. Presentation and discussion of the project around large maps showing the preliminary alignment for the Highway. The discussion included updated information about the project, e.g., preliminary alignment, traditional knowledge, environmental and socio-economic issues.
	November 26, 2010 (Community Supper)	Presentation and discussion of the project around large maps showing the preliminary alignment for the Highway. The discussion included updated information about the project e.g. preliminary alignment, Traditional Knowledge, environmental and socio-economic issues.
	March 17, 2011 (Community Supper)	Community meeting with a presentation to show how community input was included in the PDR and discussion of the project around large maps.
Aklavik	May 27, 2010 (Elders' Lunch)	Meeting with Elders and project presentation and discussion around maps showing the preliminary corridor for the Highway.
	May 27, 2010 (Afternoon Meeting)	Meeting with Chief and Council and members of the RRC. Project presentation and discussion around maps showing the preliminary corridor for the Highway.
	May 27, 2010 (Community Supper)	Community meeting with a presentation and discussion around maps showing the preliminary corridor for the Highway.
	November 23, 2010 (Elders' Lunch)	Meeting with leadership and Elders. Project presentation and discussion of the project around large maps showing the preliminary alignment for the Highway. The discussion included updated information about the project, e.g., preliminary alignment, Traditional Knowledge, environmental and socio-economic issues.
	November 23, 2010 (Community Supper)	Community meeting with a presentation and discussion of the project around large maps showing the preliminary alignment for the Highway. The discussion included updated information about the project, e.g., preliminary alignment, Traditional Knowledge, environmental and socio-economic issues.
	March 14, 2011 (Community Supper)	Community meeting with a presentation to show how community input was included in the PDR.
Inuvik	May 28, 2010 (Community Supper)	Community meeting with a presentation and discussion around maps showing the preliminary corridor for the Highway.
	November 24, 2010 (Community Supper)	Early meeting with Chief Herbert Blake followed by community meeting with a project presentation and discussion of the project around large maps showing the preliminary alignment for the Highway. The discussion included updated information about the project, e.g., preliminary alignment, Traditional Knowledge, environmental and socio-economic issues.
	March 16, 2011 (Community Supper)	Community meeting with a presentation to show how community input was included in the PDR.

Table 9.3-1: Consultation Summary

Consultation Location	Date	Format and Content of Meeting
Tsiigehtchic	July 27, 2010 (Community Supper)	Community meeting with a presentation and discussion around maps showing the preliminary corridor for the Highway.
	November 25, 2010 (Community Supper)	Community meeting with a presentation and discussion of the project around large maps showing the preliminary alignment for the Highway. The discussion included updated information about the project, e.g., preliminary alignment, Traditional Knowledge, environmental and socio-economic issues.
	March 15, 2011 (Community Supper)	Community meeting with a presentation to show how community input was included in the PDR.

9.3.1 Information Provided to the Communities

At each of the meetings in the communities a presentation was given. A copy of each of the presentations is provided in Appendix C. As a summary, the presentation given at the first round of consultations covered the following topics:

- the main organizations involved in the project (GTC and DOT);
- introductions of the project team (Mackenzie Aboriginal Corporation and Nehtruh-EBA);
- partnership approach to the project;
- decision-making and timeline for producing the PDR;
- history of the development of the Highway including highlights from the *GCLCA;*
- planned community consultations;
- the next steps; and
- possible discussion topics (many topics listed to aid discussion).

The first consultation in Tsiigehtchic took place at a later date than the other consultations because of other activities in the community in the month of May. This meant that it was possible to share comments from the other communities at the Tsiigehtchic meeting and these were included in the presentation. Apart from this, the first presentation in Tsiigehtchic was identical to the one presented in the other three communities.

The presentation given at the second round of consultations in November (Appendix C) included many of the points covered above, and also included information on how the project has developed since the previous consultation. An emphasis was placed on having a discussion about the project around maps and adding comments to the maps. Copies of the maps were left in each of the communities.

The third round of consultations in March 2011 (Appendix C) included a brief review of the history and background of the highway, a short video showing the Highway alignment and touched on the next steps of the process. Emphasis for the sessions was placed on how the community's comments and input, received in the two previous consultation rounds, were incorporated into the PDR. Copies of the large maps (approximately 1.25 m by 0.75 m) used at the consultations were also left in the communities for reference.

In the initial consultations, the maps included an overview of the proposed alignment of the Highway from Inuvik to Wrigley and a more detailed view of the preliminary corridor for the Highway within the GSA. In the second round, the maps showed the preliminary alignment for the Highway, bridge and culvert locations, wildlife and other observations from the field programs, traditional use information made available from the GSCI, and location of potential borrow sources. In the third round of consultation, in addition to the detailed alignment maps, two new figures were included that detailed the Gwich'in Settlement Area Land Ownership and Management Zones.

Photograph 9.3.1-1
Fort McPherson Meeting – May 2010

Photograph 9.3.1-2
Aklavik Community Meeting – March 2011

Photograph 9.3.1-3
Tsiigehtchic Community Meeting – July 2010

Photograph 9.3.1-4
Inuvik Community Meeting – March 2011

9.4 Community Consultations – What Was Heard

The comments and questions received at the community meetings about the Highway were catalogued under six categories, as follows:

- Mackenzie Valley Highway (practical considerations);
- Society;
- Economy;
- Environment;
- Consultation; and
- Other.

The comments and questions received in the communities were recorded in tables and organized by community to allow the comments and questions to be compared across the communities. The tables are included in Appendix D and include information specific to how the comment or question was addressed in this PDR. This information is shown in the column titled, "Consideration of Comments" in the summary tables.

9.5 Comments Received

Below are examples of the comments and questions that were raised more than once, either within a community, or by more than one community. The answers for these and other comments have been addressed throughout the PDR, for more detail see Appendix D.

Mackenzie Valley Highway (Practical Considerations)

- *Will the Highway become part of the National Highway System?*
- *How much will the Highway cost to construct and where will the funding come from?*
- *How long will it take to construct the Highway?*
- *Are the Highway and pipeline projects "tied" together? Is one dependent on the other?*
- *If the Highway and pipeline were constructed together, or if the Highway was constructed first, then this would reduce construction costs for the pipeline.*
- *A lot of studies were completed for the proposed pipeline. This information should be used when considering the requirements for the Highway.*
- *Many people asked what the distances would be from Inuvik to southern cities, such as Edmonton and Calgary, if the Highway was built.*
- *Mistakes were made when the Dempster Highway was constructed. The designers should learn from those mistakes.*
- *It's important to remember that the Highway is passing through the GSA. The Gwich'in need to give permission for the Highway before it is constructed.*
- *Where will the construction camps and the maintenance camps be located? Two or three maintenance camps will be required, and these could also include other facilities such as offices for monitoring and enforcement personnel.*
- *How many bridges will be required, and how will they be constructed?*
- *When will the construction take place (seasons)?*
- *Are the consultants physically checking the proposed routes?*
- *How will the construction of the Mackenzie Highway impact the maintenance of the Dempster?*

Society

- *How will the Highway affect traditional pursuits on the land?*
- *Will the Highway interfere with traditional pursuits such as hunting, fishing, and trapping?*
- *Will compensation be available for those people who are affected by the Highway?*

Economy

- *It's important to start training people now for the jobs that will be available during construction and operation of the Highway, including environmental monitors.*
- *What kinds of jobs will be generated by the Highway (construction and operation)?*
- *Access and benefits agreements with the Gwich'in will need to be completed before the Highway is constructed.*
- *The Highway should generate business opportunities, particularly from tourism.*

Environment

- *How will the Highway affect climate change and permafrost?*
- *The potential effects that Highway may have on water need to be given special consideration.*
- *What environmental studies have been completed to date for the Highway?*
- *The area around Travaillant Lake is very special to the Gwich'in and must be protected, including the interconnected waterbodies in the area.*
- *The access created by the Highway to the pipeline may pose a security and environmental risk.*
- *The Highway would allow easier access to the pipeline in the event that emergency repairs were needed to the pipeline, and recognize the plan of minimizing the overall footprint with one Transportation Corridor.*

Consultation

- *The Andre family should be contacted as the family knows the Travaillant Lake area very well.*
- *Talk to the school children in the GSA about the Highway as it will affect their future.*
- *Communication and consultation about the project is very important.*

9.6 Consultations and Meetings with Regulators and Agencies

The following sections provide summaries of discussions that took place with various government regulators and agencies regarding the Highway. Where specific actions have been suggested by the agencies these have either been incorporated into the preliminary design of the Highway or will be given further consideration at the detailed design stage of the project.

9.6.1 Gwich'in Land and Water Board (GLWB)

A meeting with the GLWB Executive Director, Mr. Robert Alexie, took place on November 25, 2010. The main points raised by the Mr. Alexie are presented below:

- Application for approval of the Highway from Wrigley to Inuvik may be best to go as one project application to the MVLWB. It is likely that it will go from there to the MVEIRB.
- A discussion about the Highway with staff at the MVLWB is suggested to get their advice.
- Some permits would also need to be issued by the local districts, e.g., the GLWB, such as land use and quarry permits.
- Any amendments required to the project, such as moving a camp or adding a borrow source, would require and amendment application to MVLWB.

9.6.2 Gwich'in Land Administration (GLA)

A meeting with Ms. Mardy Semmler of the GLA took place on May 28, 2010, in Inuvik. The main points raised at the meeting are summarized below:

- The source of revenue currently generated for Dawson and Whitehorse (Yukon Territory) from the Mackenzie Delta area will likely change over time as revenue generated from tourism replaces the revenue generated from people living in the Delta region due to the 'loop' being created by the new highway.
- Advertisements for community meetings could go through the DGO, the rolling TV channel, and the radio as well.
- The Geological Survey of Canada has completed some permafrost modelling in Mackenzie Valley. There is also a permafrost monitoring network in Yellowknife.
- NRCAN can be contacted regarding the Mackenzie Valley Landslide Geotechnical Project.
- Registered Gwich'in Research/Wildlife Monitors should be hired from the local communities, to participate in the field programs.
- Some of the access roads to borrow material sites go through conservation status areas. Fish Lake and Travaillant Lake are two important lakes along the proposed pipeline and highway corridor.
- The *GLUP* identifies acceptable land uses, not specific locations or corridors.
- The future land use permit application will need to include all the necessary engineering details regarding the Highway.
- The MVLWB website has examples of 'engineering plans' that can be reviewed by proponents. The MVLWB also has a senior technical advisor in Yellowknife who can provide advice, as required.
- GTC has a Harvester Compensation Policy for those people who would be affected by the Highway construction or long-term operation of the Highway. Ms. Marlene Evans at the DFO may have information or studies pertaining to the Highway.

9.6.3 Government of Northwest Territories (GNWT), Department of Environment and Natural Resources (ENR)

A meeting with representatives from ENR took place on July 28, 2010. The main points and questions raised by the Department are summarized below:

- The top notable wildlife species that use the area of the Highway will pass through include: Bluenose West caribou (Special Management); Woodland caribou; North Cape Bathurst caribou; grizzly bear (Special Management); wolverine and other furbearers; peregrine falcon; and nearly all boreal forest species. The Highway will pass through a lot of past and current harvesting areas.
- The Highway also passes through an area that includes cabins, recreational use areas (some no longer used, or just float plane access), subsistence harvesting, 'spring hunt' area, fishing areas, and caribou hunting areas.
- ENR does not participate in bird programs. Birds are the responsibility of Environment Canada – Canadian Wildlife Service (CWS).

9.6.4 Department of Indian and Northern Affairs Canada (INAC)

INAC was contacted on June 23, 2010. The main points raised by the Department are summarized below:

- INAC's mandate in the GSA is ensuring compliance with the MVRMA in the GSA and Sahtu.
- The Highway, in its entirety, will be a transboundary project. The project will likely need to be reviewed by the MVLWB and by the MVEIRB.
- INAC encouraged discussion with those people who already use the land along the proposed alignment for the Highway, e.g., trappers, hunters, people with cabins.
- INAC asked about the proposed construction methods and timelines.

9.6.5 Department of Fisheries and Oceans Canada (DFO)

DFO was contacted in June 2010. The following points were raised by DFO:

- DFO has aerial photos and coordinates of all the water crossings. They can probably be provided to support this assessment and planning process.
- There may be studies available or ongoing for Travaillant Lake and Campbell Lake.
- DFO's role with this project will be regulatory, with respect to the *Fisheries Act*. The land claim describes how the GRRB is responsible for wildlife resource management, including fish. The focus is on harvested species.
- Where are the watersheds? i.e., Where does the flow go? What is the water connectivity across the Highway?
- Which fish are in the lakes approximately halfway between Inuvik and Travaillant Lake? This is not known. Ask the people in the communities if they know what species exist in those lakes, and what they think would be caught if the Highway is opened.

- Source of materials – pressure from blasting nearby is a concern, as is using rip-rap (must be free of fines).
- Any HADD of fish habitat will be challenging to authorize because there are so few examples in the area. DFO suggests asking the communities for their ideas for improving or creating fish habitat.
- The 1974 proposed route presented a drainage issue between Travaillant Lake and the Mackenzie River. DFO sees benefit of the new route as it is located upstream from Travaillant Lake.
- Inuvik-Campbell Lake area has bedrock outcroppings but should not be considered for construction material as it is one of few Peregrine Falcon habitats around.
- Washed out culverts are a concern. Frozen culverts, as well as soft road material, combine to create washouts. Culverts need to be steamed out to handle flow.
- Options for stream crossings from DFO include Operational Statements (expectation for clear span bridges), Letter of Advice, or Authorizations (expectation for culverts).

9.6.6 Prince of Wales Northern Heritage Centre (PWNHC)

The Proponent met with the PWNHC in May, 2010. PWNHC is the GNWT's museum and archives. The PWNHC acquires and manages objects and archival materials that represent the cultures and history of the Northwest Territories, and plays a primary role in documenting and providing information about the cultures and history of the Northwest Territories. Northwest Territories Archives also provides technical and logistical support to individuals and organizations that are involved in cultural activities, and authorizes archaeological studies in the Northwest Territories.

Archival material supplied by the Northwest Territories Archives was reviewed as part of the preliminary heritage assessment for the Highway. The PWNHC also issued the project archaeologist with the appropriate documentation to undertake the preliminary field assessment in June 2010 (Permit No. 2010-0016). Any site mitigation actions for dealing with the effects of the project on heritage resources must be finalized in consultation with the Territorial Archaeologist based at the PWNHC.

9.6.7 Gwich'in Social and Cultural Institute (GSCI)

The GSCI were contacted in October 2010, to discuss the project and the availability of traditional land use and traditional knowledge information pertaining to the Highway. On October 19, 2010, the GSCI authorized the use of information contained in a report that was produced for the MGP (same general corridor alignment as the Highway). The GSCI stated that further heritage studies would be required before any construction work started on the Highway. The information provided to date, coupled with the preliminary field and desktop assessments undertaken by an archaeologist, allows for a general assessment to be undertaken that highlights areas of actual and potential heritage value along the Highway. Consultation with the GSCI's archeologist will be ongoing in the next development stages of the project.

10.0 ENVIRONMENTAL OVERVIEW

The following section provides a description of the biophysical conditions and resources existing in the GSA in the vicinity of the Mackenzie Valley Highway. The human environment is also described in a discussion of the communities and demographics of the GSA. This information about the setting for the Highway is subsequently considered in Section 11.0, which describes anticipated project effects and proposes mitigation to avoid or minimize negative effects.

10.1 Climate

The Highway is situated in the northernmost part of the Mackenzie Valley, or Lower Mackenzie Valley, as it is described in this section. The climate of the Lower Mackenzie Valley is described using meteorological data recorded by Environment Canada at the Inuvik Airport (68°18'15" N 133°28'58" W; Climate ID: 220B6Q3) and Little Chicago (67°10'45" N, 130°13'41" W; Climate ID: 220B6Q3), near the southern end of the Highway (Figure 10.1-1). The climate in the Lower Mackenzie Valley is distinct from the Middle and Upper Mackenzie Valley areas to the south.

Thirty-year climate normals for Inuvik over the period from 1981 to 2010 have been created using a combination of monthly, daily, and hourly data and summarized in Table 10.1-1. Temperature and wind observations recorded at Little Chicago for the period of November 2005 to October 2010 have been summarized in Table 10.1-2. To provide a coincidental period of record between the two sites, Inuvik temperature and wind data have also been summarized for the same five-year period in Table 10.1-3.

Table 10.1-1: Climate Data, Inuvik A Station, NWT (October 1980 to September 2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature:													
Daily Maximum (°C)	-22.6	-21.0	-17.3	-6.0	5.2	17.7	19.5	15.8	8.0	-4.1	-16.7	-19.9	-3.5
Daily Average (°C)	-26.6	-25.4	-22.6	-11.3	0.5	11.8	14.1	10.9	4.0	-7.4	-20.5	-23.9	-8.0
Daily Minimum (°C)	-30.6	-29.9	-28.0	-16.7	-4.3	5.7	8.7	6.1	0.2	-10.6	-24.4	-27.9	-12.6
Extreme Maximum (°C)	5.9	5.2	4.7	14.9	29.2	32.8	32.8	32.5	26.2	20.9	6.9	3.7	32.8
Extreme Minimum (°C)	-49.1	-49.1	-46.6	-40.0	-26.6	-5.1	-1.0	-5.9	-20.1	-32.9	-42.6	-45.2	-49.1
*Precipitation:													
Total Precipitation (mm)	12.6	12.4	12.1	10.4	14.7	19.8	33.9	40.3	28.6	24.5	16.8	15.4	241.4
Snowfall (cm)	16.0	17.0	15.2	12.6	12.9	1.6	0.0	2.6	10.6	29.4	22.7	20.7	161.2
Rainfall (mm)	0.1	0.0	0.0	0.4	7.0	17.6	33.4	35.3	19.2	1.2	0.0	0.0	114.3
Extreme Daily Precipitation (mm)	9.0	10.7	18.4	13.8	24.2	24.4	41.0	32.6	22.2	15.0	16.9	20.0	41.0
Extreme Daily Snowfall (cm)	10.2	11.2	12.8	13.8	24.0	6.4	0.4	6.4	9.6	17.7	22.0	24.0	24.0
Extreme Daily Rainfall (mm)	1.8	0.2	0.8	10.0	17.0	24.4	41.0	28.4	22.2	5.2	0.0	0.4	41.0
**Average Snow Depth (cm)	46	54	57	54	20	0	0	0	0	11	29	39	26
**Snow Depth at Month End (cm)	51	56	59	41	1	0	0	0	2	22	34	41	25

Source: Environment Canada, 2010. Inuvik A Station : 68°18' N, 133°28.8' W; Elevation: 68.3 m ; Climate Station ID: 2202570.
Meteorological data recorded at Inuvik between July 1995 and December 31, 1996 has been flagged by Environment Canada as having undergone only preliminary quality analysis and was omitted from analysis.
* Precipitation data between March 2003 and October 2010 recorded at Inuvik Climate Station: 68°19' N 133°31' W ; Elevation: 103.0 m; Climate ID: 2202578.
** Average snow depth and snow depth at month end taken from Environment Canada 1971-2000 climate normals for Inuvik.

Table 10.1-2: Summary of Meteorological Data, Little Chicago, NWT (October 2005 to September 2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature:													
Daily Maximum (°C)	-24.3	-20.8	-16.9	0.8	11.0	20.1	21.6	17.2	9.8	-2.0	-15.6	-19.0	-1.5
Daily Average (°C)	-28.0	-25.4	-22.9	-5.6	5.3	14.6	15.9	12.2	5.6	-5.2	-19.2	-22.9	-6.3
Daily Minimum (°C)	-31.7	-29.8	-28.9	-11.9	-0.5	9.1	10.1	7.2	1.4	-8.4	-22.8	-26.8	-11.1
Extreme Maximum (°C)	2.3	-0.7	0.4	17.5	29.5	30.4	31.0	28.4	22.2	10.8	-3.3	-1.2	31.0
Extreme Minimum (°C)	-46.5	-46.7	-43.5	-29.0	-13.7	-0.7	2.3	-0.8	-12.4	-24.7	-36.5	-43.0	-46.7
Wind:													
Average Hourly Speed (kph)	4.2	4.9	6.9	7.9	9.3	9.7	8.8	8.6	8.2	6.7	5.2	4.3	6.8
Maximum Hourly Average (kph)	44	28	35	32	35	32	32	28	33	33	26	44	44
Predominant Wind Direction	NW	NW	NW	NW	NW	NW	NW	E	E	E	E	E	NW/E

Source: Environment Canada, 2009. Little Chicago Station : 67°10'45" N, 130°13'41" W; Elevation: 62.5 m ; Climate ID: 220B6Q3.

Table 10.1-3: Summary of Meteorological Data, Inuvik A Station, NWT (October 2005 to September 2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature:													
Daily Maximum(°C)	-22.1	-19.3	-20.1	-4.7	5.4	17.4	19.2	14.9	8.1	-4.1	-15.5	-17.5	-3.2
Daily Average (°C)	-25.4	-23.1	-24.7	-9.0	1.1	12.2	14.5	10.8	4.5	-6.6	-18.4	-20.6	-7.1
Daily Minimum (°C)	-28.8	-27.2	-29.3	-13.5	-3.5	6.3	9.3	6.8	1.2	-9.4	-21.6	-24.1	-11.2
Extreme Maximum (°C)	5.9	1.5	-1.9	14.9	29.2	28.0	30.4	29.2	22.0	7.4	-5.4	-1.4	30.4
Extreme Minimum (°C)	-43.5	-42.1	-43.8	-27.8	-20.0	-4.3	0.9	-2.0	-11.4	-23.3	-37.5	-39.5	-43.8
Wind:													
Average Hourly Speed (kph)	6.8	7.6	8.3	10.3	11.2	13.1	11.3	10.9	10.7	9.8	8.3	7.4	9.7
Maximum Hourly Average (kph)	57	41	33	37	35	44	46	35	44	37	39	65	65
Predominant Wind Direction	E	E	E	E	NW/ENE	ENE	NNW/E	NNW	E	E	E	E	E

Source: Environment Canada, 2009. Inuvik A Station : 68°18' N, 133°28.8' W ; Elevation: 68.3 m ; Climate Station ID : 2202570.

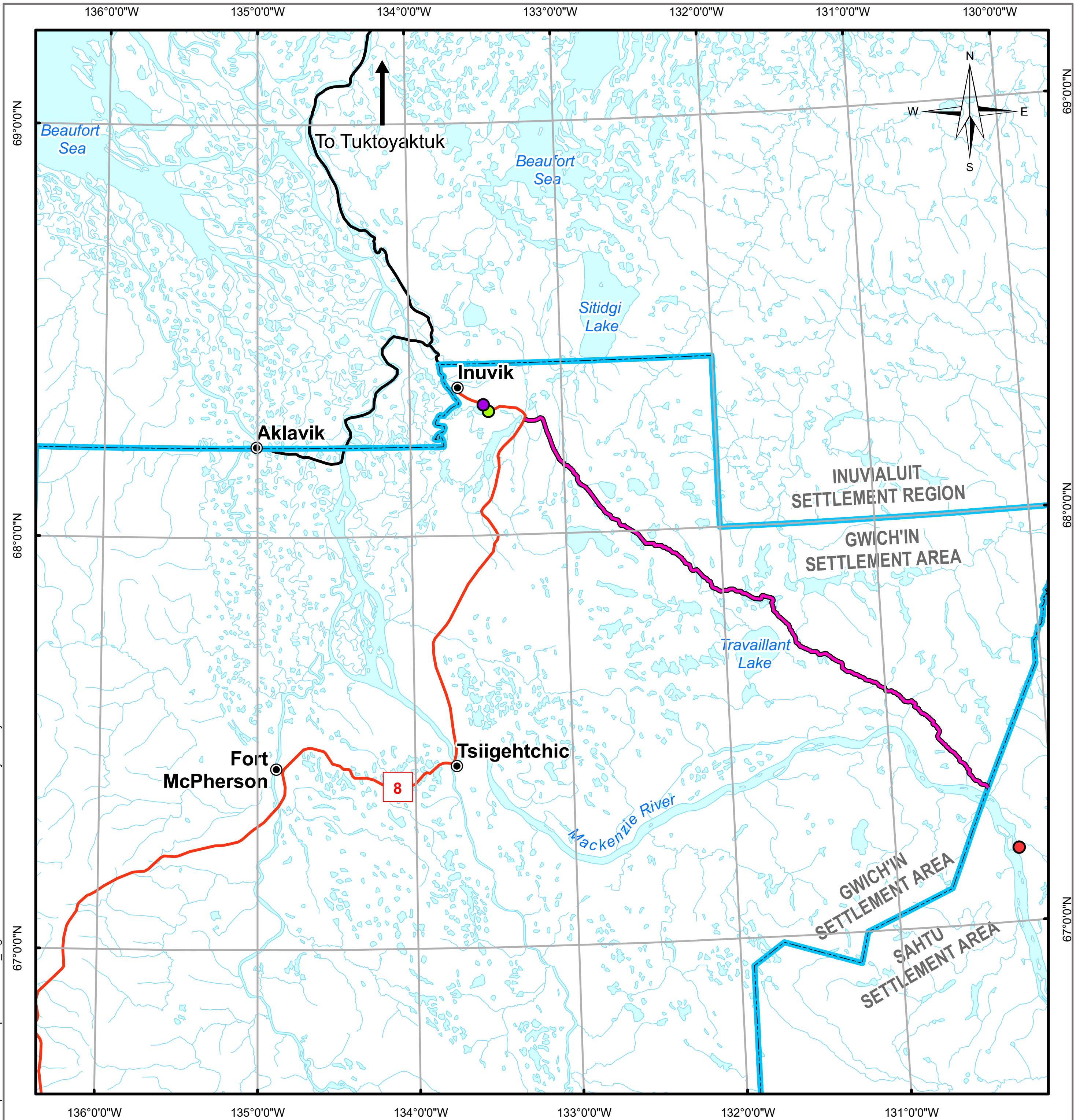
10.1.1 General

The general climate of the study area is sub-arctic, characterized by long, cold winters, short, cool summers, and extreme annual temperature variations. The transition between seasons is abrupt (Hinzman et al. 2005). Snow and ice cover typically persists between October and May. Annual precipitation is typically moderate, occurring more frequently in the warmer summer months than during the winter.

10.1.2 Air Temperature

Inuvik temperature normals for the period of November 1980 to October 2010 are summarized by month in Table 10.1-1 in terms of daily mean, average daily maximum and minimum, and extreme maximum and minimum. Mean annual temperatures are calculated as an average of all months. Extreme annual temperatures show the highest and lowest temperature recorded over the 30-year period. Environment Canada historical data provides temperature extremes recorded in Inuvik since 1957.

The mean annual temperature at Inuvik is -8.0°C. Annual temperature distribution is typical for mid-to-high latitudes in the northern hemisphere, with July as the warmest month (mean temperature 14.1°C) and January as the coldest (mean temperature -26.6°C). Temperatures are typically below zero between October and April. The highest temperature recorded between 1981 and 2010, which is also the historical high temperature, was 32.8°C (June 1999 and July 2001). The lowest temperature recorded between 1981 and 2010 was -49.1°C (January 1983 and February 1984). The historical low temperature recorded at Inuvik was -56.7°C in April 1968.



LEGEND

- Inuvik A
- Inuvik Climate
- Little Chicago
- Communities
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- Public Winter Road
- Settlement Area Boundary
- Waterbody
- River

NOTES

Base data source: NTS 1:250,000
Alignment is considered preliminary and is subject to change

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA

Location of Environment Canada Meteorological Stations

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:1,500,000

20 10 0 20

Kilometres

FILE NO.
V33101053_Figure10.1.1.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Northwest Territories

Nehtruh - EBA

Figure 10.1-1

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Based on five years of meteorological data at Little Chicago, the mean annual temperature is -6.3°C (Table 10.1-2). Over the same period at Inuvik, the mean annual temperature is -7.1°C (Table 10.1-3). The slightly warmer average temperature at Little Chicago agrees with previous observations of increasing mean annual temperature with decreasing latitude along the Highway (IOL et al. 2004). Furthermore, 1971 to 2000 climate normals for Tuktoyaktuk (69°26'00" N 133°01'35" W; Climate ID: 2203912) show a mean annual temperature of -10.6°C, compared to -8.8°C for Inuvik over the same period (Environment Canada 2010).

10.1.3 Precipitation

Daily precipitation data from Inuvik Airport is not available after March 2006 as automated recording was moved to the Inuvik Climate Station (68°19'00" N 133°31'00" W; Climate ID: 2202578). Daily rainfall and snowfall is also missing from August 2003 to present. Daily precipitation data, as well as snow and rainfall where available, recorded at the Inuvik Climate Station has been used for the period between October 2003 and October 2010. Precipitation data has not been recorded at Little Chicago. Environment Canada historical data provides precipitation extremes since 1957.

Mean annual precipitation at Inuvik is 241 mm based on available data between 1981 and 2010 (Table 10.1-1). On average, Inuvik receives 114 mm of rainfall annually, occurring mainly between May and September. Winter rainfall is extremely rare. Mean annual snowfall is 161 cm (67% of total annual precipitation) and typically occurs in every month except July.

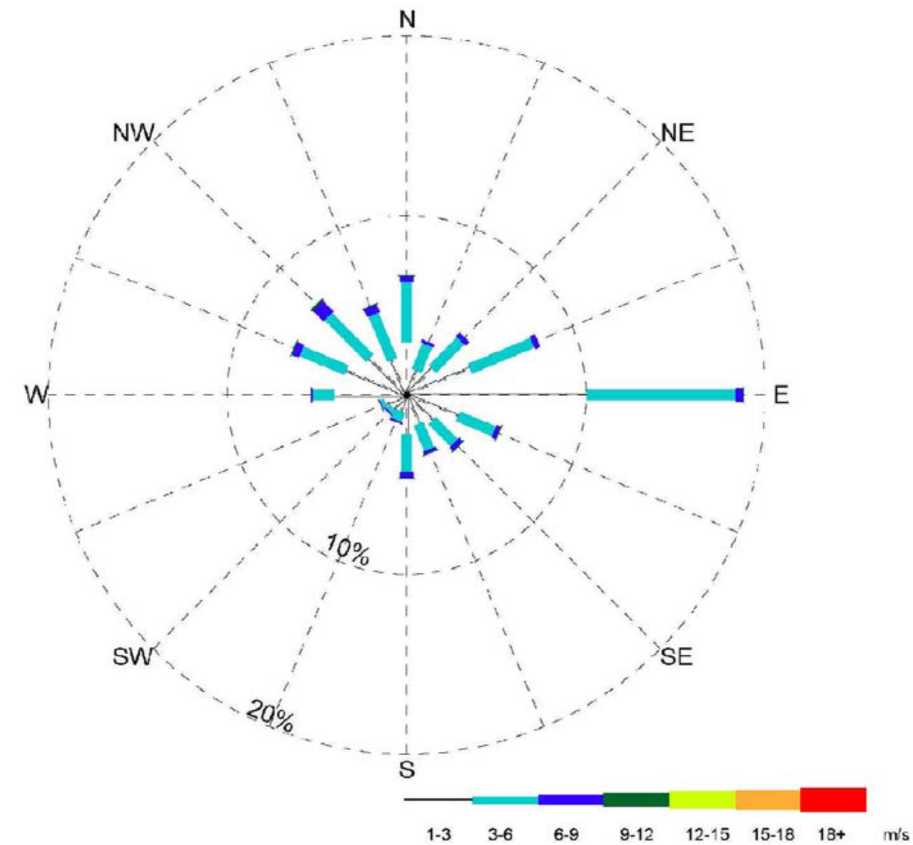
The highest one-day rainfall over the 30-year period was 41.0 mm (July 8, 1998), which also represents both the historical extreme daily rainfall and extreme daily precipitation recorded at Inuvik. The largest single-day snowfall between 1981 and 2010 was 24.0 cm (May 2, 1987). The largest single-day snowfall event ever recorded at Inuvik was 44.2 cm on October 17, 1971.

Mean annual precipitation in the Northwest Territories between 70°N and 60°N tends to increase non-linearly with decreasing latitude, as illustrated by a plot of seven reporting stations on Figure 5.9 of the EIS for the MGP report (IOL et al. 2004). Based on the plot, and ignoring any effects of terrain, mean annual precipitation towards the southern portion of the GSA can be estimated at approximately 115% of that at Inuvik, or approximately 275 mm.

Snow depth data is incomplete at Inuvik after mid-1995. Environment Canada's 1971 to 2000 climate normals for average snow depth by month and snow depth at the end of each month are substituted in Table 10.1-1. The majority of the snow melt typically occurs in May. Snow pack begins to accumulate in September. The average maximum snow depth prior to freshet (the peak average monthly snow depth for March) is 57 cm.

10.1.4 Wind Speed and Direction

The wind rose for the 5-year period between October 2005 and September 2010 at Inuvik is illustrated on Figure 10.1.4-1. Winds in Inuvik are predominantly from the east (ENE, E, ESE; 32% frequency of occurrence). Winds from the northwest and north have secondary predominance. Calm winds (average hourly wind speeds less than 1 m/s) occurred over 11.9% of the record. Winds from the east are typical throughout the year; however, north/northwest winds occur with higher frequency between May and August (Table 10.1-3).



Station Name: Inuvik A
NAD 27 location:
N68° 18' 15.0" W133° 28' 58.0"
Elevation above SL: 68 m
Tower Height: 10 m
Record Length: 5 Years
Start Date: Oct. 1, 2005
End Date: Sep. 30, 2010

Wind Speed & Direction Frequency Distribution Table

	Percent Occurrence (%)								
Direction	0-1 m/s	1-3 m/s	3-6 m/s	6-9 m/s	9-12 m/s	12-15 m/s	15-18 m/s	18+ m/s	Total (%)
ENE	-	3.84	3.77	0.28	-	-	-	-	7.90
NE	-	2.05	2.22	0.28	-	-	-	-	4.56
NNE	-	1.48	1.55	0.14	-	-	-	-	3.18
N	-	2.96	3.33	0.36	0.01	-	-	-	6.65
NNW	-	2.12	2.74	0.47	0.02	-	-	-	5.35
NW	-	2.92	3.28	0.84	0.07	-	-	-	7.12
WNW	-	3.65	2.72	0.42	0.03	-	-	-	6.82
W	-	4.05	1.20	0.11	0.01	-	-	-	5.37
WSW	-	1.27	0.26	0.02	-	-	-	-	1.55
SW	-	1.05	0.31	0.04	-	-	-	-	1.40
SSW	-	0.97	0.56	0.08	-	-	-	-	1.60
S	-	2.17	2.12	0.35	0.03	-	-	-	4.68
SSE	-	1.75	1.54	0.18	0.02	-	-	-	3.49
SE	-	2.05	1.74	0.26	0.01	-	-	-	4.06
ESE	-	3.11	2.19	0.23	0.03	-	-	-	5.56
E	-	10.01	8.36	0.40	0.03	-	-	-	18.80
Calm	11.91	-	-	-	-	-	-	-	11.91
Total (%)	11.91	45.44	37.88	4.47	0.27	0.02	-	-	100.00

MACKENZIE VALLEY HIGHWAY
PROJECT DESCRIPTION REPORT

Inuvik Station
Wind Rose
Period of Record

Northwest Territories

Nehtruh - EBA

FILE NO.
V33101053_Figure10.1.4-1.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE
EBA-RIV

DATE
May 10, 2011

Figure 10.1.4-1

STATUS
ISSUED FOR USE

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The wind rose for the same period at Little Chicago is illustrated on Figure 10.1.4-2. Winds at Little Chicago are equally predominant from the northwest (NNW, NW, WNW; 27% frequency of occurrence) and the east (ENE, E, ESE; 25% frequency of occurrence); however, east winds are typically of lower speed. Average hourly wind speeds are typically light with calm conditions occurring 22.6% of the time. Winds tend to come more commonly from the northwest between January and July and from the east between August and December (Table 10.1-2).

Winds are more intense in Inuvik (mean annual wind speed 9.7 kph; maximum 1-hour wind speed 65 kph) than in Little Chicago (mean annual wind speed 6.8 kph; maximum 1-hour wind speed 44 kph) (Table 10.1-3). At both locations, wind speeds are higher during the summer months, with the highest wind speeds on average occurring in June; however, some consideration must be given to potential ice affected data during the winter resulting in diminished or non-readings. The highest hourly wind gust speeds have occurred in December and January at both locations. The maximum historical gust speed recorded at Inuvik was 109 kph on December 21, 1964.

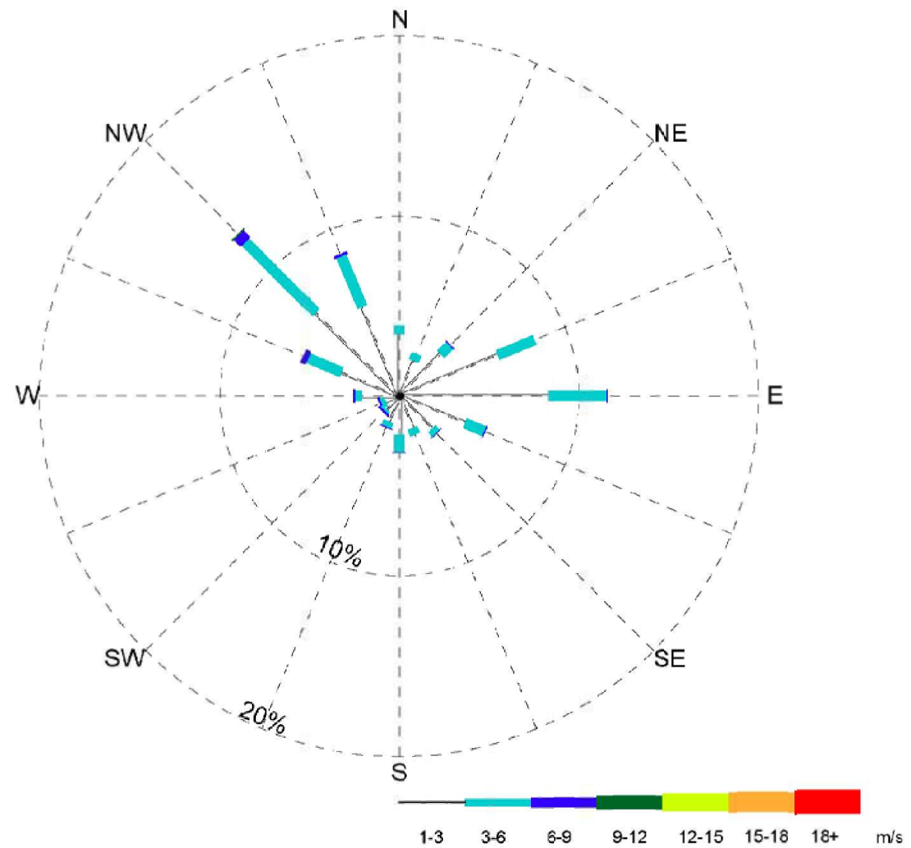
10.1.5 Air Quality

Ambient air quality is monitored in the GSA at the ENR station in Inuvik. Results from the 2008 and 2009 Northwest Territories Air Quality Report are presented in Table 10.1.5-1 along with current Northwest Territories air quality standards. National (NAQQO) or Provincial standards have been adopted in the Northwest Territories have been denoted with an asterisk.

Table 10.1.5-1: Inuvik Baseline Air Quality (2008 and 2009)

Species	NWT Standard (*NAQQO, **Alberta)		2008 Maximum	2008 Exceedances	2009 Maximum	2009 Exceedances
	Maximum	Avg. Period				
SO_2	450 µg/m^3	1 hour	11 µg/m^3	0	8 µg/m^3	0
	150 µg/m^3	24 hours	-	0	-	0
	30 µg/m^3	annual	2 µg/m^3	0	<1 µg/m^3	0
NO_2	*400 µg/m^3	1 hour	48 µg/m^3	0	n/a	n/a
	*200 µg/m^3	24 hours	n/a	n/a	n/a	n/a
	*60 µg/m^3	annual	2 µg/m^3	0	n/a	n/a
CO	*15 mg/m^3	1 hour	n/a	n/a	n/a	n/a
	*6 mg/m^3	8 hours	n/a	n/a	n/a	n/a
$PM_{2.5}$	30 µg/m^3	24 hours	16 µg/m^3	0	35 µg/m^3	2
PM_{10}	50 µg/m^3	24 hours	70 µg/m^3	3	175 µg/m^3	10
Ground Level O_3	*160 µg/m^3	1 hour	104 µg/m^3	0	112 µg/m^3	0
	127 µg/m^3	8 hours	100 µg/m^3	0	106 µg/m^3	0
H_2S	**14 µg/m^3	1 hour	6 µg/m^3	0	3 µg/m^3	0
	**4 µg/m^3	24 hours	n/a	n/a	3 µg/m^3	0

*Northwest Territories Air Quality Report, Northwest Territories Environment and Natural Resources, 2008 and 2009.



Station Name: Little Chicago

NAD 27 location:

N67° 10' 45.0" W130° 13' 41.0"

Elevation above SL: 63 m

Tower Height: 10 m

Record Length: 5 years

Start Date: Oct. 1, 2005

End Date: Sep. 30, 2010

Wind Speed & Direction Frequency Distribution Table

Direction	0-1 m/s	1-3 m/s	3-6 m/s	6-9 m/s	9-12 m/s	12-15 m/s	15-18 m/s	18+ m/s	Total (%)
	Percent Occurrence (%)								
ENE	-	5.94	2.21	-	-	-	-	-	8.15
NE	-	3.30	0.70	0.01	-	-	-	-	4.01
NNE	-	2.11	0.40	-	-	-	-	-	2.51
N	-	3.45	0.43	-	-	-	-	-	3.88
NNW	-	5.36	3.05	0.11	-	-	-	-	8.53
NW	-	6.56	5.55	0.55	0.03	-	-	-	12.69
WNW	-	3.47	2.05	0.24	-	-	-	-	5.76
W	-	2.05	0.41	0.05	-	-	-	-	2.51
WSW	-	0.81	0.27	0.09	-	-	-	-	1.17
SW	-	1.02	0.15	0.08	-	-	-	-	1.25
SSW	-	1.54	0.32	0.02	-	-	-	-	1.88
S	-	2.16	0.98	0.01	-	-	-	-	3.15
SSE	-	1.93	0.37	-	-	-	-	-	2.30
SE	-	2.59	0.35	0.01	-	-	-	-	2.95
ESE	-	3.96	1.19	0.03	-	-	-	-	5.17
E	-	8.30	3.24	0.04	-	-	-	-	11.58
Calm	22.47	-	-	-	-	-	-	-	22.47
Total (%)	22.47	54.53	21.67	1.28	0.05	-	-	-	100.00

MACKENZIE VALLEY HIGHWAY
PROJECT DESCRIPTION REPORT

Little Chicago
Wind Rose
Period of Record

Northwest Territories

Nehtruh - EBA

FILE NO.
V33101053_Figure10.1.4-2.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

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May 10, 2011

STATUS
ISSUED FOR USE

Figure 10.1.4-2

SO_2 concentrations are very low at Inuvik (annual average typically less than 2 µg/m^3). Since industrial, commercial, and residential processes are a major contributor to SO_2, baseline levels throughout the GSA are expected to be highest near Inuvik, decreasing along the Highway to negligible levels in areas to the southeast.

Ambient concentrations of NO_2 are well below applicable standards (monthly mean concentrations below 5 µg/m^3); however, mechanical failure of instrumentation resulted in no data being recorded between October 2008 and November 2009. NO_2 concentrations are much higher in the winter months as winter inversions, characterized by very low wind speeds and a stable atmosphere, are very common in Inuvik resulting in a diminished ability for dispersion of pollutants (ENR 2009). Baseline NO_2 is expected to be lower in more remote areas of the GSA due to fewer sources of combustion (automobiles, butane stoves/heaters, industry).

Fine particulate matter ($PM_{2.5}$) is typically higher on average during winter months due to inversion conditions. Short-period peaks that exceeded air quality standards occurred during summer months due to forest fire smoke. Annually, average $PM_{2.5}$ concentrations at Inuvik are 5 µg/m^3. Throughout the GSA, $PM_{2.5}$ would be variable during the summer as a result of forest fires.

Coarse particulate matter (PM_{10}) concentrations are higher in snow-free months due to road dust and are particularly elevated in April and May due to 'spring-time dust events' from residual winter gravel (ENR 2010). Monthly average concentrations in Inuvik are typically in the range of 5 µg/m^3 during the winter to 25 µg/m^3 during the spring.

Ground level ozone (O_3) exhibits a typical springtime maximum with a monthly average exceeding 60 µg/m^3 in April and May compared to the annual average of 40 µg/m^3 at Inuvik. Peak 1-hour and 8-hour average concentrations also occurred in April (in 2008) and May (in 2009). Similar levels would be expected throughout the GSA.

H_2S is monitored in Inuvik due to oil and gas development in the region. Hourly concentrations indicate essentially non-detectable levels (less than 1 µg/m^3). H_2S concentrations are expected to be zero in less disturbed areas of the GSA, southeast of Inuvik.

The monitoring station at Inuvik does not monitor CO; however, 2009 data recorded at Yellowknife shows a peak 1-hour maximum concentration of 2.2 mg/m^3, well below air quality standards (ENR 2010). In small northern communities, the major contributor to CO production is individual-dwelling wood burning, so peak values would tend to occur during the winter months and made worse by temperature inversions. However, due to the population distribution that characterizes the region, CO levels are not expected to pose a concern to air quality.

10.1.6 Climate Change

Changes in mean annual temperature have been found to affect the distribution of permafrost and thermokarst processes in the region (Lawford 1989). A general warming and a snow cover of shorter duration would disrupt the thermal stability of the permafrost, which is sensitive to minor changes in heat transfer at the ground surface, initiating thaw and decreasing the overall stability of the ground

(EBA 2010). Permafrost stability depends on maintaining ground temperatures to minimize the thickness of the active layer and to impede thaw (EBA 2010).

General circulation models in combination with various population and economic growth scenarios provide simulations of climate change over the period of 2010 to 2039 for the Mackenzie Valley referenced to 1961 to 1990 climate normals (Burn 2003). Projections for the Lower Mackenzie Valley are distinct from those for the Upper and Middle Valley (Burn 2003). Climate projections of future temperatures indicate greater change for northern (Lower Mackenzie) portions of the valley compared to the south (Middle and Upper Mackenzie).

In addition to general circulation model projections, 50-year mean annual temperature and precipitation trends (1958 to 2009) for Inuvik are presented as a comparison to the future scenarios. Due to the uncertainty of climate change, it is no longer an accepted procedure to adopt historical trends as design parameters in regions of permafrost (EBA 2010); however, the trend allows for a preliminary validation of the projections.

Seven highly regarded general circulation models in combination with various atmospheric change scenarios provided 29 projections of temperature and precipitation change over the next 30 years (Burn 2003). Upper and lower estimates (selected as the 86th percentiles) and the median projection scenarios are summarized in Table 10.1.6-1 for mean annual temperature, mean winter temperature, and annual precipitation for the Lower Mackenzie Valley. The 50-year trend at Inuvik is also shown.

Table 10.1.6-1: Climate Change Scenarios For Northern Mackenzie Valley

	[1]1961 to 1990 Climate Normals (Baseline)	1981 to 2010 Climate Normals (Inuvik)	1958 to 2009 Trend (Inuvik)	2010 to 2039 Climate Change Projections		
				[2]Low	Mid	[2]High
Mean Annual Temperature (°C)	-9.5°C	-8.0°C	+0.07°C/yr	+1.3	+1.6	+2.5
[2]Mean Winter Temperature (°C)	-27.8°C	-25.3°C	+0.12°C/yr	+1.1	+1.9	+3.1
Annual Precipitation (mm)	257 mm	241 mm	-1.0 mm/yr	+2.1%	+7.4%	+11.8%

Source: Burn (2003).
[1] Source: Environment Canada: Inuvik A.
[2] Low and high represents the 12th and 86th percentile of 29 climate change projections.
[3] Mean winter temperature defined in climate scenarios as DJF and as the mean of December, January, and February monthly means in climate normals.

10.1.6.1 Air Temperature

The mean annual temperature over the period of 2010 to 2039 in the Lower Mackenzie Valley is projected to increase by between 1.3°C and 2.5°C over the 1961 to 1990 baseline mean temperature for the region (-9.5°C at Inuvik). The rate of increase is similar to what has been observed over the past 50 years at Inuvik.

Mean winter temperatures are projected to increase at a slightly faster rate in the region, with an upper estimate of 3.1°C. The 50-year plot of mean winter (December, January, February) temperatures, plotted for Inuvik, also illustrates a faster rate of warming during the winter months.

A winter warming trend would tend to shorten the length of the snow season. Illustrating the trend at Inuvik, the final day of the spring with at least 1 cm of snow is plotted for the period between 1961 and

2007. As would be expected, the overall trend is towards an earlier melt (0.23 days per year on average) and more snow-free days.

Although the warming trends are evident in the region, the magnitude of natural year-to-year variations in annual temperature is 2 to 3 times the projected increase over the next 30 years. Additionally, the plot of mean annual temperature and mean winter temperature over the past 50 years suggests a cyclic pattern of approximately 20 years.

Over the next 30 years, annual air temperatures will be increasing on average in the Lower Mackenzie Valley, decreasing the duration of continuous snow cover and sub-zero temperatures for the region of continuous permafrost; however, year-to-year natural climate variability will be larger than the general warming trend; hence, it will be more noticeable to area residents.

10.1.6.2 Precipitation

Although climate models tend to predict that an increase in precipitation at high latitudes is very likely, the effects of climate change on regional precipitation patterns are uncertain as they will be significantly influenced by changes in global circulation patterns (Hengeveld 1997). For the Lower Mackenzie Valley, the general circulation model projected increase in precipitation over the next 30 years is between 2.1% and 11.8% over the 1961 to 1990 baseline (257 mm for Inuvik). The 50-year plot of annual precipitation at Inuvik, however, shows a trend towards decreasing precipitation at an average rate of 1 mm/year.

Climate models have tended to produce mixed results in terms of precipitation projections and have often over-predicted (Burn 2003). Environment Canada's Climate Global Circulation Model (CGCM2) projects an overall decrease in annual precipitation of between 0% and 10% for the Lower Mackenzie Valley by 2050, while a net increase of the same magnitude is projected for Mid- and Upper-Valley regions to the south.

Although most long-term climate records in arctic regions do indicate increasing trends, some stations do show decreases in precipitation (Hinzman et al. 2005). While an annual decrease of 1 mm/year is evident at Inuvik, precipitation has been increasing by 0.4 mm/year at Tuktoyaktuk on average.

The 50-year plot of annual rainfall at Inuvik shows an average decrease annually of 0.3 mm per year. Over the same period, annual snowfall has been decreasing at 0.7 cm/yr (or approximately 0.7 mm per year of water-equivalent precipitation). These trends indicate that a larger portion of annual precipitation is falling as rain at Inuvik.

10.2 Terrain and Topography

10.2.1 Terrain Conditions Along the Preferred Alignment

Table 10.2.1-1 below, provides a summary of terrain conditions along the Highway, from km 1328.4 northward to the junction with the Dempster Highway, just south of Inuvik, at km 1509.2. This summary incorporates observations made during the 2010 field program and information readily available in published documents.

Table 10.2.1-1: Terrain Conditions Along Preferred Alignment

Kilometre		Description of Terrain Conditions
1328.4	1341.0	From the border between the Sahtu Settlement Area and the GSA at km 1328.4, the Highway trends northwestward along the high right (east) bank of the Mackenzie River across a flat to gently undulating glaciolacustrine plain. Typically the Highway is approximately 2 km to 8 km northeast of the river and approximately 40 m above the river channel. Elevation (topographic relief) along this section of the Highway changes from 60 m above sea level (masl) (in the southeast) to 100 masl (in the northwest). The plain, which slopes gently (less than 5% grade) towards the Mackenzie River, is composed predominantly of glaciolacustrine silt and clay with minor sand. It is commonly overlain by a discontinuous veneer of organic deposits and locally overlain by outwash sand. The Highway crosses several shallow drainage paths, but drainage conditions are generally poor. Permafrost is continuous and ice-rich throughout the GSA. Several retrogressive thaw flow landslides, which are geohazards related to ice-rich permafrost, were observed from the air in nearby areas, e.g., south of km 1330. Similarly, large-scale active thermokarst development, i.e., ground subsidence and formation of shallow lake depressions caused by thawing of ice-rich permafrost, was observed south of the Highway between km 1328 and km 1329. More thermokarst depressions within the glaciolacustrine plain were observed further northwest. Vegetation along this section of the Highway is sparse spruce forest with small moderately dense stands of spruce around some lakes and along watercourses. Extensive areas of burnt spruce forest revegetated with mixtures of juvenile spruce, aspen, and birch were observed. Muskegs occupy low-lying areas.
1341.0	1345.5	At approximately km 1341, the Highway ascends northward onto an elevated (upland) rolling moraine plain characterized locally with broad hummocks or low hills. Elevation (topographic relief) along this section of the Highway changes from 100 masl (in the southeast) to 175 masl (in the northwest). Slopes are gentle, not exceeding 4% grade. Drainage conditions appear good. The moraine is generally comprised of silt, clay, and sand with about 20% to 50% pebble size gravel (Duk-Rodkin, A. and Hughes, O.L. 1992). Locally there are small alluvial fans and aprons overlying the till. These are composed mainly of silt, sand, and minor gravel, locally with discontinuous interbedded layers of woody peat (Duk-Rodkin, A. and Hughes, O.L. 1992). Permafrost in the morainal till is anticipated to be ice-rich, although no significant signs of permafrost geohazards were noted in this short section. Vegetation along this section of the Highway is moderately dense to sparse spruce forest with extensive burnt areas re-vegetated with mixtures of juvenile spruce and aspen.
1345.5	1361.0	Northwest of km 1345.5, the Highway would be located on an undulating to rolling moraine plain, locally with broad hummocks or low hills. Elevation (topographic relief) along this section of the Highway changes from 175 masl to 216 masl. Slopes are gentle – up to 6% grade. This section is distinct from the one to the southwest because of the number of shallow drainage channels that must be crossed. Drainage conditions appear good. Low-lying areas commonly have an organic cover from 2 m to 3 m thick (Duk-Rodkin, A. and Hughes, O.L. 1992). The morainal tills consist of non-sorted silt, sand, and clay with some coarser clasts (Duk-Rodkin, A. and Hughes, O.L. 1992). There are numerous lakes and shallow depressions in this section, some of which appear to have thermokarst origin. This suggests ice-rich condition of the underlying glacial deposits. Vegetation along this section of the Highway consists of muskeg species within shallow drainage paths and sparse to moderately dense spruce forest with extensive burnt areas, which are partially re-vegetated with juvenile aspen and spruce.

Table 10.2.1-1: Terrain Conditions Along Preferred Alignment

Kilometre		Description of Terrain Conditions
1361.0	1363.3	**Thunder River** (located between km 1361 to km 1363.3). The Thunder River is one of the major watercourse crossings on the Highway. The river channel is only few metres wide when not in spring flood (observed during the site visit on June 29, 2010), and is located in a prominent valley with moderate to moderately steep slopes incised about 90 m into the upland moraine plain. The channel of the Thunder River meanders on a narrow valley floor. In this area, shale bedrock underlies the morainal till about 10 m below the level of the upland plain. On the slopes of the valley, morainal till, weathered bedrock, and some glaciofluvial soils are exposed. Generally these slopes have been extensively modified by slope movement and related colluvial processes. Furthermore, the soils are moderately well to poorly drained, ice-rich and locally unstable. The moderately dense spruce forest that used to cover the valley slopes was destroyed by a large fire in 1985 and juvenile aspen now dominates the vegetation cover on the slopes and within the floodplain. **West-facing Slope.** The Highway on the west-facing slope is on well drained and generally stable terrain. The average slope gradient is about 9%, which includes a 300 m long section of 13% gradient located midslope and a 50 m long section of approximately 20% gradient located near the toe of the slope. Drainage conditions along the Highway are generally good. The slope configuration is uniform and straight to slightly concave. The lower portion of the west-facing slope crosses an area of hummocky ice-contact glaciofluvial deposits (gravel and sand) and a low terrace of outwash deposits (sand and gravel with silt). Micro hummocks and depressions formed from freeze-thaw cycles in the active layer characterize the micro topography of the slope surface. There was no evidence of thaw flow landslides or any other permafrost-related geohazards on the west-facing slope near the Highway. **East-facing Slope.** The east-facing slope of the Thunder River Valley is characterized by irregular broad swales, which host areas of exposed soils from fire-induced active retrogressive thaw flow landslides. Exposed ice-rich soils were observed in the retrogressive thaw flow landslide headscarps. Other indicators of slope instability include thaw subsidence, tensions cracks, jack-strawed trees, solifluction lobes, and flowing saturated soil at large open slumped bowls. On average, the slope gradient along the Highway ranges from about 10% to 15%, with the steepest section near the lower portion of the slope being approximately 25% grade. Drainage conditions along this section of the Highway appear to be good. Micro hummocks, shallow depressions, thermal contraction cracks, and solifluction lobes characterize the slope micro topography. Parallel, downslope-oriented, active thermal erosion gullies were observed midslope.
1363.3	1385.0	Northwest of Thunder River, the MVH route crosses undulating to rolling (gently to locally moderately sloping) upland moraine plain, characterized by broad hummocks or low hills. Elevation (topographic relief) along this section of the Highway changes from 140 m (in the southeast) to 300 m (in the northwest). On average, the slope gradient along this section of the Highway does not exceed 8%. Drainage conditions are generally good. The morainal till consists of non-sorted silt, sand, and clay with some coarser clasts (gravel to boulders). In this section, the Highway crosses a number of shallow drainage channels with an organic cover from <1 m to 3 m thick at the bottom of low-lying areas. . There are numerous lakes and shallow depressions in this section of the route, some of which appear to have thermokarst origin. This suggests ice-rich condition of the permafrost. Active retrogressive thaw slumping observed along the shore of a lake approximately 0.5 km north of km 1384 is also indicative of ice-rich permafrost. From km 1363.3 to approximately km 1370, there are extensive areas of burnt white spruce forest with patches of mixtures of juvenile aspen and white spruce. From km 1370 northwestward, vegetation is predominantly moderately dense white spruce forest.

Table 10.2.1-1: Terrain Conditions Along Preferred Alignment

Kilometre		Description of Terrain Conditions
1385.0	1391.0	The Highway crosses undulating to rolling moraine plain, which, within this section, is characterized by gullying and occurrences of shallow shale bedrock. Elevation (topographic relief) along the Highway changes from 350 m (in the southeast) to 270 m (in the northwest). On average, the slope gradient along this section of the Highway does not exceed 8%, except for a 400 m long section of approximately 10% gradient located at km 1390. Drainage conditions are generally good. Till is anticipated to be similar to the previous sections, i.e., unsorted sandy silt-clay mixtures with some gravel, cobbles, and boulders. Thaw slumps and slides observed from the air in nearby areas suggest ice-rich condition of the permafrost. Vegetation is predominantly moderately dense to sparse white spruce forest. Muskeg species were observed in low-lying areas.
1391.0	1399.0	The Highway crosses undulating to rolling moraine plain. Elevation (topographic relief) along this section of the Highway changes from 257 masl to 290 masl. On average, the slope gradient ranges from 6% to less than 4%, except for a 100 m long section of approximately 10% gradient located at km 1392 and a 60 m long section of approximately 17% gradient located at km 1398.1. Drainage conditions appear relatively good. Morainal soils are anticipated to be similar to previous sections, i.e., sandy silt-clay mixtures with some gravel, cobbles, and boulders. Permafrost is anticipated to be ice-rich. Several retrogressive thaw flow landslides, which are geohazards related to ice-rich permafrost, were observed from the air in nearby areas, e.g., south of km 1395 and 500 m southwest of km 1397 (see Map (Airphoto) 24 in the Map book and aerial photographs, June 29 by VER). There are extensive areas of burnt spruce forest that have re vegetated with a mixture of juvenile white spruce and aspen, and includes isolated moderate to sparse stands of white spruce. Elongated drainage path depressions are treeless and occupied by low shrub bogs. Small stream valleys are densely vegetated with high shrubs (willow and alder) and\or moderately dense stands of spruce. Isolated areas of treeless muskeg terrain were observed from the air.
1399.0	1401.3	Northward of km 1399, the Highway the moraine plain and crosses an area of hummocky ice-contact terrain underlain by glaciofluvial deposits. The terrain is characterized by ridges and hummocks composed of sand and gravel and locally underlain by shallow shale bedrock. Elevation (topographic relief) along this section of the Highway changes from 240 masl to 257 masl. The slope gradient ranges from few percent along most of the Highway to about 12% grade along an 80 m long section at km 1401. The ridges and hummocks are well drained; however, swales between the ridges are poorly drained and covered by a veneer of organic material less than 1 m thick with ice-wedge polygons. Perennially frozen glaciofluvial deposits are known (Roujanski, Jones et al., 2010) to contain discrete bodies of massive ground ice, although no significant signs of permafrost-related geohazards were noted along this short section. Ridges and hummocks are covered with sparse to dense white spruce forest. Swales between the ridges are occupied by low shrub bogs with sparse black spruce trees.

Table 10.2.1-1: Terrain Conditions Along Preferred Alignment

Kilometre		Description of Terrain Conditions
1401.3	1412.0	The Highway returns onto the undulating moraine plain crossing a number of shallow drainage channels and watercourse in this section. Elevation (topographic relief) along this section of the Highway changes from 280 masl (at km 1403.7) to 168 masl (at km 1412.0). On average, the slope gradient does not exceed 6%, except for two 100 m long sections of approximately 10% gradient located at km 1401.3 and km 1412 and one 100 m long section of approximately 20% gradient located at km 1402. Drainage conditions appear relatively good; however, low-lying areas are poorly drained and commonly have an organic cover of <1 m to 3 m. Morainal soils are anticipated to be similar to previous sections: unsorted sandy silt-clay mixtures with some gravel, cobbles, and boulders. Permafrost is anticipated to be ice-rich. East of km 1412, along the shore of a large lake, there are several retrogressive thaw flows indicative of ice-rich permafrost in the area. Large-scale active thermokarst development, i.e., ground subsidence and formation of shallow lake depressions caused by thawing of ice-rich permafrost, was observed east of the Highway at km 1410. Vegetation is predominantly moderately dense to sparse white spruce forest with burnt areas re-vegetated with mixed juvenile white spruce and aspen. Muskegs were observed in low-lying areas.
1412.0	1416.0	The Highway crosses flat to gently sloping glaciolacustrine plain, underlain by thick glaciolacustrine sediments, typically silt and clay with minor sand. In many places this is overlain by discontinuous veneer (<2 m) of organic material (peat/muskeg) with ice-wedge polygonal micro topography. Elevation (topographic relief) along this section of the Highway changes from 170 masl (at km 1412) to 160 masl (at km 1414.6). On average, the slope gradient is less than 4%, except for an 80 m long section of approximately 12% gradient located at km 1412.3. Drainage conditions appear imperfect to moderately good. Low-lying areas and near-lakeshore zone are poorly drained and commonly have an organic cover of 1 m to 2 m. Ice-rich permafrost with various forms of ground ice is prevalent. Large lakes are situated on either side of the Highway. The plain is covered with moderately dense to sparse spruce forest. Small stream valleys are densely vegetated with high shrubs (willow and alder). Areas of muskeg terrain were observed from the air.
1416.0	1433.8	The Highway returns onto the undulating moraine plain crossing a number of shallow drainage channels and watercourses in this section. Elevation (topographic relief) along this section of the Highway changes from 170 masl (along most of the southeast portion of the section) to 234 masl (at km 1429). On average, the slope gradient does not exceed 6% and drainage conditions appear moderately good to imperfect. Low-lying, poorly drained areas typically have from <1 m and 3 m of organic cover. Morainal soils are anticipated to be comprised of unsorted sandy silt-clay mixtures with some gravel, cobbles, and boulders. There are signs of ice-rich, thermally sensitive permafrost conditions in the area, such as a large retrogressive thaw flow landslide just south of km 1426 and several retrogressive thaw flows along the shore of a lake south of the Highway (between km 1426 and km 1427). The plain is covered with moderately dense white spruce forest and bush alder. Muskegs were observed in low-lying areas.
1433.8	1435.0	The Highway crosses a short section of gently sloping flat to undulating outwash plain underlain by sand and gravel with silt and peat in some channels. Elevation is approximately 170 masl. The slope gradient is less than 4%. Drainage conditions are good. There is no evidence of ice-rich thermally sensitive permafrost conditions within this short section; however, glaciofluvial deposits are known (Roujanski, Jones et al. 2010) to contain buried bodies of massive ground ice. The plain is covered by predominantly sparse white spruce forest with extensive areas affected by old forest fires. Upright and fallen dead spruce trees are interspersed with juvenile spruce, aspen, and birch. The ground surface is covered with lichen (*Cladonia*) and patches of low shrubs.

Table 10.2.1-1: Terrain Conditions Along Preferred Alignment

Kilometre		Description of Terrain Conditions
1435.0	1441.0	The Highway returns onto the undulating to rolling moraine plain. The morphology of the till-covered terrain along this section of the Highway is generally controlled by shallow bedrock. Elevation (topographic relief) along the Highway changes from 170 masl (in the southeast) to 280 masl (at km 1437.2). On average, the slope gradient does not exceed 8%. The terrain is generally moderately well drained to imperfectly drained. Till ranges from a veneer less than 1 m thick to a blanket up to 3 m thick and is anticipated to be comprised of unsorted sandy silt-clay mixtures with some gravel, with cobbles and boulders disseminated throughout (Duk-Rodkin, A. and Hughes, O.L. 1992). Permafrost is anticipated to be ice-rich. Retrogressive thaw flow landslides developed in the morainal soils were observed further northwest in the Travaillant River valley (discussed in the next section). The plain is vegetated by a mixed spruce-birch forest with brush of dwarf birch and alder. Small stream valleys are densely vegetated with high shrubs (willow and alder) and\or moderately dense stands of spruce.
1441.0	1444.3	**Travaillant River.** The Travaillant River is another major stream crossing on the Highway. The meandering channel of the Travaillant River occupies a sinuous valley incised about 70 m below the surrounding undulating moraine plain. The open forest is dominated by spruce with willow and dwarf birch. **West-facing Slope.** The gentle gradient west-facing valley slope is moderately well drained to imperfectly drained. There are several retrogressive thaw flow landslides on the gentle gradient valley slopes north of the Highway crossing. Unstratified silty clay and massive ground ice were observed previously in the headwall of one of the nearby thaw flow landslides. **Floodplain.** The flat to very gently sloping floodplain of the Travaillant River is approximately 80 m wide at the Highway crossing site. The floodplain is composed of fluvial silty sands, overlying fine-textured ice-rich till. The floodplain is moderately well to imperfectly drained covered with organic soils. **East-facing Slope.** The gentle gradient (4% to 10% along the Highway) east-facing slope is anticipated to be comprised of unstratified silt with some clay and gravel, and with cobbles and boulders disseminated throughout. Permafrost is anticipated to be ice rich since massive ground ice was previously observed in the headwalls of several retrogressive thaw flow landslides located upriver from the Highway crossing. There was evidence of slow mass movement on the slope, such as scattered small tension cracks oriented sub-parallel to the river channel.
1444.3	1489.3	North of the Travaillant River crossing, the Highway climbs back onto the undulating to rolling moraine plain, locally with broad hummocks or low hills with 10 m to 20 m of relief. Elevation (topographic relief) along the Highway changes from 200 masl to 280 masl. On average, the slope gradient is less than 4%. The terrain is generally moderately well drained to imperfectly drained. Morainal soils are anticipated to be comprised of unsorted sandy silt-clay mixtures with some gravel, cobbles and boulders. In this section, there are short, isolated patches of well-drained glaciofluvial deposits comprising kames, short ridges and fragments of kame terraces, and a number of shallow drainage channels, most of which were dry at the end of June 2010. These low-lying areas typically have an ice-rich organic cover (from <1 m to 3 m thick) over recent fluvial deposits (predominantly silt and clay, locally with fine sand). The permafrost is anticipated to be ice-rich. Small, oval-shaped lakes, likely of thermokarst origin, and ice-wedge polygons in the muskeg terrain were observed from the air in nearby areas. The moraine plain is densely to sparsely-vegetated with spruce, high brush alder, dwarf birch, and willow. Glaciofluvial landforms (kames, kame terraces, etc.) are covered with moderately dense to sparse white spruce with scattered patches of low brush dwarf birch with ground surface covered with lichens. Small stream valleys are densely vegetated with high shrubs (willow and alder) and/or moderately dense stands of spruce. Low-lying areas are occupied by bogs and fens.

Table 10.2.1-1: Terrain Conditions Along Preferred Alignment

Kilometre		Description of Terrain Conditions
1489.3	1489.4	The Highway crosses a stream with a well-defined 6 m to 8 m wide channel incised into the flat to gently sloping moraine plain. Gentle gradient slopes of the valley are composed of fine-grained fluvial deposits (silt and clay with fine sand) underlain by clayey till. The permafrost is anticipated to be ice-rich, although no open soil exposures or indications of rapid mass movement processes were observed during the 2010 field program of the stream crossing or upstream/downstream from this location. The stream valley is densely vegetated with high shrubs (predominantly willow and alder) with scattered isolated spruce.
1489.4	1493.8	The Highway continues northwest across the flat to gently undulating moraine plain. Elevation (topographic relief) along the Highway changes from 180 masl (km 1489.4) to 160 masl (km 1493.8). On average, slope gradients are less than 3%. The plain is generally moderately well drained to imperfectly drained. There are extensive areas of poorly-drained muskeg terrain. Morainal soils (till) are anticipated to be comprised of unsorted sandy silt-clay mixtures with some gravel, cobbles, and boulders. The plain is vegetated with a sparse black spruce forest, often "drunken forest" indicative of ice-rich condition of the underlying permafrost, with low brush of dwarf birch, Labrador tea, etc., and surface covered with organic soils (peat, moss, and lichen).
1493.8	1494.0	The Highway crosses a stream with well-defined 4 m to 5 m wide channel incised into the flat to gently sloping moraine plain. The sideslopes are gently sloping towards the peat-covered valley floor. Slopes of the valley are composed of fine-grained fluvial deposits (silt and clay with fine sand) underlain by clayey till. The permafrost is anticipated to be ice-rich, although no open soil exposures or indications of rapid mass movement processes were observed from the air at the stream crossing or upstream/downstream from this location. The stream valley is densely vegetated with high shrubs (predominantly willow and alder) with scattered black spruce and isolated sparse to moderately dense stands of black spruce.
1494.0	1509.2	The northernmost section of the Highway crosses an area of flat to gently undulating moraine plain that appears moderately well-drained to imperfectly-drained. Elevation (topographic relief) along the Highway changes from 160 masl (km 1494) to 12 masl (km 1509.2). On average, slope gradients are less than 3%. Drainage is fair to poor and numerous poorly defined cross-drainage rills are evident. Morainal soils (till) are typically unsorted, fine grained (silts and clays) with some sand and minor gravel, cobbles, and boulders. Ice-rich permafrost is expected throughout the area. Small lakes, ponds, and small oval-shaped dry depressions, i.e., thermokarst terrain features indicative of ice-rich conditions, were observed locally from the air. The plain is vegetated with predominantly sparse spruce forest, often "drunken forest" indicative of ice-rich condition of the underlying permafrost, with low brush of dwarf birch, Labrador tea, etc., and surface covered with organic soils (peat, moss, and lichen). Locally, the vegetation cover is moderately dense on higher ground (white spruce) but remains sparse (black spruce) in lower, wetter areas. Extensive areas of muskeg terrain with characteristic bog and fen vegetation species and isolated black spruce trees were observed from the air. At km 1504, the Highway turns westward across the moraine plain to a junction with the Dempster Highway at km 1509.2, approximately 21 km southeast of Inuvik.

10.2.2 General Topography

The Highway is located within the Anderson Plain North subdivision of the Anderson Plain Division of the Interior Plains Region. The Anderson Plain is predominantly an upland area with topography that is generally 300 masl. Relief along the Highway varies from flat to gently undulating glaciolacustrine plain in the south to undulating and rolling moraine plain further north.

Along most of the Highway, the surface elevation descends from about 60 m at approximately km 1329 to 12 m at km 1509.2 (the Dempster Highway Junction), near Inuvik. Local relief is typically in the 15 m to 40 m range, except at three areas. From the Sahtu Settlement Area border (km 1328) to near the Thunder River, the elevation along the Highway changes from 60 m (km 1329) to 216 m (km 1347) to 170 m (east bank of the Thunder River valley). At the Thunder River crossing, there is a 90 m deep valley in an approximately 2.3 km section. At the Travaillant River, there is a 70 m deep valley in an approximately 2.0 km section.

10.2.3 Permafrost

Permafrost is ground (soil or rock) that remains at or below 0°C for at least two years (NRCC 1988). Permafrost is defined as a ground thermal condition without consideration of the presence of ground ice. However, it is the amount of ground ice in the frozen ground that determines its physical-mechanical properties and the resulting stability of the foundation soils.

Ground ice refers to all types of ice formed in permafrost. It occurs in two main forms: as structure-forming ice bonding the enclosing sediments, and as large bodies of more or less pure ice known as massive ground ice. Massive ground ice is a comprehensive term that includes ice wedges, pingo cores, buried ice, and predominantly horizontal beds of segregated ice known as massive ice(y) beds. The distinction between these two groups of ground ice, i.e., structure-forming ice and bodies of massive ground ice, is important for the highway design and construction purposes.

According to the Permafrost Map of Canada (NRC 1995), the Highway is located within the continuous permafrost zone characterized by high (>20%) ground ice content (percent by volume of visible ice). This has been confirmed by several previous studies for the MGP, and during the 2010 field program. Numerous retrogressive thaw flow landslides indicative of the ice-rich permafrost were observed from the air and on the ground along lakeshores near the Highway, especially in the central and southern portions of the route, and in the Travaillant River and the Thunder River valleys. Exposed massive ground ice was encountered in shallow testpits and observed in the headwalls of the retrogressive thaw flows in the Travaillant River and Thunder River valleys in September 2006 (EBA 2007).

10.2.4 Geohazards

Geohazards are natural, existing or potential, geomorphic and geologic processes and formations that could lead to damage to engineering structures. Geohazards identified along the Highway during the 2010 field program are all classified as permafrost-related because they occur in a permafrost-dominated terrain. These permafrost-related geohazards include the near-surface occurrence of ice-rich ground or massive ground ice bodies, as indicated by thermokarst and thermal erosion features, retrogressive thaw flow landslides, and ice-rich, thaw-sensitive peatland (muskeg) terrain.

10.2.5 Massive Ground Ice

Some features indicating massive ground ice deposits are readily identifiable on air photos and from the air, such as ice wedges, which were interpreted by the presence of a prominent polygonal pattern on the ground surface. Other types of the massive ground ice, such as massive ice beds, are not directly revealed by the present-day surface features. Their occurrence is suggested by indirect geomorphic indicators developed where massive ice has been disturbed naturally, such as thaw flow landslides, oval-shaped depressions, and thermokarst lakes. Some observations of prominent polygonal patterned ground were made in the 2010 field program.

10.2.5.1 Retrogressive Thaw Flows

According to J.M. Aylsworth et al. (2000), landslides in permafrost terrain are characterized by two distinct classes: flows and slides based on mechanism of failure and their morphology. Several different types of landslides make up each of these two major classes. Flows can be further subdivided into shallow active layer detachments (or skin flows), deeper retrogressive thaw flows, and rapid debris flows. Slides are also subdivided into rotational slides and translational slides.

Along the Highway, the most common type of landslide is "retrogressive thaw flows". These were observed in several locations close to the Highway, mostly in central and southern portions of the GSA. Thaw flows are indicative of ice-rich permafrost terrain and are often associated with thawing of massive ground ice bodies. They have a characteristic bowl shape and a bimodal profile with a steep headwall and a low-angle tongue. The headwall gradually erodes upslope as massive ground ice or icy sediment thaws in the scarp, and the resulting water-saturated sediment flows downslope away from the scarp (Aylsworth 2000).

10.2.5.2 Peatland (Muskeg) Terrain

Peatland is any wetland terrain with a surficial layer of peat that is greater than 0.4 m in thickness (Mollard and Janes 1984). Along the Highway, organic deposits, which comprise peatlands, are commonly found in the low-lying areas within the undulating glaciolacustrine or moraine plain, and as a cover over recent alluvial deposits at the floor of drainage paths and river valleys.

Although there are many classes of the peatland, two major classes, bog and fen, are found along the Highway. Each of these two major classes has distinctive vegetation assemblages (bogs consist of *Sphagnum* and dwarf shrubs with a few stunted trees, whereas fens are dominated by grassy species, shrubs, and scattered trees), morphologies, water regimes, and thermal conditions, with soils and organic deposits underlying bog area being typically frozen (and ice-rich) and with soils underlying fen deposits being typically unfrozen. Along the Highway, bogs dominate the peatland (muskeg) terrain.

10.2.5.3 Thermokarst

The melting of discrete bodies of massive ground ice and thawing of ice-rich perennially frozen fine-grained soils result in conspicuous irregular surface relief comprising isolated depressions and mounds, known as thermokarst terrain. Such terrain indicates subsurface conditions that require additional design and construction care or terrain that should be avoided altogether. There are areas of thermokarst terrain that were observed in the 2010 field program in the vicinity of the Highway and alternatives.

10.2.5.4 Thermal Erosion

Thermal erosion is a dynamic process involving the wearing away of frozen ground by thermal means (the melting of ground-ice) often augmented by mechanical means (hydraulic transport). In the 2010 field program, it was found to be especially prevalent on the slopes composed of sandy deposits of glaciofluvial origin.

10.3 Vegetation

This section describes the vegetation communities and habitats that are present in the area. It identifies key sources of background information about the area and it describes the field activities undertaken for the Highway in 2010.

10.3.1 General

The Highway is located within the Taiga Plains Ecozone near Inuvik, Northwest Territories. An ecozone represents a large generalized unit at the top of the ecological hierarchy as defined by the Canada Committee on Ecological Land Classification, and is characterized by distinctive regional ecological factors, including climate, physiography, vegetation, soils, water, fauna, and land use (Ecosystem Classification Group 2007). The Taiga Plains Ecozone is dominated by Canada's largest river, the Mackenzie, and its tributaries. The Mackenzie Valley forms one of North America's most travelled migratory corridors for waterfowl (ducks, geese, and swans) breeding along the arctic coast.

The Highway is located within the Travaillant Upland High Subarctic ecoregion (Level IV) found within the larger Taiga Plains High Subarctic ecoregion (Level III) (Ecosystem Classification Group 2007). The vegetation community characteristic of this ecoregion is a white spruce forest with scrub birch, mountain cranberry, Labrador tea (both northern and common), red bearberry, lichens, and mosses (Ecosystem Classification Group 2007). In general, the composition of plant species remains similar throughout the ecoregion, but the tree density and heights vary in response to local conditions (Ecosystem Classification Group 2007).

In the southernmost third of the ecoregion, closed canopy white spruce forests with Alaska paper birch commonly occur on upland landscapes. Regenerating scrub birch stands have replaced the forest cover following fires in the late 1980s and 1990s (Ecosystem Classification Group 2007; Seccombe-Hett and Walker-Larsen 2004). Northward, spruce forest canopies open and trees become shorter on uplands, and polygonal peat plateaus with an accumulation of organic deposits are common in the lowlands (Ecosystem Classification Group 2007). The northernmost third of the ecoregion is characterized by increasingly open canopied, short, spruce woodlands with shrubs and sedge tundra (Ecosystem Classification Group 2007).

The Highway shares a common Transportation Corridor with the MGP; running parallel in places, varying by kilometres in others, and crossing in a number of locations. The MGP EIS (IOL et al. 2004) has been a key source of information in pre-field planning for the 2010 field program and in the preparation of this PDR. The vegetation assessment approach for this PDR focused on ground-truthing available 'high-level' information, establishing links to the MGP information, and assessing gaps in the existing data which can be filled in later stages in the development of the Highway.

10.3.2 Vegetation Communities

The 2010 field program was completed along the Highway and alternative routes from June 27 2010 to June 30, 2010. In general, the northern portion of the Highway is dominated by level topography characterized by open black spruce and shrub meadows. The southern portion of the Highway is characterized by rolling topography with upland open black spruce, mixed, upland tall, and regenerating forests.

Nine broad vegetation communities were observed along the Highway and alternatives in the 2010 field program, including:

- shrub meadow;
- open black spruce;
- riparian shrub;
- upland mixed forest;
- upland tall spruce;
- regenerating forests;
- palsa bog;
- graminoid fen; and
- emergent.

These broad vegetation communities encompass the community types described by the MGP EIS. Many of the vegetation communities within the Travaillant Upland High Subarctic ecoregion we described in the MGP using satellite imagery and detailed ground surveys (IOL et al. 2004). This link between the 2010 field observations and the community types described by the MGP EIS demonstrates that the information in the MGP EIS is applicable to the Highway where the areas that have been studied for the MGP overlap with the location of the Highway.

The MGP divides this ecoregion into a Transitional Forest Ecological Zone and a North Taiga Plains Ecological Zone. The Transitional Forest corresponds roughly to the northern third of the Highway and the North Taiga Plains corresponds to the remaining two thirds of the Highway. The MGP EIS describes the following vegetation communities along the MGP:

- Transitional forest vegetation communities (northern third of the Highway):
  - white spruce/ground birch;
  - upland Alaska birch-spruce;
  - riparian willow;
  - black spruce/ground birch;
  - upland black spruce-lichen;

  - black spruce-northern labrador tea-lichen bog;
  - graminoid wetland;
  - ground birch/leatherleaf wetland;
  - upland shrub;
  - cotton-grass tussock;
  - riparian sedge-cotton-grass.
- North taiga plains vegetation communities (southern two thirds of the Highway):
  - common juniper/common bearberry;
  - white spruce/stair-step moss;.
  - white spruce-black spruce/shrubby cinquefoil;.
  - upland white spruce-Alaska birch;
  - regenerating upland white spruce-Alaska birch;
  - riparian willow;
  - riparian willow-grey alder;
  - black spruce-tamarack;
  - black spruce-labrador tea/mountain cranberry;
  - regenerating black spruce-labrador tea/mountain cranberry;
  - black spruce/cloudberry-lichen;
  - bog rosemary/cotton-grass/peat moss;
  - graminoid wetland;
  - ground birch/water-sedge wetland.

What follows is a description of each of the nine broad vegetation communities observed along the Highway during the 2010 field program. Each section is accompanied by commentary about linkages with MGP vegetation communities.

10.3.2.1 Shrub Meadow

Shrub meadow communities are common in the northern portion of the Highway. This community type exists interspersed with open black spruce stands in level to depressional topography. Shrubs, such as willow (*Salix* species) and scrub birch (*Betula glandulosa*) dominate the community, and isolated black spruce form a particularly open canopy (Photograph 10.3.2.1-1). In the ground cover layer, Labrador tea (*Ledum* species), bog bilberry (*Vaccinium uliginosum)*, mosses, and lichens are present. The shrub meadow community documented during the 2010 field program is similar to the Upland Shrub community type described within the MGP EIS (IOL et al. 2004).

Photograph 10.3.2.1-1
This Shrub Meadow community is common in the northern portion of the Highway.

10.3.2.2 Open Black Spruce

Open black spruce communities are the most common vegetation community throughout the Highway (Photograph 10.3.2.2-1). The canopy cover, dominated by black spruce and some tamarack, ranges from approximately 5% to 20%. Understory vegetation includes black spruce, Labrador tea, willow, scrub birch, bog bilberry, and variable cover of mosses and lichens. The ground cover in the northern portion of the Highway was observed to be dominated by lichen; whereas, moss dominates the southern portion of the Highway. This broad community type is similar to the Black Spruce/Ground Birch, Black Spruce-Tamarack, Upland Black Spruce/Lichen, and Black Spruce-Labrador Tea/Mountain Cranberry communities described in the MGP EIS (IOL et al. 2004).

Photograph 10.3.2.2-1
The northern portion of the Highway is dominated by Open Black Spruce communities dominated by lichen ground cover.

10.3.2.3 Riparian Shrub

Most of the small drainage channels throughout the length of the Highway include a riparian shrub community along the water's edge (Photograph 10.3.2.3-1). These small drainage channels were observed to have low to negligible valleys, but include a shrub dominated community of varying widths. These riparian shrub communities are dominated by willow, scrub birch, alder (*Alnus* species), and sedges (*Carex* species). The Riparian Shrub broad vegetation community type is similar to the the Riparian Willow community described in the MGP EIS.

Photograph 10.3.2.3-1
Riparian shrub communities are present along the majority of the small drainage channels that cross the Highway.

10.3.2.4 Upland Mixed Forest

A forest mixed with white and black spruce and Alaska Birch occur on middle slopes to crest positions, including some potential borrow sources. This community includes an open canopy of spruce and birch trees. The understory is dominated by Alaska Birch, willow, alder, and Labrador tea, moss, and lichens. This Upland Mixed Forest broad community type is similar to the Upland Alaska Birch-Spruce and Upland White Spruce-Alaska Birch communities described in the MGP EIS.

Photograph 10.3.2.4-1
This Upland Mixed Forest community type occurs primarily in the central and southern portions of the Highway.

10.3.2.5 Upland Tall Spruce

Tall stands of white and black spruce communities occur on upper slopes and crests of isolated moraine deposits. Some Alaska Birch occurs in this community; however, its cover is typically less than 1%. Willow, alder, and shrubby cinquefoil (*Dasiphora fruticosa)* are present in the understory, as well as a minor component of lichen, moss, and grass. The Upland Tall Spruce broad community type is similar to the White Spruce-Black Spruce/Shrubby Cinquefoil community described in the MGP EIS.

Photograph 10.3.2.5-1
Upland Tall Spruce communities occur as isolated pockets on moraine deposits.

10.3.2.6 Regenerating Forests

Forest fires, approximately 10 and 20 years earlier, have affected a large portion of the area in the vicinity of the Highway, from the south end of the Khaii luk, Nagwichoonjik, Dachan choo gehnjik (Travaillant Lake, Mackenzie River, Tree River) Conservation Zone to the most southerly reaches of the Highway (Seccombe-Hett and Walker-Larsen 2004). Deciduous trees (paper birch species) and shrubs (willow and alder), white and black spruce, fireweed, and grass are regenerating these areas. Small isolated patches of un-burnt upland mixed, tall spruce forests, and lowland riparian shrub communities remain.

Photograph 10.3.2.6-1
The majority of the southern portion of the Highway has been affected by forest fires.

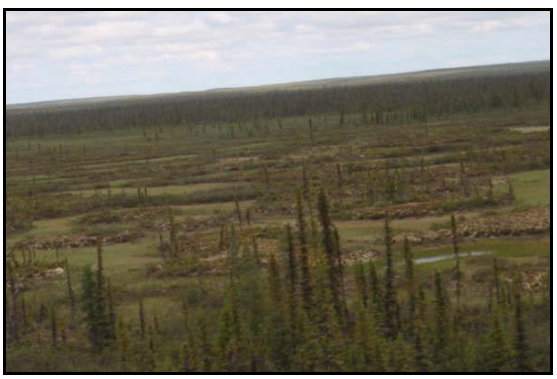
10.3.2.7 Palsa Bog

Isolated palsa bog communities are found in the northern half of the Highway. This community occurs in depressions or level landscapes, including adjacent to lakes. The vegetation cover is dominated by lichens and sphagnum mosses; however, a few black spruce and Labrador tea were observed to be present. The Palsa Bog broad community type is similar to the Black Spruce-Northern Labrador Tea/Lichen Bog community described in the MGP EIS.

Photograph 10.3.2.7-1
Palsa bog communities occur in isolated pockets primarily in the northern portion of the Highway.

10.3.2.8 Graminoid Fen

Graminoid Fens are frequently associated with palsa bogs and open water in the northern half of the Highway. This community type is found on depressional or level topography and is dominated by sedges. A minor component of shrubs including scrub birch, willow, and sweet gale may be present. This Graminoid Fen broad community type is similar to the Graminoid Wetland community described in the MGP EIS.



Photograph 10.3.2.8-1
Graminoid Fens associated with Palsa Bog communities.

10.3.2.9 Emergent

Emergent vegetation communities exist along shallow shorelines of lakes and ponds along the Highway. Emergent vegetation, dominated by sedges, forms a continuous to discontinuous cover of vegetation along lake margins. The Emergent broad community type is similar to the Water Emergent community mapped, but not described in the MGP EIS.

Photograph 10.3.2.9-1
Emergent vegetation communities are present along shallow lake margins primarily in the central and southern portions of the Highway.

10.3.3 Rare Plants

Rare plant surveys were conducted for the MGP in 2002 and 2003. Within the GSA, a total of two rare plants were documented near Caribou Lake (IOL et al. 2004). These are the weak sedge (*Carex laxa*) and circumpolar sedge (*Carex adelostoma*). Both listed rare species, ranked as "Critically Imperiled" in the Northwest Territories, were found in a patterned fen(s) (IOL et al. 2004). Specific geo-referencing of the location of the rare plant observations is not available in the MGP information, but the locations correspond approximately to km 1466.80 and km 1484.00 of the Highway. At km 1466.80, the Highway is approximately 400 m from the MGP and at km 1484.00, the Highway is approximately 600 m from the MGP on the opposite side of a small lake. It is unlikely that these rare plant locations will be impacted by the Highway.

10.4 Wildlife

10.4.1 General

The distribution and abundance of wildlife tends to vary with season, life history stage, habitat availability, prey abundance, and hunting and trapping pressures. A list of wildlife species occurring or potentially occurring along the Highway study area are presented in Appendix E.

A total of 32 species of mammals, 123 birds, and 1 amphibian occur or potentially occur within the study area (Appendix E) (Cornell Lab of Ornithology and the American Ornithologists' Union 2010; Sibley 2003; Banfield 1977). Of these, eight species are designated a special conservation status by the Canada Species at Risk Act (SARA), Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and or the Territorial general status program (Table 10.4.1-1) (COSEWIC 2010; ENR 2010a; Government of Canada 2010). For purposes of this report, a species with special conservation status is one that is listed by SARA and/or assessed by COSEWIC as Endangered, Threatened, and Special Concern, and ranked by ENR as At Risk and May Be At Risk.

Table 10.4.1-1: Wildlife Species with Special Conservation Status[1]

Common Name	Scientific Name	Conservation Status		
		NWT	SARA	COSEWIC
Horned Grebe	*Podiceps auritus*	Secure	No Status	Special Concern
Peregrine Falcon	*Falco peregrinus anatum/tundrius*	Sensitive	No Status	Special Concern
Short-eared Owl	*Asio flammeus*	Sensitive	Special Concern (Schedule 3)	Special Concern
Gray-headed Chickadee	*Poecile cincta*	May Be At Risk	No Status	Not Assessed
Rusty Blackbird	*Euphagus carolinus*	May Be At Risk	Special Concern (Schedule 1)	Special Concern
Grizzly Bear	*Ursus arctos*	Sensitive	Not Assessed	Special Concern
Wolverine	*Gulo gulo*	Sensitive	No Status	Special Concern
Woodland Caribou (Boreal)	*Rangifer tarandus caribou*	Sensitive	Threatened (Schedule 1)	Threatened
Barren-ground Caribou	*Rangifer tarandus groenlandicus*	Sensitive	No Status	Special Concern

[1] Species ranked as Sensitive in the NWT are not listed (refer to Appendix E).

Species considered important to area residents, those with special conservation status, or those that commonly use habitats associated with the study area are described in further detail.

Wildlife data collected for the MGP is the most current, publicly available information specific to the study area. The following wildlife surveys were conducted (2002 and 2003 surveys) within the study area for the MGP:

- winter track surveys (March to April) primarily assessing marten, snowshoe hare, lynx, and wolverine;
- aerial ungulate surveys (April and June) primarily assessing moose, barren-ground caribou, and woodland caribou;
- pellet group surveys (June and July) primarily assessing moose, caribou, and snowshoe hare; and
- aerial and ground based bird surveys (June).

10.4.2 Barren-Ground Caribou

Barren-ground caribou (*Rangifer tarandus groenlandicus)* are ranked by ENR as "Sensitive" under the general status program, but are not listed under SARA.

In 2006, ENR estimated the Bluenose-West herds' population at 18,050 (±527) non-calf caribou, and 1,821 (±149) non-calf caribou in the Cape Bathurst herd (Nagy and Johnson 2006). The 2009 population estimates for these herds are unavailable at the time of publication.

Both the Cape Bathurst and the Bluenose-West barren-ground caribou herds may occupy the areas along the Highway during winter months (November to May). Based on satellite collared caribou data from both herds, the northern portion of the Highway is infrequently used by the Cape Bathurst herd in the winter (Nagy et al. 2005); whereas Nagy et al. (2005) reported low to moderate frequency of winter use the Bluenose-West herd.

Both herds are known to calve and spend the summer and fall along the coast on tundra habitats outside the GSA. However, by November, the herds begin migrating south to their winter ranges within the Gwich'in and Sahtu Settlement Areas, and may be stay there until spring migration (November till May). Occupied winter ranges are known to vary annually in response to food availability, snow depth, and predator abundance.

Winter is a critical period for caribou populations. Caribou dig craters in the snow and graze on the exposed vegetation, principally ground lichens. Habitats that provide winter foraging habitat include open, mature, spruce forests with an abundance of lichen, and areas with low snow depths. Lichens are an important food for caribou all year, but especially during the winter. Sedges and evergreen leaves are also eaten during the winter (ENR 2010b). During times with low snowfall, caribou will also feed in richer valleys and low-lying lakeshores and wetlands. Carruthers et al. (1986) reported over-wintering Bluenose caribou use open coniferous habitats in proportion to the habitat available in the landscape; whereas all other habitat types, particularly fire regenerating habitats, are used less than their occurrence.

Caribou seek security from predators and travel in open habitats, such as frozen lakes, where wind action has hardened the snow and predators are easily visible (Carruthers et al. 1986). Carruthers et al. (1986) reported Bluenose caribou use lakes and open wetlands four times more often than their availability on the landscape. Cow caribou reportedly favour landscapes with a high density of smaller lakes (Carruthers et al. 1986).

As indicated in the draft 2010 Gwich'in Land Use Plan, the Bluenose-West caribou herd over-winters in the Khaii luk, Nagwichoonjik, Dachan choo gehnjik (Travaillant Lake, Mackenzie River, Tree River) Conservation Zone. This area is consequently an important caribou harvesting area for the Gwich'in (GLUPB 2010).

Habitat suitability modeling results prepared for the MGP indicate 13% of the Transition Forest Ecological Zone within a 40 km of the pipeline corridor provides effective over-wintering habitat (IOL et al. 2004). Habitat modeling for the North Taiga Forest Ecological Zone was not completed for the MGP, so this is a gap in the information that will need to be filled in the next detailed investigation stages of the Highway development.

Aerial ungulate, track, and pellet count surveys were conducted in the GSA in 2002 and 2003 for the MGP (IOL et al. 2004). Barren-ground and woodland caribou data were reported collectively since they have similar appearances and their tracks and pellets are indistinguishable in the field. No caribou (either barren-ground or woodland caribou) were observed in the area described as the Transition Forest Ecological Zone (approximately the northern third of the Highway). However, 11 caribou were observed within the GSA along the MGP south of the Transitional Forest zone (0.16 caribou/km^2 calculated density) (IOL et al. 2004). In addition, 93 caribou were observed in the Travaillant Lake area (0.54 caribou/km^2 calculated density) (IOL et al. 2004). Based on the track and pellet count survey data, the highest density of caribou tracks/pellets were reported in black spruce coniferous forests; however, tracks/pellets were also documented in riparian shrub, mixed wood forests, and burned areas (IOL et al. 2004).

During the 2010 field program, two antler sheds were recorded. Antlers were not identified to species.

10.4.3 Woodland Caribou, Boreal Population

Woodland caribou (*Rangifer tarandus caribou)* boreal population (herein referred to as boreal caribou) are listed by SARA as "Threatened". By definition, this is a species likely to become endangered if limiting factors are not reversed. In the Northwest Territories, boreal caribou are ranked by ENR as "Sensitive" under the general status program. In the Northwest Territories, the boreal caribou population is estimated to be between 6,000 to 7,000 animals (ENR 2010a). The population size specifically within the GSA is estimated at 500 animals, and the population is reportedly increasing (Environment Canada 2008). The current range conditions are described as sufficient to support a self-sustaining population given the existing disturbance level (largely fire influenced disturbances) (Environment Canada 2008).

Although boreal caribou may occur year round in the area surrounding the Highway, they were not observed at the time of the 2010 field program.

Boreal caribou may occur in all forested habitats along the Highway; however, they prefer mature or old growth coniferous forests (greater than 100 years old) associated with peatland complexes, lakes, and ponds that have abundant ground and tree lichens and few predators (ENR 2010b; Environment Canada 2008).

Cows widely disperse during the calving season (late May to mid-June) and are typically found in groups of one to two animals (Nagy et al. 2003; Environment Canada 2008). During calving season, cows favour treed islands surrounded by open water in peatlands, lakes, and ponds to minimize predation risks, even if these islands provide sub-optimal forage resources (Environment Canada 2008). High fidelity to these calving sites has been reported (Environment Canada 2008). Nagy et al. (2003) reported two collared cows calved in open black spruce and black spruce-paper birch dominated habitat types that consist of 20% to 30% crown closure, 10% to 15% shrub cover (dominated by willows and scrub birch), and moss and lichen groundcover.

In the summer, caribou feed on fresh green growth of flowering plants, sedges, grasses, lichens, and horsetail found in open coniferous forests with an abundance of lichens, low shrub, riparian, sparsely vegetated, and recently burned habitats (Nagy et al. 2003; Nagy et al. 2006). Their winter diet consists of up to 80% ground and tree lichens; however, the remaining diet is supplemented by evergreen shrubs, grasses, sedges, and other vascular plants (ENR 2010b). In winter, boreal caribou tend to favour open coniferous forests with an abundance of lichen, with only a minor selection of open mixed forests and riparian areas (Nagy et al. 2006).

Boreal caribou can be expected to use all available habitat types along the Highway at some time during the year. Traditional knowledge indicates the area around Travaillant Lake supports boreal caribou year-round (GLUPB 2010). The MGP's habitat suitability modeling indicated 54% of the North Taiga Plains Ecological Zone (includes the southern two thirds of the Highway) provides effective boreal caribou habitat (IOL et al. 2004). Habitat suitability modeling was not conducted for the Transition Forest Ecological Zone (the northern third of the Highway).

Based on land cover maps classified from satellite imagery, collaring data, and modeling, Nagy et al. (2006) reported a moderate to high probability of boreal caribou habitat use within the GSA. Broad scale maps of the GSA indicate there is a moderate to high probability of use during calving and post calving seasons north of Caribou Lake, near Travaillant Lake, and in isolated pockets along the southern portion of the Highway (Nagy et al*.* 2006). However, the majority of habitats with a moderate to high probability of use during calving and post calving season were farther west of the Highway along the Dempster Highway (Nagy et al. 2006). The remainder of the area is mapped as moderate to high probability of use by boreal caribou during summer, fall, and winter seasons (Nagy et al*.* 2006).

The MGP conducted aerial ungulate, track, and pellet count surveys. In these surveys, caribou or signs of caribou were not observed in the northern third of the Highway. However, caribou (either barren-ground and/or boreal caribou) density in the remaining southern portion of the Highway was reported at 0.16 caribou/km^2 (IOL et al. 2004). An additional aerial survey in the Travaillant Lake area reported a caribou density of 0.54 caribou/km^2 (IOL et al. 2004). Based on track and pellet count survey data, the highest density of caribou tracks/pellets were reported in black spruce coniferous forests; however, tracks/pellets were also documented in riparian shrub, mixed wood forests, and burned areas (IOL et al. 2004).

No caribou were observed during the 2010 field program; however, two antler sheds were recorded (antlers not identified to species).

10.4.4 Moose

Moose (*Alces alces)* do not have any special conservation status; however, they live near their northern-most range within the Highway region.

Moose are generally non-migratory and may occupy all habitats along the Highway throughout the year. Moose prefer semi-open early successional habitats with an abundance of browse (e.g., willow and alder) found on floodplains, riparian areas, lakeshores, regenerating burns (approximately 15 to 30 years following the fire), and disturbance areas. Preferred habitats, particularly during the fall and winter are those dominated by shrubs and deciduous trees; most conifer dominated habitats provide suboptimal moose feeding habitat. During the spring and summer when forbs, grasses, and aquatic plants are available, the use of browse material declines. The use of wet and aquatic habitats for food commonly occur during all non-winter months, but tend to peak during late June to early August when plant nutrition and digestibility and insect harassment are highest (Peek 1998).

Moose also seek forests or tall shrub stands to reduce detection from bears and wolves, their major predators. Shorelines and islands are also used to reduce predator encounters, particularly during calving (late May to early June) (Van Ballenberghe 1987; ENR 2010b).

MGP habitat suitability modeling results indicate 54% of the Transition Forest Ecological Zone (northern third of the Highway) provides effective moose habitat; whereas, 71% of the North Taiga Plains Ecological Zone (includes the southern two thirds of the Highway) provides effective moose habitat (IOL et al. 2004).

The draft Gwich'in Land Use Plan reports the Khaii luk, Nagwichoonjik, Dachan choo gehnjik (Travaillant Lake, Mackenzie River, Tree River) Conservation Zone is an important moose harvesting area (GLUPB 2010).

In 1996, Chetkiewicz et al. (1998) reported moose densities of 0.02 moose/km^2 in the Inuvik-Tsiigehtchic Region. In 2002 and 2003, 0.12 moose/km^2 was reported during aerial ungulate surveys along the MGP, and 0.03 moose/km^2 was reported in a survey block surrounding Thunder River (IOL et al. 2004). Further south, 0.03 moose/km^{2}was reported along the remaining MGP to the GSA southern boundary, and 0.08 moose/km^2 was reported in a survey block in the Travaillant Lake area (IOL et al. 2004). Moose tracks and pellets were observed (including incidental observations outside the survey) in many of the available habitat types, including riparian shrub, lowland spruce, the regenerating burn area, and in mixed wood forests (IOL et al. 2004).

A total of 13 moose, including 4 cow/calf pairs were observed along the Highway during the 2010 field program (Figure 10.4.4-1). In addition, three antler sheds and multiple trails were also documented.

10.4.5 Grizzly and Black Bears

Grizzly bears (*Ursus arctos)* (including barren-ground and northern interior populations) and black bears (*Ursus americanus)* occur in all habitat types along the Highway. Grizzly bears are assessed by COSEWIC as "Special Concern" (as of May 2002), but have no status under SARA. In the Northwest Territories, grizzly bears are ranked by ENR as "Sensitive" under the general status program. Black bears are assessed by COSEWIC as "Not At Risk", and ranked by ENR as "Secure".

An estimated 3,500 to 4,000 grizzly bears occur in the Northwest Territories, and approximately 420 over the age of two are estimated in the GSA (ENR 2010a; GRRB et al. 2000). Black bear densities at their northern limits are estimated at 10 bears/100 km^2 (ENR 2010a). There have been no formal attempts to estimate grizzly or black bear densities in the area.

Both bear species use similar habitat types and their distributions may overlap; however, black bear abundance is expected to diminish with an increase in grizzly bear presence and a decrease in forest cover. Bears require extensive home ranges with a variety of landforms and plant types to adequately provide food and cover.

Bears are omnivores and feed on a variety of plant material, small and large mammals and birds, fish, and insects. In the spring, bears gravitate towards areas with early-emerging vegetation, such as roadsides and wetlands, as well as areas with winter-killed wildlife. Moose and caribou calves are also preyed upon opportunistically during this time. In summer, insect activity peaks, and bears feed heavily on colonies of ants, bees, and wasps. By fall time, their diet shifts as berries become ripe and available. Forests regenerating from fires (at least 20 years prior) commonly provide bear summer and fall feeding habitat as berry producing plants regenerates and ants invade downed and burned trees (Laviviere 2001; Snyder 1991).

Grizzly and black bears typically begin denning in September with the first frosts and emerge from their dens in April (ENR 2010b). Bears typically dig dens in till material available on eskers, drumlins, stream banks, or in natural cavities. Appropriate denning habitat for both species occurs in patches throughout the Highway. In particular, drumlins and moraine landscape types along the Highway, especially from km 1,383 to km 1,400 may be used for denning. In addition, the Gwich'in Land Use Plan indicates the Khaii luk, Nagwichoonjik, Dachan choo gehnjik (Travaillant Lake, Mackenzie River, Tree River) Conservation Zone is an important area for bears (GLUPB 2010).

Habitat suitability modeling results prepared for the MGP (within a 40 km buffer along the pipeline), indicate the Transition Forest Ecological Zone (north of Travaillant Lake) provides 6% effective fall foraging habitat, 3% effective denning habitat, and 22% effective spring foraging habitat (IOL et al. 2004). In the North Taiga Plains Ecological Zone (south of Travaillant Lake), habitat modeling results indicate there is 66% effective fall foraging habitat, 21% denning habitat, and 72% effective spring foraging habitat within a 40 km buffer along the pipeline corridor (IOL et al. 2004). Field surveys specifically for grizzly bear distribution and abundance along the MGP was not completed. However, incidental grizzly bear signs were documented during the 2002 and 2003 surveys, most often in mixed wood forest, riparian and upland shrub, black spruce-tamarack/shrub, and sedge-peat moss community types in the North Taiga Plains Ecological Zone (IOL et al. 2004).

During the 2010 field program, two grizzly bears and one black bear were observed along the Highway (Figure 10.4.5-1). In addition, two bear dens were documented during the 2010 field program near km 1466 (Figure 10.4.5-1). Both dens are located in upland tall spruce habitats. One den is located near the Highway, while the second den is located approximately 1.2 km southwest of the Highway.

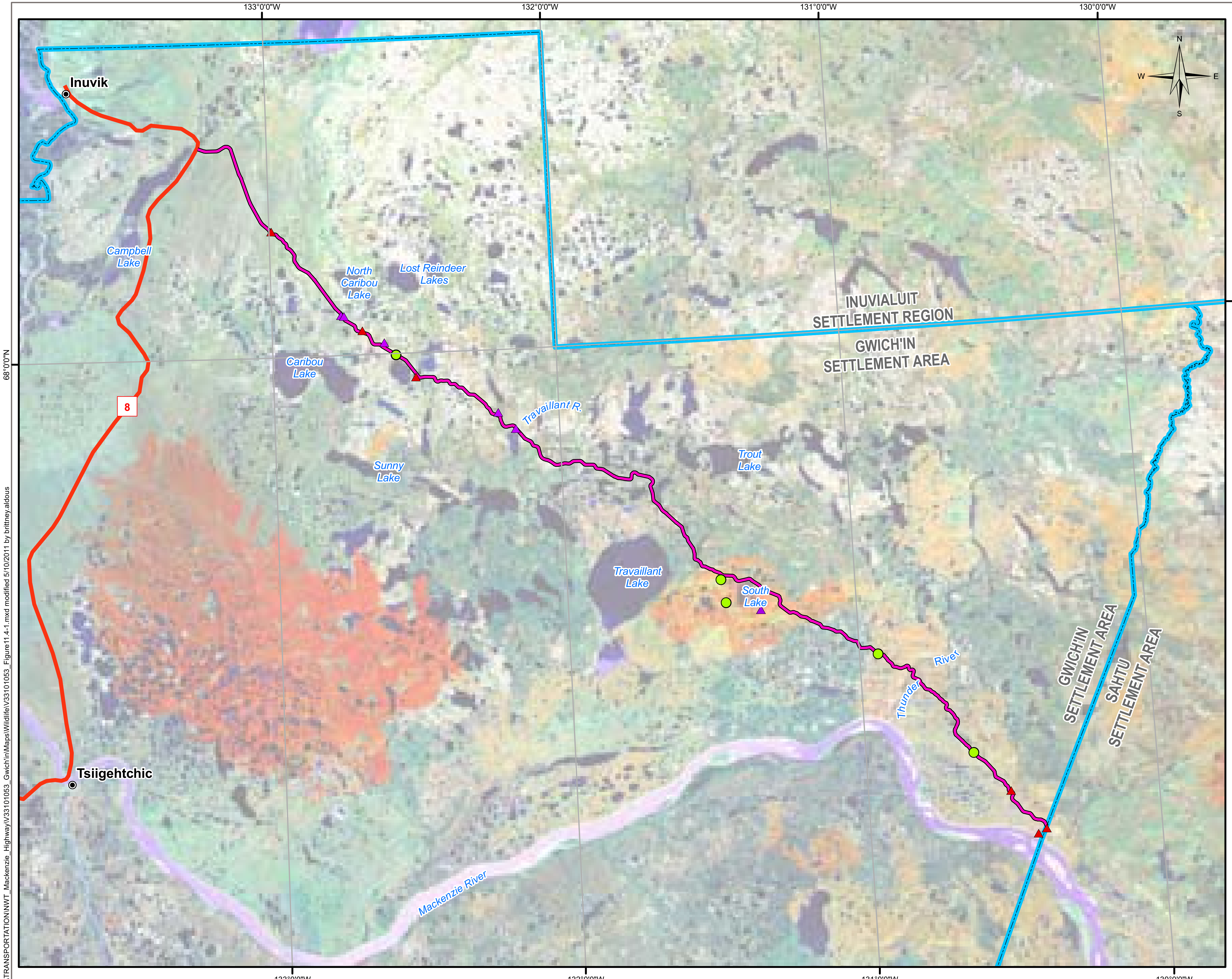
10.4.6 Wolf

The grey wolf (*Canis lupus)* is assessed by COSEWIC as "Not At Risk" (April 1999), and is ranked by ENR as "Secure" under the general status program. The density of wolves in the northern Northwest Territories is estimated at 1 wolf/944 km^2 (ENR 2010a). Wolf densities specific to the Highway are unknown; however, they have been shown to be are dependent on prey densities. Wolves are expected to occupy all habitat types available along the Highway.

Two different groups of grey wolves can be expected to occur in the vicinity of the Highway: migratory and resident. Migratory wolves (also known as tundra wolves) follow the barren-ground caribou herds and would occupy the study area in the winter if barren-ground caribou were present. The resident wolves (also known as timber or boreal wolves) remain below the tree line year round and depend on non-migratory prey such as moose and boreal caribou. Timber wolves maintain regular territories, which vary in size depending on prey densities. Tundra wolves do not maintain regular territories and travel extensively following the barren-ground caribou herds. Besides moose and caribou, wolf diets also include snowshoe hares, small rodents, beaver, muskrat, birds, fish, eggs, and even small quantities of grass and other vegetable matter (ENR 2010b).

Wolf dens are traditional and may be used over many years; however, some wolves may have several dens in the territory (ENR 2010b). Wolf dens are constructed in esker material, within a rock crevice, or along creek or riverbanks. Dens are commonly constructed near water or heights of land. The denning period typically begins in early May, and litters of are born inside the den in late May or early June (ENR 2010b).

A single wolf was observed along the Highway during the 2010 field program (Figure 10.4.5-1).



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LEGEND

- Moose, Sign
- Moose, Visual
- Caribou, Sign
- Communities
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- Settlement Area Boundary

NOTES

Base data source: ESRI Base Data
NTS 1:250,000
Alignment is considered preliminary and is subject to change

STATUS

ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Moose and Caribou Observations
June 27-30, 2010

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:550,000

10 5 0 10

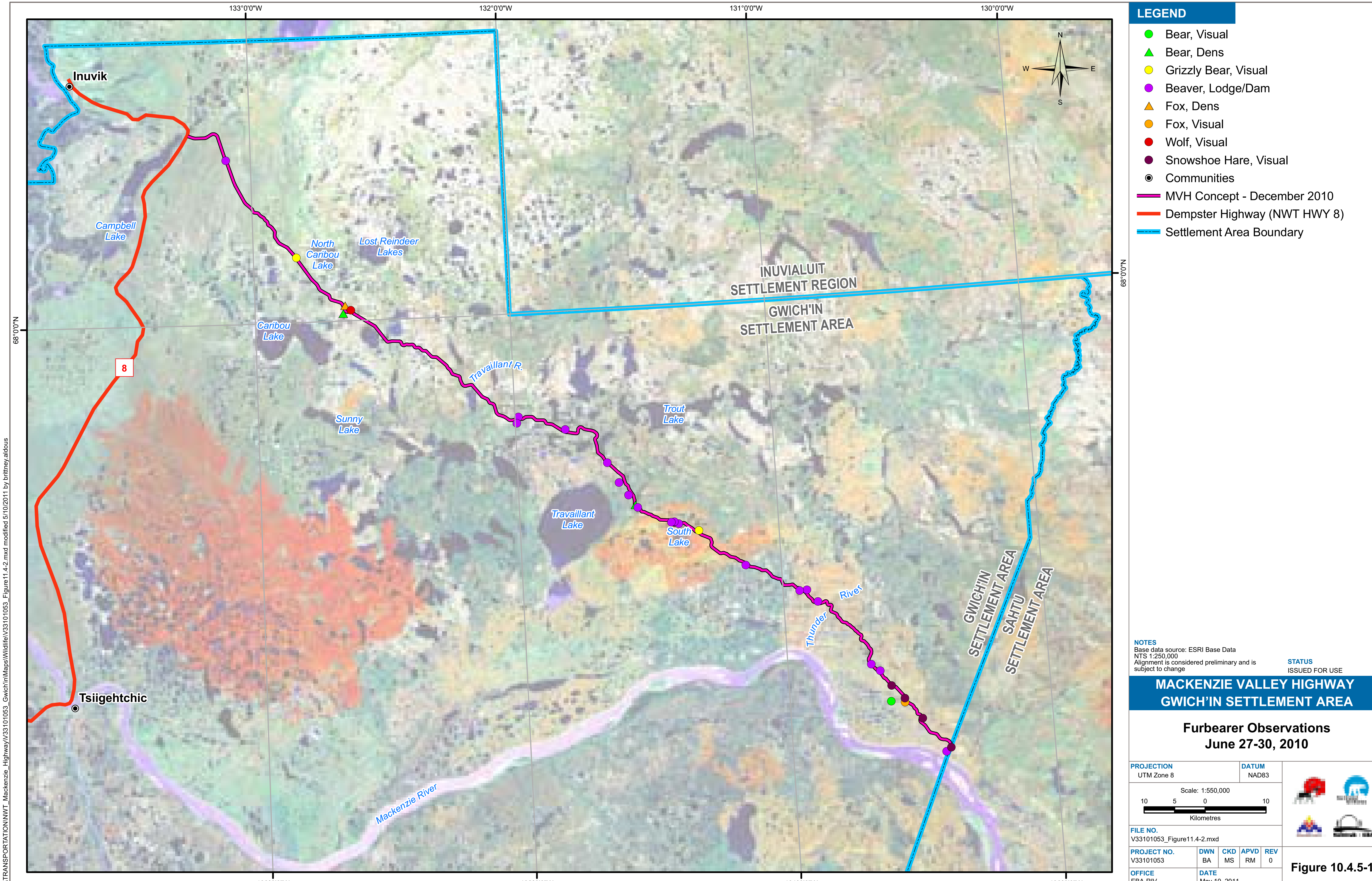
Kilometres

FILE NO.
V33101053_Figure11.4-1.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure 10.4.4-1



NOTES
Base data source: ESRI Base Data
NTS 1:250,000
Alignment is considered preliminary and is subject to change

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Furbearer Observations
June 27-30, 2010

PROJECTION	DATUM
UTM Zone 8	NAD83

FILE NO.
V33101053_Figure11.4-2.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE: EBA-RIV
DATE: May 10, 2011

Figure 10.4.5-1

10.4.7 Red Fox and Arctic Fox

The red fox (*Vulpes vulpes)* and the Arctic fox (*Vulpes lagopus)* are not assessed by COSEWIC, but are ranked by ENR as "Secure" under the general status program. Population estimates for both fox species in the Northwest Territories are unknown, but both populations are considered secure (ENR 2010a).

Both fox species occur in the vicinity of the Highway; however, Arctic fox abundance is anticipated to diminish with an increase in red fox densities and an increase in forest cover. Red foxes, which are larger, may displace Arctic foxes by usurping their dens and other limiting habitat resources (Bailey 1992; ENR 2010b). Both species numbers fluctuate in response to their primary food sources (ENR 2010b). Fox diets includes a variety of small mammals and birds including mice, voles, lemmings, muskrats, squirrels, snowshoe hares, grouse/ptarmigan and waterfowl, eggs, carrion, and plant materials.

Foxes require suitable substrate to establish their dens, and commonly re-use den sites in consecutive years. Fox dens are commonly found on eskers, riverbanks, and other areas with glaciofluvial materials. Arctic fox pups are born in the den between mid-May and mid-June; whereas, red fox pups are born between March and May (ENR 2010b). Family groups focus much of their activity around dens until midsummer, and juvenile foxes disperse in the fall or winter.

One red fox was observed within the proposed Highway area during the 2010 field program. In addition, a fox den consisting of at least two entrances was observed in upland tall spruce habitat. This den is located near the Highway (Figure 10.4.5-1).

10.4.8 Wolverine

Wolverines (*Gulo gulo*) are assessed by COSEWIC as "Special Concern" and by ENR as "Sensitive" under the general status program; however, they have not been listed by SARA. Population numbers for the Northwest Territories are unknown; however, estimates suggest the population is stable (ENR 2010a).

Wolverines live at low densities even under optimal conditions (Banci 1994). They are opportunistic hunters and travel extensively in search of food. Their diet includes carrion, moose and caribou, small mammals, birds, fish, beaver, and berries (Banci 1994; ENR 2010b; Pasitschniak-Arts and Lariviere 1995). Wolverines occupy multiple habitats types provided sufficient food resources are present.

Although active year round, wolverines will construct snow dens to escape predators, cache food, and raise their young. Kits (young) are born in February or March in a shallow pit dug in the ground within a constructed snow den (Banci 1994). In addition, natal dens have been documented in abandoned beaver lodges and bear dens, in upturned roots and fallen logs, or rocks crevices (Banci 1994).

No wolverines were documented during the 2010 field program.

10.4.9 American Marten

The American Marten (*Martes americana)* is not assessed by COSEWIC, but is ranked by ENR as "Secure" under the general status program. Although population densities are unknown across the Northwest Territories, martens occur at 0.5 animals/km^2 in the southern Northwest Territories with smaller densities further north (ENR 2010a).

The Highway is located at the northernmost limit of the martens' known range (ENR 2010b). Marten prefer mature spruce forests, particularly those with a complex understory structure and 30% to 50% crown closure (Clark et al. 1987), but will also use other forest types including sparse open forests, riparian areas, and forest edges if sufficient prey and cover exist (Clark et al. 1987; ENR 2010b). Large burned areas typically provide little habitat for martens for approximately 15 years, unless a complex of unburned patches and significant deadfall remain as cover (Clark et al. 1987; Winbourne 2004; ENR 2010b).

They are opportunistic foragers, and will feed on voles, mice, snowshoe hare, squirrels, birds, eggs, insects, berries, and carrion (ENR 2010b; Buskirk and Ruggiero 1994).

In March or April, litters are born in dens located in rock piles, tree roots, deadfall, peat banks, usually in mature forests (ENR 2010b). These dens, as well as red squirrel middens may also be used in the winter during inclement weather (Clark et al. 1987).

No martens were documented during the 2010 field program.

Habitat suitability modeling results within a 40 km buffer along the MGP indicates there is 57% and 74% effective marten habitat in the Transition Forest and the North Taiga Plains ecological zones, respectively (IOL et al. 2004). Winter track surveys conducted in 2002 and 2003 for the MGP indicated marten were common throughout the area, particularly in the black spruce-tamarack/shrub, medium shrub, treed bog, sedge-peat moss, and burn habitat types (IOL et al. 2004). Densities within these habitat types range from 2.33 marten/km/day to 17.33 marten/km/day (IOL et al. 2004).

10.4.10 Beaver and Muskrat

Beaver (*Ondatra zibethicus*) and muskrat (*Castor canadensis*) are ranked by ENR as "Secure", and are not assessed by COSEWIC.

Beavers and muskrats are common throughout the GSA wherever appropriate aquatic habitat is found, such as lakes, ponds, wetlands, and slow-moving watercourses. Beaver and muskrat densities are highly variable and are dependent on habitat quality.

Both beavers and muskrats cache food under the water for winter use. The beaver's main diet is believed to include twigs, leaves and buds, and soft inner back of willow, alder, and dwarf birch, as well as roots and stems of various aquatic plants (Environment Yukon 2010; Jenkins and Busher 1979). Muskrat diets include roots, stems, and leaves of aquatic plants including pondweeds, water milfoils, and burreed, and horsetails along the shoreline (Environment Yukon 2010).

Aerial surveys conducted in 1972 by Wooley (1974) indicated the area east of Inuvik is low quality beaver habitat; however, further south, they recorded 0.37 occupied beaver colonies/km in the Travaillant Lake and Thunder River area.

Twenty beaver lodges and one dam were documented during the 2010 field program (Figure 10.4.5-1). No muskrats or their sign were documented during this time.

Beaver sign was recorded in medium shrub, treed bog, water, mixed wood forest, riparian shrub, black spruce-tamarack/shrub, sedge-peat moss, and burn habitat types along the MGP (IOL et al. 2004).

10.5 Birds

The Mackenzie River acts as a major flyway for Arctic breeding birds during spring and fall migrations (USGS 2010). Numerous bird species, including waterfowl and waterbirds, raptors, and other upland birds use the Mackenzie River during migrations and disband along the route to appropriate breeding habitat. As with breeding territories, the migration route between wintering and breeding grounds are traditional and are used each year. Migration is influenced and governed by weather (Terres 1982). Birds advance northward as the weather warms and return south when the weather cools. The speed of migration varies among species and is influenced by the annual prevailing weather patterns.

10.5.1 Waterfowl and Waterbird

The term waterfowl is typically used in the context of swans, geese and ducks; however, for this report it also includes loons and grebes. Furthermore, the term waterbird includes cranes, shorebirds, gulls, and terns.

A total of 50 waterfowl and waterbird species may occur along the Highway (Appendix E). Many of these species migrate to the area for breeding and summer feeding, and some use the area for staging before continuing on with migration. Within the vicinity of the Highway, waterfowl and waterbirds breed in varying densities, and can be expected to breed wherever their habitat requirements are met. Many species show fidelity to nesting territories.

The diets of waterfowl consist primarily of aquatic vegetation; however, aquatic invertebrates and minnows are also eaten. In general, the majority of waterfowl exploit food resources found in the shallow waters of lakes, ponds, marshes, sedge meadows, and bogs. Shallow bays containing emergent and submerged vegetation are also important feeding areas and provide appropriate cover for their young.

Waterbirds, as a group, use a variety of habitats for nesting and feeding, including shorelines of wetlands, ponds, and lakes, dry uplands, sandy ridges, and disturbed areas, depending upon the species. Their diet ranges from aquatic and terrestrial invertebrates, seeds, berries, small fish, and frogs. Gulls and Jaegers are opportunistic feeders and will also feed on carrion, small mammals, and eggs.

The Lakes Around Travaillant Lake Special Management Zone (as indicated in the draft *GLUP*) is identified as an important area for waterfowl staging and breeding (GLUPB 2003). In addition, the Khaii luk, Nagwichoonjik, Dachan choo gehnjik (Travaillant Lake, Mackenzie River, Tree River) Conservation Zone is designated as significant waterfowl habitat (GLUPB 2003).

The MGP field surveys indicated scaups were widely distributed in the spring and summer (May and June), but became concentrated in larger groups in August and September. Within the GSA, scaup densities (species not distinguished) reported during the June 2001 and 2002 surveys were 132 birds/100 km^2.

From June 30 1973 to July 2, 1973, Salter reported waterfowl densities near the northern half of the Highway was 12.02 waterfowl/km^2; whereas, in the southern half of the study area, waterfowl densities were estimated at 36.69 birds/km^2.

Although formal waterfowl/waterbird surveys were not conducted during the 2010 field program, a total of 11 waterfowl and 2 waterbird species were observed (Table 10.5.1-1) (Figure 10.5.1-1). During this time, a total of nine family groups (female with ducklings or lone ducklings) were documented. Breeding pairs of Tundra Swans were commonly observed in the northern half of the Highway; whereas pairs of Pacific Loons were most common in the southern half of the study area. Other waterfowl species were documented throughout.

Table 10.5.1-1: Summary of Waterfowl and Waterbird Observations, June 27, 2010 to June 30, 2010

Species	Number Observed
American Wigeon	12
Common Loon	2
Green-winged Teal	21
Mallard	25
Northern Pintail	2
Northern Shoveler	1
Pacific Loon	36
Red-breasted Merganser	1
Ring-necked Duck	1
Tundra Swan	17
White-winged Scotter	39
Duck species	42
Scaup species	58
Scotter species	12
Herring Gull	3
Sandhill Crane	5

10.5.1.1 Horned Grebe

The Horned Grebe has been assessed by COSEWIC as "Special Concern" (as of April 2009). This conservation status is imparted upon species whose inherent characteristics (e.g., low reproductive rates) make them sensitive to human activities or natural events. To date, the Horned Grebe is ranked by ENR as Secure and is not listed by SARA. Population estimates for Horned Grebes in the Northwest Territories are unknown.

Horned Grebes occupy small ponds, wetlands, shallow lakeshores and protected bays, and other natural or man-made permanent or semi-permanent waterbodies (ENR 2010c; Government of Canada 2010). Their diet consists of aquatic insects, fish, frogs, and crustaceans. In the Yellowknife area, Horned Grebes were found to prefer lakes less than 1 hectare (ha) in size, although breeding also occurred on larger lakes as well (Fournier and Hines 1999). Favourable breeding ponds include areas of open water and emergent vegetation.

Horned Grebes are expected to arrive in the area in May and depart by September (ENR 2010c). Adults are known to leave the young well before they have fledged (Fournier and Hines 1999). These adults may remain at larger waterbodies immediately prior to fall migration (Fournier and Hines 1999).

10.4.7 Red Fox and Arctic Fox

The red fox (*Vulpes vulpes)* and the Arctic fox (*Vulpes lagopus)* are not assessed by COSEWIC, but are ranked by ENR as "Secure" under the general status program. Population estimates for both fox species in the Northwest Territories are unknown, but both populations are considered secure (ENR 2010a).

Both fox species occur in the vicinity of the Highway; however, Arctic fox abundance is anticipated to diminish with an increase in red fox densities and an increase in forest cover. Red foxes, which are larger, may displace Arctic foxes by usurping their dens and other limiting habitat resources (Bailey 1992; ENR 2010b). Both species numbers fluctuate in response to their primary food sources (ENR 2010b). Fox diets includes a variety of small mammals and birds including mice, voles, lemmings, muskrats, squirrels, snowshoe hares, grouse/ptarmigan and waterfowl, eggs, carrion, and plant materials.

Foxes require suitable substrate to establish their dens, and commonly re-use den sites in consecutive years. Fox dens are commonly found on eskers, riverbanks, and other areas with glaciofluvial materials. Arctic fox pups are born in the den between mid-May and mid-June; whereas, red fox pups are born between March and May (ENR 2010b). Family groups focus much of their activity around dens until midsummer, and juvenile foxes disperse in the fall or winter.

One red fox was observed within the proposed Highway area during the 2010 field program. In addition, a fox den consisting of at least two entrances was observed in upland tall spruce habitat. This den is located near the Highway (Figure 10.4.5-1).

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10.5.1.1 Horned Grebe

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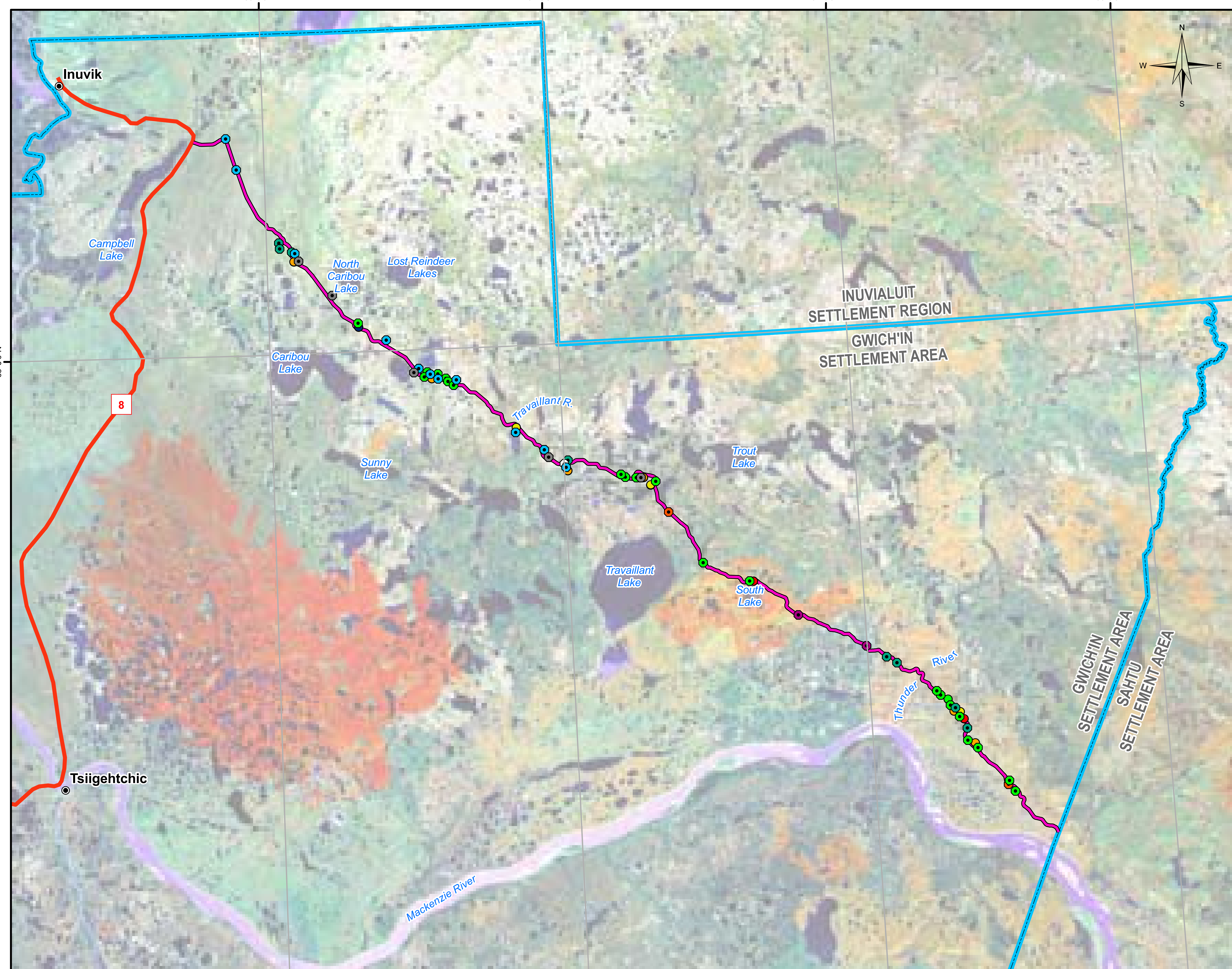
Horned Grebes occupy small ponds, wetlands, shallow lakeshores and protected bays, and other natural or man-made permanent or semi-permanent waterbodies (ENR 2010c; Government of Canada 2010). Their diet consists of aquatic insects, fish, frogs, and crustaceans. In the Yellowknife area, Horned Grebes were found to prefer lakes less than 1 hectare (ha) in size, although breeding also occurred on larger lakes as well (Fournier and Hines 1999). Favourable breeding ponds include areas of open water and emergent vegetation.

Horned Grebes are expected to arrive in the area in May and depart by September (ENR 2010c). Adults are known to leave the young well before they have fledged (Fournier and Hines 1999). These adults may remain at larger waterbodies immediately prior to fall migration (Fournier and Hines 1999).



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LEGEND

Visual Observations

- American Wigeon
- Common Loon
- Duck species
- Green-winged Teal
- Herring Gull
- Mallard
- Northern Pintail
- Pacific Loon
- Sandhill Crane
- Scaup species
- Scotter species
- Tundra Swan
- White-winged Scoter
- Communities
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- Settlement Area Boundary

NOTES

Base data source: ESRI Base Data
NTS 1:250,000
Alignment is considered preliminary and is subject to change

STATUS

ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA

Waterfowl and Waterbird Observations June 27-30, 2010

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:550,000

10 5 0 10

Kilometres

FILE NO.
V33101053_Figure11.4-3.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure 10.5.1-1

10.5.2 Raptors

Raptors, also known as Birds of Prey, make up a small but important group of birds frequenting habitat along the Highway. Although this group covers a small number of species, it is diverse and includes hawks, eagles and osprey, falcons, and owls.

A total of 16 raptor species potentially occur in the vicinity of the Highway. The majority of these species are summer residents; however, five species (Northern Goshawk, Gyrfalcon, Northern Hawk Owl, Great Horned Owl, and Great Grey Owl) may over-winter, particularly in years when prey densities are greatest. Little is known about the local population abundance of individual species. However, appropriate nest sites and food are the main resources that naturally limit breeding populations of Peregrine Falcon (Bromley 1992) and other raptors (Blood and Anweiler 1994).

Raptors breed throughout the Highway area where their habitat requirements are met. Some species nest in trees, while others nest on cliffs and on the ground. Raptors exhibit nest site fidelity, returning to the same nest site each year. Summer residents may appear within the area as early as mid-April and depart in October, while others overwinter. Other raptors are spring and/or fall migrants and may pass through en route to and from their breeding ranges on the tundra.

A total of eight observations of raptors, representing four different species were documented during the 2010 field program (Figure 10.5.2-1). Bald Eagle, Northern Harrier, Red-tailed Hawk, Short-eared Owl, and an unidentified raptor species were observed. In addition, an active Bald Eagle nest was observed along the Travaillant River (Figure10.5.2-1).

Of the raptor species that potentially occur within the vicinity of the Highway, two are listed by SARA as "Special Concern" and are discussed below.

10.5.2.1 Short-eared Owl

The Short-eared Owl is listed by SARA as "Special Concern" (Schedule 3), and is ranked by ENR as "Sensitive". Under SARA Schedule 3, the Short-eared Owl requires assessment or reassessment by COSEWIC and is not yet protected under SARA.

The Short-eared Owl arrives in the Northwest Territories to breed by late April or May and depart by late October (ENR 2010c). Short-eared Owls occur wherever an abundance of small mammals are present, particularly in bogs, marshes, and other non-forested areas (ENR 2010c). Nests are normally located in dry open sites with enough vegetation to conceal an incubating female.

The Northwest Territories population status of these owls is difficult to assess because individuals are nomadic and prone to annual fluctuations in numbers. The Northwest Territories Short-eared Owl population is unknown, but estimated to be between 1,000 and 10,000 individuals (ENR 2010a).

Short-eared Owls were observed three times during the 2010 field program (Figure 10.5.2-1). All three observations were within a few kilometres of each other, near km 1470 to km 1474 and likely represent a single breeding territory. This potential breeding territory is located within shrub meadows and open black spruce habitat types.

10.5.2.2 Peregrine Falcon

The Peregrine Falcon (*anatum/tundrius)* has been assessed by COSEWIC as "Special Concern" (April 2007), but has not been listed by SARA. Peregrine Falcons are ranked by ENR as "Sensitive" under the Northwest Territories general status program.

Peregrines have three main habitat requirements. They need appropriate cliff nesting sites, a nesting range (actively guarded range approximately 1 km from nest), and a home range that can extend up to 27 km from the nest for hunting (not defended) (ENR 2010b). Between May and early June, two to four eggs are laid in a scrap usually on cliff ledges near water. Peregrines mainly hunt other birds in the air, so open habitats and waterways are important.

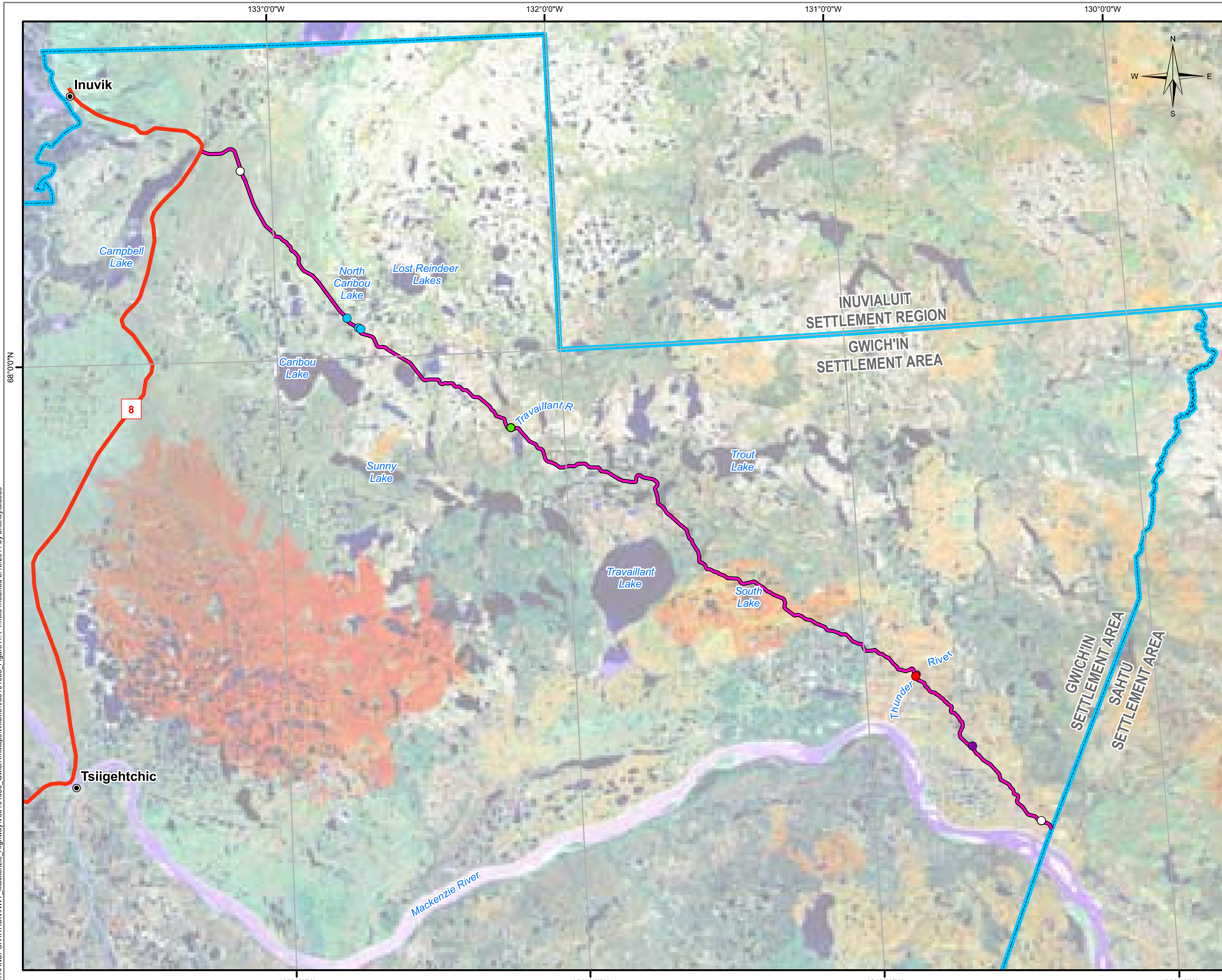
During the 2002 and 2003 field surveys, no Peregrine Falcons were observed along the MGP (IOL et al. 2004) or during the June 2010 field program. However, IOL (2004) reports 22 historical and active nests are present near Campbell Lake (at the northernmost portion of the Highway), and 18 other nests are known in the North Taiga Plains Ecological Zone (inland from the Mackenzie River).

10.5.3 Upland Birds

For the purposes of this report, the term Upland Bird refers to a group of birds that nest in upland habitats and includes perching birds, woodpeckers, kingfishers, and grouse/ptarmigan. Densities of upland birds within the GSA are unknown.

Upland birds occupy all terrestrial habitat types along the Highway. A total of 57 upland bird species potentially occur in the area as summer or year-round residents (Appendix E). Twelve upland bird species regularly over-winter in the study area, including: Sharp-tailed Grouse, Spruce Grouse, Willow and Rock Ptarmigan, American Three-toed Woodpecker, Gray Jay, Common Raven, Boreal and Gray-headed Chickadee, Hoary and Common Redpoll, and White-winged Crossbill (Sibley 2003).

During the June 2010 field program, a total of 5 ptarmigan (not identified to species) and 14 Rusty Blackbirds were observed. Other upland birds are typically too small and/or concealed to document from aerial surveys.



LEGEND

- Bald Eagle, Visual + Nest
- Northern Harrier, Visual
- Raptor species, Visual
- Red-tailed Hawk, Visual
- Short-eared Owl, Visual
- Communities
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- Settlement Area Boundary

NOTES

Base data source: ESRI Base Data
NTS 1:250,000
Alignment is considered preliminary and is subject to change

STATUS

ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Raptor Observations
June 27-30, 2010

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:550,000

10 5 0 10

Kilometres

FILE NO.
V33101053_Figure11.4-4.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure 10.5.2-1

M:\TRANSPORTATION\NWT_Mackenzie_Highway\V33101053_Gwich'in\Maps\Wildlife\V33101053_Figure11.4-4.mxd modified 5/10/2011 by brittney.aldous

10.5.3.1 Gray-headed Chickadee

In the Northwest Territories, the Gray-headed Chickadee's (*Poecile cincta*) range is limited to the northwest Mackenzie District, including the Highway. This species is ranked by ENR as "May Be At Risk" as a result of its limited distribution; however, it has not been assessed by COSEWIC. Little is known about Gray-headed Chickadee ecology and density in the Northwest Territories, but ENR estimates the population is less than 100,000 (ENR 2010b).

The Gray-headed Chickadee is a year round resident of open canopied coniferous, deciduous, and mixed forests that have an abundance of tall shrubs (Hailman and Haftorn 1995). Typical canopy closures at occupied habitats are less than 20% (Hailman and Haftorn 1995). Appropriate habitat occurs within the vicinity of the Highway, especially at its northernmost portion.

Gray-headed Chickadees are obligate cavity nesters, and depend on existing natural and woodpecker cavities for nesting (Hailman and Haftorn 1995). Their preferred diet includes insects and larvae, spiders, and seeds (e.g., spruce, tamarack, birch, alder, and juniper) (Sibley 2003; Hailman and Haftorn 1995).

10.5.3.2 Rusty Blackbird

Rusty Blackbirds are listed by SARA as "Special Concern" (Schedule 1) and ranked by ENR as "May Be At Risk". By definition this species possesses inherent characteristics (e.g., specific habitat requirements) that make them sensitive to human activities or natural events. Population densities within the Northwest Territories are unknown (ENR 2010b).

Rusty Blackbirds occur along the Highway where suitable habitat exists. Rusty Blackbirds forage primarily on the ground along the edges of ponds, wetlands, and streams for aquatic and terrestrial insects and plant materials (e.g., seeds and fruits) (Avery 1995). Typical feeding habitat consists of wet coniferous and mixed forests, such as fens, bogs, muskegs, beaver ponds, and swampy shores along lakes and streams (Avery 1995; ENR 2010c). Nest sites are commonly in dense areas of vegetation, close to the water in either dead or alive trees or shrubs (Avery 1995).

Near Yellowknife, Rusty Blackbirds have been recorded arriving as early as April or May and departing by mid-October (Bird Studies Canada et al. 2010; Bromley and Trauger ND). Arrival and departure dates along the Highway are unknown.

A total of 14 Rusty Blackbirds were observed during the 2010 field program (Figure 10.5.3-1).

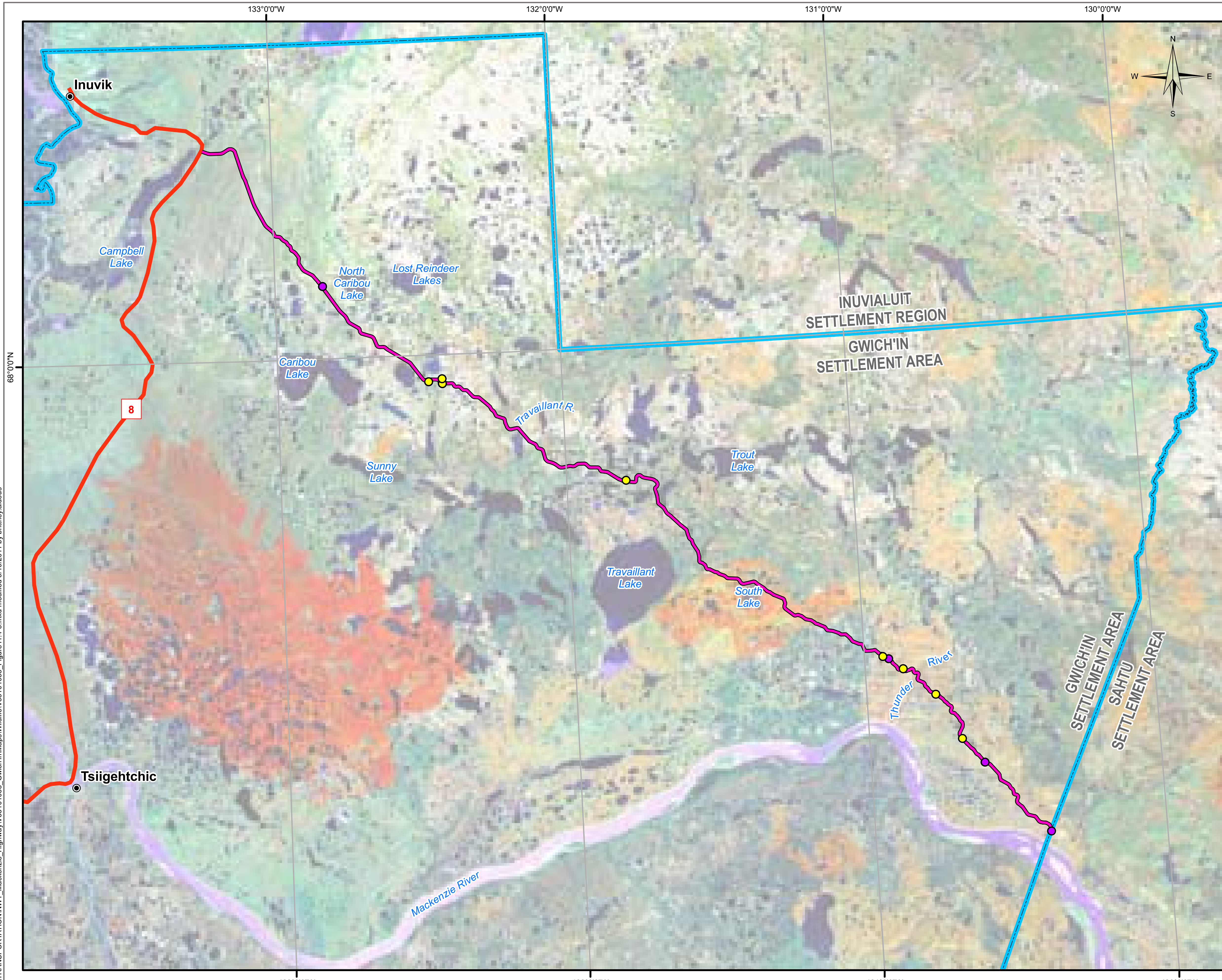
10.6 Fish and Fish Habitat

10.6.1 General

The Highway will cross numerous ephemeral and permanent streams, and pass near many lakes along its route within the GSA. It is, therefore, important to identify the fish and fish habitat resources that these waterbodies sustain to develop suitable avoidance and mitigation strategies designed to protect fish populations that are ecologically important, and socially and economically valuable to northern residents. This section of the report identifies the species that may be encountered or affected by highway construction and operation, and is based on information available in the EIS for the MGP and observations made in the 2010 field program.

Previous fish and fish habitat surveys have been conducted in streams along the Highway. Results of these surveys were summarized in the EIS for the MGP (IOL et al. 2004). Generally, these surveys identified the following fish species as having the potential to utilize habitats in streams along the Highway: lake whitefish, round whitefish, inconnu, northern pike, Arctic grayling, lake trout, burbot, least cisco, ninespine stickleback, and sculpin. Actual species presence is dependent on several habitat and watershed characteristics, often including the availability and accessibility of upstream lakes that provide feeding, rearing, and/or overwintering habitats. It is unlikely that any of the streams along the Highway would provide overwintering habitat due to complete freezing.

Table 10.6.1-1 provides a generalized summary of habitat preferences and life cycle information for each of the major fish species likely utilizing stream habitats in the vicinity of the Highway. Arctic grayling is the valued species most likely to be affected by highway construction activities and stream crossing structures. This is because grayling utilize and are dependent upon stream habitats for spawning, juvenile rearing, and adult life stages, and require clean, well oxygenated gravel-cobble substrates to complete their life cycle (Table 10.6.1-1). As such, their productivity within a system is highly sensitive to perturbations that degrade or alter migration access or habitat quality. The following sections provide brief life history and habitat preference information for each of the valued fish species that will possibly be encountered along the Highway.



LEGEND

- Ptarmigan Species, Visual
- Rusty Blackbird, Visual
- Communities
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- Settlement Area Boundary

NOTES
Base data source: ESRI Base Data
NTS 1:250,000
Alignment is considered preliminary and is subject to change

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Upland Bird Observations
June 27-30, 2010

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:550,000
10 5 0 10
Kilometres

FILE NO.
V33101053_Figure11.4-5.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure 10.5.3-1

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Table 10.6.1-1: Life History Information for Common Fish Species in Streams along the Highway

Fish Species	Migratory Behaviour	Spawning Period	Spawning Habitat	Hatching Period	Juvenile Freshwater Habitat Preferences	Adult Freshwater Habitat Preferences	Risk of Potential Effects from Highway Construction
Burbot *Lota lota*	▪ Migrate to lake spawning areas in winter ▪ Migrate to tributaries in late winter/early spring ▪ Migrate to deep water in summer	▪January to March ▪Water temp. 0°C to 4°C	▪Under ice in Lakes or river ▪Sand/gravel substrate ▪shallow (<3 m bays or on gravel shoals	At ice-out	▪Shallow waters ▪Debris cover ▪Rocky riffles ▪Pools or deeper water in lakes	▪Mouths of creeks in fall ▪May be found during winter/spring in coastal embayments (brackish or freshwater) ▪Deep water in summer	Moderate
Lake whitefish *Coregonus clupeaformis*	Resident or anadromous	Late September to early October	▪Lakes and large rivers ▪Hard or stony substrate ▪Water <7.5 m	Late spring	▪Larvae along steep shorelines ▪Juveniles move to deep water in summer	Deep water in lakes and large rivers	Low
Round whitefish *Prosopium cylindraceum*	Limited migrations to lake shallows or upstream to rivers	Late September to October	Gravelly shallows of lakes or river mouths	Spring	Near or beneath rocks	Moderate to deep lakes	Low
Least cisco *Coregonus sardinella*	Migrate upstream to spawning grounds in fall	Early October	▪Clear streams ▪Gravel substrates	Spring	Lakes, rivers, lowest reaches of tributary streams	▪Lakes and streams ▪Estuaries, plume of home river	Moderate
Inconnu (Coney) *Stenodus leucichthys*	▪Anadromous or lake dwelling ▪Begin upstream migrations at spring break up ▪Return to coastal areas or lakes after spawning	Late September to early October	▪1 m to 3 m depth ▪Fast current ▪Gravel substrate	6 months after spawning	Fry washed downstream to coastal areas or lakes	Coastal areas or lakes	Low
Northern pike *Esox lucius*	▪Limited range ▪Move from deep water winter habitat to spawning habitat in spring	Early spring, occasionally before ice melt	▪Grassy margins of lake shores ▪Slow moving streams or sloughs	Spring, ~30 days after spawning	▪Stream or lake margins ▪Slow flowing waters	▪Lakes ▪Main river channels ▪Slack water areas in rivers	Moderate
Lake trout *Salvelinus namaycush*	▪Limited migrations, usually within resident lake or large, deep river ▪Migrate to near shore areas for spawning ▪Move into surface waters in winter ▪Move into deeper waters in summer	Early September	▪Littoral areas of lakes ▪Cobble boulder substrates ▪5 m to 40 m water depth	May to June, depending on water temperature	Shallow, inshore waters	▪Large deep lakes (common) ▪Large rivers (less common) ▪Little movement in summer	Low

Table 10.6.1-1: Life History Information for Common Fish Species in Streams along the Highway

Fish Species	Migratory Behaviour	Spawning Period	Spawning Habitat	Hatching Period	Juvenile Freshwater Habitat Preferences	Adult Freshwater Habitat Preferences	Risk of Potential Effects from Highway Construction
Arctic grayling *Thymallus arcticus*	▪Can be highly migratory at all life stages or non-migratory ▪Usually migrate to winter habitat in early fall	Spring, just as ice breaks up	▪Gravel substrate ▪<20% to 30% fines ▪Good flow (25 cm/s to 60 cm/s)	Hatch 3 weeks after spawning	Fry: quiet waters near site of hatching	▪Clear small, shallow streams or medium rivers ▪Groundwater fed springs ▪Overwinter in lakes or lower reaches of rivers ▪Segregate in streams by age	High
Slimy sculpin *Cottus cognatus*	Very limited movements	Spring, after breakup	Cobble in shallow water	Hatch 30 days after spawning	Gravel/cobble substrates in streams	Rocky or gravel substrates	Low
Ninespine stickleback *Pungitius pungitius*	Very limited movements	Summer	Male builds nests of vegetation and debris	Summer	Quiet, shallow waters in vegetated areas of streams or brackish waters	▪Brackish or freshwater lakes and streams ▪Streams: vegetated areas in quiet waters	Low

10.6.2 Burbot

Burbot (*Lota lota*) are unique in that they spawn in rivers and lakes during the winter under ice. Spawners tend to select shallow waters over gravel substrates. Eggs filter down into interstitial spaces where they develop for the next 4-5 weeks. The newly hatched larvae are only about 3 mm to 3.5 mm and are transported downstream into quiet waters where they feed. In streams, young burbot seek out shallow waters that have vegetation and debris. As they grow they move to rocky riffles and then on to pools or beneath undercut banks. Adult burbot prey on smaller fish. The selection of stream habitats by some burbot for both spawning and rearing suggests that they may be encountered in streams crossed by the Highway.

10.6.3 Lake Whitefish

Lake whitefish (*Coregonus clupeaformis*; "Humpback") are primarily a freshwater fish, with a preference for cool water lakes and larger rivers; however, they will enter brackish water (Scott and Crossman 1973). In lakes, they generally move from shallow to deep water during the summer months, and then back into shallow water as the temperature cools. Spawning occurs in early fall, normally in shallow areas of lakes where the substrate is composed of cobble and gravel, and less frequently, sand. Whitefish may on occasion move into tributary streams to spawn. Eggs are broadcast over the substrate and hatch during the following spring. Larval fish tend to stay near steep shorelines, but as juveniles, move into deeper waters during summer. Lake whitefish feed on aquatic insects, mollusks, amphipods, and a variety of small fish and fish eggs.

10.6.4 Round Whitefish

Round whitefish (*Prosopium cylindraceum*) is primarily a freshwater species, although it is known to inhabit brackish estuarial waters, such as in the mouth of the Mackenzie River (Scott and Crossman 1973). Spawning normally occurs during October in northern latitudes, over the gravelly shallows of lakes or river mouths. Eggs hatch in spring. Round whitefish are predominantly found in moderate to deep lakes where they feed on benthic invertebrates. Given their habitat preferences, it is unlikely that these fish will be encountered in the small, shallow streams that make up most of the watercourses crossed by the Highway.

10.6.5 Cisco

Least cisco (*Coregonus sardinella*; "Big-Eye Herring") occur in many inland waters, including the Mackenzie River and the lower reaches of many Arctic rivers (Scott and Crossman 1973). They are less migratory than the Arctic cisco and tend to be associated with the plume of their home river. In freshwater, spawning migrations take place in the fall (late September-early October). Clear streams or lakeshores with sand or gravel bottoms are their preferred spawning habitats. They are eaten by predacious inconnu, pike, and burbot, as well as other mammals and birds.

10.6.6 Inconnu

Inconnu (*Stenodus leucichthys*; "Coney") are the largest and fastest growing member of the whitefish family. They are primarily anadromous (fish that migrate from the sea to spawn in fresh water), migrating long distances up the Mackenzie River and its major tributaries to spawn just prior to freeze up in October. After spawning, inconnu move back downstream to the lower reaches of the Mackenzie River, Tuktoyaktuk Harbour, and west along the Beaufort Sea coast to feed and overwinter (DFO 1998). At maturity, these fish are greater than a half-metre in length (Scott and Crossman 1973). Their size and preference for large tributaries for spawning suggests that they are unlikely to spawn in the small streams that are frequently encountered along the Highway.

10.6.7 Northern Pike

Northern pike (*Esox lucius*) are carnivorous fish that prefer slow, meandering vegetated rivers or lakes. Spawning takes place in shallow, heavily vegetated areas (Scott and Crossman 1973) soon after ice-out. The eggs adhere to grass, rocks, or other debris. Incubation generally takes about 30 days in the north. Pike fry start life feeding on small crustaceans and insects, but begin eating smaller fish by the time they are only about 5 cm in length. As adults, these voracious feeders principally feed on fish, but will also take shore birds, small ducks, muskrats, mice, shrews, and insects. In winter, pike will migrate to large rivers or lakes; smaller lakes are avoided due to the potential for oxygen depletion. Generally, pike migrations between summer and winter habitats are short. In summer, their movements from feeding habitat areas are minimal. Due to the habitats selected by pike, it is expected that the Highway will cross streams used by pike for spawning, rearing, and feeding.

10.6.8 Lake Trout

Lake trout (*Salvelinus namaycush*) are representatives of the char family that live exclusively in deep, cold lakes throughout their life cycle. They spawn during early fall over clean cobble substrates in water that is generally less than 16 m deep (Marsden and Chotkowski 2001). Lake trout may also occur in large rivers and brackish waters. However, due to the preference of this species for lake habitats during all life stages, it is unlikely that spawning or rearing would take place in the relatively shallow streams that would be crossed by the Highway.

10.6.9 Arctic Grayling

Arctic grayling (*Thymallus arcticus*), a cousin of the trout, are game fish of clear, cold streams and are known for their beautiful colours and sail-like dorsal fins. They can be highly migratory, or spend much of their lives within a fairly short distance of their preferred section of stream or lake. Generally, grayling spawn in clean, cool streams in spring at about the time of ice break up, over silt free gravel substrates. They do not create nests (redds), which leaves the eggs vulnerable to high water velocities and streambed disturbances (Beauchamp 1990). During the fall, grayling will migrate to overwintering habitats in lakes or deep sections of slow flowing rivers. Due to their choice of stream habitats for spawning and rearing in summer, the Highway will inevitably cross streams that support these fish.

10.6.10 Northern Pike

Northern pike (*Esox lucius*) are carnivorous fish that prefer slow, meandering vegetated rivers or lakes. Spawning takes place in shallow, heavily vegetated areas (Scott and Crossman 1973) soon after ice-out. The eggs adhere to grass, rocks, or other debris. Incubation generally takes about 30 days in the north. Pike fry start life feeding on small crustaceans and insects, but begin eating smaller fish by the time they are only about 5 cm in length. As adults, these voracious feeders principally feed on fish but will also take shore birds, small ducks, muskrats, mice, shrews, and insects. In winter, pike will migrate to large rivers or lakes; smaller lakes are avoided due to the potential for oxygen depletion. Generally, pike migrations between summer and winter habitats are short. In summer, their movements from feeding habitat areas are minimal. Due to the habitats selected by pike, it is expected that the Highway will cross streams used by pike for spawning, rearing, and feeding.

10.6.11 Stream Crossing Site Investigations

A preliminary fish habitat field study was carried out during the 2010 field program, over a four day period, from June 27 to June 30 within the GSA. The survey involved aerial reconnaissance (low level helicopter flights) over the 181 km long Highway and alternate routes to permit visual inspection of streams at stream crossing locations. The overview flights also afforded an opportunity to observe watershed conditions upstream and downstream of the crossing sites as an indication of the potential of these systems to support valued fisheries resources. For this field program, the scope of the field survey was limited to an aerial overview of channel characteristics along the Highway, and as such, no ground investigation took place.

The purpose of the preliminary field program was to:

- provide input as to the preferred routing of the Highway from a fisheries habitat perspective;
- assist with identifying preliminary engineering constraints with respect to road construction through potential fish habitat; and
- characterize and prioritize watercourse crossings for a future field sampling program of fish and fish habitat.

The following basic fish habitat parameters were identified where possible:

- approximate wetted width;
- approximate total channel width, determined from abrupt changes in elevation and from vegetation changes;
- substrate (type);
- cover (type and percent); and
- flow/habitat characteristic (e.g., riffle, run, pool).

In total, 162 crossings were identified along the Highway (Table 10.6.11-1) during the 2010 field program. The streams described in this section have been characterized by reviewing available background information and topographic data, and through observations made in the 2010 field program. Future ground-truthing and field measurements will confirm these preliminary observations.

Two categories of streams are along the Highway, ephemeral streams and perennial streams.

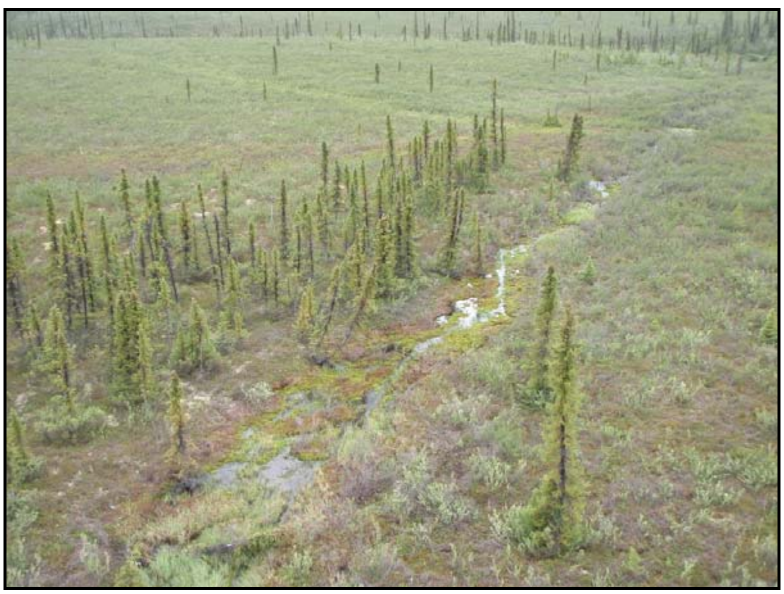
The ephemeral drainage areas were identified as watercourses that do not provide suitable fish habitat and will likely require appropriately sized culverts to convey meltwater. These watercourses typically consisted of a drainage area without a defined channel, varied in size from l m to greater than 30 m, with dense grasses, willows, and other vegetation throughout the drainage. In many cases, flow was not observed or water existed intermittently through dense in-stream vegetation. In addition, typical watercourse characteristics favourable for fish habitat were not apparent from the 2010 field program as these drainages were typically obscured by dense riparian overgrowth. These streams were small, ephemeral streams that generally drain terrestrial upland areas or small, shallow lakes, or ponds, most of which do not provide suitable fish habitat features. Ephemeral streams that are not utilized by fish for any part of their life cycles are likely not fish bearing. These stream crossings require only an appropriately sized culvert to permit conveyance of meltwater.

Perennial (except in winter) streams that are potentially utilized by one or more life cycle stages of fish during open water periods or which contribute to downstream habitat quality. These stream crossings will likely require appropriately sized culverts according to channel and stream flow characteristics, and to permit unimpeded fish passage.

Perennial (except in winter) streams that are utilized by one or more life cycle stages of fish for spawning, rearing, feeding during open water periods, in addition to migration. These stream crossings will require a bridge due to permanency and morphology of the watercourses and the terrain within which the watercourses exist.

The perennial channels were identified as watercourses that likely provide suitable fish habitat for one or more life cycle stages; however, given their relatively narrow channel width, will require appropriately sized culverts. These watercourses were between 1 m and 3 m wide; with dense riparian vegetation consisting predominantly of grasses, willow, and some coniferous and deciduous forest cover. The terrain at these locations was typically flat enough that a bridge would not be required to span the relatively narrow watercourse. In addition, the lack of gullies or deep ravines precludes the need for clear span bridges at these locations.

One hundred and twelve stream channels to be crossed by the Highway were assessed as ephemeral drainage areas. These varied in size and generally drain terrestrial upland areas or small, shallow lakes or ponds, most of which do not provide suitable fish habitat features (Photograph 10.6.11-1 to Photograph 10.6.11-3). Forty three crossings were identified as being perennial watercourses and will require appropriately sized culverts according to channel and stream flow characteristics, and to permit unimpeded fish passage (Photograph 10.6.11-4 to Photograph 10.6.11-6). Based on available fish data, fish habitat observations, the permanency and morphology of the watercourses, and the terrain within which the watercourses exist, seven watercourses were identified as large, permanent watercourses likely to require a bridge structure (Photograph 10.6.11-7 to Photograph 10.6.11-9).



Photograph 10.6.11-1
Crossing 1480E, identified as an ephemeral drainage area during June 2010 aerial reconnaissance.

Photograph 10.6.11-2
Crossing 1500A0, a drainage area greater than 30 m in width.

Photograph 10.6.11-3
Ephemeral drainage crossing 1380A-1 contributes seasonal meltwater to downstream lake.

Table 10.6.11-1: Preliminary Stream Crossing Structure Recommendations Based on Stream and Fish Habitat Characteristics or Potential

Crossing Structure	Crossing Number(s)	General Habitat Comments
Bridge	1490A; 1480F; 1470F; 1430J; 1430B;1410D; 1360D	Generally good or known fish habitat observed. Channel between 3 m and 10 m wide with coarse bed materials (sands, gravels, and cobbles). Channel morphology typically consisted of riffle-run and riffle-pools and contained LWD[1] or SWD[2] complexes. Channels were well incised and often occurred within a large gulley or deep ravine. Dense riparian vegetation predominantly mixed coniferous-deciduous forest and low shrub layer.
Large or Oversized Culvert	1500A; 1490D; 1480D; 1480B; 1470L; 1470H; 1470G; 1470D; 1470A; 1460O; 1460M; 1460J; 1460G; 1450G; 1450C; 1450B; 1440H; 1440E; 1440A; 1420B1; 1420B; 1420A; 1410F; 1410B; 1400A; 1390G; 1390D1; 1390A; 1380A; 1370H; 1370F; 1370C; 1370A; 1350B; 1350A; 1340D; 1340B; 1330J; 1330H; 1330F; 1330D; 1330C;	Moderate or seasonal fish habitat observed. Channel between 1 m and 3 m wide with moderate sized bed materials (silts, sands, small gravels). Channel morphology typically consisted of riffle-pools and contained in-stream vegetation (grasses). Channels were not well incised and predominantly did not occur within a gulley or ravine. Dense riparian vegetation consisted predominantly of grasses and shrubs with less dense forest cover.
Standard Culvert	1500E – 1500B; 1500A0; 1490I -1490E; 1490C; 1490A1; 1490A2; 1480H; 1480G; 1480E; 1480D1;1470N; 1470J1; 1470J; 1470I; 1470E; 1470C; 1470B; 1460T; 1460S1; 1460S; 1460R1; 1460R; 1460Q; 1460P; 1460N; 1460L; 1460H; 1460E;1460A; 1450M1; 1450M; 1450K - 1450K5; 1450J; 1450H; 1450F-1450D; 1450A; 1440J; 1440I; 1440F; 1440D; 1440C; 1440B-1440B2; 1430I; 1430F; 1420E1; 1420E; 1420A1; 1420A2; 1420L1; 1420L; 1420J; 1410H; 1410D2; 1410D1; 1400E2;1400E1; 1400E; 1400C; 1390F; 1390D; 1390A3; 1390A2; 1390A1;1380C1; 1380C; 1380A2; 1380A1; 1370J; 1370I; 1370E1 1370D; 1370B1; 1370B; 1360N2; 1360N1; 1360L; 1360D3; 1360D2; 1360D1; 1350F2; 1350F1; 1350F; 1350D; 1350C; 1340C; 1340A; 1330K; 1330B; 1330A	Drainages with no defined channels. Often densely vegetated throughout. Provides no fish habitat except potential provision of water, food. and nutrients. Drainage area varied in size from less than 1 m to greater than 30 m. Bed materials usually not observed. Dense riparian vegetation consisted predominantly of grasses and shrubs (willow) with less dense forest cover.

[1] LWD – Large woody debris.

[2] SWD – Small woody debris.

Photograph 10.6.11-4
Typical permanent watercourse (1490D) requiring an appropriately sized culvert.

Photograph 10.6.11-5
Crossing 1330J, assessed as permanent in June 2010, likely requires an appropriately sized culvert.

Photograph 10.6.11-6
Crossing 1340D, assessed as permanent, likely requires an appropriately sized culvert.

Photograph 10.6.11-7
Aerial view of stream crossing 1490A, Miner River, requiring a bridge structure.

Photograph 10.6.11-8
Aerial view of stream crossing 1430J, Travaillant River requiring a bridge structure.

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Photograph 10.6.11-9
Aerial view of watercourse crossing 1360D, Thunder River requiring a bridge structure.

The seven perennial watercourse crossings requiring bridges are identified in Table 10.6.11-2 along with stream channel and habitat characteristics as these are anticipated to include the highest abundance of preferred fish habitat characteristics for those species expected.

Table 10.6.11-2: Stream Channel and Habitat Characteristics at Suggested Bridge Crossing Locations Along the Highway, June 2010

Stream Crossing	Approximate Width	Cover		Habitat Type	Substrate	Comments
		Type	Percentage			
1490A (Miner River)	3 m to 10 m	grasses shrubs conifers	20 50 10	riffle-pool	gravels	Habitat complexity includes SWD and LWD, high cover.
1480F	3 m to 10 m	grasses shrubs conifers	20 70 15	riffle-pool	undetermined	Extensive meanders with abundant pools.
1470F	3 m to 10 m	grasses shrubs	25 50	riffle-pool	undetermined	Flow originates from North Caribou Lake.
1430J (Travaillant River)	>10 m	grasses shrubs conifer	10 50 40	riffle-pool/run	gravels, cobbles	Habitat complexity includes SWD and LWD, high cover.
1430B	3 m to 10 m	grasses shrubs conifer	20 60 10	glide/pool	silt/sand	Sourced from upstream lake.
1410D	3 m to 10 m	shrubs conifer	80 10		undetermined	High riparian cover limited view of watercourse; beaver dams observed downstream near lake.
1360D (Thunder River)	3 m to 10 m	shrub conifer deciduous	30 20 50	Riffle-pool/run	gravel/cobble	Deep valley, significant meanders. Arctic grayling observed within river.

In general, all seven permanent watercourses identified in Table 10.6.11-2 provide perennial migratory, spawning, rearing, and feeding habitat; however, none are expected to provide overwintering habitat as they freeze nearly completely solid during the winter. IOL et al. (2004) assessed winter conditions of the Travaillant River and found: ice depths up to 2.5 m; the river was mostly frozen to the stream bed; there was limited under-ice water (approximately 0.2 m deep); and dissolved oxygen levels in under-ice water that would be lethal to fish. Similarly, the Thunder River was found to be frozen to the stream bed with ice thickness to 1.2 m. The other four unnamed streams all had similar conditions where ice extended to the stream bed, or the limited under-ice water had no flow and was nearly anoxic and would be lethal to fish and incubating eggs (IOL et al. 2004).

Rearing habitat was observed in areas of slow moving water with an abundance of over- or in-stream cover including vegetation, deep pools, and woody debris. Good or excellent spawning habitat was also observed within the permanent watercourses where appropriate bed material within each watercourse included a component of gravels and cobbles.

Results of previous stream surveys along the Highway were summarized in the EIS for MGP (IOL et al. 2004). Sampled fish included Arctic grayling, slimy sculpin, northern pike, longnose sucker, and lake chub. These results included sampling results for Travaillant River and Thunder River, as well as four unnamed streams and one unnamed lake.

According to IOL et al. (2004) the predominant fish habitats observed within the streams assessed would provide spawning and incubating, rearing, and adult feeding and holding habitat for northern pike, whitefish species, Arctic grayling, burbot, and sculpin species.

In addition, several other species have been documented in previous studies in tributaries or lakes connected to Travaillant River, Thunder River, and the Mackenzie River. These included northern pike, walleye, lake trout, broad whitefish, lake whitefish, least cisco, inconnu, pond smelt, longnose sucker, lake chub, ninespine stickleback, trout-perch, and sculpin species. It is also known that residents have harvested burbot and whitefish species from Fishtrap Lake, located approximately 5 km upstream of the pipeline crossing site on the Travaillant River (IOL et al. 2004). Fish species documented in Thunder River during previous studies included Arctic grayling, broad whitefish, lake chub, lake trout, lake whitefish, longnose sucker, northern pike, pond smelt, round whitefish, and slimy sculpin.

Actual species presence would be dependent on several habitat and watershed characteristics. As indicated earlier, it is unlikely that any of the stream locations along the Highway would provide overwintering habitat due to complete freezing. Similarly, many of the small, shallow headwater lakes within the watersheds crossed by the Highway would freeze either to the bottom or to a sufficient depth to preclude the possibility of overwintering, partly due to a diminishment of oxygen to lethal levels (Cott et al. 2008b).

Further site investigations at the specific crossings will be undertaken in later stages of the Highway development to provide a more complete inventory of habitat conditions, as well as fish presence and relative abundance in streams that will be crossed along the Highway.

10.7 Hydrology

10.7.1 General

The hydrology of the region is defined by climatic factors (long cold winters, short mild summers, and low precipitation with 67% falling as snow) (Section 10.1) and the properties of the underlying permafrost. Surface runoff patterns are defined by the annual freeze-thaw cycle, in which only four months of the year have a mean temperature above zero (May to September). Freshet is the dominant flow event, which typically begins in May and is relatively brief. Peak water levels in creeks often occur due to high flows and to backwatering effects from ice jams in the Mackenzie River (IOL et al. 2004). During the summer, intense precipitation events can also produce floods, particularly in smaller creeks (IOL et al. 2004). Freeze up typically begins to occur in late September or October with a noticeable drop in discharge as water is stored as ice (IOL et al. 2004). The Highway will cross rivers and streams, but will not encroach on any lakes. There are many large and small lakes in the area, and it is anticipated that in some cases the edge of the Highway embankment (toe of the sideslope) will be close to the shore of a lake.

10.7.2 Watersheds

The region is characterized by low relief (less than 300 m) and numerous small shallow lakes with small drainage basins which drain into the Mackenzie River through permanent and ephemeral channels. Permafrost underlies the majority of the area, above which is an active layer that varies in depth (Kiggiak-EBA 2010).

Ice decay in lakes begins once snow is melted from the ground surface. Increases in lake water storage lag behind the spring snow melt due to meltwater retention under the snow cover and in small depressions on the land surface (Kiggiak-EBA 2010). During the melt, snow dams generally cause water levels in lakes to rise above outlet elevations. Breaching of these dams causes rapid increases in downstream discharge. The spring freshet recharges ponds that might otherwise have low water levels, creating surface flow connections typically for a period of two weeks (Kiggiak-EBA 2010).

The spring freshet results in a sudden peak in the hydrograph as meltwater fills the many depressions on the land surface and flows over-land in sheets or rills (Kiggiak-EBA 2010). The shallow active layer is not able to retain much water, causing the water table to rise rapidly, delivering runoff to the lower slopes and stream channels. Over the spring and summer, the active layer increases in depth due to heating from the surface, causing the water table to drop and resulting in a decline in surface flows. Summer rainfall causes short-period rises in water levels above base flows, the magnitude of which is a function of the ability of the ground to receive and attenuate flow.

10.7.2.1 Streams and Rivers

The Highway has 162 watercourse crossings, 112 of which were assessed in the 2010 field program as ephemeral stream crossings. Of the 50 perennial streams that have undergone preliminary assessment, seven were identified as likely requiring a bridge crossing. Flow data has not been recorded at any of the bridge crossings and descriptions are limited to aerial field observations and descriptions of the topography from the Map Book in Appendix A. However, any historical discharge data recorded at Water Survey of Canada (WSC) stations that may be relevant at the crossings is also described in this section:

- 1490A (Map 04) is a 3 m to 10 m wide channel in a gully with 20 m of relief on either side. The river runs north into the chain of lakes between Sitidgi Lake and Campbell Lake, east of Inuvik. The river has approximately 15 m of relief on either bank and drains runoff from relatively flat terrain to the southwest and east.
- 1480F (Map 05) is a 3 m to 10 m wide channel, running northwards. The crossing is at the base of a 30 m slope on its east bank, 500 m downstream of a confluence of a tributary that carries runoff from slightly raised terrain to the southeast and a network of streams that drain slightly flatter terrain to the southwest. The creek runs towards the north and eventually joins the Miner River.
- 1470F (Map 07) is a 3 m to 10 m wide channel with originates from North Caribou Lake, approximately 2 km to the northeast. The creek has very little relief on either side and runs southwest at the crossing; however it is a tributary of a river system which flows northwards.
- 1430J (Map 15) – Travaillant River. The bridge crossing over the Travaillant River is located approximately 600 m upstream of Wood Bridge Lake. The crossing is approximately 25 km upstream

of WSC Station Travaillant River Above Travaillant Lake (10LB006), which has recorded six years of hydrological data between 2004 and 2009. The channel at the crossing has 80 m of relief on either bank, gradually sloping to the floodplain.

The Travaillant River passes through Wood Bridge Lake and a smaller lake prior to the hydrometric station, which is located approximately six km upstream of Travaillant Lake. Downstream of Travaillant Lake, the Travaillant River flows east and then west through several kilometres of meanders before its confluence with the Mackenzie River.

Based on the 6-year period of record, freshet typically causes a sharp rise in discharge, occurring over a period of a week to 10 days at the beginning of June and has an average peak discharge of 30 m^3/s. The highest peak freshet discharge recorded was 45 m^3/s (estimated) and the minimum was 12.5 m^3/s. Baseline summer flows are typically less than 3 m^3/s (Figure 10.7.2.1-1).

Due to the natural controls of the lakes and the distance between the crossing and the station, discharges recorded at 10LB006 likely differ from those at the bridge crossing.

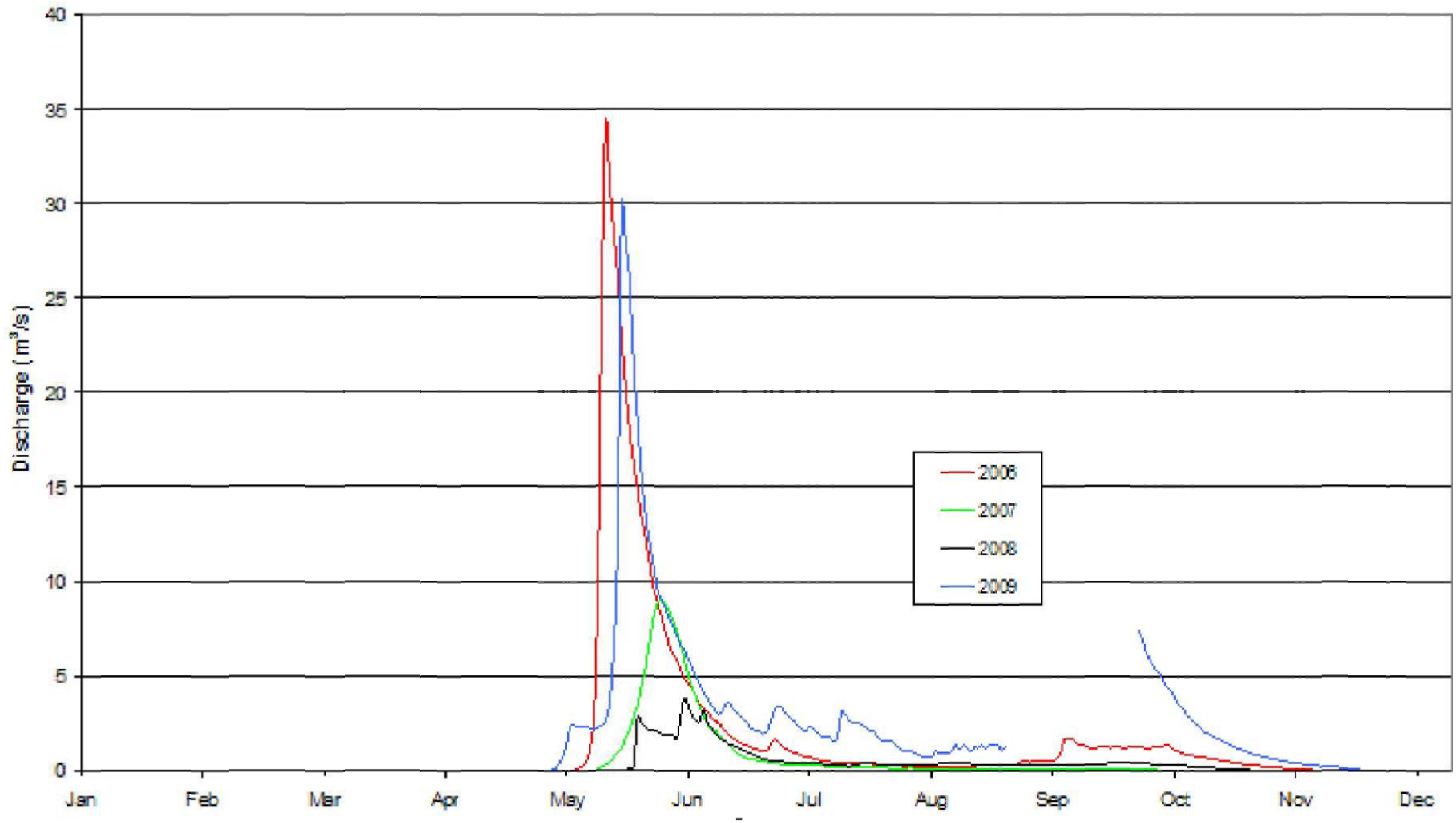
- 1430B (Map 16) is a 3 m to 10 m wide channel which originates at a group of upstream lakes in a pocket of low terrain. The stream is a tributary of the Travaillant River, with its confluence approximately 2 km downstream. The confluence is 17 km upstream of hydrometric station 10LB006.
- 1410D (Map 20) is a 3 m to 10 m wide channel which connects two lakes, above Travaillant Lake. The channel is approximately 500 m long and has less than 5 m of relief on either bank.
- 1360D (Map 31) – Thunder River. The crossing over the Thunder River is approximately 6 km upriver of WSC hydrometric station Thunder River Near the Mouth (10LB006). The station has recorded four years of hydrometric data (2006 to 2009). The station is approximately 3 km from the confluence with the Mackenzie River. The river has a relatively straight morphology and is confined in an incised channel with 80 m of relief on either side.

  Discharge patterns at 10LB006 are likely characteristic of those at the crossing upstream, but would likely be somewhat higher due to a larger drainage area, including two tributaries of the Thunder River located near the Mackenzie River.

  The four year hydrograph is plotted on Figure 10.7.2.1-2. Based on the period of record, freshet at the crossing typically occurs in early to late May. The freshet causes a sharp rise in discharge, occurring over a period of a week to 10 days. The freshet peak has ranged from 5 m^3/s to 35 m^3/s, although peak discharges recorded in 2006 (34.3 m^3/s) and 2009 (30 m^3/s) may have been the result of snow dam breaching, peaking over the course of two or three days. Furthermore, WSC has stated that discharges over 20 m^3/s are likely erroneous for this station. Baseline flows are typically less than 0.5 m^3/s; however, the 2009 data shows higher baseline flows, over 1.5 m^3/s, with short period increases to 3.5 m^3/s due to precipitation events.

The 43 perennial streams that do not require bridge crossings are characterized by a channel width of between approximately 1 m and 3 m, and are not confined to an incised channel, gully, or ravine. The ephemeral streams are characterized as drainages without a defined channel, varying in widths between 1 m and 30 m with water existing intermittently through dense in-stream vegetation.

M:\TRANSPORTATION\NWT_Mackenzie_Highway\V33101053_Gwich'in\Maps\Overview Map\V33101053_Figure10.7.2.1-2.mxd modified 4/25/2011 by brittney.aldous



NOTES

Source: Water Survey of Canada

** 2004 All discahrges above 25.0 m³/s considered estimates.
** 2005 Discharges above 14.0 m³/s are to be used with discretion.
** 2006 Open water record and considered good.
** 2007 Open water record and considered good.
** 2008 Open water record and considered good.
** 2009 Open water record and considered good.

STATUS
ISSUED FOR USE

FILE NO.
V33101053_Figure10.7.2.1-2.mxd

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Travaillant River Above Travaillant Lake
Discharge Hydrograph
(2006 - 2009)

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Northwest Territories
Nehtruh - EBA

Figure 10.7.2.1-1

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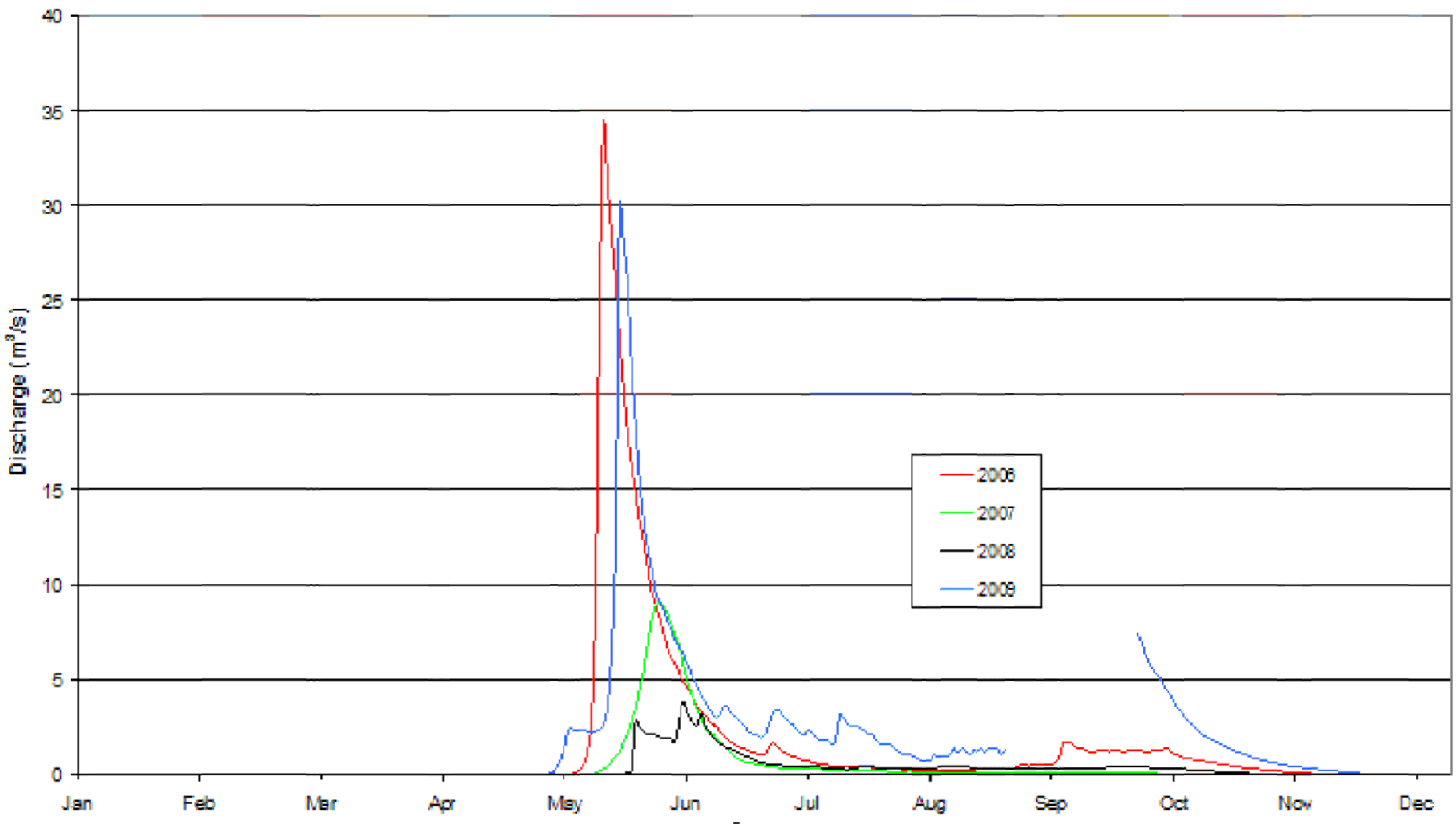


NOTES

Source: Water Survey of Canada

** 2006 record is fair. Use breakup and freezeup with discretion. E's above 20 m³/s.
** 2007 record is fair. Use breakup and freezeup with discretion.
** 2008 record is fair. Curve is not well defined. Use May with discretion.

STATUS
ISSUED FOR USE

FILE NO.
V33101053_Figure10.7.2.1-1.mxd

Northwest Territories

Nehtruh - EBA

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Thunder River Near the Mouth Discharge Hydrograph (2006 - 2009)

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure 10.7.2.1-2

10.8 Communities and Demographics

The socio-economic study area for the Highway includes each of the four communities in the GSA. These communities are likely to experience effects due to their proximity to the Highway, the increased connectivity between communities that will arise from the Mackenzie Valley Highway extension, as well as their possible contributions to the project workforce. On this basis, this section describes the communities of Aklavik, Inuvik, Fort McPherson, and Tsiigehtchic. The communities' geographic locations in relation to the Highway are shown on Figure 10.8-1. Communities outside of the GSA are considered potentially affected communities, but these are included in the regional PDRs being produces for other segments of the Mackenzie Valley Highway.

Community profile information was obtained from several primary and secondary resources, such as the GNWT Bureau of Statistics, Legislative Assembly of Northwest Territories, and available information from each Town, Hamlet, or Charter Community. The statistical data used to prepare the figures and tables in this section are included in the appendix entitled "Community Data".

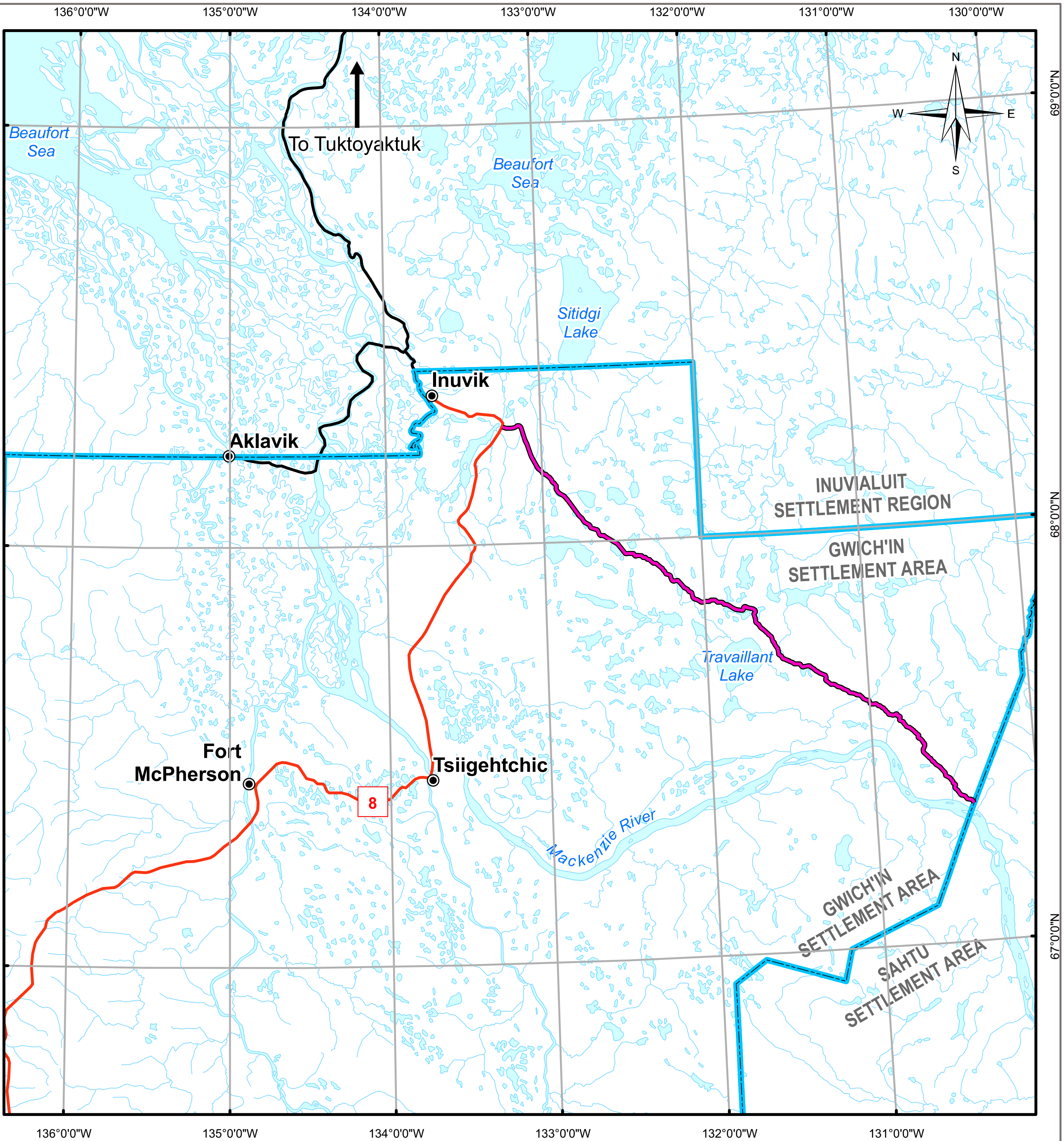
10.8.1 Aklavik Community Profile

10.8.1.1 Background

The Hamlet of Aklavik is located on the west shore of the Peel Channel in the Mackenzie Delta (Figure 10.8-1). It is accessible by air from Inuvik year round and an ice road connects Aklavik to Inuvik and other communities in the winter. During the summer months, a barge is used to transports bulk supplies and food to the community [Legislative Assembly of the Northwest Territories ND(a)].

Aklavik has historically been populated by Gwich'in, Inuvialuit, Metis, and non-aboriginal cultures. Small trading posts were established in the area by 1910 and in 1912, the Hudson's Bay Company founded a post at Pokiak, an Inuvialuit camp located across the river. With the growth of the fur trade, the Hudson's Bay Company moved their post to Aklavik in 1918, and this started the permanent settlement of Aklavik (Hamlet of Aklavik 2010; Outcrop Ltd. 1990).

The community became the primary trapping, commercial, and transportation centre of the Western Arctic. In the 1920s, the Anglican and Roman Catholic missions, the western Arctic headquarters of the RCMP, and a Royal Canadian Corps of Signals station were established in the community. During the winter of 1931/1932, the community was the scene of the famous RCMP manhunt and eventual burial for the "Mad Trapper of Rat River." The population increased to approximately 1,600 by 1952, with the expansion of the mission hospitals, residential school, and government regional administrative offices. Due to serious flooding and erosion problems, the federal government recommended the community be relocated to a new site, called East Three (Inuvik). The new town of Inuvik was completed in 1961 and all major facilities were transferred there; however, many residents remained in Aklavik. While Aklavik's population has declined and the community is no longer a regional centre, its inhabitants proudly call it "the town that wouldn't die" [Hamlet of Aklavik 2010; Legislative Assembly of the Northwest Territories ND(a); Outcrop Ltd. 1990].



LEGEND

- Communities
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- Public Winter Road
- Settlement Area Boundary
- Waterbody
- River

NOTES
Base data source: NTS 1:250,000
Alignment is considered preliminary and is subject to change

MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA

Communities in the Vicinity of the Proposed Highway

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:1,500,000
20 10 0 20
Kilometres

Northwest Territories
Nehtruh - EBA

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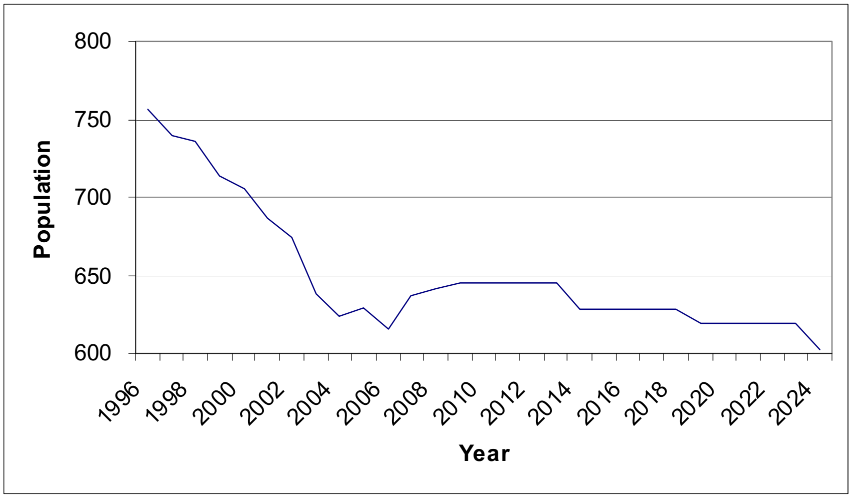
V33101053	BA	MS	RM	0
OFFICE	DATE			
EBA-RIV	May 10, 2011			

STATUS
ISSUED FOR USE

Figure 10.8-1

10.8.1.2 Population

The historical and projected population data for Aklavik are provided on Figure 10.8.1.2-1. Aklavik's population has decreased from 756 to 645 between 1996 and 2009, indicating an average annual growth rate of -1.2 since 1996 (GNWT Bureau of Statistics 2010). Between 2004 and 2006, the population decreased to a low of 616 residents. The population is projected to continue to decrease from 2009 until 2024. Approximately 91.6% of Aklavik's population is Aboriginal (GNWT Bureau of Statistics 2010).

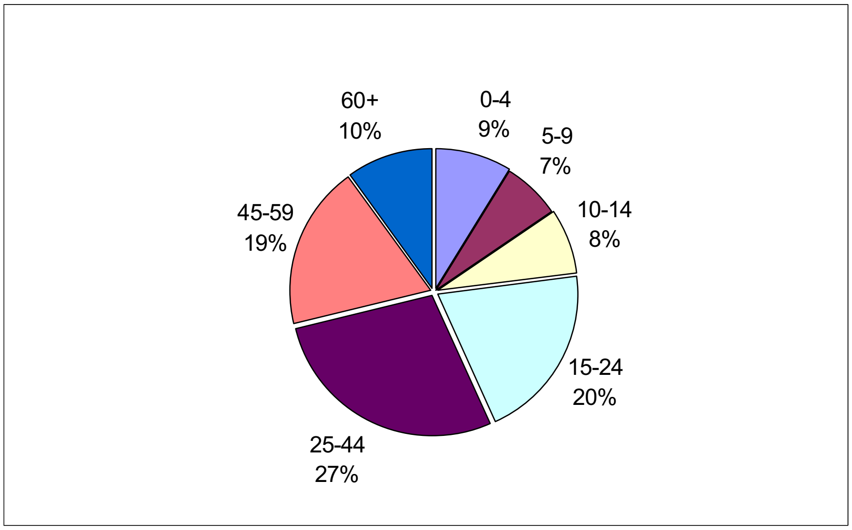


Source: GNWT Bureau of Statistics (2010)

Figure 10.8.1.2-1
Aklavik Historic and Projected Population, 1996 to 2024.

From 1998 to 2007, there were between 2 and 13 births each year, with an average of 9.3 births per year over the 10 year period. The number of teen births (births to women aged 19 years or less) ranged between 0 and 6 from 1998 to 2007, with an average of 1.6 teen births per year. The annual death rates have fluctuated between 4 and 11 deaths reported per year between 1997 and 2006 (GNWT Bureau of Statistics 2010).

The population by age and gender are presented on Figure 10.8.1.2-2 and Table 10.8.1.2-1, respectively. The population in Aklavik is relatively young, with 71% of the population aged 44 or younger. There are a greater number of males than females in the community (GNWT Bureau of Statistics 2010).



Source: GNWT Bureau of Statistics (2010)

Figure 10.8.1.2-2
Aklavik Population by Age Group, 2009.

Table 10.8.1.2-1: Aklavik Population by Gender, 2009

Gender	Population	Percent
Male	352	54.6%
Female	293	45.4%

Source: GNWT Bureau of Statistics (2010).

10.8.1.3 Employment

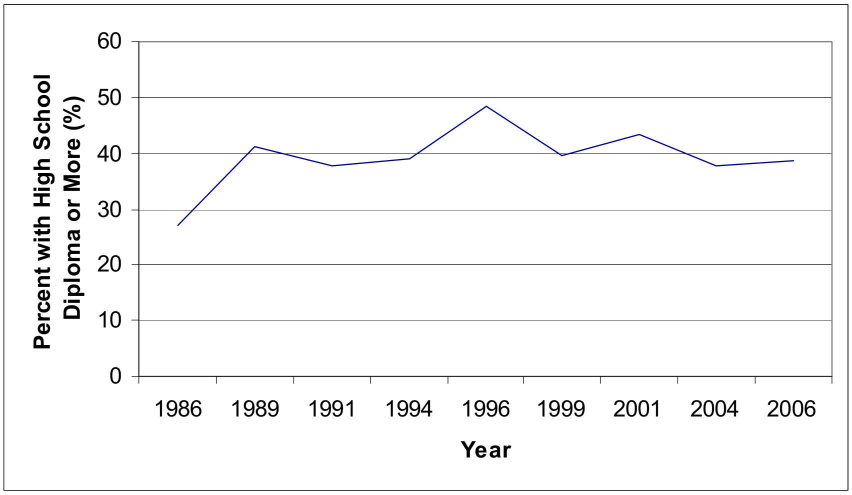
Community employment data for Aklavik are provided on Figure 10.8.1.3-1. In 2006, 440 residents were aged 15 years and older. Employment data indicates that 185 residents were employed, 55 residents were unemployed, and 195 residents were not in the labour force. The GNWT Bureau of Statistics does not provide an explanation as to why the number of people employed, unemployed, and not in the labour force do not equal the number of people aged 15 and older. Of the 240 Aklavik residents in the labour force, this translates into a participation rate (the percentage of persons 15 years of age and over who are in the labour force) of 54.5% and an unemployment rate of 22.9%. Since 1986, the general trend for Aklavik indicates a decline in unemployment over time. The trend of the employment rate indicates an increase over time, but since 1999, the employment rate has remained fairly constant (GNWT Bureau of Statistics 2010).

Source: GNWT Bureau of Statistics (2010).

Figure 10.8.1.3-1
Aklavik Employment and Unemployment Rates, 1986 to 2006.

10.8.1.4 Education

The percent of residents achieving a high school diploma has increased overall since 1986 (Figure 10.8.1.4-1). The percentage of people achieving a high school diploma was 27.0% in 1986; this increased to 48.4% in 1996 and has since declined to 38.6% in 2006 (GNWT Bureau of Statistics 2010). Of those employed in 2006, 63.6% had a high school diploma or a higher qualification, whereas 31.5% had less than a high school diploma (GNWT Bureau of Statistics 2010). The GNWT Bureau of Statistics does not provide an explanation as to why the total percentage of employed people (with or without diplomas) does not equal 100%.



Source: GNWT Bureau of Statistics (2010).

Figure 10.8.1.4-1
Aklavik Educational Levels, 1986 to 2006.

10.8.2 Inuvik Community Profile

10.8.2.1 Background

The Town of Inuvik is located on the east channel of the Mackenzie River Delta (Figure 10.8-1) and is within the GSA. Inuvik is accessible year round by air. It is accessible by the Dempster Highway year round except during freeze-up (fall) and break-up (spring) of the river crossings. Ice roads also link Inuvik with Aklavik and Tuktoyaktuk during the winter months [Legislative Assembly of the Northwest Territories ND(b)].

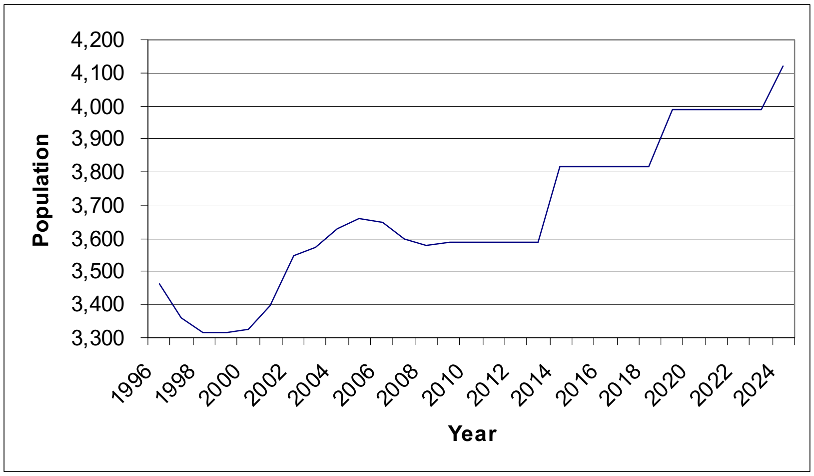
The Gwich'in and the Inuvialuit traditionally hunted and fished in the region of Inuvik and Alexander Mackenzie paddled by the present site as early as 1789 on his journey to the Arctic Ocean. Inuvik was seldom visited until 1954, when it became the site selected for the relocation of the Hamlet of Aklavik following the severe flood damage in Aklavik in the 1950s. The site was selected because of its large, level area, the opportunities for modern airport facilities, and the presence of gravel materials for construction. Originally known as East Three, the Town of Inuvik was constructed between 1955 and 1961. Inuvik is the Northwest Territory's first modern planned town and is the largest Canadian community north of the Arctic Circle.

By 1961, the community boasted a government dock, bank, temporary school, airport, water and sewage systems, RCMP station, and nursing station. With the discovery of oil in the Beaufort Sea, the population of Inuvik increased significantly. In 1986, the Canadian Armed Forces station closed, causing the population to decline by 700 residents. The station was converted into the Aurora College Campus. Inuvik continues to be the Forward Operating Location for F18 military jets and is the resupply base for the western portion of the North Warning System.

With the collapse of oil prices in 1986, oil exploration activities declined. With the uncertainty in oil, attention has shifted to natural gas. If the recently approved MGP is constructed, the community is projected to increase in population. Currently, the economy is based on regional government services, oil and gas exploration, and other services [Town of Inuvik 2010; Legislative Assembly of the Northwest Territories ND(b); Outcrop Ltd. 1990].

10.8.2.2 Population

The historic and projected population data for Inuvik are provided on Figure 10.8.2.2-1. Inuvik's population has increased from 3,461 to 3,586 between 1996 and 2009, indicating an average annual growth rate of 0.3 since 1996. Between 1996 and 2001, the population decreased to a low of 3,313. The population is projected to increase significantly between 2010 and 2024. Approximately 62.9% of Inuvik's population is Aboriginal (GNWT Bureau of Statistics 2010).

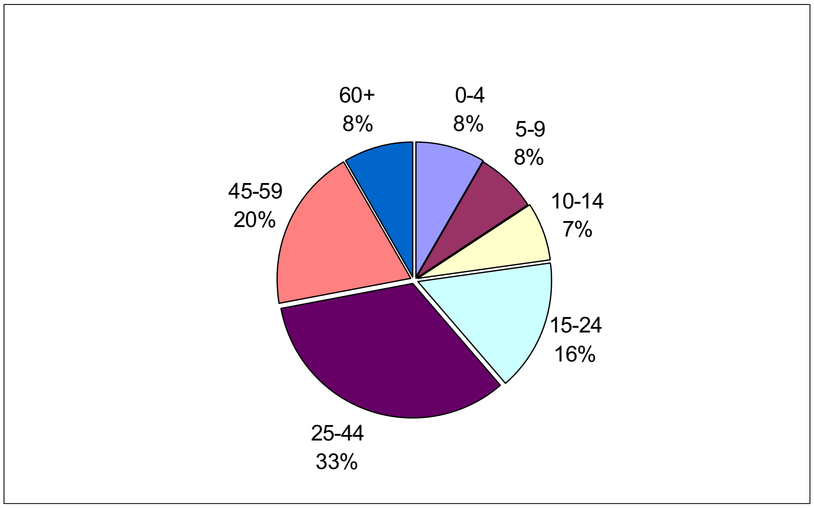


Source: GNWT Bureau of Statistics (2010).

Figure 10.8.2.2-1
Inuvik Historic and Projected Population, 1996 to 2024.

From 1998 to 2007, there were 48 to 79 births each year, with an average of 63.9 births per year over the 10 year period. The number of teen births (births to women aged 19 years or less) ranged from 3 to 13 between 1998 and 2007, with an average of 7.7 teen births per year. The annual death rates have fluctuated between 9 and 20 deaths reported per year between 1997 and 2006 (GNWT Bureau of Statistics 2010).

The population by age and gender are presented on Figure 10.8.2.2-2 and Table 10.8.2.2-1, respectively. The population in Inuvik is relatively young, with 72% of the population aged 44 or younger. There are a greater number of males than females in the community (GNWT Bureau of Statistics 2010).



Source: GNWT Bureau of Statistics (2010).

Figure 10.8.2.2-2
Inuvik Population by Age Group, 2009.

Table 10.8.2.2-1: Inuvik Population by Gender, 2009

Gender	Population	Percent
Male	1,817	50.6%
Female	1,769	49.4%

Source: GNWT Bureau of Statistics (2010).

10.8.2.3 Employment

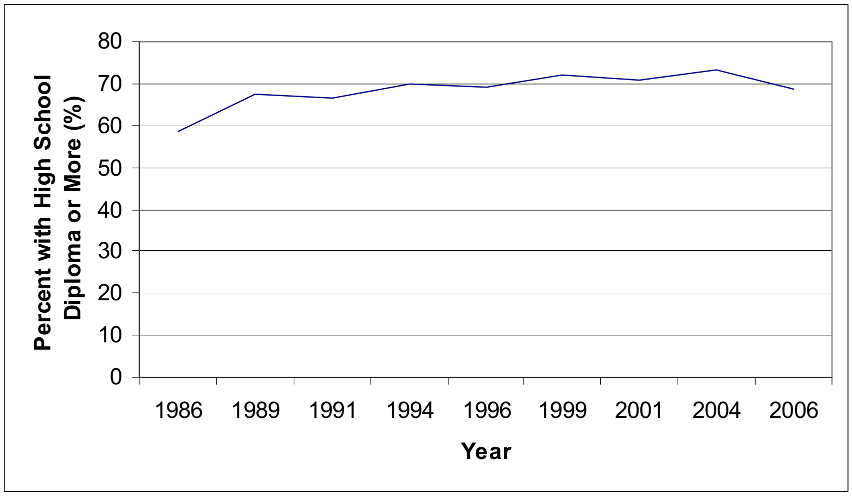
Community employment data for Inuvik are provided on Figure 10.8.2.3-1. In 2006, 2,570 residents were aged 15 years and older. Employment data indicates that 1,825 residents were employed, 230 residents were unemployed, and 515 residents were not in the labour force. Of the 2,055 Inuvik residents in the labour force, this translates into a participation rate (the percentage of persons 15 years of age and over who are in the labour force) of 79.8% and an unemployment rate of 11.2%. Since 1986, the general trend for Inuvik indicates a very slight decline in employment over time, while the unemployment rate has remained fairly constant. This is likely due to the consistent work opportunities in the area (GNWT Bureau of Statistics 2010).

Source: GNWT Bureau of Statistics (2010).

Figure 10.8.2.3-1
Inuvik Employment and Unemployment Rates, 1986 to 2006.

10.8.2.4 Education

The percent of residents achieving a high school diploma has generally increased since 1986 (Figure 10.8.2.4-1). In 1986, 58.7% of the Inuvik population had completed high school, compared to 68.8% in 2006 (GNWT Bureau of Statistics 2010). Of those employed in 2006, 83.2% had a high school diploma or higher qualification, whereas 43.2% had less than a high school diploma (GNWT Bureau of Statistics 2010). The GNWT Bureau of Statistics does not provide an explanation as to why the total percentage of employed people (with or without diplomas) does not equal 100%.



Source: GNWT Bureau of Statistics (2010).

Figure 10.8.2.4-1
Inuvik Educational Levels, 1986 to 2006

10.8.3 Fort McPherson Community Profile

10.8.3.1 Background

The Hamlet of Fort McPherson is located on the east bank of the Peel River. Fort McPherson is accessible year round by air and road (Dempster Highway), with the exception of break-up and freeze-up periods of the river crossings [Legislative Assembly of the Northwest Territories ND(c)].

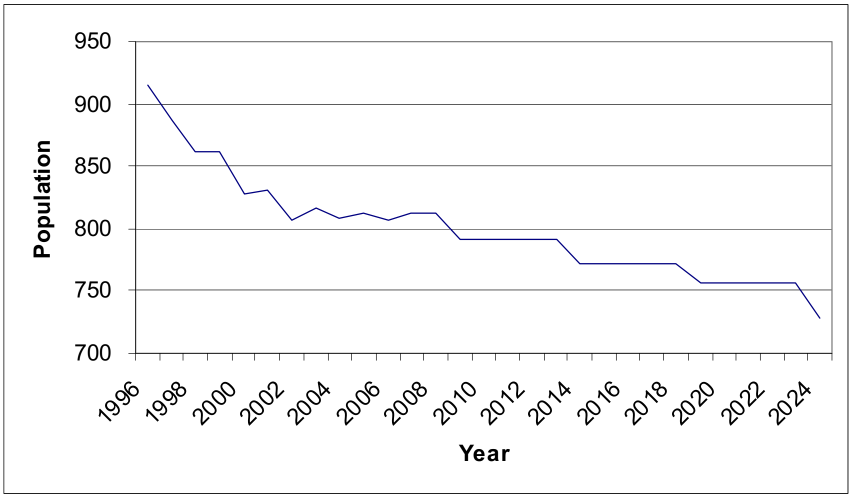
Historically, the area of Fort McPherson was used by the Gwich'in. Sir John Franklin was in the area during his second expedition (1825 to 1828) and advised the Hudson's Bay Company that the area was rich in furs. The Hudson's Bay Company first established a post on the Peel River in 1840, which was relocated 6 km downriver in 1848 to its present location. The area was named after Murdoch McPherson, the chief trader for the Hudson's Bay Company. By 1852, a Loucheux village moved to Fort McPherson and an Anglican Mission was established in 1860. The RCMP built a detachment post in 1903 for its regular patrols through the Mackenzie Mountains from Dawson City to Fort McPherson. In 1918 and 1919, the influenza epidemic was brought north by the sternwheelers traveling the Mackenzie River, killing large parts of the population. The Loucheux maintained their traditional hunting lifestyle well into the 1960s. The current economy is based on hunting, trapping, and oil exploration [GSCI 2010; Legislative Assembly of the Northwest Territories ND(c); Outcrop Ltd. 1990].

Several notable Gwich'in and Metis leaders have called Fort McPherson home: Mr. John Tetlichi, the first aboriginal member of the Northwest Territories Territorial Council; Mr. Wally Firth, the first northern aboriginal Member of Parliament; and Mr. Richard Nerysoo, the first elected Northwest Territories government leader of Aboriginal descent.

The traditional name for the community is Teetl'it zheh, named after the Gwich'in name for the Peel River, Teetl'it njik (GSCI 2010).

10.8.3.2 Population

The historic and projected population data for Fort McPherson are provided on Figure 10.8.3.2-1. Fort McPherson's population has decreased from 915 to 791 between 1996 and 2009, indicating an average annual growth rate of -1.1 since 1996 (GNWT Bureau of Statistics 2010). The population's steepest decline occurred between 1996 and 1998, with the population stabilizing between 2002 and 2008. The population is projected to continue to decrease in 2014, 2019, and 2024. Approximately 93.3% of Fort McPherson's population is Aboriginal (GNWT Bureau of Statistics 2010).

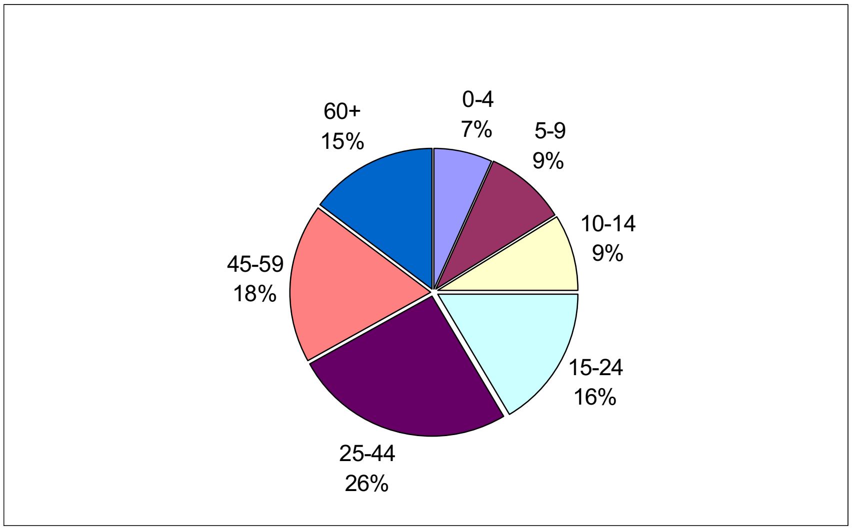


Source: GNWT Bureau of Statistics (2010).

Figure 10.8.3.2-1
Fort McPherson Historic and Projected Population, 1996 to 2024.

From 1998 to 2007, there were between 3 and 20 births each year, with an average of 12.4 births per year over the 10 year period. The number of teen births (births to women aged 19 years or less) ranged from 0 to 3 between 1998 and 2007, with an average of 1.4 teen births per year. The annual death rates have fluctuated between 2 and 9 deaths reported per year between 1997 and 2006 (GNWT Bureau of Statistics 2010).

The population by age and gender are described on Figure 10.8.3.2-2 and Table 10.8.3.2-1, respectively. The population in Fort McPherson is relatively young, with 67% of the population aged 44 or younger. There are a greater number of males than females in the community (GNWT Bureau of Statistics 2010).



Source: GNWT Bureau of Statistics (2010).

Figure 10.8.3.2-2
Fort McPherson Population by Age Group, 2009.

Table 10.8.3.2-1: Fort McPherson Population by Gender, 2009

Gender	Population	Percent
Male	420	53.1%
Female	371	46.9%

Source: GNWT Bureau of Statistics (2010).

10.8.3.3 Employment

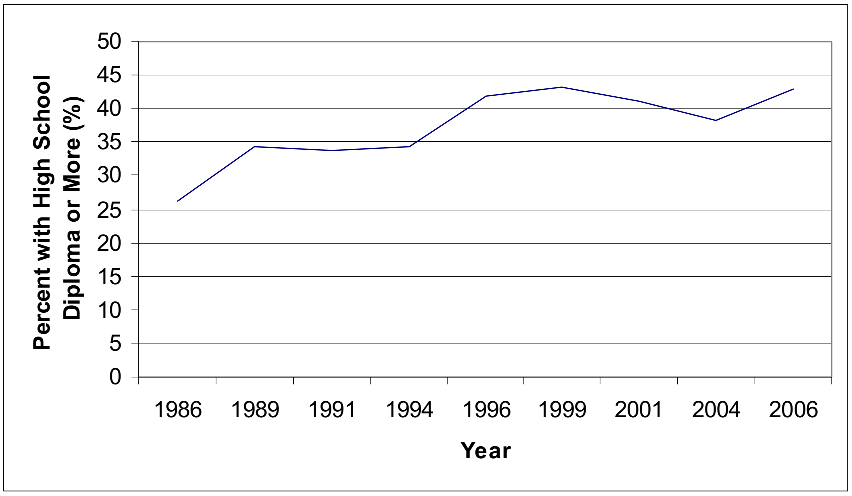
Community employment data for Fort McPherson are provided on Figure 10.8.3.3-1. In 2006, 570 residents were aged 15 years and older. Employment data indicates that 240 residents were employed, 95 residents were unemployed, and 235 residents were not in the labour force. Of the 335 Fort McPherson residents in the labour force, this translates into a participation rate (the percentage of persons 15 years of age and over who are in the labour force) of 58.8% and an unemployment rate of 28.4%. Since 1986, the general trend for Fort McPherson indicates an overall increase in employment over time, with periods of significant increase and decrease. Similarly, unemployment rates have experienced periods of significant increase and decrease, but have remained relatively constant overall (GNWT Bureau of Statistics 2010).

Source: GNWT Bureau of Statistics (2010).

Figure 10.8.3.3-1
Fort McPherson Employment and Unemployment Rates, 1986 to 2006.

10.8.3.4 Education

The percent of residents achieving a high school diploma has increased since 1986 (Figure 10.8.3.4-1). In 1986, 26.2% of the Fort McPherson population had completed high school, compared to 43.0% in 2006. Of those employed in Fort McPherson in 2006, 66.7% had a high school diploma or greater, whereas 23.9% had less than a high school diploma (GNWT Bureau of Statistics 2010). The GNWT Bureau of Statistics does not provide an explanation as to why the total percentage of employed people (with or without diplomas) does not equal 100%.



Source: GNWT Bureau of Statistics (2010).

Figure 10.8.3.4-1
Fort McPherson Educational Levels, 1986 to 2006.

10.8.4 Tsiigehtchic Community Profile

10.8.4.1 Background

Tsiigehtchic also known as the Charter Community of Arctic Red River, is located at the confluence of the Mackenzie River and the Arctic Red River (Figure 10.8-1). The community is accessible by road (Dempster Highway) with the exception of break-up and freeze-up periods of the river crossings and is also accessible from Inuvik and Fort McPherson by ferry and by barge from Hay River in July [Legislative Assembly of the Northwest Territories ND(d)]. Tsiigehtchic does not have an airstrip, so helicopter is the only means of accessing the community during the break-up and freeze-up period.

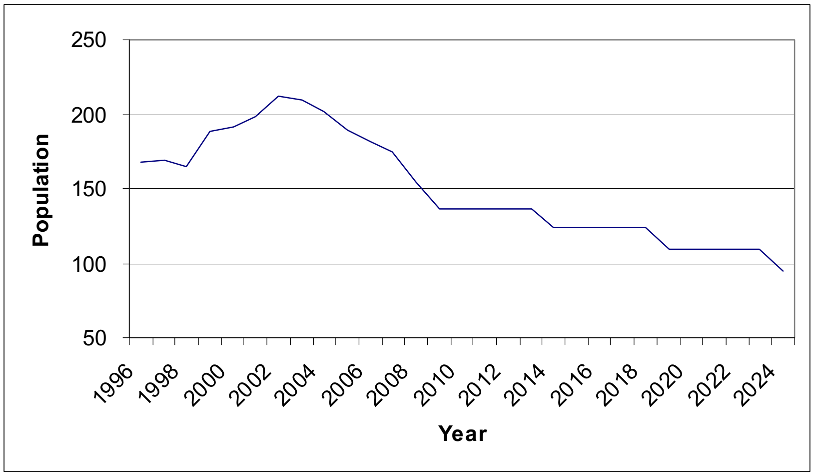
Formerly called Arctic Red River, the community officially changed its name to Tsiigehtchicin 1994.

This location has a very long history as a summer fish camp for the Gwichya Gwich'in and was the site of many gatherings and trade between the Gwichya Gwich'in, Dene, and Inuvialuit (GSCI 2010).

Missionaries established a Roman Catholic Church in the area in 1868, which was followed by a Hudson's Bay Company trading post in the early 1870s. Many families continued to winter in the mountains until the 1960s, with only a few families living year-round in the community. Construction of the Dempster Highway in the 1970s brought wage based employment opportunities, and some local residents operate the ferry that carries summer traffic across the Mackenzie and the Arctic Red Rivers. With access to larger communities, Tsiigehtchic attracted more residents. Traditional activities of trapping, fishing, and hunting are still conducted, while other jobs are provided by the ferry crossing and local store/post office [GSCI 2010; Legislative Assembly of the Northwest Territories ND(d); Outcrop Ltd. 1990].

10.8.4.2 Population

The historic and projected population data for Tsiigehtchic are provided on Figure 10.8.4.2-1. Tsiigehtchic's population has decreased from 168 to 136 between 1996 and 2009, indicating an average annual growth rate of -1.6 since 1996 (GNWT Bureau of Statistics 2010). Between 1998 and 2002, the population increased to a high of 212, but has since decreased to 136. The population is projected to decrease to less than 100 residents by 2024. Approximately 94.9% of Tsiigehtchic's population is Aboriginal (GNWT Bureau of Statistics 2010).

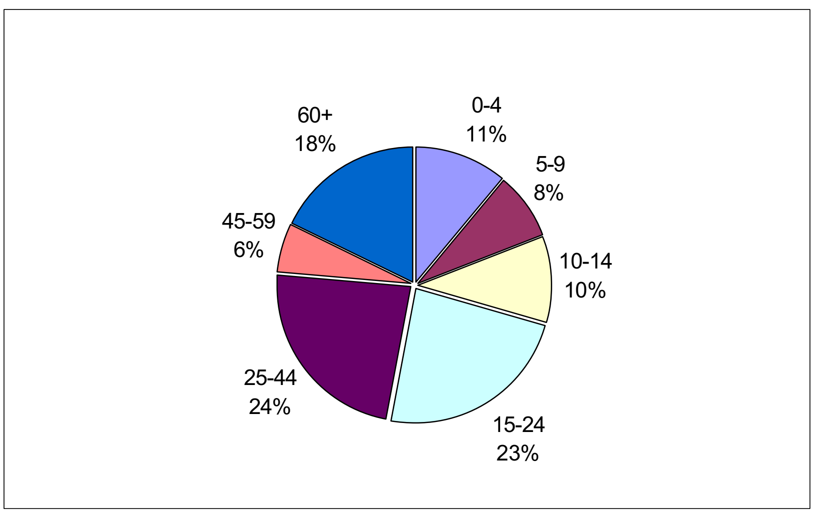


Source: GNWT Bureau of Statistics (2010).

Figure 10.8.4.2-1
Tsiigehtchic Historic and Projected Population, 1996 to 2024.

From 1998 to 2007, there were between 2 and 7 births each year, with an average of 4.3 births per year over the 10 year period. The number of teen births (births to women aged 19 years or less) ranged from 0 to 2 between 1998 and 2007, with an average of 0.7 teen births per year. The annual death rates have fluctuated between 0 and 4 deaths reported per year between 1997 and 2006 (GNWT Bureau of Statistics 2010).

The population by age and gender are described on Figure 10.8.4-2 and Table 10.8.4-1, respectively. The population in Tsiigehtchic is relatively young, with 76% of the population aged 44 or younger. There are a slightly greater number of females than males in the community (GNWT Bureau of Statistics 2010).



Source: GNWT Bureau of Statistics (2010).

Figure 10.8.4-2
Tsiigehtchic Population by Age Group, 2009.

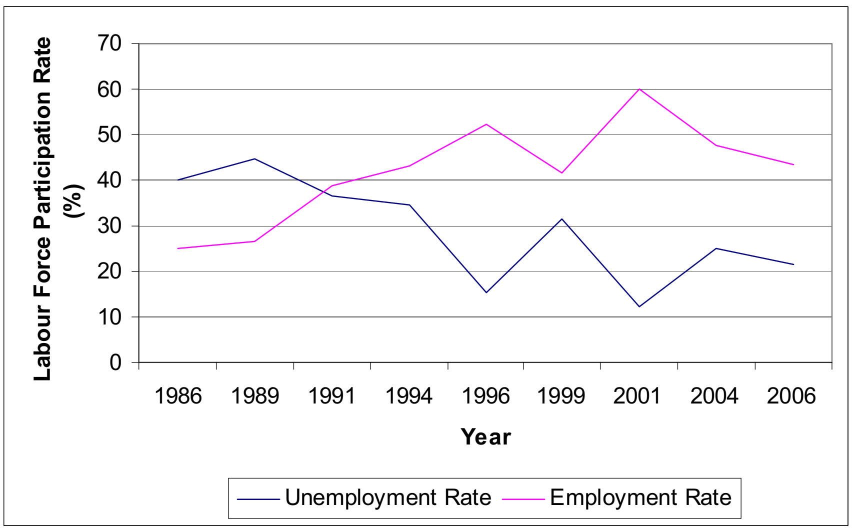
Table 10.8.4.2-1: Tsiigehtchic Population by Gender, 2009

Gender	Population	Percent
Male	67	49.3%
Female	69	50.7%

Source: GNWT Bureau of Statistics (2010).

10.8.4.3 Employment

Community employment data for Tsiigehtchic are provided on Figure 10.8.4.3-1. In 2006, 115 residents were aged 15 years and older. Employment data indicate that 50 residents were employed, 15 residents were unemployed, and 50 residents were not in the labour force. Of the 65 Tsiigehtchic residents in the labour force, this translates into a participation rate (the percentage of persons 15 years of age and over who are in the labour force) of 60.9% and an unemployment rate of 21.4%. Since 1986, the general trend for Tsiigehtchic indicates an increase in employment and a decrease in unemployment over time (GNWT Bureau of Statistics 2010).

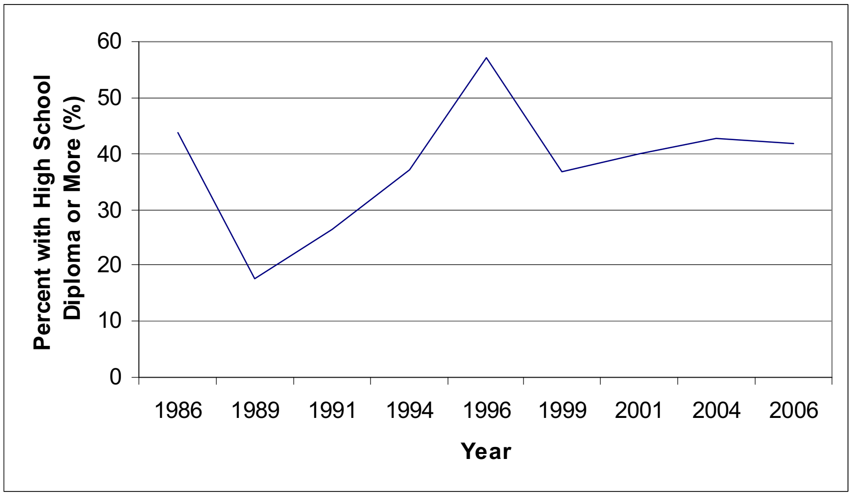


Source: GNWT Bureau of Statistics (2010).

Figure 10.8.4.3-1
Tsiigehtchic Employment and Unemployment Rates, 1986 to 2006.

10.8.4.4 Education

The percent of residents achieving a high school diploma has had significant fluctuations since 1986, but overall has decreased slightly (Figure 10.8.4.4-1). In 1986, 43.8% of the population had completed high school, compared to 41.7% in 2006. Significant fluctuations occurred in 1989 when the percentage declined to 17.7%, and then rose to a high of 57.1 in 1996 (GNWT Bureau of Statistics 2010). Of those employed in Tsiigehtchic in 2006, 63.6% had a high school diploma or higher qualification, whereas 21.4% had less than a high school diploma (GNWT Bureau of Statistics 2010). The GNWT Bureau of Statistics does not provide an explanation as to why the total percentage of employed people (with or without diplomas) does not equal 100%.



Source: GNWT Bureau of Statistics (2010).

Figure 10.8.4.4-1
Tsiigehtchic Educational Levels, 1986 to 2006.

11.0 ANTICIPATED ENVIRONMENTAL EFFECTS AND PROPOSED MITIGATION

The Valued Components (VCs) presented in this PDR, draw from the extensive Cumulative Effects Assessment (CEA) completed for the MGP (IOL et al. 2004) and from the scoping studies completed for DOT in 1999.

The VCs that have been identified for the Highway include:

- climate (including air quality, noise and climate change);
- terrain and topography (including permafrost and geohazards);
- vegetation (including rare plants);
- wildlife;
- fish and fish habitat;
- hydrology;
- communities and demographics;
- traditional and other land uses (including heritage resources);
- safety; and
- the economy.

The overview information relative to the Highway for each of the VCs is presented in the previous sections of this PDR.

The following section reviews the proposed activities for construction of the Highway, assesses the potential environmental effects and impacts, and describes mitigation measures. It includes discussion of all of the above VCs with the exception of the economy. The economic impact of the Mackenzie Valley Highway is discussed in Section 12 and the cumulative effect of the Highway combined with other projects is discussed in Section 13.

This PDR focuses on the construction of the Highway; however, some a brief discussion of selected activities for operation, maintenance and preservation of the Highway is presented to address questions that were raised in the consultations.

11.1 Approach to Environmental Management

The Proponent is committed to constructing the Highway, borrow sources, and associated winter access roads in a safe and environmentally responsible manner and will deliver the project in a framework of environmental management for the construction of the Highway that includes the following:

- Regulatory and other management instruments that define environmental terms and conditions, including:

- Land and Water Board preliminary screening decision, including recommended Terms and Conditions;
- Land Use Permit Terms and Conditions;
- Quarry Permit Terms and Conditions;
- Water Licence Terms and Conditions;
- Navigable Waters Protection Act Approval Terms and Conditions;
- Conformance with DFO Operational Statements, Letters of Advice and potential Fisheries Authorization(s); and
- Directions from the GTC, DGOs, RRCs, Bands and Band councils, and the GRRB.

- Avoidance and protection of sensitive terrain and habitats.
- Avoidance of identified heritage and traditional values and archaeological sites.
- Hiring environmental monitors and wildlife monitors with experience on the land and knowledge of the area.
- Hiring experienced and qualified construction contractors.
- Requiring contractors to develop and implement management plans that include:
  - contractor HSE manuals including general spill contingency and emergency response plans (an example of a fuel spill contingency plan is included in Appendix G);
  - contractor work procedures documents;
  - site-specific health and safety plans; and
  - site-specific spill contingency plans.
- Monitoring and enforcing contractor compliance in the delivery of activities within the prescribed management plans.

11.2 Effects on Climate (Air Quality, Noise, and Climate Change)

11.2.1 Air Quality

Dust and air emissions associated with the construction of the Highway and borrow sources are expected to have localized and temporary effects on air quality in the vicinity of the Highway.

Dust particles of various sizes will be generated by handling of embankment and granular materials in borrow sources and along the Highway during construction. Dust is also generated by vehicles travelling along the Highway during construction and after the Highway is in operation. Dust control products such as calcium and magnesium chloride that are traditionally used in spot applications each year as part of highway maintenance, can coat granular dust particles and the chemical can become airborne with the dust particle as the dust control application nears the end of its serviceable life (a few months without rewatering). Larger particles (>44 microns diameter) are typically associated with nuisance issues, while smaller particles (<10 microns diameter) can potentially create human health issues at elevated levels in populated areas.

The application of water from nearby, suitable lakes, as per the GNWT Guideline for Dust Suppression (GNWT 1998), will be effective during summer construction periods in controlling dust created by loading and unloading materials, stockpiling, and wind erosion. Any water extracted for dust control or other purposes will be undertaken in accordance with Northwest Territories Water Licence requirements and DFO water withdrawal criteria.

Once the Highway is in operation, dust control applications with products other than water will be undertaken in selected areas, such as curves and approaches to waterbodies. Products other than calcium and magnesium chloride have been discussed in Section 6.0.

Emissions from diesel engine combustion exhaust during construction and operation will be generated and will negatively impact air quality in the local area around where the equipment is operating at the particular time. To minimize emissions from construction and maintenance equipment, contractors will be required to keep equipment well maintained and in good operating conditions, and to minimize unnecessary idling even during winter months. Power sources and heated maintenance facilities will be included at construction and maintenance camps to minimize the need to keep a vehicle or equipment running during cold weather.

11.2.2 Noise

Most of the noise during the construction phase will be associated with equipment operation and, if required, blasting activities to break up the frozen material in a borrow site. Increases in noise level and unfamiliar noise will disturb wildlife.

Trucks will typically be dump trucks or other haul trucks, operating at slow speeds. Noise levels associated with such trucks are typically within 78 dBA to 82 dBA at 15 m from the truck. This noise level is low and the impact will be to the local area within which the specific activity is taking place.

Although there are no local noise regulations that directly apply to construction, the contractors will be directed to apply reasonable mitigation to reduce possible effects associated with construction noise. These will include adequate maintenance of their construction equipment, including mufflers.

Blasting activities require special care in planning and execution. The use of explosives will be timed to avoid periods when sensitive wildlife species are in the area. Locations will be chosen to avoid potential harm to fish species in local waterbodies. Prudent design, best management practices, and mitigation can be combined to minimize sound levels generated by blasting during the construction phase.

Aggregate borrow activities, including blasting will be intermittent and temporary in nature. Most of the noise will be associated with earth-moving equipment operation during periods of aggregate borrow activity. Best management practices and mitigation measures will be applied to reduce the effect of noise.

Examples of prudent design and management practices include:

- limitation of construction activity during sensitive time periods to minimize effects on wildlife;

- effective logistics planning such as the use of vans or extended cab pick-up trucks to transport workers, thereby minimizing vehicle movements; and
- regular maintenance of equipment and provision of appropriate mufflers for all internal combustion engines.

11.2.3 Climate Change

Climate change is occurring and the effects are already observed in some regions. As previously discussed in Section 10.0, projections show that increase of ground and air temperatures due to climate change is expected to be most significant in Canada's northern territories.

The Highway does not have impact on climate change. Instead, the effects of climate change (i.e., warming temperatures, greater precipitation, extreme and unpredictable weather events) will impact the stability of the Highway from operation, maintenance, and preservation aspects, resulting in negative impacts to the surrounding environment.

The stability of permafrost and the stability of infrastructure built on it depend on maintaining ground temperatures to minimize the thickness of the active layer, and to impede thaw. The Highway is located within the permafrost region and stability of the highway structure will be dependent on maintaining the perennially frozen ground.

The frozen ground has variable proportions of ground ice. When thaw occurs, the excess water is expelled and consolidation produces substantial settlements. The thermal stability of the frozen ground is sensitive to minor changes in heat transfer at the ground surface. These minor changes in heat transfer alter the surface heat balance, initiating thaw and increased active layer thickness. Such heat transfer and potential settlement due to thaw is possible in permafrost regions even without climate warming. Subtle increases in temperature and extreme weather events that result in extreme precipitation and rapid snow melt can contribute to the thaw and accelerate it.

A risk-based approach for incorporating climate change into design of highway infrastructure on permafrost is now recommended practice. The challenge for design and construction over thaw-sensitive permafrost terrain is to assess the capital cost of constructing the Highway and the long-term maintenance implications. The design parameters and construction techniques take into account consideration of these risks and provide mitigative approaches in the Highway design. The two most significant elements of the design are the use of non-woven geotextile between the existing ground and the embankment, and maintaining minimum height, based on terrain type, to mitigate heat gain that can result in thawing of the permafrost.

Another risk factor that is related to climate uncertainty is precipitation, including both summer rain and winter snow. Building conservatism into a design to account for climatic warming is more complex than simply projecting air temperature trends into the future. The greatest risk is often associated with extreme events that are now being observed in the northern Canada. Unprecedented warm winters are often followed by rapid and early thaw. High snow cover years are resulting in extreme snow drifting that blankets the downwind sideslopes, insulating the surface and raising the ground temperature under the fringes of the embankment. Standing water against the sideslopes retards winter freezeback of the active layer and can accelerate thaw below the sideslopes.

Key mitigative measures that have been incorporated into the design parameters to manage uncertainty related to future climate trends and extremes in the permafrost region that this Highway will be constructed in include:

- thick embankments that insulate and stabilize the active layer and the use of non-woven geotextiles for reinforcement;
- where available, use of porous embankment materials, such as coarser gravels, to reduce the risk of ponding along the toe of the embankment;
- where such material is not available, the use of culverts to balance surface flow has been included; and
- adoption of construction methods that eliminate cuts and minimize disturbance of the natural vegetation before fill is placed.

Of greater importance is what activities are undertaken after the Highway is put into operation. Given the uncertainty of the events associated with climate change, greater vigilance and effort on the part of maintenance operators will be required including, greater effort for spring culvert clearing and fall protection of culverts and drainage structures, more frequent inspections, and monitoring of the performance of the infrastructure. There will also be a greater need for additional resources for maintenance and rehabilitation in the face of potential permafrost degradation.

11.3 Effects on Terrain and Topography

The Highway will be built on sensitive terrain that is predominantly over permafrost and where there are or is the potential for geohazards such as massive ground ice, retrogressive thaw flows, peatland (muskeg) terrain, thermokarst, and thermo erosion.

11.3.1 Permafrost

Permafrost with little or no ice generally does not cause engineering problems; whereas, ice-rich permafrost can cause serious problems if allowed to thaw. As noted above, an increase of average temperatures due to climate change can result in the thawing of permafrost, which has an impact on the Highway itself. Alternatively, the construction and maintenance activities for the Highway and the physical presence of the Highway embankment can cause ground disturbance and/or a change in the ground/air temperature balance, the effect of which is an increase in the active layer and permafrost thaw. Thawing of permafrost results in instability of the Highway structure, which has the impact of erosion, loss of habitat, and structural failure on the Highway that presents safety issues. Thawing of permafrost also results in ponding of surface water and other drainage issues that have similar impacts as those noted above.

The Highway will be constructed using end dumping methods to initially lay down the borrow material and then top it with finer surfacing material. The Highway embankment will be constructed in the winter months to minimize ground disturbance that could cause permafrost degradation. Key design and construction activities to mitigate permafrost thaw are listed above in the discussion on climate change.

11.3.1.1 Sensitive Terrain

Activities that will affect the terrain during construction of the Highway include the removal of overburden at borrow sites, the excavation of highway construction material from the borrow sources, the construction of the Highway, and the re-contouring of construction sites and associated facilities.

Borrow sources have been selected as close to the Highway as possible to minimize haul distances. The borrow sources will be operated and reclaimed in a manner consistent with INAC quarry permit requirements and existing environmental standards and guidelines. To further minimize potential impacts on the permafrost through ground disturbance, temporary winter access roads, constructed of snow and ice over the frozen ground, will be employed for access to the borrow sources.

The potential effects of activities on terrain can be related to surface disturbance during construction that can cause damage to soils, permafrost, cause erosion, and alter landforms. Mitigation strategies to reduce effects on soils and landforms include:

- reducing surface disturbance;
- controlling potential erosion;
- stabilizing slopes, if required; and
- re-vegetation, if possible.

To minimize impacts on the existing terrain of the project area, the footprint of the Highway, the temporary construction camps and the borrow sources will be confined to the extent possible. With the application of the proposed mitigation measures, the effects of the Highway and associated borrow activities on the terrain of the project area are generally expected to be limited to the physical footprint and are considered to be minor in the context of the overall project area.

11.3.1.2 Massive Ground Ice

Massive ground ice deposits are a potential threat to the road and related infrastructure in several ways. On flat ground, thawing of massive ice bodies triggered by surface disturbance commonly leads to the development of thermokarst and extensive subsidence of the ground. On slopes, thawing of massive ice bodies can eventually lead to slope failures in the form of retrogressive thaw flow landslides. The area impacted could be relatively large, on the order of 0.5 ha to 1.5 ha, and once failure is initiated it is very difficult to contain.

11.3.1.3 Retrogressive Thaw Flows

Retrogressive thaw flows may be triggered by any process or event that results in the exposure to melting of massive ground ice or icy sediment. Disturbance of the ground surface by construction activities, borrow pit development, and exposure of icy ground caused by erosion resulting from poorly controlled drainage are plausible triggers related to construction work associated with the Highway. Thaw flows could have a significant impact on a road if one were to occur. The likelihood of such a slide impacting the Highway has been reduced by purposely routing away from areas where landslides presently exist and away from steeper slopes that would be susceptible to failure. Furthermore, design and construction control measures will address ground disturbance and surface water erosion concerns.

11.3.1.4 Peatland (Muskeg) Terrain

Road construction and maintenance on thick, frozen, and ice-rich bog, as well as on saturated unfrozen fen, is very challenging; therefore, these areas identified during the 2010 field program and from the air photos have been avoided, as much as possible.

11.3.1.5 Thermokarst

The Highway has been selected to avoid area where thermokarst features suggest massive ground ice or icy organic or fine-grained mineral soils, wherever possible.

11.3.1.6 Thermal Erosion

This potential permafrost-related geohazard develops locally and has been avoided by careful routing.

11.4 Effects on Vegetation

When constructed, the Highway will have a footprint that includes the 60 m wide right-of-way, two to three borrow sources that are needed for long-term maintenance of the Highway, and two to three Highway maintenance camps. During construction, the footprint is larger given that there are more borrow sources used during construction (a total of 13 potential borrow sources have been identified in this PDR), that will be closed and restored when the construction is completed. There is a direct impact to vegetation within the footprint ranging from permanent removal (i.e., where permanent buildings are constructed for highway maintenance camps, to frequent cutting and regrowth (i.e., clearing and cutting of the right-of-way on either side of the Highway as part of maintenance activities), to removal and restoration (i.e., in borrow sources that are used for construction only).

In addition to the direct effects from the construction, several indirect effects may also occur, including the introduction of non-native or invasive plant species, alteration of the hydrology conditions (either ponding of water or reducing water flow), and increased erosion or slumping whereby changing plant communities. Pomeroy (1985) indicates ponding of water from the construction of roads may lead to the degradation of the underlying permafrost and eventual changes in hydrologic conditions and, thus, the vegetation community.

Vehicle traffic and road maintenance activities (including snow removal, grading, and possibly dust suppressants) will continue throughout the life of the Highway. These activities have the potential to directly or indirectly alter vegetation cover and plant assemblages, plant phenology, fire frequencies, and additional vegetation loss.

The amount of dust produced along the Highway will increase during operation. Dust loading is expected to be localized and seasonal. Dust along the roads can lead to early snow melt, which in turn leads to early green up. In addition, dust loading may lower vegetation cover and change plant assemblages. Dust suppressants (including chloride based) may also negatively affect vegetation health (Goodrich et al. 2008). Even though the Highway is anticipated to have low traffic volumes, dust generation at key locations (curves, bridge approaches, etc.) will be addressed during the operation of the Highway. Dust suppressants other than calcium and magnesium chloride are being investigated for use on the Highway.

Snow removal and grading will be necessary during winter operations; however, the build-up of snow in the ditches has the potential to affect the vegetation communities due to delayed melting in the spring.

In addition, the Highway may increase access to off-road areas, which may result in additional vegetation loss or plant damage, and an increase risk of forest fires.

The measures to minimize the impact to vegetation are relative to minimizing the size of the footprint, avoid locations of rare plants, and keep water from ponding. To do this, specific measures include:

- an effective design that selection of borrow sources to minimize footprint;
- confirmation of, more specifically, the two locations of rare plants as identified in the MGP studies and refine the design of the Highway and borrow sites to avoid those locations;
- designing and installing culverts and other drainage structures to maintain existing flow conditions;
- during construction and in the operation of the Highway, performing inspections of culverts, particularly during spring flows, and removing any blockages that will cause ponding;
- implementing progressive reclamation of quarries, including re-contouring and re-vegetating to pre-disturbance conditions;
- restricting construction traffic to the planned footprint; and
- cleaning equipment thoroughly prior to use on site to avoid the transfer of plant species.

11.5 Effects on Wildlife

The Highway may directly and indirectly result in loss and alteration of habitat, reduced connectivity between habitats or fragmentation, and wildlife mortality.

Effects may occur at both the individual and population levels (Jalkotzy et al. 1997). Individual animals, particularly grizzly bear, wolverine, and boreal caribou, are more sensitive to human disturbances and may avoid roads as a result of repeated disturbances (Jalkotzy et al. 1997). However, Jalkotzy et al. (1997) indicated avoidance behaviours in areas without hunting are either nonexistent or very short term. That being said, animals can become used to the Highway and the low levels of traffic that are estimated (less than 50 vehicles per day). Yost and Wright (2001) report caribou show an uneasiness to traffic in Denali National Park, Alaska, but no pattern of traffic or road avoidance was detected. Similarly, the distribution of grizzly bears in the park did not indicate road avoidance (Yost and Wright 2001).

The effects on wildlife include habitat loss or alteration, fragmentation of habitat, mortality, and selective removal of habitats appropriate for denning. The impacts of these effects are discussed more specifically below.

11.5.1 Habitat Loss or Alteration

Habitats in the vicinity of roads are effectively lost to many species (Jalkotzy et al. 1997). Species with large home ranges and or those that move large distances are more vulnerable from habitat loss than species with smaller area needs (Clevenger and Huijser 2009). In addition, species populations that occur in low densities (including those designated with special conservation status) may be especially vulnerable to further human disturbances and habitat loss (Clevenger and Huijser 2009).

The construction of the Highway will open habitat patches, such as stands of forest, which were previously undisturbed. This will alter the habitat for the plant, animal, and other species in the habitat patch by introducing 'habitat edges'. Habitat edges differ from the inner contiguous habitat patch in light regime, moisture levels, microclimatic conditions, available shelter, and so on. New habitat edges may benefit edge-dwelling species and habitat generalists, but can be expected to negatively affect interior forest species whose tolerance for environmental change is limited. Habitat specialists are typically more sensitive to disturbances.

11.5.2 Habitat Connectivity and Fragmentation

The Highway may create a barrier to small forest mammal and amphibian movements (Foresman 2004). These prey species for larger carnivores and raptors are vulnerable crossing areas without protective cover. They are more likely to be preyed upon if they cross the Highway, or may avoid crossing altogether. The Highway may negatively effect small forest mammal and amphibian dispersal, resulting in fragmentation of the populations.

Increased noise and edge effects may make adjacent habitats less favourable for many species. Some species may avoid the Highway or change their pattern of use (Jalkotzy et al. 1997; Clevenger and Huijser 2009). Animals that avoid or hesitate to cross roads or those that are disturbed by a vehicle expend greater energy. This expenditure of energy may be considerable in the winter if snow depths are deep or the surrounding landscape provides little security cover and animals must travel further for security cover.

Certain species, such as wolves use roads and road rights-of-ways for travel, which allow greater access into previously inaccessible or difficult to access areas (Jalkotzy et al. 1997). Furthermore, Jalkotzy et al. (1997) reported roads with little traffic are also frequently used by a number of wildlife species (including wolves, grizzly and black bear, and caribou) as a travel route. Grizzly bears are also known to cross highways with low traffic volumes (Gibeau and Herrero 1998). However, in northeastern Alberta, roads were considered semi-permeable barriers to boreal caribou movements (Dyer 1999). Clevenger and Huijser (2009) indicated low traffic volumes (less than 2,500 annual average daily traffic volumes) had little effect on the number of animals attempting to cross the road.

The Highway may also increase off-road traffic by snowmobiles or snow machines and other all-terrain vehicles. This increase in off-road traffic has the potential to adversely affect wildlife distributions. For example, woodland caribou have been documented to abandon areas frequented by snowmobiles (Dyer 1999).

11.5.3 Wildlife Mortality

Potential direct and indirect wildlife mortality may occur as a result of the Highway. Direct effects include wildlife-vehicle collision; whereas, indirect effects include increased predation, hunting, and trapping as a result of the Highway.

Wildlife-vehicle collisions may result in direct wildlife mortality. Amphibians, birds, and small mammals are the species group most often injured or killed by traffic collisions (Foresman 2004). However, large mammal-vehicle collisions are also a human safety and property hazard, and as a result are the most commonly reported wildlife encounter along highways. Clevenger and Huijser (2009) indicated at low traffic volumes (less than 2,500 annual average daily traffic volumes) traffic related mortality is generally low. The traffic volumes estimated for the Highway are less than 50 vehicles per day.

Certain species, such as herbivores (including boreal caribou) and bears may be attracted to the road ditches in search for food, especially in the spring when plant emergence may be earlier than in the forest (Gibeau and Herrero 1998; Dyer 1999). In turn, carnivores (including raptors) may be attracted to the Highway to prey on these foraging animals or carrion (Jalkotzy et al. 1997). Mortality risks from vehicle collisions increases for all animals along the right-of-way.

The primary source of indirect mortality is related to human access (Jalkotzy et al. 1997). As human access increases, furbearer trapping, hunting, and poaching increases, in addition to an increase in problem wildlife. An increase in trapping, hunting, and poaching along the Highway may lead to over harvesting of populations. Wildlife, such as bears, wolverines, and foxes may become attracted to the harvester's gut piles, food wastes, and wildlife killed by vehicles resulting in an increase in human-wildlife encounters and problem wildlife. Regulations and policies that are in place for Crown Lands and Gwich'in Lands will apply.

11.5.4 Loss of Habitat Suitable for Denning

Den site fidelity is common in carnivores such as grizzly and black bears, wolves, and foxes. Like most carnivores, wolves can be sensitive to disturbance, especially during their denning period (Chapman 1977). Nevertheless, wolves' high productivity and dispersal capabilities have shown resiliency to sustained levels of moderate human disturbance (Weaver et al. 1996). Similarly, fox populations may also tolerate moderate levels of human disturbance. That being said, suitable denning areas may be limiting, particularly in the northern half of the study area.

The Highway and the borrow sites may remove some habitats appropriate for denning. Any removal of denning habitat will affect carnivores in the local area.

11.5.5 Mitigation Measures for Impacts on Wildlife

The draft Gwich'in Land Use Plan acknowledges the development of the Highway and subsequently permits this land use through the Travaillant, Mackenzie River, Tree River Conservation Zone (GLUPB 2010). In the preliminary routing and assessment of alternative routes, the Highway was placed in a proposed corridor with the MGP to create a common Transportation Corridor. Since the effect of roads can be reduced by avoiding areas more sensitive to disturbance, the following additional siting strategies were also considered (Table 11.5.5-1).

Table 11.5.5-1: Strategies to Avoid Potentially Sensitive Areas during Route Planning

Species or Species Group	Sensitive Area	Strategy Utilized
Caribou	Suitable feeding habitat with an abundance of ground lichens exists intermittently across the study area. In addition, barren-ground caribou security habitat in the form of frozen lakes is common.	Remain as far as possible from lakes to minimize disturbance to animals and reduce hunter visibility from the Highway.
Moose	Appropriate moose habitat exists throughout the proposed rights-of-way, particularly along lake shorelines, along the willow riparian zones at the proposed culvert crossings, and in the southern portion of the road routes that have been previously burnt.	Remain as far as possible from lake shorelines and minimize the number of riparian crossings.
Carnivore	Bears, wolves, and foxes are expected to occur in all habitat types; however, possible denning habitats are considered most sensitive to disturbance. Bears, wolves, and foxes can be expected to den in all areas suitable for road borrow material.	All disturbances to the proposed borrow areas should be minimized as much as possible.
Beaver	Signs of beaver were observed throughout the study area.	Avoid altering the natural drainage conditions (water quality and quantity) as much as possible.
Waterfowl	All open water habitats, including large and small wetlands and lakes are suitable habitat for multiple waterfowl species.	Remain as far from lakes and wetlands as much as possible. The draft Gwich'in Land Use Plan recommends a setback distance of a minimum of 250 m from waterfowl nesting and staging areas (GLUPB 2010).
Raptor	Tree and ground nesting raptors are expected to occupy all habitat types within the study area. However, a negligible amount of cliff nesting habitat exists within the study area to support cliff nesting species, such as Peregrine Falcons.	The Highway should avoid all known nests by a conservative 1 km, if possible. The draft Gwich'in Land Use Plan recommends a setback distance of a minimum of 250 m from raptor nests (GLUPB 2010).
Upland Bird	Multiple upland bird species occur in the study area during the summer months. Of particular importance, Rusty Blackbirds (species listed by SARA as Special Concern) were observed occupying lakeshores throughout the study area.	Remain as far from lakes and wetlands as possible to minimize impacts to Rusty Blackbirds.
General Wildlife	Wildlife are expected to occupy the entire study area year round.	Minimize the disturbance footprint as much as possible.

Since all habitat types within the study area support wildlife species and the Highway can not avoid all areas, mitigation and best management practices are recommended to minimize adverse effects (Table 11.5.5-2).

Table 11.5.5-2: Mitigation and Best Management Practices during Construction and Operation

Species or Species Group	Rationale	Mitigation and Best Management Strategies
Barren-ground Caribou	Sensitive time = winter (November to May). Sensitive to human disturbance and over-harvesting year round. Along the Dempster Highway, local residents have raised concerns regarding the practice of shooting the lead animals as they approach and cross the Highway. This is thought to cause the herd to change its migration and even abandon its winter range (Benn 2001). Similar concerns may be raised within the study area.	Avoid clearing and construction in selected areas when caribou are present. If clearing and construction during caribou over-wintering period is unavoidable, a wildlife monitor will be present to monitor the location of over-wintering caribou. Cease clearing and construction activities if caribou are in the local vicinity. Endorse a hunting best practices education program: respect a one week voluntary hunting closure along the Highway (including 8 km on either side) to permit lead animals to pass (similar to the Dempster Highway volunteer program). See general mitigation below.

Table 11.5.5-2: Mitigation and Best Management Practices during Construction and Operation

Species or Species Group	Rationale	Mitigation and Best Management Strategies
Boreal Caribou	Sensitive time = year round, especially winter and calving (November to July). Sensitive to human disturbance and over-harvesting year round. Listed by SARA as Threatened.	Cease clearing and construction activities if caribou are in the local vicinity. Avoid open, mature spruce habitats (near peatland complexes, lakes, and ponds) that have abundant ground and tree lichens, as much as possible. See general mitigation below. See mitigation specific to species at risk (Table 11.5.4-1 below).
Moose	Sensitive time = year round, especially winter (November to May).	Minimize disturbance to riparian shrub communities. See general mitigation below.
Furbearers, including bears and wolves	Sensitive time = year round, especially in the winter.	Conduct an active den survey in the fall prior to disturbing these areas to locate active den sites. Cease clearing and construction activities during carnivore denning season (September to May) within 1 km of all known den sites. See general mitigation below.
Waterfowl	Sensitive time = spring, summer, and fall.	As indicated in the draft *GLUP*, avoid all waterfowl nesting and staging areas by a minimum of 250 m.
Raptors	Sensitive time = nesting and fledging season, but year round for some resident species. Raptors and their nests are protected under the *NWT Wildlife Act*.	Avoid clearing and construction during raptor nesting and fledging season (March to August) in all habitat types (this timing restriction includes early nesters such as owls and later nesters such as hawks). As indicated in the draft Gwich'in Land Use Plan, avoid raptor nesting sites by a minimum of 250 m, and not cause adverse negative effects on nesting raptors from the beginning of March to the end of August. Aircraft remain at an altitude of 650 m (minimum) when flying over areas likely to support nesting raptors (draft Gwich'in Land Use Plan 2010). See general mitigation below.
Upland Birds	Sensitive time = spring, summer, and fall. The majority of upland birds and their active nests within the study area are protected by the federal Migratory Birds Convention Act.	Avoid clearing and construction during bird nesting and fledging season (May to August) in all habitat types as per the Migratory Birds Convention Act and the NWT Wildlife Act. See general mitigation below.
General Wildlife	Suited for all wildlife species. Recommendations set out in the draft Gwich'in Land Use Plan (GLUPB 2010). Volunteer based Hunting Best Practices outlined along the Dempster Highway (Yukon Environment 2006; Porcupine Caribou Harvest Management Plan) may also be appropriate for the Highway.	Minimize the project footprint, and re-contour and re-vegetate cleared areas with native vegetation mixes as soon as possible. The Draft Gwich'in Land Use Plan recommends aircraft flying inside the Lakes Around Travaillant Lake Special Management Zone in June, July, and August should maintain a minimum altitude of 650 m. Maintain proper waste management along the Highway and around construction and maintenance camps; Endorse a hunting best practices education program: define and retain a no-shooting zone along the Highway. Endorse a hunting best practices education program that references the appropriate legislation. Ensure construction crews have wildlife training and awareness and understand the regulations for fishing, hunting and land access. Maintain existing drainage patterns by using appropriate sized drainage culverts. Design and install culverts such that inlets and outlets are not perched to allow small mammal and amphibian access. Minimize the line-of-sight from the Highway.

11.5.6 Mitigation Measures Specific to Species at Risk

A total of eight species with special conservation status exist or potentially exist within the study area. Of these eight species, boreal caribou have the highest level of conservation status (listed by SARA as Threatened). Mitigation specific to species with special conservation status are provided in Table 11.5.6-1.

Table 11.5.6-1: Summary of Effects and Mitigation Specific to Species At Risk

Species	Potential Adverse Effects	Proposed Mitigation	Proposed Monitoring	Existing Species Recovery, Action, or Management Plans
Horned Grebe (assessed by COSEWIC as Special Concern) Sensitive period=spring, summer, and fall.	Habitat loss or alteration, particularly from changes in water quality and quantity. Disturbance during nesting and fledging.	Avoid in-stream work during nesting, incubating, and rearing (May to August). Maintain natural drainage patterns (including quantity and quality). Maintain at least 250 m distance between lakes and construction operations. Adhere to construction restriction window near nesting habitat from May to August.	If in-stream work occurs from May to August, monitor water quality and quantity to ensure changes, if any are at acceptable levels. Cease in-stream work if water quality and quantity changes are unacceptable.	No plans currently exist.
Peregrine Falcon (assessed by COSEWIC as Special Concern) Sensitive period = spring, summer, and fall.	Disturbance during nesting and fledging. Habitat loss or alteration.	No clearing or construction operations within 1 km of Campbell Lake (known nesting locations) from April to August.	No monitoring proposed as ENR periodically surveys these known sites under the Peregrine Falcon Recovery Plan.	Peregrine Falcon Recovery Plan
Short-eared Owl (assessed by COSEWIC as Special Concern) Sensitive period = spring, summer, and fall.	Habitat loss or alteration. Disturbance during nesting and fledging from construction and operation noise. Direct (vehicle-wildlife collision) mortality.	Minimize project footprint in shrub meadows and open black spruce habitats. Avoid clearing and construction during nesting and fledging season (May to August). Encourage participation in vehicle-wildlife collision reporting.	No monitoring proposed.	No plans currently exist.
Gray-headed Chickadee (ranked by ENR as May Be At Risk) Sensitive period = spring, summer, and fall.	Habitat loss or alteration. Disturbance during nesting and fledging from construction and operation noise.	Minimize project footprint in open canopied forests with an abundance of tall shrubs. Avoid clearing and construction during nesting and fledging season (May to August).	No monitoring proposed.	No plans currently exist.
Rusty Blackbird (listed by SARA as Special Concern) Sensitive period = spring, summer, and fall.	Habitat loss or alteration. Disturbance during nesting and fledging from construction and operation noise.	Maintain at least 250 m distance between lakes and construction operations. Avoid clearing and construction during nesting and fledging season (May to August).	No monitoring proposed.	No plans currently exist.

Table 11.5.6-1: Summary of Effects and Mitigation Specific to Species At Risk

Species	Potential Adverse Effects	Proposed Mitigation	Proposed Monitoring	Existing Species Recovery, Action, or Management Plans
Grizzly Bear (assessed by COSEWIC as Special Concern) Sensitive period = year round, especially during denning (September to May).	Habitat loss or alteration. Habitat fragmentation. Direct (vehicle-wildlife collision) and indirect (increased hunting, poaching, problem wildlife kills) mortality.	Encourage user participation in vehicle-wildlife collision reporting. Encourage user participation in the Gwich'in Harvest Study. Adhere to the Gwich'in Grizzly Bear Management Plan. Cease clearing and construction activities during carnivore denning season (September to May) within 1 km of all known den sites. Maintain proper waste management along the Highway and around construction and maintenance camps. Endorse a hunting best practices education program: retain a 500 m no-shooting zone along the Highway. Endorse a hunting best practices education program: off-road vehicle use is prohibited year round, except for snowmobiles once the ground is completely frozen and covered by snow (includes 8 km on either side of the Highway).	Conduct an active den survey in the fall prior to disturbing these areas to locate active den sites. Monitor known active dens during clearing and construction activities, and report any disturbance to denning bears. Cease clearing and construction if disturbance to denning bears. Continual dialogue and support to the RRCs to manage grizzly bears and their habitat along the Highway.	Grizzly Management Plan, GSA.
Wolverine (assessed by COSEWIC as Special Concern) Sensitive period = year round.	Habitat loss or alteration. Habitat fragmentation. Direct (vehicle-wildlife collision) and indirect (increased hunting, poaching, problem wildlife kills) mortality.	Encourage participation in vehicle-wildlife collision reporting. Encourage user participation in the Gwich'in Harvest Study. Maintain proper waste management along the Highway and around construction and maintenance camps. Endorse a hunting best practices education program: retain a 500 m no-shooting zone along the Highway. Endorse a hunting best practices education program: off-road vehicle use is prohibited year round, except for snowmobiles once the ground is completely frozen and covered by snow (includes 8 km on either side of the Highway).	No monitoring proposed.	No plans currently exist.
Woodland Caribou (Boreal) (listed by SARA as Threatened) Sensitive period = year round.	Habitat loss or alteration (including increased risk of fire frequency). Habitat fragmentation. Direct (vehicle-wildlife collision) and indirect (increased hunting) mortality.	Encourage participation in vehicle-wildlife collision reporting. Encourage user participation in the Gwich'in Harvest Study. Cease clearing and construction activities if caribou are in the local vicinity. Endorse a hunting best practices education program: retain a 500 m no-shooting zone along the Highway. Endorse a hunting best practices education program: off-road vehicle use is prohibited year round, except for snowmobiles once the ground is completely frozen and covered by snow (includes 8 km on either side of the Highway). Endorse a hunting best practices education program: hunter education program to encourage hunters to track wounded animals, report harvests, identify bulls from cows, and improve marksmanship and use of appropriately sized rifles.	If clearing and construction during caribou over-wintering period is unavoidable, a wildlife monitor will be present to monitor the location of caribou. Cease clearing and construction activities if caribou are in the local area. Continual dialogue and support to the GRRB to manage boreal caribou and their habitat along the Highway.	Action Plan for Boreal Woodland Caribou Conservation in the NWT 2010-1015 (ENR 2010d). Federal draft national Recovery Strategy currently in development.

Table 11.5.6-1: Summary of Effects and Mitigation Specific to Species At Risk

Species	Potential Adverse Effects	Proposed Mitigation	Proposed Monitoring	Existing Species Recovery, Action, or Management Plans
Barren-ground Caribou (Assessed by COSEWIC as Special Concern) Sensitive period – year round.	Same as above.	Same as above.	Same as above.	Barren-ground Caribou Management Strategy for the NWT for 2011-2015 - Draft (ENR 2011). Barren-ground Caribou Management Strategy for the NWT for 2006 – 2010 (ENR 2006)

11.6 Effects on Fish, Fish Habitat, and Hydrology

The assessment of the potential effects of road construction on aquatic resources, including fish and fish habitat, and the development of effective avoidance or mitigation measures, are major considerations in the preliminary design for the Highway presented in this PDR. From the perspective of fish and fish habitat protection and management, three categories of streams are recognized along the Highway:

- Non-fish bearing: streams that are not utilized by fish for any part of their life cycles.
- Migratory channels: ephemeral and perennial (except in winter) streams that are utilized by fish only for migration during open water periods or that contribute to downstream habitat quality.
- Spawning/rearing/feeding streams: ephemeral and perennial streams that are utilized by one or more life cycle stages of fish during open water periods, in addition to migration.

Table 11.6-1 identifies the principal activities in construction and operation of the Highway and the potential effect on fish and fish habitat and the measure to avoid or mitigate. The appropriate crossing structures and avoidance or mitigation measures designed to achieve no net loss (NNL) of productive capacity of fish habitat will be guided in part by the designated category of stream for each site. In accordance with the Gwich'in Land Use Plan, timing will be decided by community RRCs for conservation areas and special management areas. In other areas (i.e., crown land), appropriate DFO timing windows (DFO 2009a) will be used to avoid in-stream work in fish bearing streams during critical time periods.

Table 11.6-1: Effects of Construction and Operation of the Highway on Fish and Fish Habitat

Activity	Potential Effect	Avoidance or Mitigation
Bridge Construction	Direct loss of riparian habitat.	Design and construct bridge structures to avoid loss of habitat.
	Direct loss of in-stream habitat due to piles/piers.	Construct clear span bridges. Avoid or minimize in-stream work. Implement erosion and sediment control measures.
	Flow changes due to stream constriction.	Abutments to be placed at a sufficient distance from active stream channel and riparian vegetation.
Culvert Installation	Direct loss of habitat.	Employ best management practices for culvert installation.
	Migration barrier.	Employ best management practices for culvert installation. Annual monitoring to detect culvert subsidence or lifting.
	Sediment release during construction.	Employ sediment and erosion control measures.
	Changes in-stream flow patterns.	Appropriate sizing of culverts based on hydrological assessments.
Use of Heavy Equipment	Soil erosion and sedimentation.	Employ erosion and sediment control measures.
	Fuel, lubricant spills.	Regular maintenance of equipment away from water bodies, e.g., fuel transfer at least 100 m from high water mark. On-site spill containment equipment.
Highway Design	Direct loss of habitat.	Avoid critical habitats. Design appropriate crossing structures based on site conditions.
	Erosion and sedimentation.	Maintain sufficient distance from lakes, if possible. Install sediment control in ditches and cross drainage channels.
Quarry Development	Erosion and sedimentation.	Maintain sufficient distance of undisturbed land between quarry and any water body. Apply erosion and sediment control measures and best management practices.
Water Extraction	Oxygen level depression. Exposure of eggs and larvae. Reduction of available habitat for spring spawners. Winter fish kill.	Follow DFO Protocol for Winter Water Withdrawal.
Public Access	Increased exploitation due to improved access to remote fishing areas.	Public education.
	Risks to watercourses due to vehicle collisions and release of contaminants into a water body.	Design and construct the Highway to support climate conditions and operating speeds, and increase public education. Both in an effort to reduce risk of collisions.
Use of Heavy Equipment	Damage to stream beds. Damage to shorelines resulting in erosion.	Avoid use of heavy equipment in waterbodies or use in waterbodies that are frozen to the ground. Repair any damage done prior to spring flows.

As noted in Section 10, the Highway will cross rivers and streams, but not encroach on lakes. As there are many lakes in the area, the Highway will likely be constructed close to some of the lakes. The Highway alignment and cross section will be refined in the next detailed design stages of the project development and part of that refinement will be to move the Highway away from lakeshores where possible. The following provides a more detailed discussion of selected measures to mitigate impact on fish and fish habitat.

11.6.1 Selection of Stream Crossing Structures

In the preliminary design, initial selection of appropriate stream crossing structures has been made to mitigate impacts to fish and fish habitat noted above. The guidelines that have been used in the preliminary design are presented in Table 11.6.1-1:

Table 11.6.1-1: Guidelines for Selection of Stream Crossing Structures

Stream Category	Stream Crossing Guide
Non-fish bearing.	Culvert. Apply sediment and erosion control best management practices during construction.
Migratory channels.	Culvert. Sizing and placement of culvert is critical to avoid excessive velocities. Culvert should be set into the substrate to prevent erosion at downstream invert. Where possible, culvert should be installed in areas having a hard (gravel/cobble) bottom. Where culvert twinning is required, only one culvert should be set to permit fish passage at low flows. Apply sediment and erosion control best management practices during construction. Follow the DFO Operational Statement for Temporary Stream Crossings (DFO 2009b) where these are necessary.
Spawning/rearing/ feeding streams	Clear span bridge. Follow DFO Operational Statement for Clear Span Bridges (DFO 2009c). Apply sediment and erosion control best management practices during construction.

Table 11.6.1-2 provides a summary of the stream crossing structures recommended at each crossing location, based solely on fish and fish habitat considerations. As indicated in the table, all crossing locations require further field investigation to assess the quality of available fish habitat, collect data about stream characteristics, and move the conceptual design of the structure considered in this PDR to completed design. This will occur in the next stages of the development of the Highway. Ground surveys will provide information on fish and habitat presence or potential; hence, the appropriate construction and environmental management measures that should be adopted at each site. As indicated in Section 10, there are seven locations where clear span bridges are recommended due to known fish presence and/or habitat quality.

The preliminary reconnaissance findings indicate that the majority of channels (112 of 162) crossed by the Highway are small, ephemeral streams that generally drain terrestrial upland areas or small, shallow lakes or ponds, most of which do not provide suitable fish habitat features. Appropriately sized culverts (800 mm to 900 mm diameter) installed at these locations will require the implementation of appropriate erosion and sediment control measures to protect downstream habitats, but would not directly impact fish or fish habitat.

Table11.6.1-2: Preliminary Stream Crossing Structure Recommendations Based on Stream and Fish Habitat Characteristics or Potential

Crossing Structure	Crossing Number(s)	General Habitat Comments
Bridge	1490A; 1480F; 1470F; 1430J; 1430B;1410D; 1360D	Generally good or known fish habitat observed.
Large or Oversized Culvert	1500A; 1490D; 1480D; 1480B; 1470L; 1470H; 1470G; 1470D; 1470A; 1460O; 1460M; 1460J; 1460G; 1450G; 1450C; 1450B; 1440H; 1440E; 1440A; 1420B1; 1420B; 1420A; 1410F; 1410B; 1400A; 1390G; 1390D1; 1390A; 1380A; 1370H; 1370F; 1370C; 1370A; 1350B; 1350A; 1340D; 1340B; 1330J; 1330H; 1330F; 1330D; 1330C;	Moderate or seasonal fish habitat observed.
Culvert	1500E – 1500B; 1500A0; 1490I -1490E; 1490C; 1490A1; 1490A2; 1480H; 1480G; 1480E; 1480D1;1470N; 1470J1; 1470J; 1470I; 1470E; 1470C; 1470B; 1460T; 1460S1; 1460S; 1460R1; 1460R; 1460Q; 1460P; 1460N; 1460L; 1460H; 1460E;1460A; 1450M1; 1450M; 1450K - 1450K5; 1450J; 1450H; 1450F-1450D; 1450A; 1440J; 1440I; 1440F; 1440D; 1440C; 1440B-1440B2; 1430I; 1430F; 1420E1; 1420E; 1420A1; 1420A2; 1420L1; 1420L; 1420J; 1410H; 1410D2; 1410D1; 1400E2;1400E1; 1400E; 1400C; 1390F; 1390D; 1390A3; 1390A2; 1390A1;1380C1; 1380C; 1380A2; 1380A1; 1370J; 1370I; 1370E1 1370D; 1370B1; 1370B; 1360N2; 1360N1; 1360L; 1360D3; 1360D2; 1360D1; 1350F2; 1350F1; 1350F; 1350D; 1350C; 1340C; 1340A; 1330K; 1330B; 1330A	Not likely fish habitat.

The various stream crossings that are part of this project will be sited and designed to avoid or mitigate adverse effects on fish and fish habitat (i.e., HADD), wherever possible. As such, it is expected that some project elements, such as watershed equalization culverts, can be completed through the issuance of Letters of Advice by DFO, or by application of relevant Operational Statements. If there are circumstances where a HADD is unavoidable, DFO will be consulted to discuss and determine suitable strategies so that the necessary application for Authorization pursuant to Section 35(2) of the Fisheries Act can be submitted.

In June 2010, consultation with Ms. Amanda Joynt of DFO emphasized that from a fisheries perspective, care must be taken when using explosives as the pressure from blasting may harm fish. As well, the type and quality of material from borrow sources, and the plans for each water crossing must be considered from the perspective of protecting fish and fish habitat.

11.6.2 Controlling Sediment

Road construction activities have the potential to cause erosion and the consequent sedimentation of receiving streams and lakes. Sediment released to streams and lakes, both in suspended and settled forms, presents a serious risk to fish and fish habitat. The effects of sediment on fish and fish habitat include degradation of potential spawning areas; smothering of eggs and the benthic invertebrate food supply; reduction in feeding efficiency; avoidance of potentially suitable habitats; and abrasion of fish tissues (Birtwell 1999; Lloyd et al. 1987). For example, Arctic grayling have been found to be displaced downstream of their preferred habitats at suspended sediment levels greater than 100 mg/L (McLeay et al.

1987); Scannell (1988) determined that only 10% of Arctic grayling food supply would be available at suspended sediment concentrations of about 63 mg/L; and Birtwell (1999) reports dramatic decreases in salmonid egg survival with increasing levels of fine sediments in the gravel.

Sediment releases from road and aggregate borrow source development originate from exposure of soils during site preparation and grubbing, the erosion of particulates that make up the highway surface and slopes, and the erosion of soils in unstable ditches, which is then carried in runoff. In recognition of the potential adverse effects of sediment and when the final design is complete, an environmental management plan (EMP) that builds on the information and mitigation measures presented in this PDR, will be prepared by the Proponent prior to construction and approved by regulators, to provide specific and detailed guidance to avoid sediment releases to the aquatic environment. The EMP will refer to appropriate erosion and sediment control guidelines, best management practices, and measures outlined in the DFO (1993) Land Development Guidelines for the Protection of Aquatic Habitat. These guidelines are widely applicable throughout Canada, but were designed for British Columbia. Modifications that reflect the more sensitive and critical requirements of Arctic conditions will be included in the EMP to meet the specific needs of development in the Mackenzie Valley.

Some of the important measures to be followed include:

- limiting the use of construction equipment to the immediate footprint of the Highway, quarry or borrow source ;
- minimizing vegetation removal and conducting progressive reclamation at the quarry sites;
- keeping ice bridge and ice road surfaces free from soils and fine gravel that may be tracked by vehicles;
- avoiding the use of heavy equipment in streams or on stream banks and the adherence to the DFO Operations Statement for Temporary Stream Crossings, where these are deemed necessary;
- installing silt fencing and/or check dams, and cross drainage culverts as necessary to minimize siltation in runoff near waterbodies; and
- sizing and installing appropriate culverts to avoid backwatering and washouts.

11.6.3 Managing Water Extraction

Considerable amounts of water will be required for highway construction. The estimated volumes are described in Section 4.0 and Section 6.0 of this PDR. It is proposed that water for these purposes will be extracted from lakes in proximity to the Highway.

The extraction of water from ice covered lakes can potentially contribute to lethal and sub-lethal effects on fish due to depression of dissolved oxygen concentrations, exposure or freezing of littoral spawning beds due to falling water levels, and loss of important habitats for spring spawning fish (e.g., northern pike) if water levels do not sufficiently rebound to flood critical spawning habitats (Cott et al. 2008a; Cott et al. 2008b). As a result, DFO, in conjunction with other regulators and industry, has developed the Protocol for Winter Water Withdrawal in the Northwest Territories and Nunavut (DFO 2010), for projects where a water withdrawal of greater than 100 m^3 is required from any individual water body that has the potential to provide fish habitat. Based on recent research in Northwest Territories lakes, this protocol sets limits to water withdrawal as a percentage of available under ice water volume, with consideration given to latitude and maximum lake water depth (Cott et al. 2008b). Those water withdrawal thresholds for the region encompassing the Highway are:

- 0% for lakes with less than 1.5 m of free water below the maximum ice thickness (i.e., 2 m);
- 10% of available under ice water volume for lakes with a minimum depth of ≥3.5 m; and
- 100% if the maximum depth of the water body is less than the predicted maximum ice thickness (implying no available overwintering fish habitat).

In addition, the protocol directs that water be withdrawn from areas of a lake that are greater than 2 m below the ice surface to avoid removing the more highly oxygenated water that tends to collect at the water-ice interface. Water intake screening with mesh of 2.5 mm should be used to avoid entrainment of fish (DFO 1995).

To conform to the thresholds set out in the DFO Protocol, it will be necessary to carry out bathymetric surveys on the lakes proposed for water extraction. The selection of specific lakes and such surveys are part of the next steps in engineering and detailed design phases of the development of the Highway. Minimum requirements for the collection and submission of bathymetric survey information are provided in the Protocol, and are further detailed in Cott et al. (2005).

11.6.4 Monitoring

Compliance monitoring during construction is required to determine to what extent the prescribed mitigation measures and best management practices are being implemented, and to detect and correct any instances of non-compliance and deal with possible unanticipated problems. Contractors will be responsible for the development and adaptation of management plans, the conduct of their crews, the condition of their equipment, and timely reporting (e.g., water withdrawal locations and volumes, accidental spills and/or release) to the appropriate authorities.

Compliance monitoring of the Highway construction will be carried out by environmental and wildlife monitors certified by the GTC. Contractors will be required (through specifications in their construction contracts) to hire certified monitors directly or fund the GTC to hire the monitors. During construction of the Highway, wildlife and environmental monitors will be on site.

11.7 Effects on Communities and Cultural Resources

The Highway has the potential to have both positive and negative effects on the communities within the GSA. The main positive effects of the Highway on the Gwich'in communities of Fort McPherson, Tsiigehtchic, Aklavik, and Inuvik are discussed in Section 12.0. Any human activity or development has the potential to generate negative effects and mitigation measures can be planned and implemented ahead of time to minimize detrimental effects. Likewise, some of the benefits associated with the Highway can be enhanced with similar foresight and planning. A summary of the positive effects and the potential negative effects are presented in Table 11.7-1 along with enhancement and mitigation measures.

The Highway has the potential to affect areas of cultural importance directly through highway construction activities and indirectly through providing increased access to the land. As described in Section 8.0, there are some recorded heritage resources in the vicinity of the Highway. Some sites linked to traditional knowledge and culturally important sites that are not necessarily known heritage resource sites are also within the vicinity of the Highway. The potential effects of the Highway on these areas are summarized in Table 11.7-1.

Table 11.7-1: Potential Effects of the Highway on Communities

Main Area of Potential Effects	Potential Effects	Enhancement or Mitigation Measures
Gwich'in Communities	Reduced cost of living.	Reduce costs and shorten driving times to resupply communities from Yellowknife and Edmonton. Increase reliability of supply and general availability of consumable goods.
	New business opportunities that are directly and indirectly associated with the construction and operation of the Highway.	Promote and support business opportunities at the appropriate time.
	Direct employment opportunities during construction and operation of the Highway.	Implement and support relevant training for employment at the appropriate time. Increase opportunities that emerge with the opening of the Highway – tourism, mining, oil and gas exploration, and development.
	Easier access to better health care, recreation and education facilities.	Shorter travel distances by road to major centres. Creates opportunity to enhance tele-health and distance education options via the new fibre optic cable.
	Increase in community, family, cultural, and sporting interactions.	
Gwich'in Communities (Continued)	An increase in waged income during highway construction and operation may lead to an increase in drug and alcohol abuse.	Strictly enforce a no alcohol and drugs policy at construction and maintenance camps.
		Explore wage payment options that reduce immediately available 'cash in the hand'
	Public health and safety: Increased traffic during the construction and operation of the Highway, mostly in Inuvik.	Preparation of a traffic management plan.
	Potential for accidents and spills.	Ensure that trained response team is available to deal with accidents and spills. As a side benefit, this creates a new employment opportunity.
	An increase in opportunities for education and training.	Implement and support relevant training for employment at the appropriate time. Increase opportunities that emerge with the opening of the Highway – tourism, mining, oil and gas exploration, and development.

Table 11.7-1: Potential Effects of the Highway on Communities

Main Area of Potential Effects	Potential Effects	Enhancement or Mitigation Measures
Heritage Sites	Potential disturbance of heritage resources, e.g., archaeological remains.	Avoid known locations of heritage resources and archaeological remains in the detailed design and constructions stages of the Highway development.
		Temporary site protection.
		In the event that avoidance of a site is not feasible, detailed mapping, recording and excavation of a sufficient number of units to ensure a representative sample of the site contents is collected should be obtained. This ensures that knowledge of that site is available for future generations.
	Increase access to known sites once the Highway is in operation.	To ensure that travellers along the Highway are aware of restrictions and requirements for accessing adjacent lands, non-typical information signs that identify land ownership, the necessity to gain permission to access, and contact information will be included in the typical highway signing.
Traditional knowledge sites and traditional activities.	Potential direct disturbance of culturally important sites, other than heritage resource sites, e.g., sources of food and shelter, places associated with legends.	Avoid small sites through minor realignments or footprint adjustments.
	Potential indirect effect: Easier access to the land may cause detrimental effects, e.g., misuse of a sacred site, over harvesting of traditionally important animals and plants. Easier access to the land may also be seen as a positive effect of the Highway as it may allow more people to pursue traditional activities and connect with the land.	Monitor and control access to lands adjacent to the Highway. Potential tourism opportunities.
		Public awareness initiatives that raise the profile of the cultural value of the land.

11.8 Effects on Safety

Safety is directly impacted by collisions or malfunctions which can be associated with any human activities, including those associated with the short-term construction periods projected for the 181 km Highway. Environmental consequences of potential accidents or malfunctions associated with the Highway and associated aggregate borrow and construction camp activities would be primarily limited to those related to:

- vehicle collisions; and
- fuel storage, transportation and handling system failures.

To minimize risks of collisions or malfunctions occurring and to minimize possible risks to the environment from such potential collisions or malfunctions, a number of preventative and mitigation measures will be employed. The overriding preventative and mitigation measures to be employed include the following:

- Implementation of best management and industry practices as appropriate to prevent or minimize the occurrence of collisions or malfunctions.

- Ensuring that all contractors onsite have industry-compliant and satisfactory HSE policies, programs, and manuals and that they are successfully implemented throughout the project.
- Compliance with Land Use Permit and Quarry Permit requirements and conditions issued for the construction project.
- Conformance with existing applicable GNWT and Workers Compensation Board standards.
- Fuel and other hydrocarbons will be stored in accordance to storage tank regulations under the *Canadian Environmental Protection Act* and the Canadian Council of Ministers of the Environment's (CCME's) *Environmental Code of Practice* for storage of these products (CCME 2003).
- Any uncontrolled discharge will be immediately managed to stop discharge and begin the mitigation process. Spills will be reported to the 24-hour Spill Report Line (867.920.8130) according to current guidelines.
- Spill containment and cleanup activities will be implemented in accordance with the site-specific spill contingency plans that will be developed by the prime construction contractors selected for the construction of the Highway (e.g., Appendix G).
- Safety measures to prevent vehicle accidents on the Highway have been and will continue to be incorporated into the Highway design. Measures to avoid or minimize accidents, particularly those which may occur at or near a watercourse crossing, will include posted speed limits, adequate signage alerting drivers to Highway curves, and upcoming bridges. Bridge design will incorporate guardrails to prevent a vehicle from going off the highway and into a watercourse in the event of an accident.

The key strategy will be to prevent collisions from occurring through education and enforcement. With the application and implementation of the preventative and mitigation measures as outlined, no significant fuel, chemical, or other product spills are expected to occur. More specific discussions on mitigative measures are as follows.

11.8.1 Fuel Storage

The estimated volume of fuel to be stored at each construction camp facility is 100,000 L (two 50,000 L storage tanks).

Fuel needed for the aggregate borrow and highway construction activities will be stored in double-walled fuel storage units. All fuel will be stored in accordance with CCME (2003). All fuel will be stored at least 100 m from waterbodies unless expressly authorized by Land Use Permit or authorized by the inspector in writing. An example fuel spill contingency plan is provided in Appendix G.

11.8.2 Refuelling Operations

All fuel truck and equipment re-fuelling will be done at least 100 m from the ordinary high water mark of any adjacent waterbodies. An example fuel spill contingency plan is provide in Appendix G.

11.8.3 Waste Management

11.8.3.1 General Waste Management Planning

Contractors for the Highway will have waste management planning in place that will ensure wastes are handled, stored, transported, and disposed of in a manner that will prevent the unauthorized discharge of contaminants, mitigate impacts to air, land, water, and minimize risks of animal attraction, while maintaining the health and safety of personnel and wildlife. The proponent will develop or require the contractor to develop a Waste Management Plan for all wastes associated with construction activities. The Waste Management Plan will apply the generation, treatment, transferring, receiving, and disposal of waste materials for the Highway. The Waste Management Plan will:

- identify waste sources and related types, including but not limited to liquid, solid, non-hazardous, hazardous and approximate quantities;
- describe all on-site or remote treatment and disposal methods;
- describe all waste streams to be transported off site and final disposal locations;
- describe the related waste segregation strategies for the identified waste sources and types to accommodate their respective storage, treatment, transport, and disposal; and
- describe food and food contaminated waste management methods to mitigate animal attraction from source to transport, treatment, or disposal.

11.8.3.2 Waste Handling and Separation, Storage, and Processing at Source

The wastes will be segregated and stored separately as described in Table 11.8.3.4-1 and 11.8.3.5-1. Effective separation of different types of wastes at the source will enable proper handling from waste creation through treatment and/or disposal.

11.8.3.3 Food and Food-Contaminated Waste and Animal Attraction

Timely and responsible segregation, storage, and disposal of food and food-contaminated waste, is of critical importance to minimize risks associated with wildlife attraction. To minimize risks of animal attraction to camps and other related activities while maintaining health and safety of personnel, wildlife, and the environment, all food and food contaminated waste will be stored separate to all other wastes, and in airtight sealed container(s), and enclosed in a bear proof container while in bulk storage prior to final transport, treatment, or disposal.

11.8.3.4 General Camp Waste and Sewage

The main wastes produced during the construction of the Highway are those resulting from camps, which is comprised of waste typical and similar to that of municipal solid waste (MSW) streams, as described in Table 11.8.3.4-1. This MSW will be generated from temporary construction camps used to house construction crews for the duration of the project, as described in 11.8.3.4-1.

Table 11.8.3.4-1: Classification of Camp Waste (MSW)

Type of Waste	Description
Recyclable Material	Paper, glass, bottles, cans, metals, certain plastics.
Food Contaminated	Biodegradable waste, food and kitchen waste, animal and vegetable wastes: typical of restaurants, hotels, markets, etc.
Composite	Waste clothing, non recyclable plastics, etc.
Human Waste	Sewage related, blackwater.
Greywater	Kitchen and washing related liquid waste.

11.8.3.5 Industrial Waste

Industrial waste, as described in Table 11.8.3.5-1, will encompass all other wastes not defined as camp sourced MSW described above.

Table 11.8.3.5-1: Classification of Industrial Waste

Type of Waste	Description
Recyclable/reusable Construction and Demolition	Building materials, etc.
Non-recyclable Construction and Demolition	Inert material, such as soil and granular material.
Hazardous Materials	Contaminated soil/snow/water. Waste fuel. Used oil. Other crankcase fluids. Solvents. Glycol. Batteries. Tank, drum, and container rinsings. Empty drums.

11.8.3.6 Hazardous Waste

Hazardous waste will be generated during the construction of the Highway. Part of this management includes compliance with ENR's requirements to track the movement of hazardous waste from registered generators, carriers, to receivers according to the *Guideline for the General Management of Hazardous Waste in the NWT*.

DOT is currently a registered generator of hazardous waste and is directly responsible for the hazardous waste generated from their operations. DOT is responsible for the hazardous waste generated from private contractors on the Highway. Hazardous waste must be disposed of at an approved facility, and it is not appropriate to dispose hazardous waste in Northwest Territories community solid waste facilities.

To mitigate potential adverse environmental effects associated with improper hazardous waste disposal and to further demonstrate that proper hazardous waste management planning is in place, a Hazardous Waste Management Plan (HWMP) will be developed. The HWMP will encompass all pre-construction and construction phases of the Highway and will apply to receiving, transferring, and transporting hazardous waste for activities on land, water, and air. The HWMP will include, but will not be limited to:

- identify hazardous waste sources, types, and approximate quantities to be produced (including liquid, solid, dangerous goods and non-dangerous goods);
- description of waste segregation methods;
- description of all on-site treatment and disposal methods; and
- description of all hazardous wastes that will be transported to approved receiving facilities.

12.0 ECONOMIC IMPACT OF THE MACKENZIE VALLEY HIGHWAY

The highway strategy developed in 1999 by the GNWT DOT had included a study of the socio-economic impacts of the Mackenzie Valley Highway. Two recent studies have updated the economic impact analyses. The highlights of the two studies, which have quantified the economic impacts, are presented below, followed by a discussion of other general benefits of the Highway. These studies estimate the impacts for the completed highway as a whole from Wrigley to Tuktoyaktuk, and not for its component parts in each region. The terms "the Highway" and the "Mackenzie Valley all-weather road" are used interchangeably in the studies.

12.1 Comprehensive Study of the Highway Economic Impacts

The Mackenzie Valley All-Weather Road Economic Analysis, September 2009, prepared by Pacific Analytics Inc. and Terra-Firma Consultants for the GNWT DOT, is a comprehensive study that quantified the various economic impacts of the Highway, which are summarized under appropriate headings below. Since certain economic impacts are directly related to the dollars invested, it is pertinent to indicate that the study used the following cost estimates (provided by DOT in October 2008) for calculating the economic impacts: for the entire Highway, construction cost is estimated at $1.67 billion (of which $1.3 billion is for road building, $223 million for bridge construction, and $178 million for engineering); and maintenance cost at $13 million a year.

12.1.1 Economic Impacts from the Construction and Maintenance of the Highway

One of the economic impacts from the construction and maintenance of the Highway is short-term and long-term employment. The September 2009 study estimates the following:

- 7,785 one-time jobs in the Northwest Territories and 6,297 one-time jobs in the rest of Canada during the period of construction; and
- 128 permanent jobs in the Northwest Territories for ongoing highway maintenance.

These estimates are for the overall highway Mackenzie Valley Highway from Wrigley to Inuvik, and a proportion of these benefits can be expected for the GSA.

The September 2009 study also reports that economic activity created by the $1.3 million spent annually on the construction and operation of the winter road from Wrigley to Fort Good Hope includes direct, indirect, and induced contributions to the Northwest Territories gross domestic product (GDP) and the GDP in the rest of Canada, permanent employment in both the Mackenzie Valley and the rest of Canada, and federal and territorial government revenues. Although these annual benefits will be lost because the winter road will no longer be constructed, the anticipated annual benefits associated with operation of the Highway will replace this loss, and will be greater. As well, a proportion of the benefits will be directly evident in the GSA.

12.1.2 Reduction in Cost of Living

By reducing transport costs in the Mackenzie Valley regions, the cost of living for residents will decline, improving economic well-being overall. Residents of the Inuvik region are estimated to save $15.7 million annually. This estimate is based on the assumption that all of the approximately 5,110 commercial transport trucks currently travelling the Dempster Highway to Inuvik each year would shift to the Highway, thus saving about $3,070 a year per transport load, or about $15.7 million a year in total. The reduced cost of shipping goods north would result in lower prices for consumers in all communities, including all GSA communities, which, although not directly serviced by the new Highway, use Inuvik as the regional supply centre.

The report does not provide detailed calculations for this estimate. The road distance between Edmonton (the assumed origin of the trucks) and Inuvik via the Highway would be 745 km or 23% shorter than the Dempster route (approximately 2,510 km compared to approximately 3,255 km), and other things being equal, this can be estimated to save at least 23% in trucking costs, which would be sufficient economic incentive for the change of route.

The Highway will have positive spin-off benefits for the rest of the Northwest Territories economy, estimated annually at $5.5 million in GDP, 41 permanent jobs, and an increase in government revenues by $1.1 million, of which $0.6 million would accrue to the GNWT. The rest of Canada will experience an increase of $0.8 million in GDP, 11 more permanent jobs, and $88,000 in additional government revenues.

12.1.3 Tourism Impacts

Northwest Territories Tourism officials suggest that the Highway would increase tourist visitations by 20%, or 2,500 to 2,700 new tourists each year. Based on an historical average spending per person of $644 (excluding airfares) and prepaid package costs of $284 (some of which do not accrue to businesses in the Northwest Territories), a conservative increase in tourist expenditures of $2 million a year is expected. This translates into $550,000 more purchasing power in the Northwest Territories each year, 10 new permanent jobs, and almost $100,000 more in government revenues each year.

The Highway will also increase tourism numbers and result in longer stays in the Northwest Territories and across the North by creating a driving loop up through the Northwest Territories and back down the Dempster Highway into Yukon.

12.1.4 Impact on the Proposed Mackenzie Gas Project (MGP)

In the proposed construction for the MGP, it is expected that in the absence of all-weather road access to the pipeline, the majority of the pipe, heavy building equipment, and materials for the MGP will be brought in by barge to existing or new barge landing and staging areas. The September 2009 study reports that even if the Highway is built before the MGP, it is not expected to significantly reduce initial construction costs. However, depending on the pipeline construction location and time of year, some cost savings could be realized if winter access roads do not need to be built due to the Highway's completion prior to pipeline construction.

For example, in the GSA there are only two locations available for barge landing and staging areas for construction of either the MGP and/or the Highway. These are at Inuvik and Little Chicago, south of the boundary between GSA and Sahtu Settlement Area. In the absence of an all-weather highway, construction of the pipeline between the GSA and north of Fort Good Hope would require access by a new winter road. If the Highway in that section is completed prior to pipeline construction, construction costs will be reduced, given that the Highway and the pipeline are proposed within a common Transportation Corridor. Reliable, public, all-weather access to a Transportation Corridor identified for development of infrastructure will have both quantifiable and unquantifiable advantages in the development of the MGP (see Section 12.3.4).

12.1.5 Positive Changes in the Structure of the Northwest Territories Economy

New economic patterns and structures will emerge to take advantage of the lower costs and lower risks provided by the Highway. Some examples that are provided in the September 2009 study include the following:

- new onshore hydrocarbon fields can be developed sooner and more efficiently, and can have a lower overall cost structure, opening up the Northwest Territories to more exploration;
- new offshore hydrocarbon exploration can be facilitated through more efficient and cheaper transportation of industrial supplies and equipment using the Highway, which is a more direct route to Edmonton, Calgary, or other North American oilfield supply centres;
- the Highway can help spread the work over a longer period of time where spur roads off the Highway or access from the Highway to barge terminals on the Mackenzie River are feasible, thus reducing the cyclical intensity of activity and the associated inflationary pressures;
- the potential for Northwest Territories-based businesses to provide additional supplies and services to the oil and gas sector via the Highway;
- the potential for new business and education opportunities in the GSA through the availability of high-speed, reliable access to the World Wide Web through installation of the fibre optic cable proposed for the Highway embankment (see Section 12.3.4).

Although it is difficult to quantify in terms of real savings, the introduction of a reliable public transportation system such as an all-weather highway provides opportunity for the development of other infrastructure and resources in an efficient and sustainable manner. This is specifically relevant to remote Arctic regions where such development may never have occurred otherwise, or may have occurred in an uncontrolled, damaging, and undesirable manner. The development of the Highway within the GSA, on one hand, provides access for the orderly development of resources and infrastructure, and on the other hand, provides opportunity to consolidate that access to a common Transportation Corridor.

The Highway will provide greater access and support development within the Transportation Corridor. Such development as the MGP will allow the Gwich'in to post Gwich'in private lands for future oil and gas exploration.

12.2 Impact of the Highway on Oil and Gas Exploration and Development

A report titled "Mackenzie Valley All-Weather Road Opportunity Assessment, October 2007", prepared by Meyers Norris Penny LLP for the Mackenzie Aboriginal Corporation, studied and quantified the impact of the Highway on future oil and gas exploration and development, assuming that the MGP would be built. The objectives of the report were to:

- assess the opportunity costs that a of lack of all-season access to the Mackenzie Valley Region has had on regional natural resource development; and
- estimate development opportunities which could result from potential access to remote exploration and production sites in the Mackenzie Valley Region.

The report was based on extensive consultation with and information from exploration and development companies active in the Northwest Territories. The estimation of impacts and benefits cited are based on currently available cost information and cost structures for exploration wells in the Mackenzie Valley.

There are premiums associated with the reliance on winter road access for oil and gas exploration and other developments. The first is most obvious, which is the cost of constructing a "one time use" road for each individual project. The second is related to uncertainties relative to the number of days a winter road can stay in operation in any particular year. Historical climate data can be used to make some estimates, but recent experience with winter roads in the Mackenzie Valley and the Slave Geologic Province north of Yellowknife indicates that this is unreliable given the impacts of climate change.

An all-weather road or highway access to oil and gas exploration provides advantages in that it can extend or confirm the length of the drilling season and reduce costs.

The October 2007 report summarizes the advantages of extending the drilling season as follows:

- the Highway would extend the drilling season from 90 to 129 days. This enables a fundamental and permanent increase in the rate at which the natural resource base may be developed, relative to the current state, thereby allowing for the full economic benefit associated with the development of the resource base over a shorter period of time;
- the estimated rate of increase in the release of the economic benefit is approximately 43%. With the Highway present, the economic benefit associated with the drilling and subsequent production from 500 wells expected over a 25-year period would accrue in approximately 17.5 years;
- the impact of this permanent increase in the rate of release of economic benefit due to the presence of the Highway in the region yields a potential additional gain of $3.4 billion to government at the end of 25 years. This net gain has the present value equivalent of approximately $1 billion at 5% annual growth.

The October 2007 study summarizes the reduction in the cost of drilling exploration and production wells as follows:

- an estimated reduction of 15% in the per unit cost of exploration and production well drilling, resulting in an average $2.25 million reduction in costs per well drilled. The total estimated cost savings to industry are $1.25 billion, predicated on the drilling of 500 new wells;
- the permanent extension of the exploration season will allow an additional $70 million in wages to be released into the regional economy, driven by the ability of industry to drill these 500 wells in the time it previously took to drill 350, and the consequential need for incremental labour hours to do so.

The October 2007 report concluded that the presence of an all-weather highway in the Mackenzie Valley region would serve to materially reduce the cost premiums on exploration and development, thereby stimulating investment in the region and generating significant positive financial and other benefits for the region and for Canadians.

12.3 Other Benefits

Other benefits, such as installing fibre optic cable in the Highway embankment, are difficult to quantify and include the following.

12.3.1 Cost of Government Program Service Delivery

The Highway will reduce the cost of providing government services and programs delivered in the region through a reduction in travel costs, operation and maintenance costs for health, education, social, and recreational facilities and services, capital programs, and local municipal services and programs. The Highway provides the backbone of an overall Transportation Corridor which, as noted above, could include fibre optic cable. The ability to provide healthcare and education through reliable high-speed World Wide Web access is a very effective means of delivering programs to small remote communities. An example of this is delivery of such services to the Sunchild First Nation in Alberta.

12.3.2 Social Aspects

The Highway will provide GSA residents year-round road connection to communities in the southern Northwest Territories and the rest of Canada, thereby allowing cheaper, easier, and safer access to regional facilities, programs, and services in health care, education, and recreation. This will help to promote family, community, and sports events, such as school indoor soccer and hockey tournaments, community feasts and festivals, and make family get-togethers such as weddings or reunions more affordable.

12.3.3 Unique Tourism Opportunity

In addition to the quantified benefits of Highway can have for tourism, mentioned above, it could also be utilized to promote a unique tourism experience. The Highway through the GSA connects with the Dempster Highway through Yukon, thereby creating a driving "loop" which could likely become an attractive driving adventure through two of the three northern territories for tourists from southern Canada and the United States. The communities along the route will become key destination points for services along the way.

12.3.4 Identification of a Transportation Corridor

The identification of a Transportation Corridor through the Mackenzie Valley will be an outcome of the development of the Highway. The concept of a Transportation Corridor, discussed earlier in this PDR, provides the opportunity to position development within a common corridor along the Mackenzie Valley. This takes advantage of access via the Highway and minimizes the development footprint on the land. Although labelled a Transportation Corridor, infrastructure within such a corridor would include pipelines, transmission lines, and communication infrastructure (i.e., fibre optic cable in the Highway embankment).

Communication infrastructure in the form of fibre optic cable has considerable advantages and benefits. It provides reliable and cheaper high-speed Web service for the northern communities, allowing access to information that is relevant to education, healthcare, business activities, and the retention of languages and culture. As well, the introduction of fibre optic cable provides for reliable transmission of data out from future satellite collection or receiving points located in Inuvik. Collection and transmission of data is an economic opportunity that is not presently available in the GSA.

12.3.5 Pollution Prevention and Spill Response in the Arctic Ocean

The Highway extension to the Arctic Ocean can potentially make the Canadian Coast Guard's Tuktoyaktuk-based Arctic pollution prevention and spill response planning and operations cheaper and more effective. A highway would allow transportation of equipment and materials required to respond to potential spills in the summer/fall Arctic shipping season; at present, any emergency equipment and supplies must be flown to Tuktoyaktuk. The shorter distance from Edmonton via the Mackenzie Valley Highway will be more attractive for transportation of such materials and equipment.

12.3.6 National Sovereignty and Security in the Arctic

In the past few years, the issue of protecting Canadian sovereignty in the Arctic has received prominent national attention and has become extremely important to Canadians. Construction of the Highway will establish a permanent transportation link to Canada's Arctic coastline, demonstrating to the international community that Canada is prepared to make significant financial investments to protect Canadian sovereignty. In this context, the Highway provides an assertion of sovereignty in Canada's Arctic, while also serving a range of interests on a local, territorial, and national scale.

Furthermore, the expected thinning of the ice in the Canadian Arctic Ocean due to climate change could encourage foreign commercial and non-commercial shipping into and through the Northwest Passage. The Highway would allow easier and cheaper access for sovereignty and security related operations in the western Arctic Ocean, which could be based in Inuvik.

The introduction of the Transportation Corridor in which fibre optic cable could be a key infrastructure element, will support the above-mentioned facilities and overall security and national defense through the introduction of reliable and efficient telecommunications.

12.4 Opportunities to Develop a Future Workforce

Throughout the consultations associated with preparation of this PDR, the question of training and education opportunities frequently arose. Although this document does not commit any organization or agency to the training and education of a future workforce, it is relevant to identify opportunities that could be undertaken now in preparation for the future. Training and career planning could begin at the high school level in the communities.

Construction of the Highway will present business and employment opportunities for general labourers, equipment operators, surveyors, environmental monitors, camp staff (cooks, camp managers, custodians), expeditors, engineering and technical staff, and construction administrators, among others. Although the Highway construction is a one-time opportunity, the result will be a well-trained and educated Gwich'in workforce that will serve the needs of future infrastructure development, as well as make the development of that infrastructure in the GSA more attractive. The economic and social benefits presented above provide a vision of opportunities beyond the construction of the Highway, relative but not limited to:

- Highway management and operation by DOT (equipment operators, highway patrol, maintenance foremen, expeditors, engineering and technical staff, environmental monitors and administrative staff, expeditors and logistics specialists, etc.);
- land access management by GTC, the landowners (enforcement, environmental and wildlife monitors, technical planning staff, etc.);
- tourism and associated community-based service businesses (environmental and wildlife monitors, professional guides, tourist accommodations, campgrounds and RV hook-ups, communications and promotions specialists, business administration professionals, chefs, restaurant managers, expeditors, logistics specialists, etc.);
- resource and exploration opportunities and associated community-based service businesses (environmental and wildlife monitors, technical and engineering specialists, oilfield welding trucks, camp support staff, expeditors, logistics specialists, drivers and local administrative and management staff, etc.); and
- offshore resource development opportunities including camp support staff, marine crews, equipment repair and maintenance staff, warehouse staff, marine wildlife monitors, local administrative and management staff.

13.0 CUMULATIVE EFFECTS

Cumulative effects are those impacts (biophysical, socio-cultural, or economic) that result from a proposed development in combination with other past, present, or reasonably foreseeable future developments (MVEIRB 2004). There are four basic steps involved in conducting a CEA. These are as follows:

a) Identify the valued parts of the environment that are potentially affected by the proposed development.

b) Determine what other past, present, or reasonably foreseeable future developments will affect these parts of the environment.

c) Predict the effects of the proposed development in combination with these other developments.

d) Identify ways to manage the combined impacts.

An assessment of cumulative effects provides a more complete understanding of what might happen to VCs beyond the influence of the project alone. This is useful for regulatory decision-makers and land and resource managers as they review specific proposals and plan for future development. Thus, an assessment of cumulative effects is done in an attempt to provide some insight into present environmental and socio-economic conditions and assess how they may change in the future if the proposed project proceeds.

The Environmental Effects and Mitigation Measures section of this PDR (Section 11.0) has presented mitigation measures to address the environmental effects associated with the construction and operation of the Highway. It is the role of the CEA to consider the potential additive and synergistic effects of overall residual effects, in combination with past, existing or known planned activities in the vicinity of the Highway within the GSA.

13.1 Spatial Boundaries

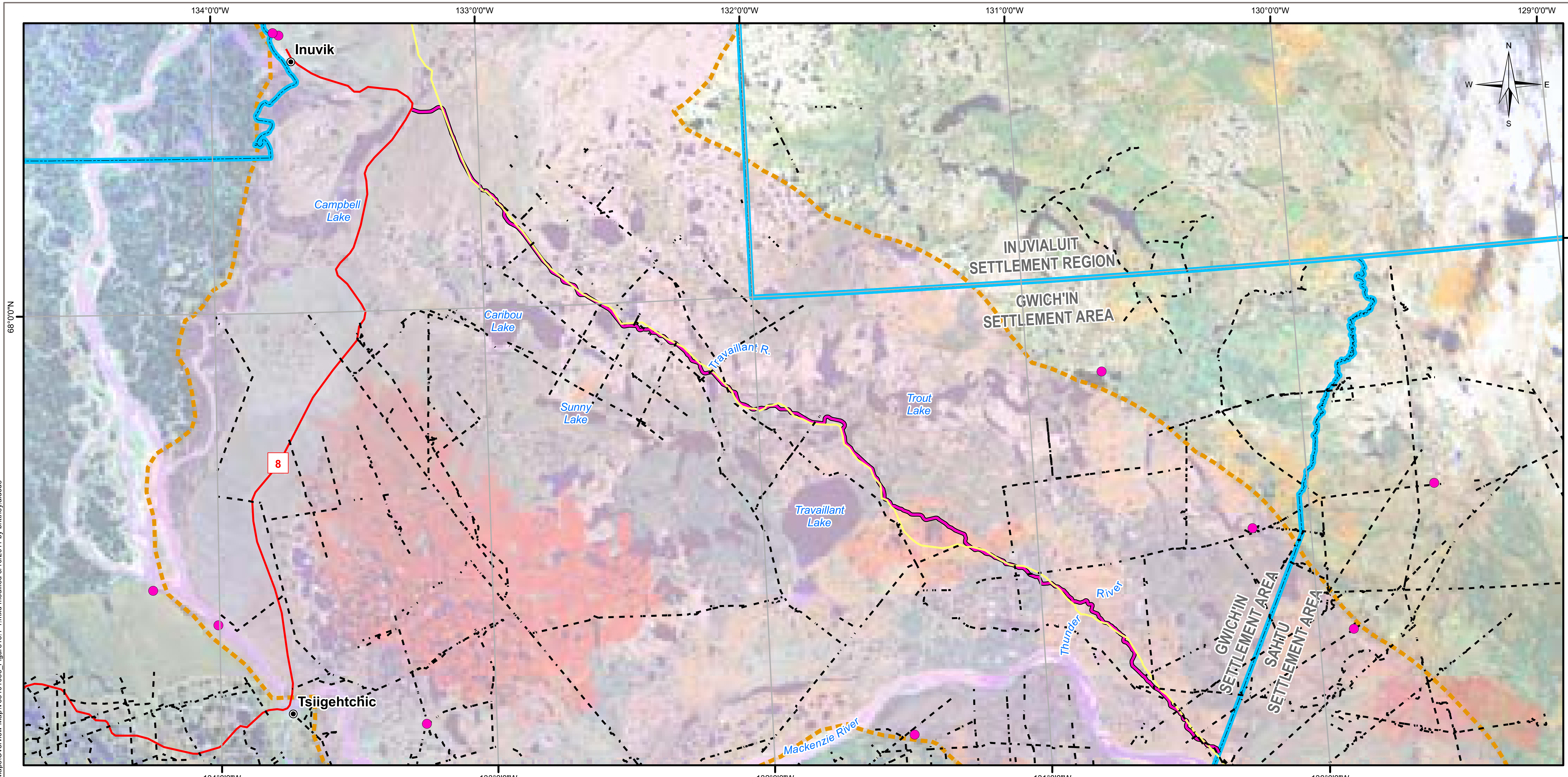
For the purposes of this CEA, the spatial boundaries include the portion of the Mackenzie Delta and northern Mackenzie Valley in the general vicinity of the Highway, extending approximately from Inuvik to the eastern boundary of the GSA. The spatial boundary for the CEA is shown on Figure 13.1-1.

The spatial boundary for the Highway generally involves a 30 km wide buffer area along both sides of the Highway, representing a 60 km wide area, except for a westward expansion to Tsiigehtchic. This general area encompasses the entire Highway, the range of environments that could reasonably be affected by the Highway, and the past, present, and future projects that may have a potential to contribute to cumulative effects.

Since the Highway closely follows the proposed alignment of the MGP, the spatial boundary selected was based on the CEA conducted for the MGP (IOL et al. 2004).

13.2 Temporal Boundaries

For purposes of the CEA presented in this PDR, the temporal boundary (time frame) for the CEA will be the next 40 years, during which time the Highway is anticipated to be completed and in operation.



LEGEND

- Communities
- Well Site
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- Mackenzie Gas Project Corridor
- Cut Line
- Settlement Area Boundary
- Cumulative Effects Study Area

NOTES

Base data source: ESRI Base Data
Gwich'in Land Use Planning Board
NTS 1:250,000
Cut Lines: CanVec
Cumulative Effects Study Area boundary is approximate - digitized from Figure 12-2 (page 12-6) of Volume 5: Biophysical IA of the MGP EIS
Highway alignment is considered preliminary and is subject to change

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA

Cumulative Effects Study Area

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:600,000
10 5 0 10
Kilometres

FILE NO.
V33101053_Figure13.1-1.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	SLA	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Figure 13.1-1

M:\TRANSPORTATION\NWT_Mackenzie_Highway\V33101053_Gwich'in\Maps\Overview Map\V33101053_Figure13.1-1.mxd modified 5/10/2011 by brittney.aldous

13.4.1.1 Winter Access Trails

Winter access trails have been developed each winter as needed, to allow the Gwich'in to pursue their traditional hunting, trapping, recreational, and other activities on the land, including in the general area of the Highway. The introduction of snow machines has increased the ease and speed with which long distances can be travelled over the land.

At consultations, residents and agencies confirmed that several families have camps and trap lines in the vicinity of the Highway, and use access trails to go to these camps in the winter. Information on trails that has been provided by the GSCI was used in the preliminary design of the Highway.

The winter access trails are considered to be low impact in nature, disappearing with the annual spring snowmelt and leaving minimal evidence that they were there. After the Highway opens, it is anticipated that trucks and trailers will haul snowmobiles and all-terrain vehicles (ATVs) to points along the Highway. From there, they would be unloaded and would then be used to access the adjacent camps and harvesting areas as was done previously.

The presence of the Highway will make it easier for people to access the land for their various traditional, cultural, and recreational activities. To ensure that the environment is protected, it will be important for the users of the Highway to abide by the existing GTC Land Management and Control Guidelines, the *GLUP,* and other applicable rules and regulations This includes communicating about plans to access the land with the GTC, DGOs, RRCs, Bands and Band Councils, and co-management boards such as the GRRB.

It is anticipated that the ongoing winter access in the vicinity of the Highway will not contribute to a potentially negative cumulative effect on the identified VCs.

13.4.1.2 Travaillant Lake

The Travaillant Lake Conservation Zone and the Lakes Around Travaillant Lake Special Management Zone are designated special areas under the *GLUP* because of their environmental and cultural importance to the Gwich'in. These areas encompass cultural and environmental values including campsites, cabins and stages, trails, burial sites, and significant heritage sites. In the Travaillant Lake area, the Gwich'in take part in traditional activities, harvesting, and spending time on the land. The Travaillant Lake area provides key wildlife habitat, important fishing resources, waterfowl staging and breeding areas, and is part of the range for barren-ground and boreal woodland caribou.

Figure 8.4-1 depicts the Highway through the Travaillant Lake area. In the early 2000s, in accordance with the input received from the Andre family which has an active camp at Travaillant Lake, Imperial Oil Resources Ventures Ltd. et al. shifted the proposed route for the MGP northeast from the original alignment in order to reduce its potential effect on the Travaillant Lake area. The Highway adopted the revised corridor for its alignment, with a view to maintaining the greatest practical setback from Travaillant Lake in respect of the traditional land users.

In the 2010 consultations, some residents expressed concern that the Highway would increase access to the Travaillant Lake area. The prospect of setting up one or more tourist lodges in the area was one that was viewed as an opportunity for some and a potential degradation of a special area by others. Indeed, the increased accessibility of the area could reasonably be foreseen to increase visitation by Gwich'in and non-Gwich'in to Travaillant Lake.

The GLA is responsible for coordinating and facilitating the management of Gwich'in private lands (including subsurface and surface rights at Travaillant Lake, see Figure 3.0-2) and dealing with issues, policies, and regulations relating to the management of harvesting, wildlife, and the environment. Accompanying harvesting pressures, particularly stress on fisheries, was another topic reflected in the comments of the communities and the regulatory agencies. DFO, for their part, noted that they would begin to work on management planning to protect fish and fish habitat in the area. The GTC, DGOs, RRCs, and the GSCI, as well as Bands and Band Councils and the GRRB are positioned within the GSA to respond to development pressures with the necessary management tools to minimize the potential for such concerns to be realized.

It is anticipated that the traditional use at Travaillant Lake, and the potential for increased traditional and recreational use will not contribute to a potentially negative cumulative effect on the identified VCs provided that the appropriate consultations, development authorization processes, and resource management plans are developed and adhered to and the development conforms to the conditions provided in the *GLUP*.

13.4.1.3 The Dempster Highway

The Dempster Highway is the only all-weather highway connecting the Mackenzie Delta to the south, via Yukon. The Dempster connects the communities of Inuvik, Fort McPherson, and Tsiigehtchic year round, except during freeze-up and break-up. The opening of the Mackenzie Valley Highway is expected to change traffic volumes on the Dempster. What is expected is that tourists may favour travelling the two highways as a loop instead of coming and going by the Dempster. Truck traffic in the Northwest Territories will have short hauls with exclusive use of the Mackenzie Valley Highway. One concern noted by the communities is that traffic volumes and service levels on the Dempster might be reduced. It is not known to what extent additional tourism might offset this effect. However, DOT has assured that access to communities, highway maintenance, ferry service, and jobs will be maintained. The Mackenzie Valley Highway is proposed as an addition to the Northwest Territories public highway system and not a trade-off.

From an environmental perspective, the *GLUP* designates the Dempster as a Transportation Special Management Zone, allowing for management of activities within 1,000 m on either side of the Dempster Highway, mostly related to transportation. The zone is set up to manage and protect Porcupine caribou; tourism; granular resource/pit management; waterfowl; water quality and quantity; and peregrine falcons and other raptors. This shows that the *GLUP* contains elements that provide for the responsible design, construction, and operation of current highway infrastructure. It provides an example of what kinds of pressures might arise from the presence of the Mackenzie Valley Highway and deals with them proactively. The effect of opening the Mackenzie Valley Highway is expected to have little interaction with the effects related to the Dempster and provides negligible opportunity for a significant cumulative effect to occur.

13.4.1.4 Oil and Gas Exploration

Seismic

Since the 1960s, the most extensive non-traditional land use that has occurred in the Mackenzie Delta, including the area near the Highway, has been 2D (linear) and 3D (grid-pattern) seismic exploration programs (see Figure 13.1-1). Although from the air the vegetation along the seismic cutlines sometimes appears to have a different colour, on the ground, little physical evidence remains of these seismic programs. Often, in permafrost environments the groundcover and permafrost disturbance of the old-style dozer or "cat cut" seismic lines stimulates vigorous re-vegetation. Recently, low-impact and heli-portable seismic methods have all but eliminated evidence of seismic programs.

Drilling

A few exploratory oil and gas wells have been drilled in the GSA. Drilling has historically taken place several kilometres from Aklavik, Inuvik, and Tsiigehtchic (see Figure 13.1-1). Publicly available data sources do not identify any drilling locations in the immediate vicinity of the Highway.

13.4.2 Proposed Future Land Uses

Figure 3.0-2 identifies the location of known proposed future projects that may be developed in the region, the proposed MGP, and the Highway. Other than the Highway, the MGP is the most significant proposed future land use envisioned within the GSA in the short to medium term. There exists an opportunity for spin-off development in the form of oil and gas exploration – seismic and drilling activities, to be stimulated by the MGP. Fibre optic cable is also a proposed future land use along the corridor.

13.4.2.1 Mackenzie Gas Project (MGP)

Developing a natural gas pipeline from the Mackenzie Delta through the Northwest Territories to southern markets has been contemplated for many years. Various pipeline projects have been proposed during the last 30 years that consider economics, regulatory requirements, socio-economic and environmental conditions, and engineering and geotechnical issues in the decision-making process (IOL et al. 2004).

The purpose of the MGP is to develop three onshore natural gas fields (anchor gas fields) in the Mackenzie Delta and to transport natural gas and natural gas liquids by pipeline to market. The MGP's Proponents are Imperial Oil Resources Ventures Limited Partnership, ConocoPhillips Canada (North) Limited, ExxonMobil Canada Properties, Shell Canada Limited, and the Mackenzie Valley Aboriginal Pipeline Limited Partnership.

The proposed MGP footprint will be located in relatively undisturbed areas and is not expected to interact in combination with effects from other land uses on the identified VCs. The MGP CEA conclusions indicated that, despite the size and duration of operations, the contribution to cumulative effects by the MGP on the environments and communities of the Northwest Territories were not expected to be significant. The conclusions also found no reason and no basis for future cumulative effects management associated with this project. These conclusions were based on the implementation of appropriate management and monitoring programs, as outlined in the MGP EIS (IOL et al. 2004).

It is unknown whether construction of other proposed future projects, in particular, the MGP will proceed before or after construction of the Highway has been completed. In December 2010, the National Energy

Board (NEB) approved the applications for the construction and operation of the MGP (NEB 2010). IOL has until the end of 2013 to decide whether to proceed with the pipeline under the terms and conditions of the NEB's approval. If IOL decides to move forward, current projections have that start of construction in 2015 and the commencement of production in 2018 (Canadian Broadcasting Corporation 2011).

13.4.2.2 Oil and Gas Exploration

The Highway has the potential to stimulate oil and gas exploration by virtue of providing greater access to lands in the GSA, as discussed in Section 12.0, thereby lowering the cost of exploration. The concern about cumulative effects of such activity is the assessment of the potential effect on the identified VCs of exploration in combination with past, present, or potential future developments.

Under the *GLUP*, the Gwich'in have seen to the protection of those areas of greatest importance (see Section 8.4 of this PDR). Oil and gas exploration is not permitted in areas designated as Conservation Zones in the *GLUP*. The Travaillant Lake Conservation Zone (see Figure 8.4-1) would, under the current plan, therefore, be excluded from oil and gas development that might be stimulated by the construction of the Highway.

The interests of the oil and gas industry will be focused where previous exploration and/or geology suggest the potential for petroleum resources to be present. Areas with low potential have a low likelihood of seeing any oil and gas exploration. For areas of higher potential near the proposed alignment, the presence of the Highway will make it easier to access the land for petroleum exploration activities. The GTC, DGOS, RRCs, and the GSCI, as well as Bands and Band Councils and the GRRB work to develop, implement, and enforce management and harvesting plans. In the event of an increase in exploration activity, management plans and enforcement will be instrumental in protecting fish and wildlife in the GSA.

As is the case now, exploration activity will require a permit, licence, or authorization and consultation with the appropriate Gwich'in organizations and communities, and government agencies. No known exploration programs have been proposed. Although future exploration is foreseeable, it is anticipated that oil and gas exploration in the vicinity of the Highway will not contribute to a potentially negative cumulative effect on the identified VCs.

13.4.2.3 Fibre Optic Cable

The GNWT is currently considering the installation of fibre optic cable (for communication) along the Mackenzie Valley. The cable is currently proposed to be located in a shallow trench within the Highway right-of-way along the toe of the Highway embankment. This is illustrated on Figure 6.3-1. The Highway has the potential to define the location of the fibre optic cable and provide access for installation and maintenance of the cable in the future.

13.4.2.4 Concept of a Transportation Corridor

The concept of a Transportation Corridor is presented in earlier sections of this PDR. The Transportation Corridor will function to consolidate linear developments (i.e., the Highway, MGP, fibre optic cable) into a common corridor to minimize the footprint of development on the land and also minimize the cumulative effects of multiple developments.

14.0 CLOSING REMARKS

The idea of building an all-weather highway through the Mackenzie Valley originated in the 1960s. Through the following decades the Federal and Territorial Governments have undertaken a variety of studies and engineering work in the development of the Mackenzie Valley Highway from Wrigley to Inuvik. Today the all-weather highway terminates at Wrigley. The link to Wrigley, Tulita, Norman Wells, and Fort Good Hope is currently only by winter road. Beyond Fort Good Hope, there is no overland link to the Dempster Highway.

As noted in the introductory section of this PDR, in 2010, an MOU was signed between the GTC and DOT to set the terms for the completion of this PDR for the construction of the Highway. This action, and DOT's determination to partner with each land claim group along proposed Highway route, have reinvigorated the dream of building the Mackenzie Valley Highway.

The Mackenzie Valley Highway will decrease travel times from the communities in the GSA to points in the Northwest Territories and southern Canada. It will improve residents' access to health care professionals, as well as employment and educational opportunities. The Mackenzie Valley Highway will support year-round social, cultural, business and recreational opportunities and will enable family, community and social interaction that were not previously available. The Mackenzie Valley Highway will also provide the spine or backbone of an overall Transportation Corridor that will support additional infrastructure development such as a communications link through fibre optic cable and the future pipeline, while minimizing the footprint on the land.

This PDR builds on the work that was completed previously for the Mackenzie Valley Highway and the available information on the work that was done for the MGP. This PDR provides a preliminary design for the Highway in the GSA and assesses its associated effects and identifies appropriate mitigation to enable the Highway to be constructed. The PDR has been prepared specifically to be included as part of the overall Mackenzie Valley Highway submission to the MVLWB for preliminary screening – the first stage of the regulatory process.

This PDR also demonstrates the viability and importance of the Highway and gives voice to the local, regional, and national desire to build the Highway. The PDR builds on work done in previous studies and describes how the anticipated effects of the Highway are manageable. This finding is derived from the scientific and engineering assessments conducted for this PDR and from the knowledge shared and views expressed by the communities of Inuvik, Aklavik, Tsiigehtchic, and Fort McPherson. Consultations revealed a general satisfaction with the approach to the location, design, and construction of the Highway contained within this PDR.

The GTC and DOT have strong support from the Gwich'in communities to move forward in the development of the Highway. We trust this PDR provides the information required for the MVLWB to successfully complete the preliminary screening of the construction of the Mackenzie Valley Highway through the GSA.

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APPENDIX A

APPENDIX A MAP BOOK

GWICH'IN TRIBAL COUNCIL AND THE
GOVERNMENT OF THE NORTHWEST TERRITORIES

PROJECT DESCRIPTION REPORT FOR THE CONSTRUCTION OF THE MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA, NT

Gwich'inat Eenjit
Gàdatr'igwijilcheii Gidilii
Gwich'in Tribal Council

Northwest Territories

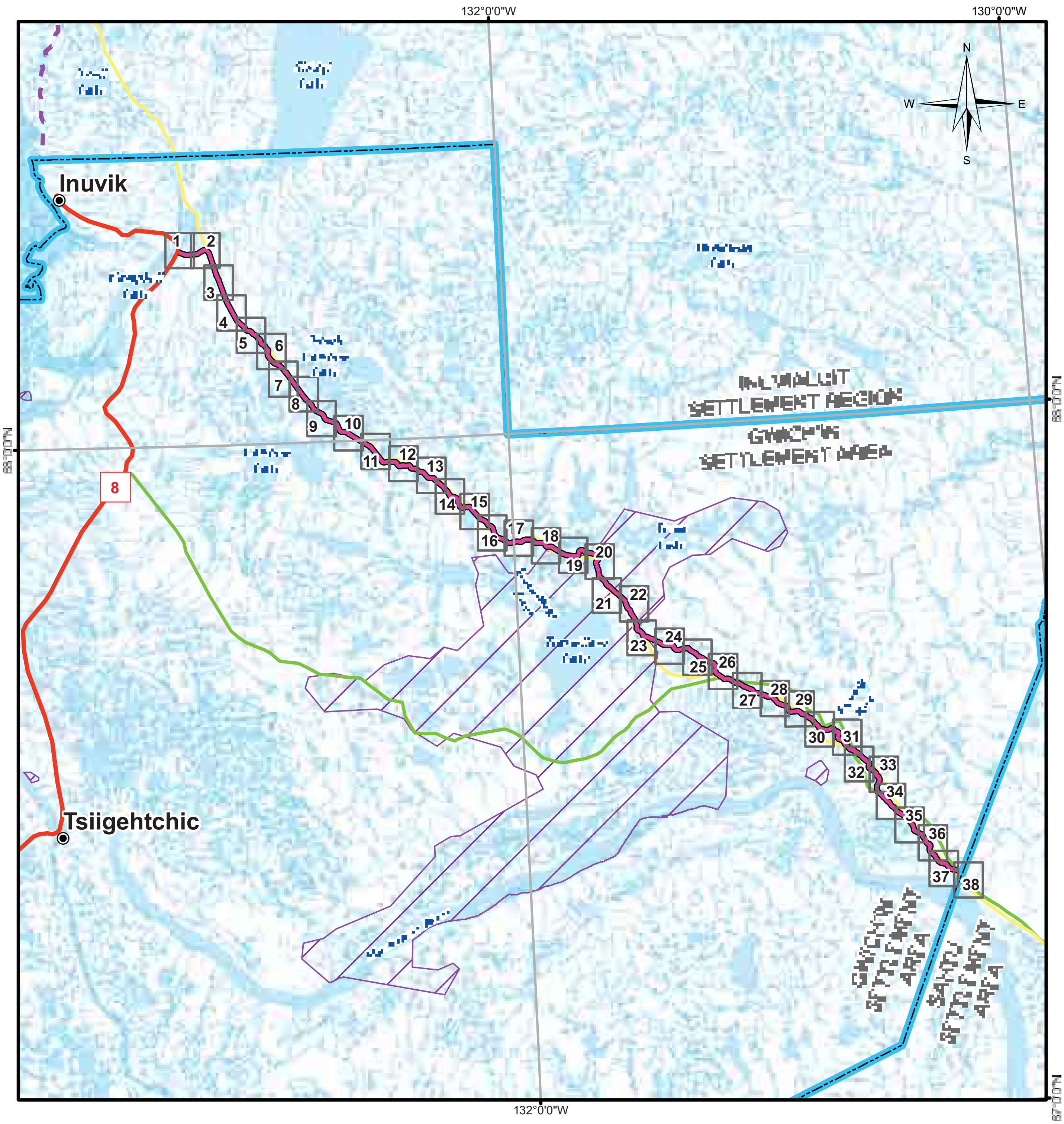




MAP BOOK 1:25,000

MAY 2011
ISSUED FOR USE

Nehtruh - EBA



LEGEND

- Communities
- Dempster Highway (NWT HWY 8)
- MVH Concept - December 2010
- Mackenzie Gas Project Corridor
- PWC 1974 Highway Concept Route
- Proposed Inuvik to Tuktoyaktuk Highway (2009)
- Settlement Area Boundary
- Watercourse
- Waterbody
- Wetland
- Conservation Zone
- 1 Map Grid

NOTES
Base data source:
MVAP Contours, PWC 1974, Orthotiles and MGP (Mackenzie Gas Project) data: Northwest Territories Centre for Geomatics,
Heritage Conservation Zone data: Gwich'in Land Use Planning Board
NTS 1:250,000: (Watercourse, Waterbody, Wetland and Dempster Highway)

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA

1:25,000 Map Book Index Map

PROJECTION	DATUM
UTM Zone 8	NAD83

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FILE NO.
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PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	May 10, 2011

Index Map

Legend

Bridge	Settlement Area Boundary
Culvert	1 km Corridor - MGP
Dempster Highway (NWT HWY 8)	Borrow Site - MGP
Proposed All-Weather Road - MGP	Preferred Borrow Sources
Proposed Winter Road - MGP	Preferred Borrow Sources
MVH Concept - December 2010	University of Waterloo Defined Borrow Source
Mackenzie Gas Project Corridor	Nehtruh-EBA Defined Borrow Source
PWC 1974 Highway Concept Route	

Proposed Facility Site - MGP
Conservation Zone
Sand
Major Contour (10 m)

MACKENZIE VALLEY HIGHWAY - GWICH'IN SETTLEMENT AREA

1:25,000 Map Book

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UTM Zone 8
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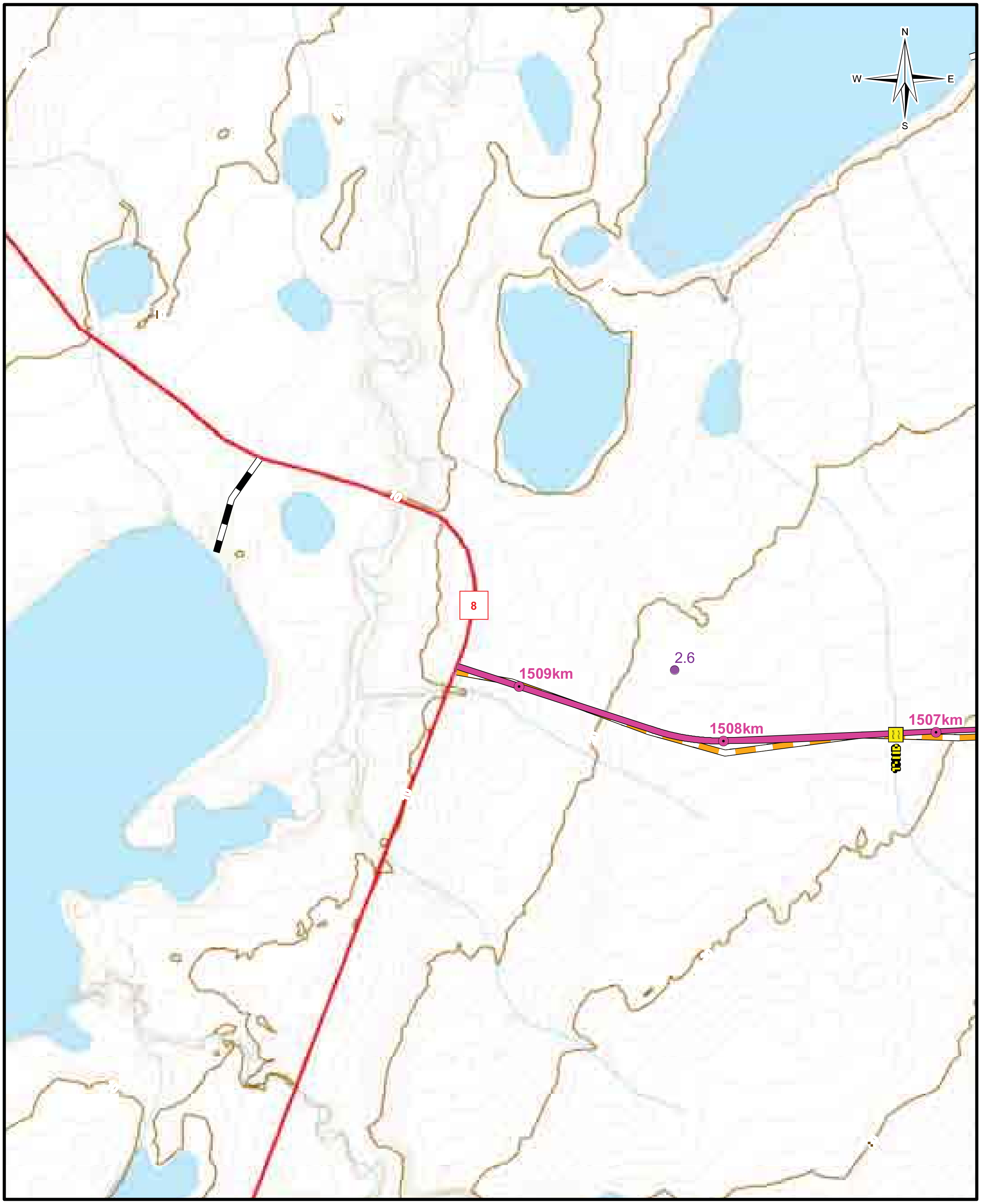
Map 01



Legend

- Bridge
- Culvert
- Dempster Highway (NWT HWY 8)
- Proposed All-Weather Road - MGP
- Proposed Winter Road - MGP
- MVH Concept - December 2010
- Mackenzie Gas Project Corridor
- PWC 1974 Highway Concept Route
- Settlement Area Boundary
- 1 km Corridor - MGP
- Borrow Site - MGP
- Preferred Borrow Source
- Preferred Borrow Source
- University of Waterloo Defined Borrow Source
- Nehtruh-EBA Defined Borrow Source
- Proposed Facility Site - MGP
- Conservation Zone
- Watercourse
- Waterbody
- Wetland
- Sand
- Major Contour (10 m)
- Minor Contour (1 m)

MACKENZIE VALLEY HIGHWAY - GWICH'IN SETTLEMENT AREA

1:25,000 Map Book

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FILE NO. V33101053_MapBook-NTS-Jan2011.mxd
PROJECT NO. V33101053 DATE May 10, 2011

Map 01

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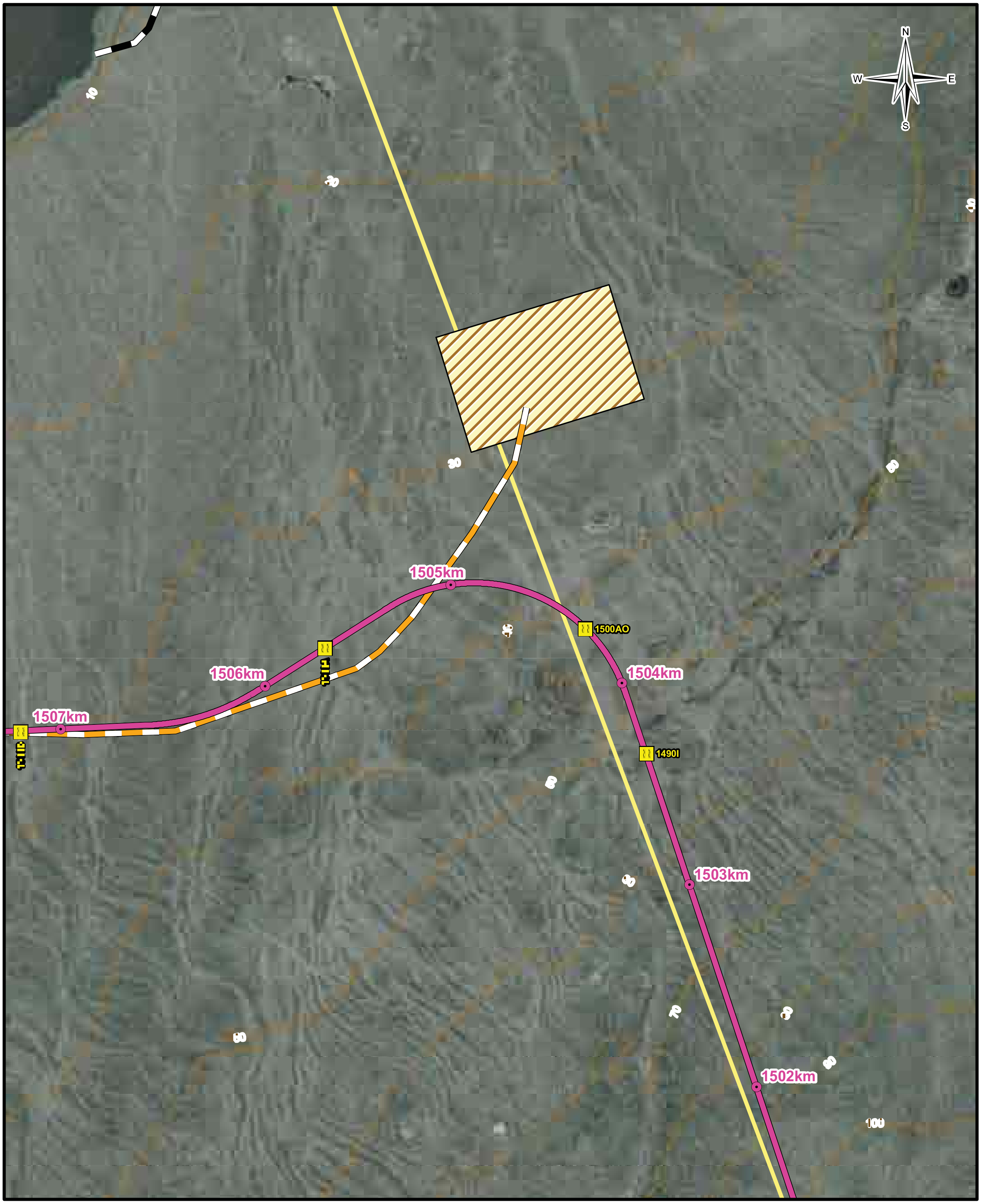

Legend

- Bridge
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- University of Waterloo Defined Borrow Source
- Nehtruh-EBA Defined Borrow Source
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- Conservation Zone
- Sand
- Major Contour (10 m)

MACKENZIE VALLEY HIGHWAY - GWICH'IN SETTLEMENT AREA

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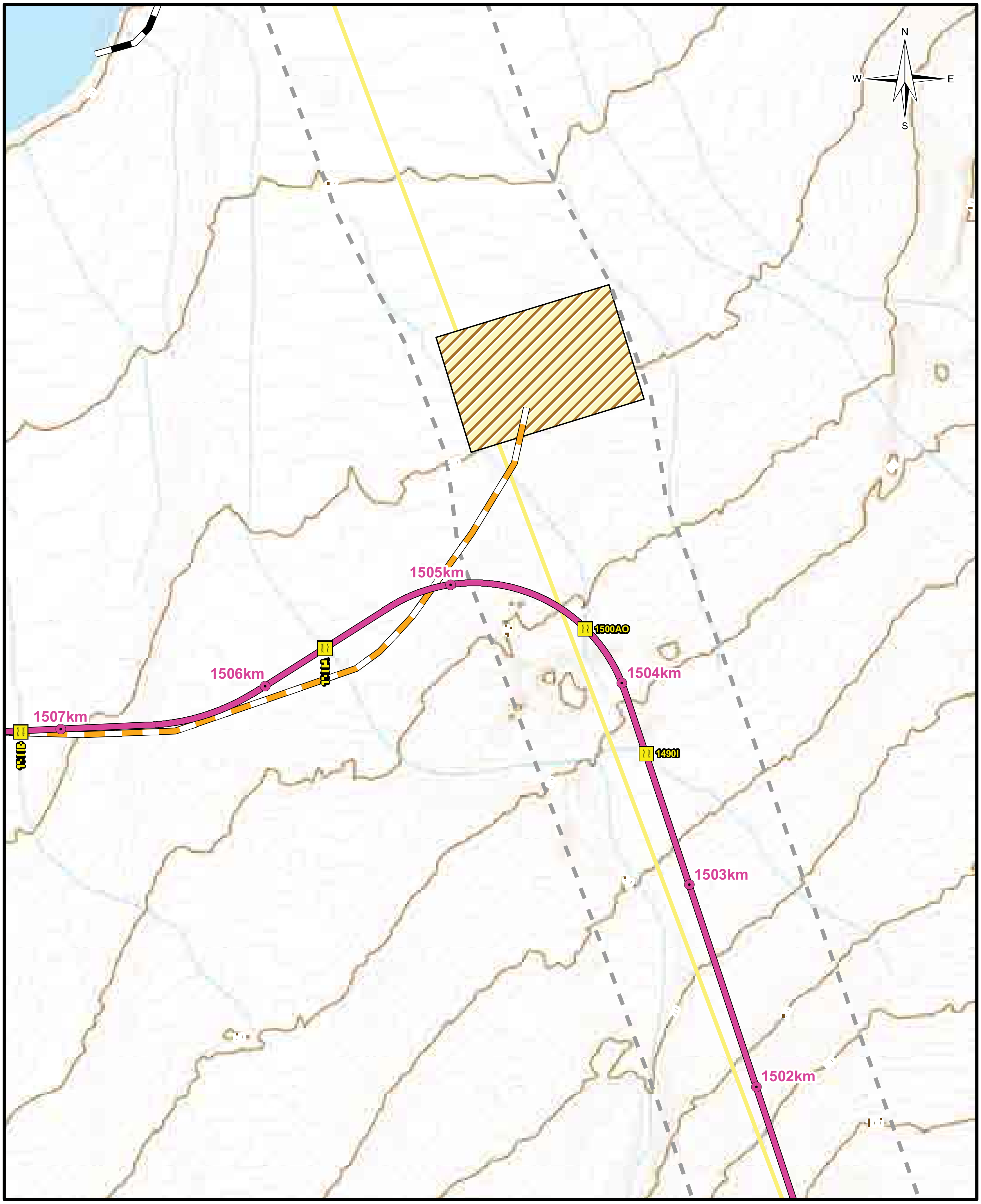
PROJECT NO. V33101053 DATE May 10, 2011

Map 02



Legend

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- Conservation Zone
- Watercourse
- Waterbody
- Wetland
- Sand
- Major Contour (10 m)
- Minor Contour (1 m)

MACKENZIE VALLEY HIGHWAY - GWICH'IN SETTLEMENT AREA

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PROJECT NO. V33101053 DATE May 10, 2011

Map 02

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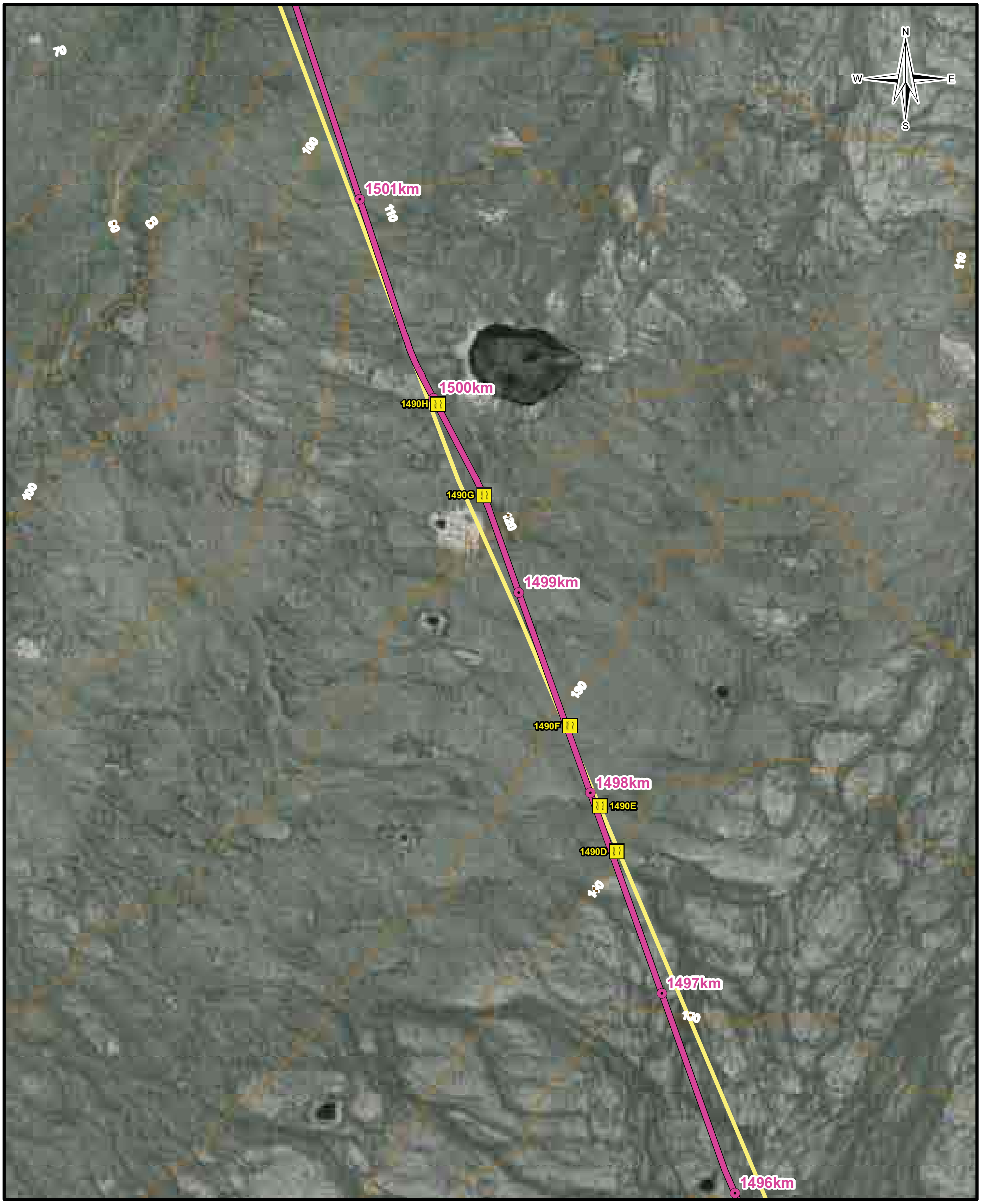

Legend

Bridge
Culvert
Dempster Highway (NWT HWY 8)
Proposed All-Weather Road - MGP
Proposed Winter Road - MGP
MVH Concept - December 2010
Mackenzie Gas Project Corridor
PWC 1974 Highway Concept Route
Settlement Area Boundary
1 km Corridor - MGP
Borrow Site - MGP
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Preferred Borrow Sources
University of Waterloo Defined Borrow Source
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MACKENZIE VALLEY HIGHWAY - GWICH'IN SETTLEMENT AREA

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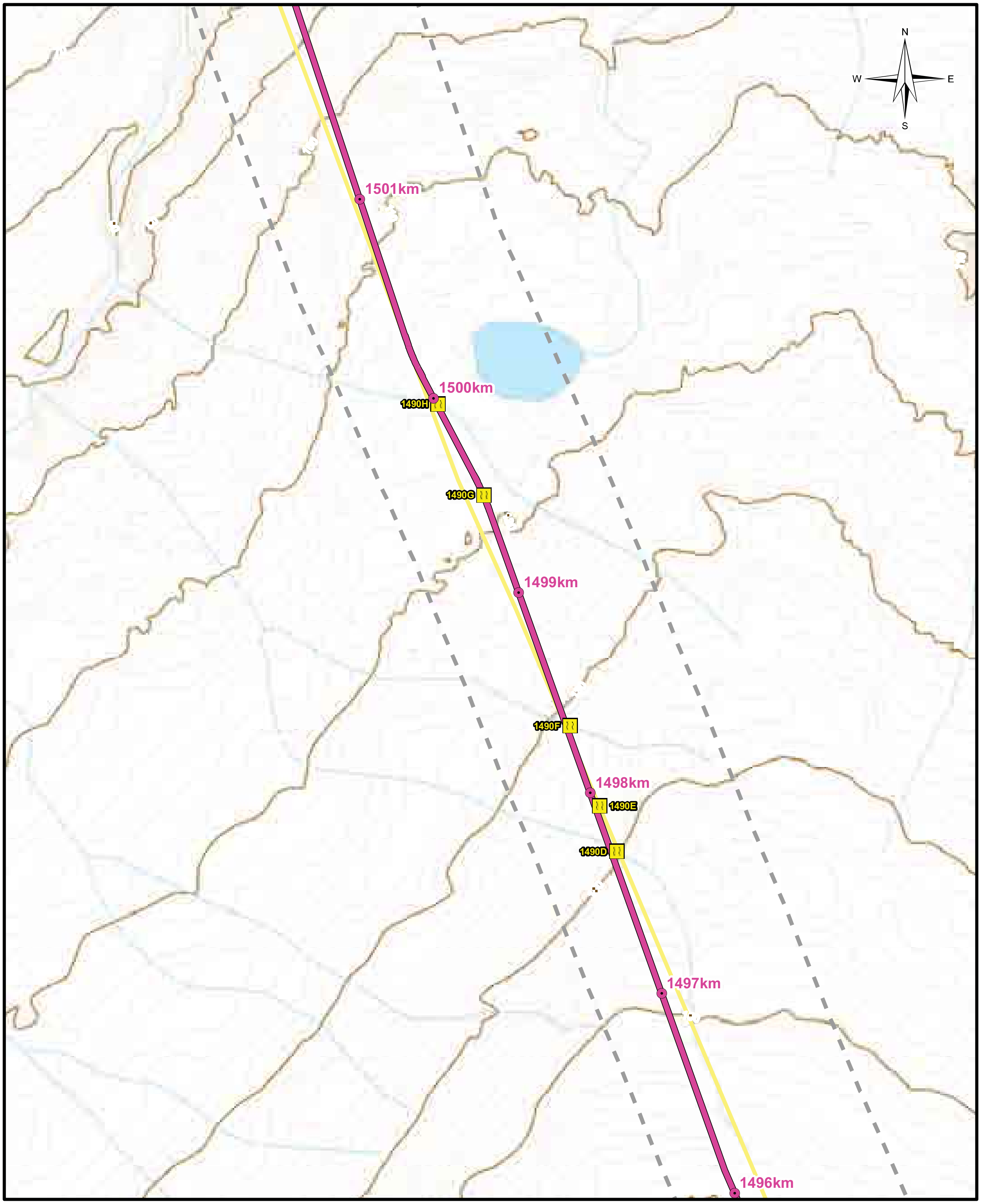
Map 03



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- Major Contour (10 m)
- Minor Contour (1 m)

MACKENZIE VALLEY HIGHWAY - GWICH'IN SETTLEMENT AREA

1:25,000 Map Book

Scale: 1:25,000

0 100 200 300 400 500

Metres

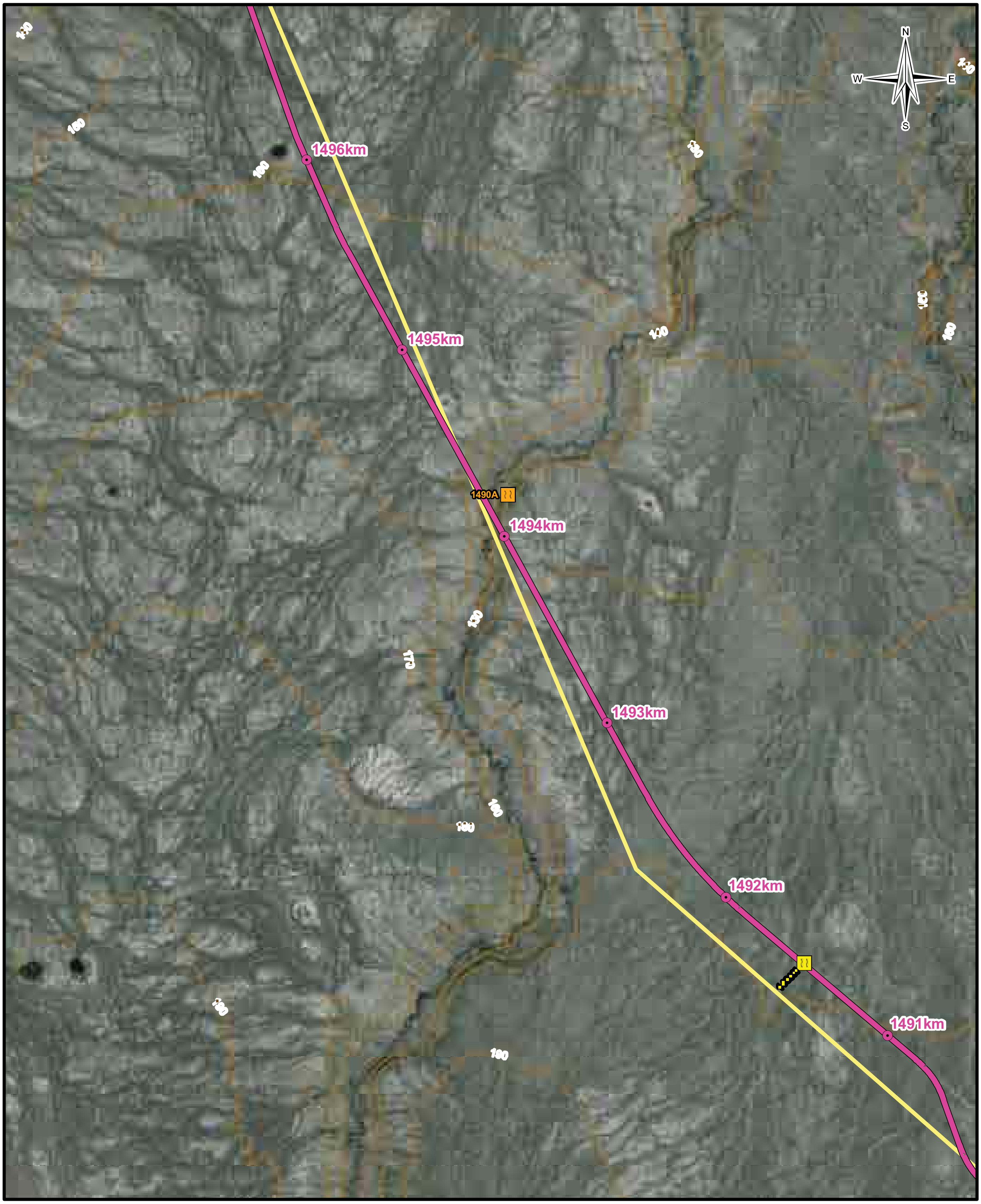
UTM Zone 8
NAD83

FILE NO. V33101053_MapBook-NTS-Jan2011.mxd

PROJECT NO. V33101053 DATE May 10, 2011

Map 03

M:\TRANSPORTATION\NWT_Mackenzie_Highway\V33101053_Gwich'in\Maps\Mapbook\V33101053_MapBook-NTS-January2011.mxd modified 4/20/2011 by brittney.aldous



Legend

- Bridge
- Culvert
- Dempster Highway (NWT HWY 8)
- Proposed All-Weather Road - MGP
- Proposed Winter Road - MGP
- MVH Concept - December 2010
- Mackenzie Gas Project Corridor
- PWC 1974 Highway Concept Route
- Settlement Area Boundary
- 1 km Corridor - MGP
- Borrow Site - MGP
- Preferred Borrow Sources
- Preferred Borrow Sources
- University of Waterloo Defined Borrow Source
- Nehtruh-EBA Defined Borrow Source
- Proposed Facility Site - MGP
- Conservation Zone
- Sand
- Major Contour (10 m)

MACKENZIE VALLEY HIGHWAY - GWICH'IN SETTLEMENT AREA

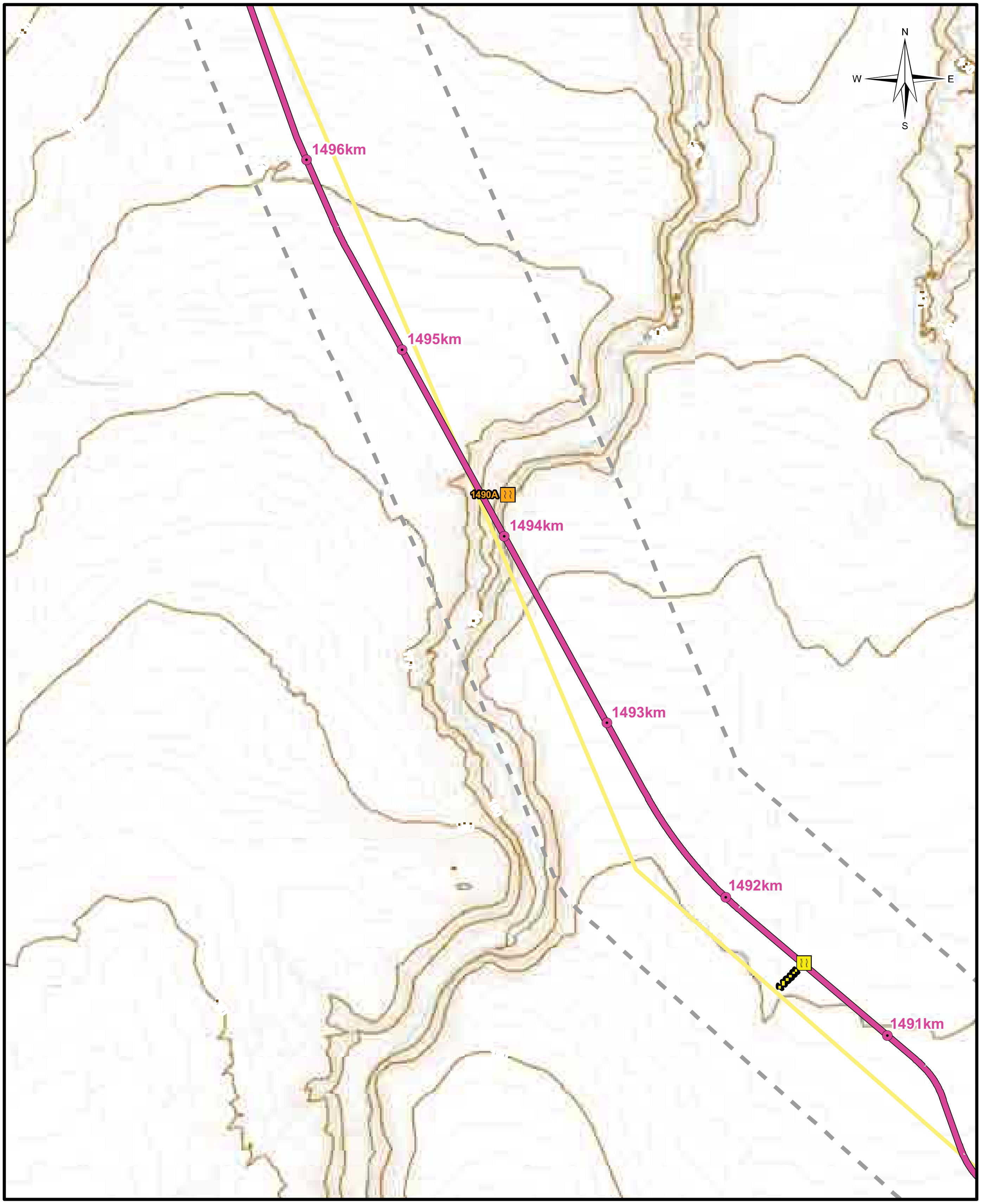
1:25,000 Map Book

Scale: 1:25,000
0 100 200 300 400 500
Metres

UTM Zone 8
NAD83

FILE NO. V33101053_MapBook-NTS-Jan2011.mxd
PROJECT NO. V33101053 DATE May 10, 2011

Map 04



Legend

- Bridge
- Culvert
- Dempster Highway (NWT HWY 8)
- Proposed All-Weather Road - MGP
- Proposed Winter Road - MGP
- MVH Concept - December 2010
- Mackenzie Gas Project Corridor
- PWC 1974 Highway Concept Route
- Settlement Area Boundary
- 1 km Corridor - MGP
- Borrow Site - MGP
- Preferred Borrow Source
- Preferred Borrow Source
- University of Waterloo Defined Borrow Source
- Nehtruh-EBA Defined Borrow Source
- Proposed Facility Site - MGP
- Conservation Zone
- Watercourse
- Waterbody
- Wetland
- Sand
- Major Contour (10 m)
- Minor Contour (1 m)

MACKENZIE VALLEY HIGHWAY - GWICH'IN SETTLEMENT AREA

1:25,000 Map Book

Scale: 1:25,000
0 100 200 300 400 500
Metres

UTM Zone 8
NAD83

FILE NO. V33101053_MapBook-NTS-Jan2011.mxd
PROJECT NO. V33101053 DATE May 10, 2011

Map 04

Legend

- Bridge
- Culvert
- Dempster Highway (NWT HWY 8)
- Proposed All-Weather Road - MGP
- Proposed Winter Road - MGP
- MVH Concept - December 2010
- Mackenzie Gas Project Corridor
- PWC 1974 Highway Concept Route
- Settlement Area Boundary
- 1 km Corridor - MGP
- Borrow Site - MGP
- Preferred Borrow Sources
- Preferred Borrow Sources
- University of Waterloo Defined Borrow Source
- Nehtruh-EBA Defined Borrow Source
- Proposed Facility Site - MGP
- Conservation Zone
- Sand
- Major Contour (10 m)

MACKENZIE VALLEY HIGHWAY - GWICH'IN SETTLEMENT AREA

1:25,000 Map Book

Scale: 1:25,000

0 100 200 300 400 500

Metres

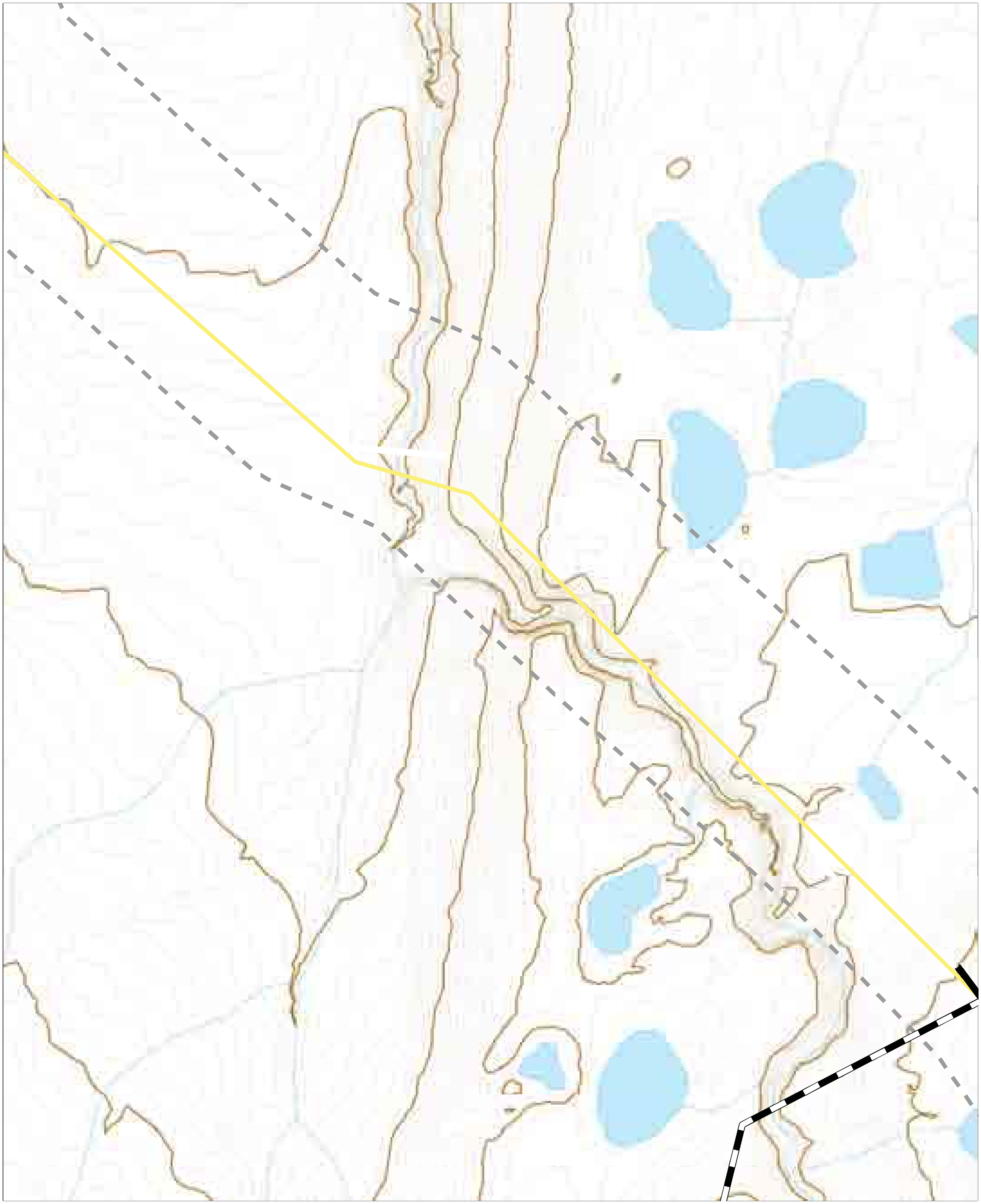
UTM Zone 8

NAD83

FILE NO. V33101053_MapBook-NTS-Jan2011.mxd

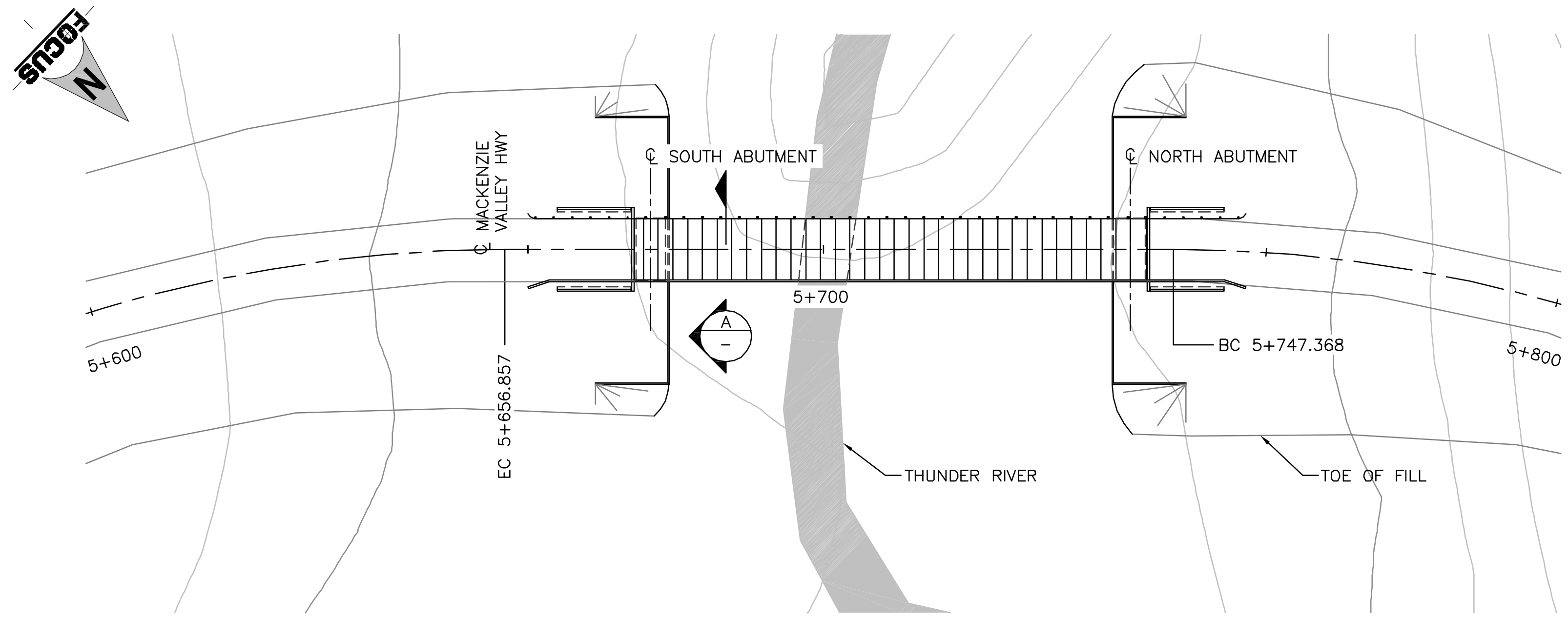
PROJECT NO. V33101053 DATE May 10, 2011

Map 05



APPENDIX B

APPENDIX B BRIDGE CONCEPTS



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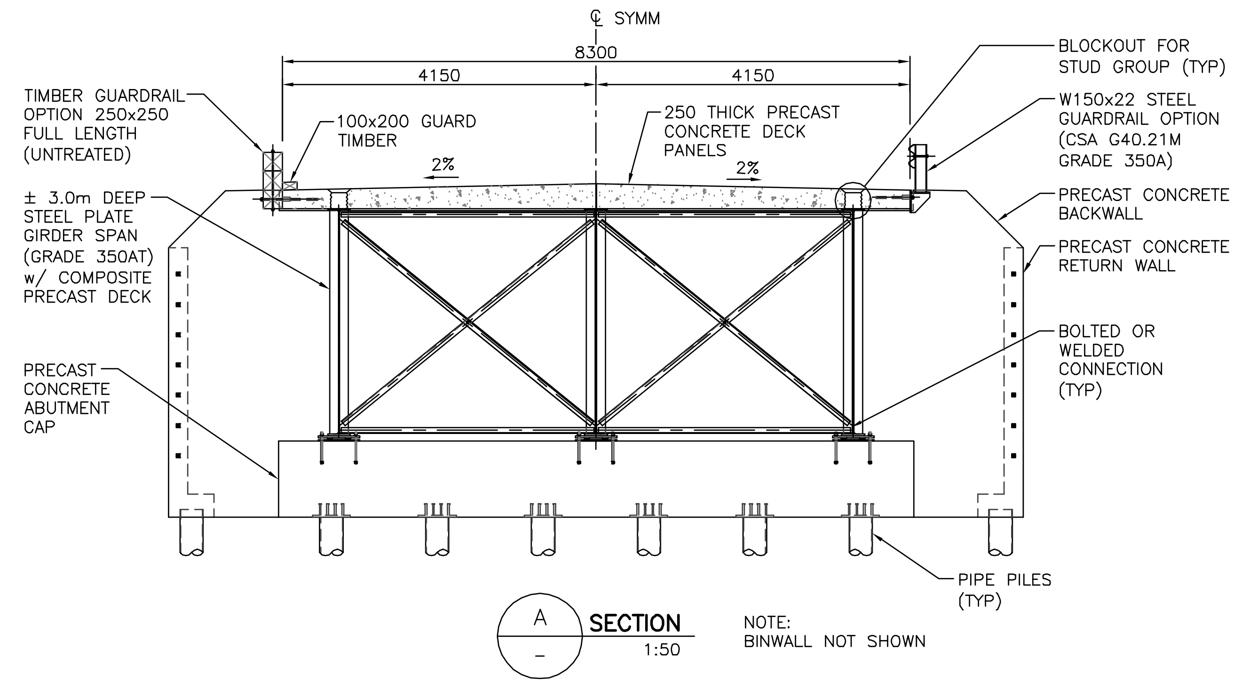
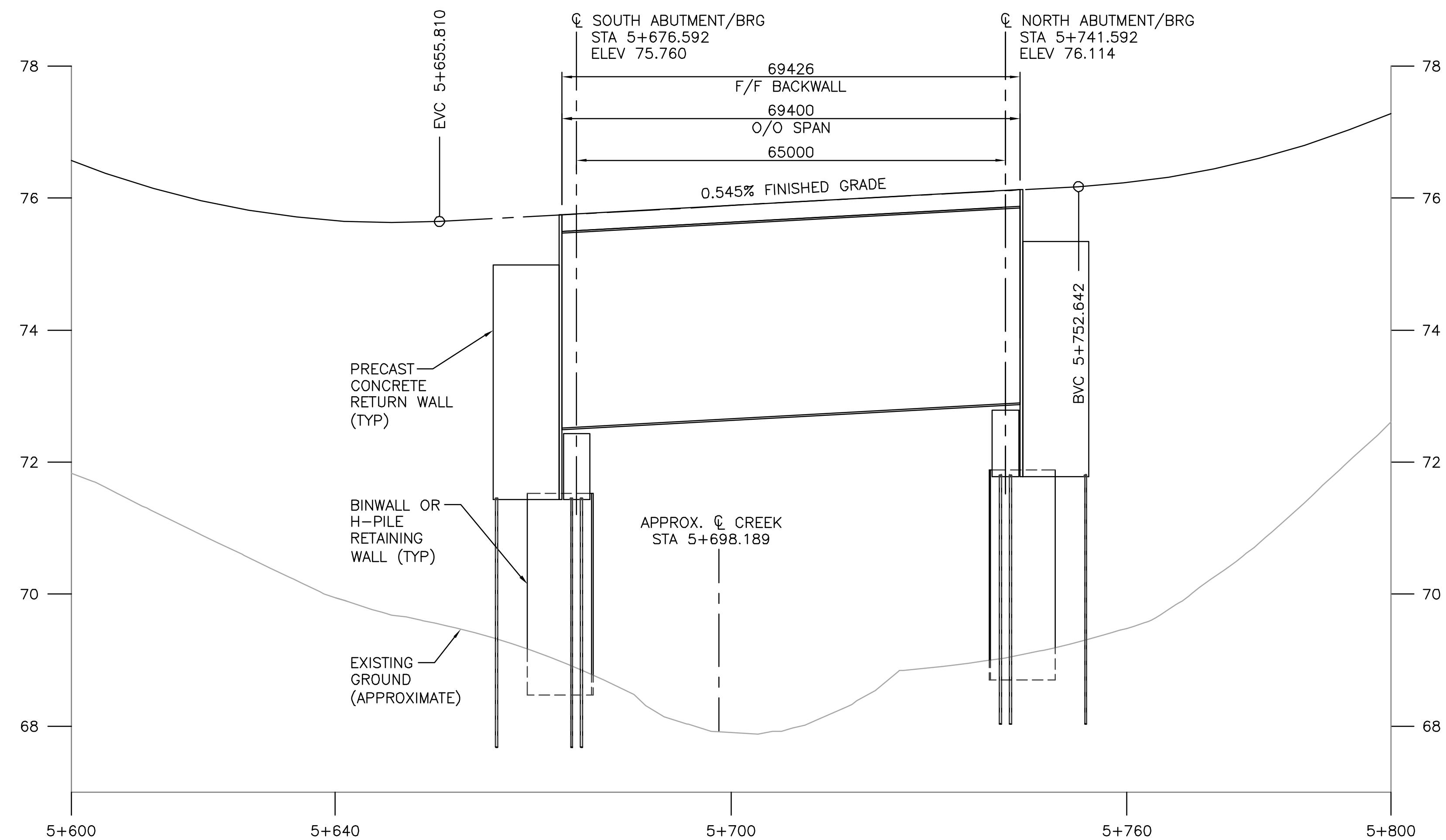


A – SECTION 1:50

NOTE:
BINWALL NOT SHOWN



ELEVATION
H-SCALE: 1:500
V-SCALE: 1:5000

PRELIMINARY LAYOUT:
- 65m SINGLE SPAN BRIDGE
- 7m FILL AT EACH ABUTMENT UTILIZING BINWALLS/RETAINING WALLS
- 10m LONG PRECAST CONCRETE RETURN WALLS
- BRIDGE SET AT 0.545% GRADE MATCHING ROAD DESIGN
- TWO LANE BRIDGE

PROPOSED BRIDGE GENERAL ARRANGEMENT PRODUCED BY FOCUS CORPORATION – EDMONTON DECEMBER, 20, 2010

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Bridge Concept
Crossing No. 1360D - 1362km
Thunder River

PROJECTION	DATUM
Scale 1:150 (1 0 1 3m)	

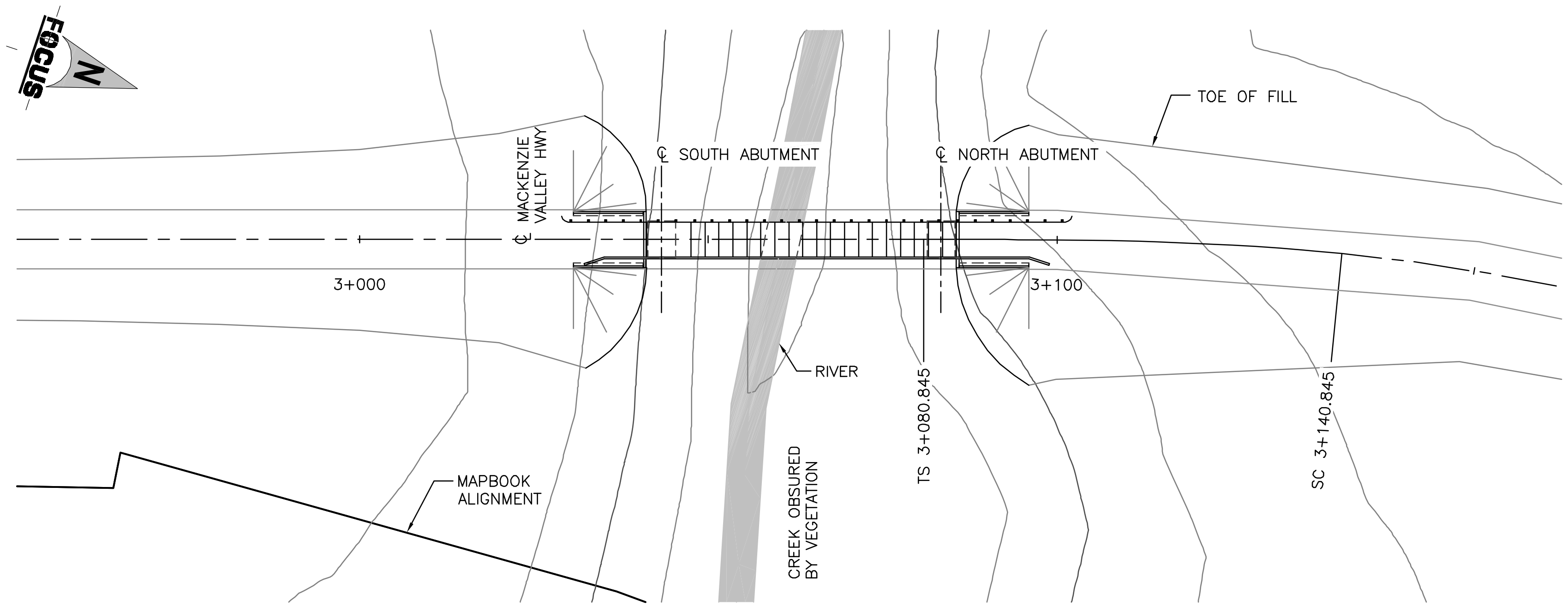
FILE NO.
Water Crossing - No.1360D Thunder River

PROJECT NO.	DWN	CKD	REV
V33101053	SM	RM	0

OFFICE	DATE
EBA-VANC	JANUARY 24, 2011

APPENDIX B

Q:\Vancouver\Transportation\V331\Projects\V33101053 - GSA PDR\CADD\Conceptual Design\Civil3D 1st run\Bridge concepts for PDR\Water Crossing - No.1360D - Thunder River.dwg [11x17] January 26, 2011 - 8:42am smatsuda



PLAN
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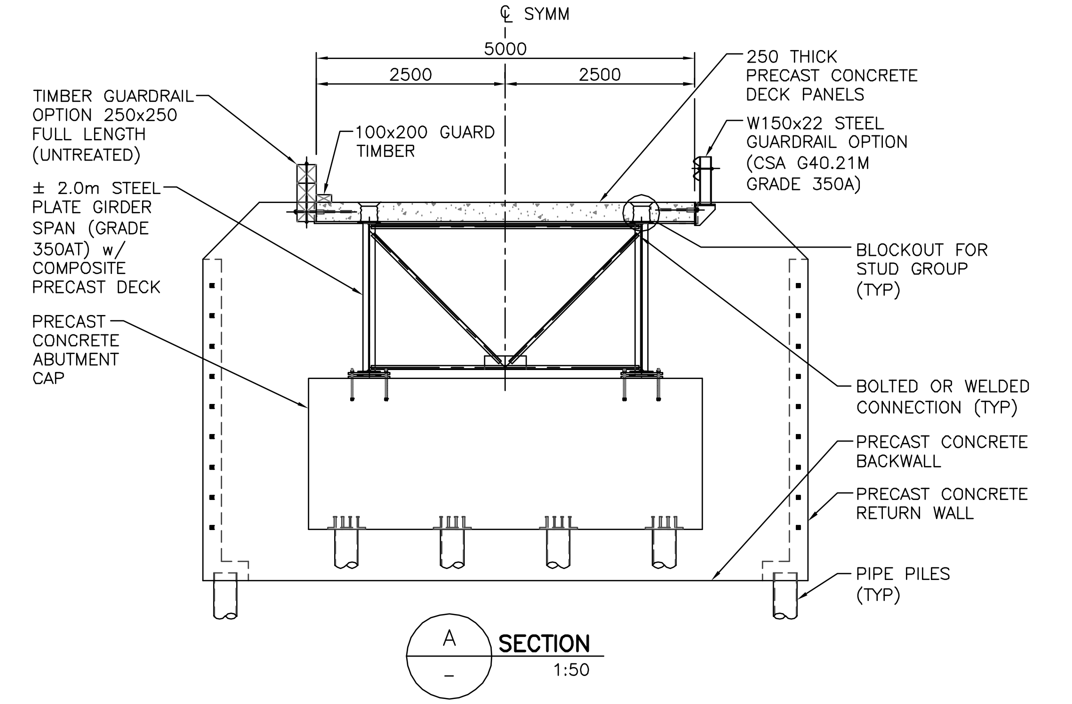

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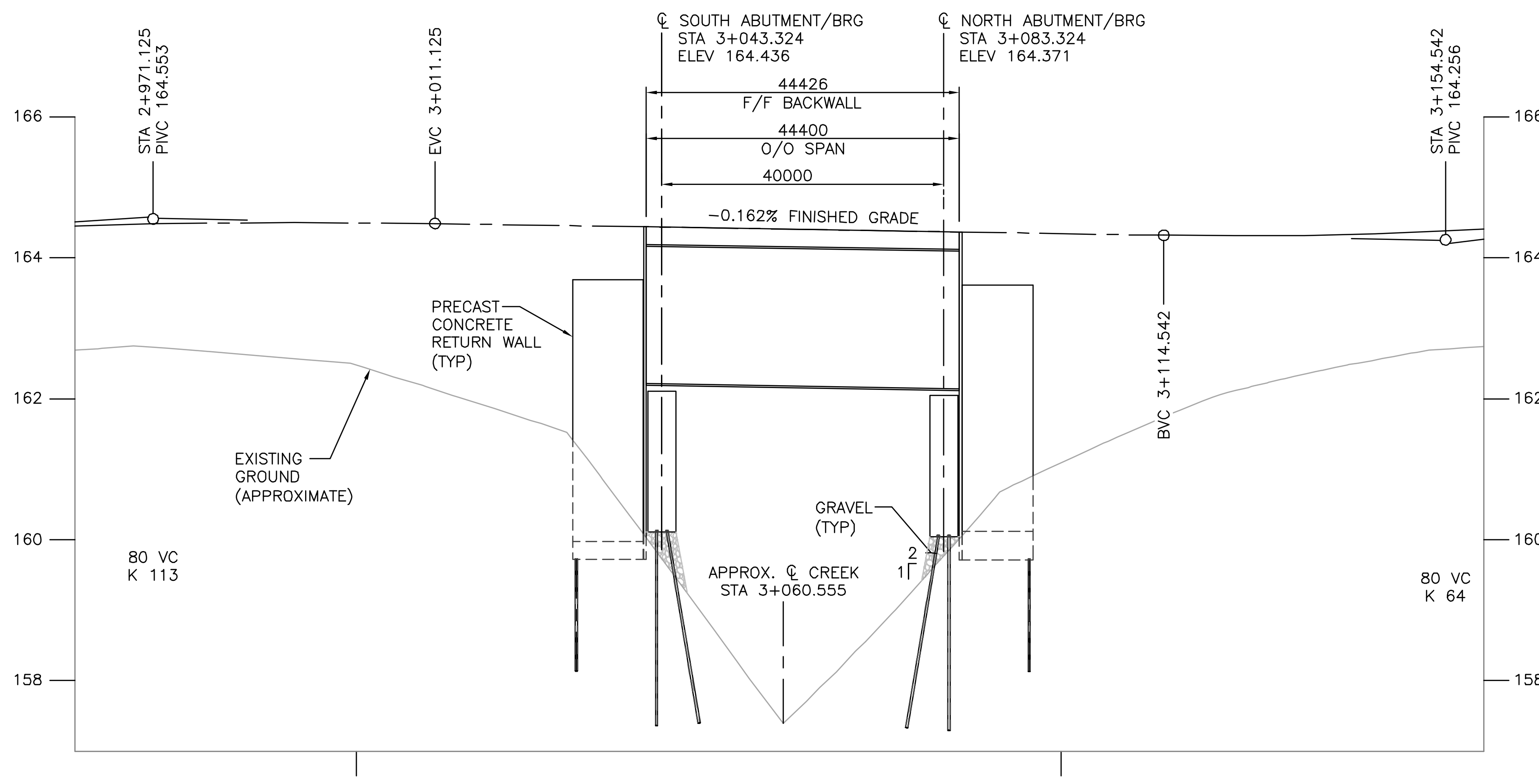
1:50



ELEVATION
SCALE: 1:500

PRELIMINARY LAYOUT:
- 40m SINGLE SPAN BRIDGE
- 4.4m FILL AT SOUTH ABUTMENT
- 4.35m FILL AT NORTH ABUTMENT
- 10m LONG PRECAST CONCRETE RETURN WALLS
- BRIDGE SET AT -0.162% GRADE MATCHING ROAD DESIGN
- ONE LANE STRUCTURE

PROPOSED BRIDGE GENERAL ARRANGEMENT PRODUCED BY
FOCUS CORPORATION – EDMONTON DECEMBER, 20, 2010

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Bridge Concept
Crossing No. 1410D - 1414km

PROJECTION	DATUM

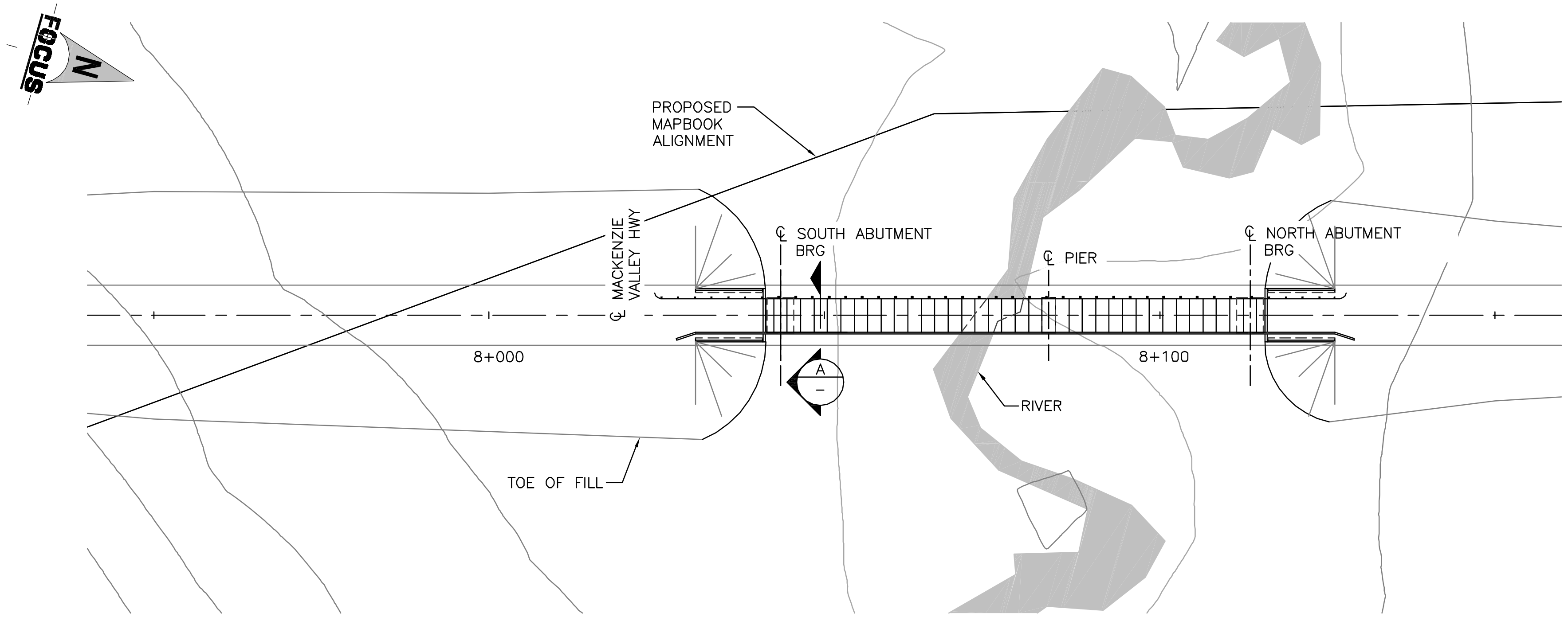
Scale 1:150
1 0 1 3m

FILE NO.
Water Crossing - No.1410D.dwg

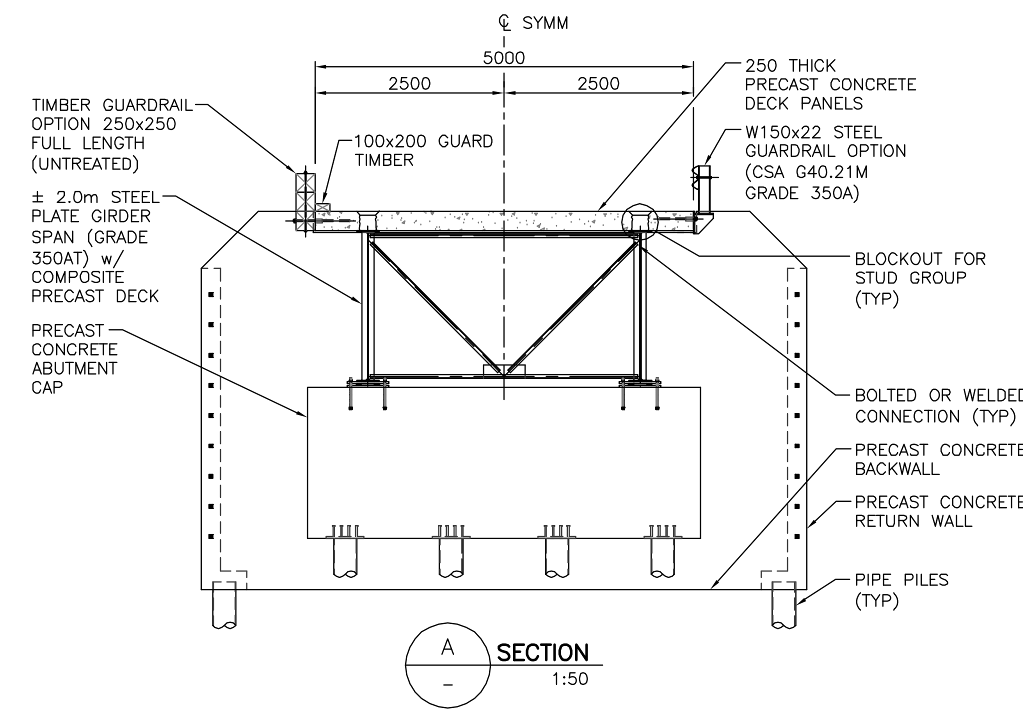
PROJECT NO.	DWN	CKD	REV
V33101053	SM	RM	0

OFFICE	DATE
EBA-VANC	JANUARY 24, 2011

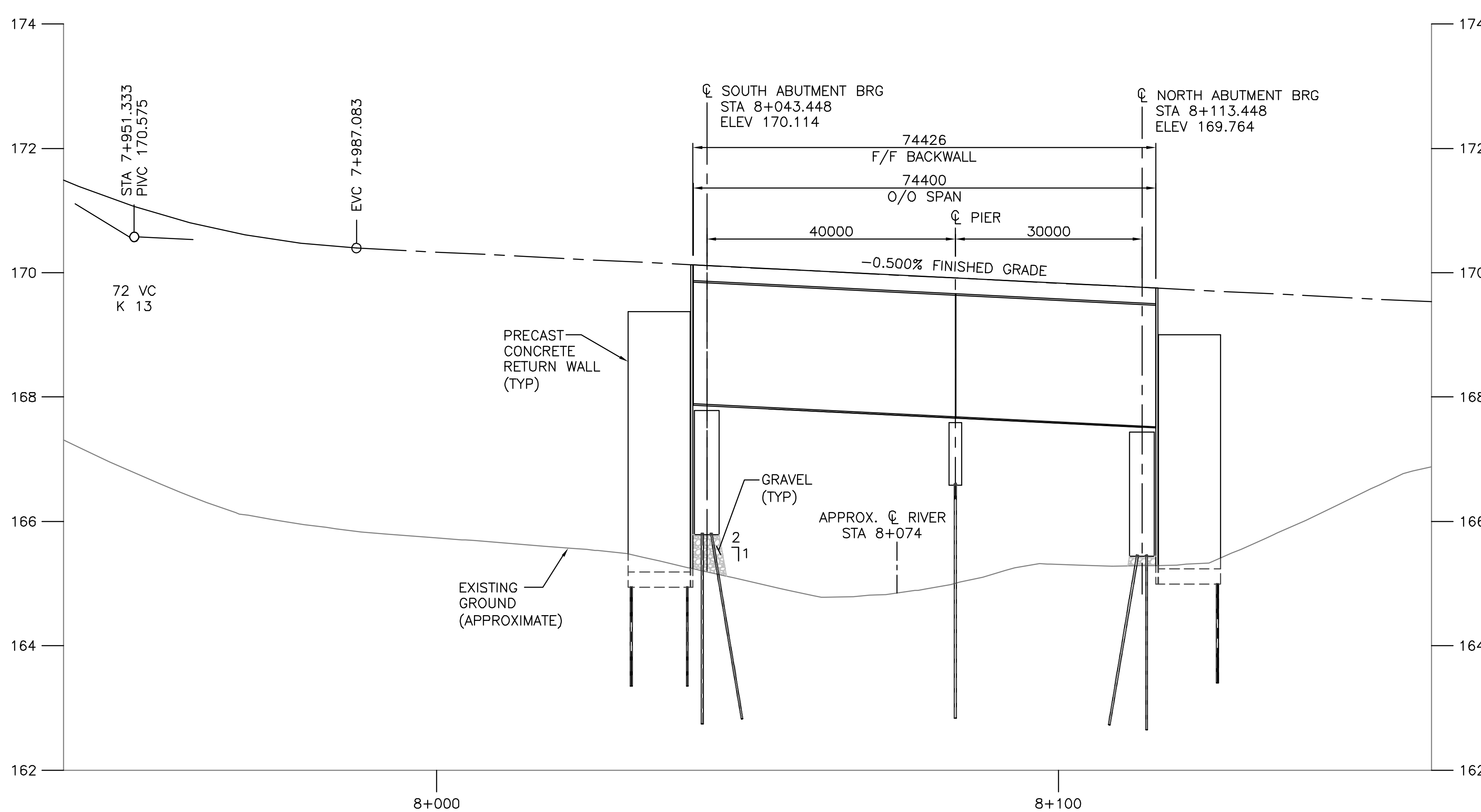
APPENDIX B



PLAN
SCALE: 1:500



A SECTION
1:50



ELEVATION
1:500

PRELIMINARY LAYOUT:
- 70m BRIDGE WITH 40–30 SPANS
- 4.5m FILL AT NORTH ABUTMENT
- 4.9m FILL AT SOUTH ABUTMENT
- 10m LONG PRECAST CONCRETE RETURN WALLS
- BRIDGE SET AT −0.500% GRADE MATCHING ROAD DESIGN
- ONE LANE STRUCTURE

PROPOSED BRIDGE GENERAL ARRANGEMENT PRODUCED BY
FOCUS CORPORATION – EDMONTON DECEMBER, 20, 2010

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Bridge Concept
Crossing No. 1430B - 1435km

PROJECTION	DATUM
Scale 1:150 (1 0 1 3m)	

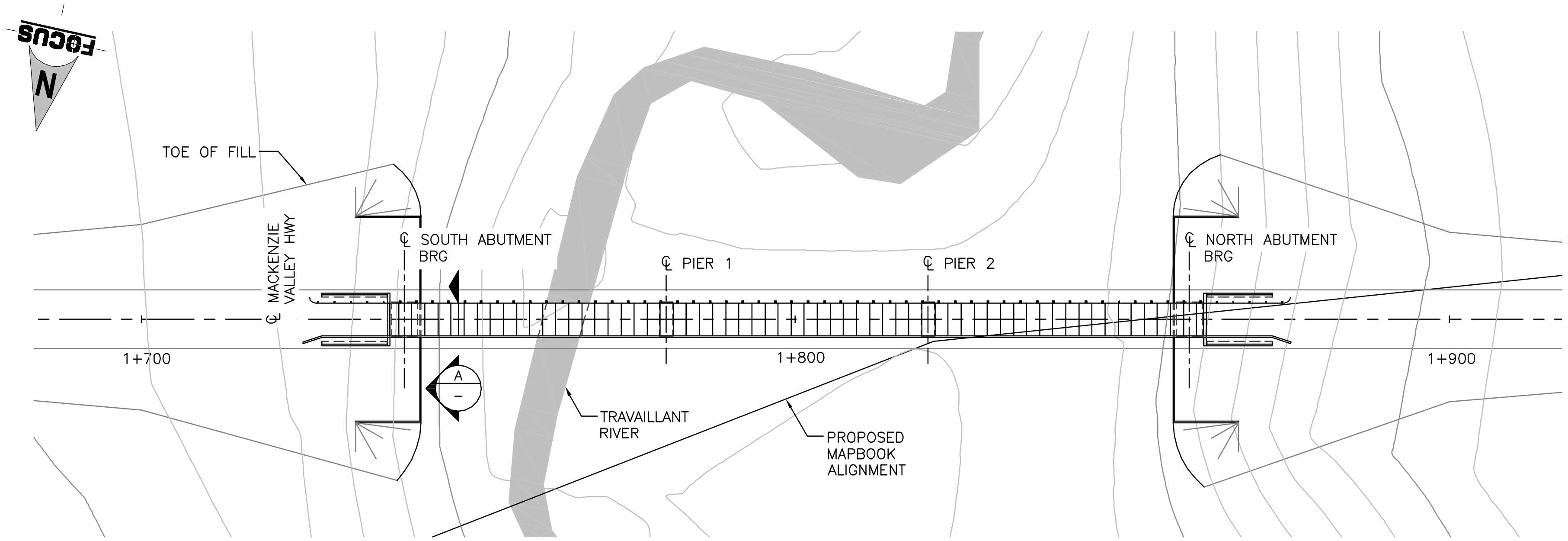
FILE NO.
Water Crossing - No.1430B.dwg

PROJECT NO.	DWN	CKD	REV
V33101053	SM	RM	0

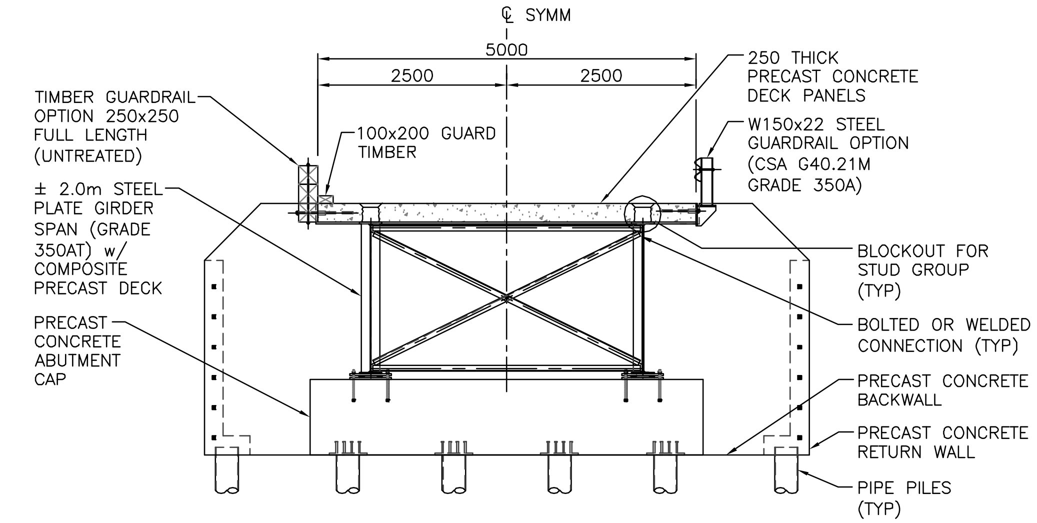
OFFICE	DATE
EBA-VANC	JANUARY 24, 2011

APPENDIX B

Q:\Vancouver\Transportation\V331\Projects\V33101053 - GSA PDR\CADD\Conceptual Design\Civil3D 1st run\Bridge concepts for PDR\Water Crossing - No.1430B.dwg [11x17] January 26, 2011 - 8:48am smatsuda

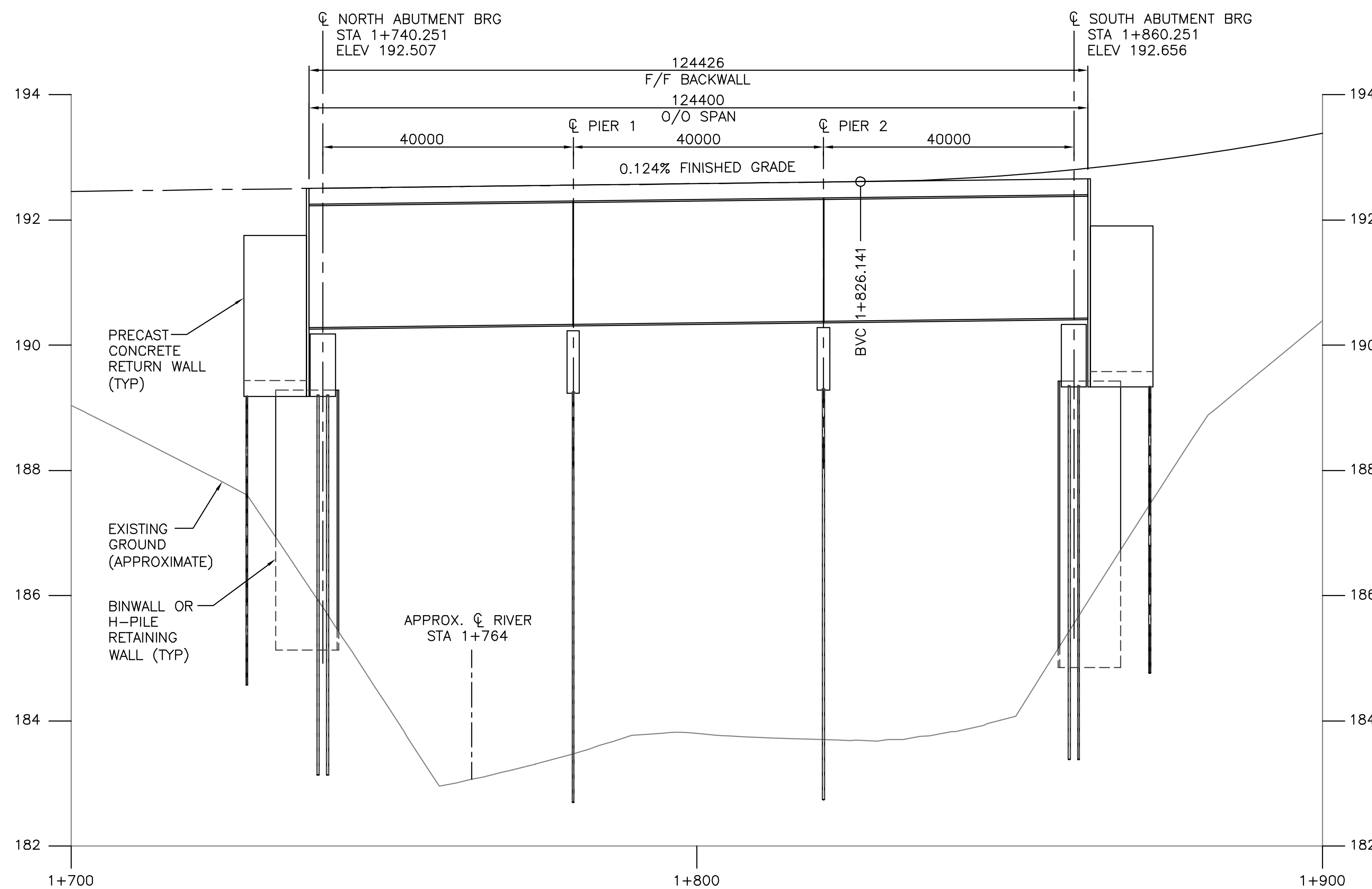


PLAN
SCALE: 1:500



A SECTION
1:50

NOTE:
BINWALL NOT SHOWN



ELEVATION
H-SCALE: 1:500
V-SCAEL: 1:5000

PRELIMINARY LAYOUT:
- 120m BRIDGE WITH 40m-40m-40m SPANS
- 7.1m FILL AT NORTH ABUTMENT
- 7.6m FILL AT SOUTH ABUTMENT
- 10m LONG PRECAST CONCRETE RETURN WALLS
- BRIDGE SET AT 0.124% GRADE MATCHING ROAD DESIGN
- ONE LANE STRUCTURE

PROPOSED BRIDGE GENERAL ARRANGEMENT PRODUCED BY
FOCUS CORPORATION - EDMONTON DECEMBER, 20, 2010

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Bridge Concept
Crossing No. 1430J - 1441km
Travaillant River

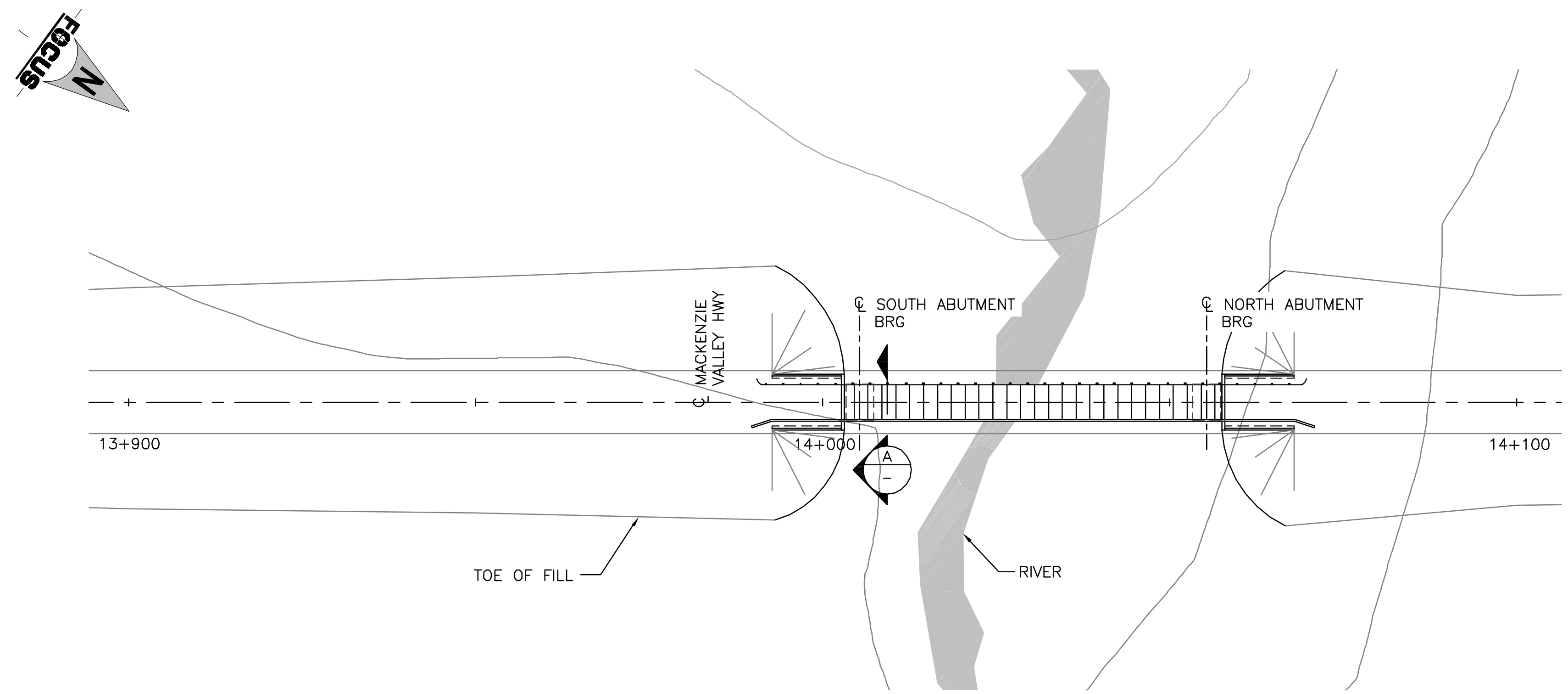
PROJECTION	DATUM

Scale 1:150
1 0 1 3m

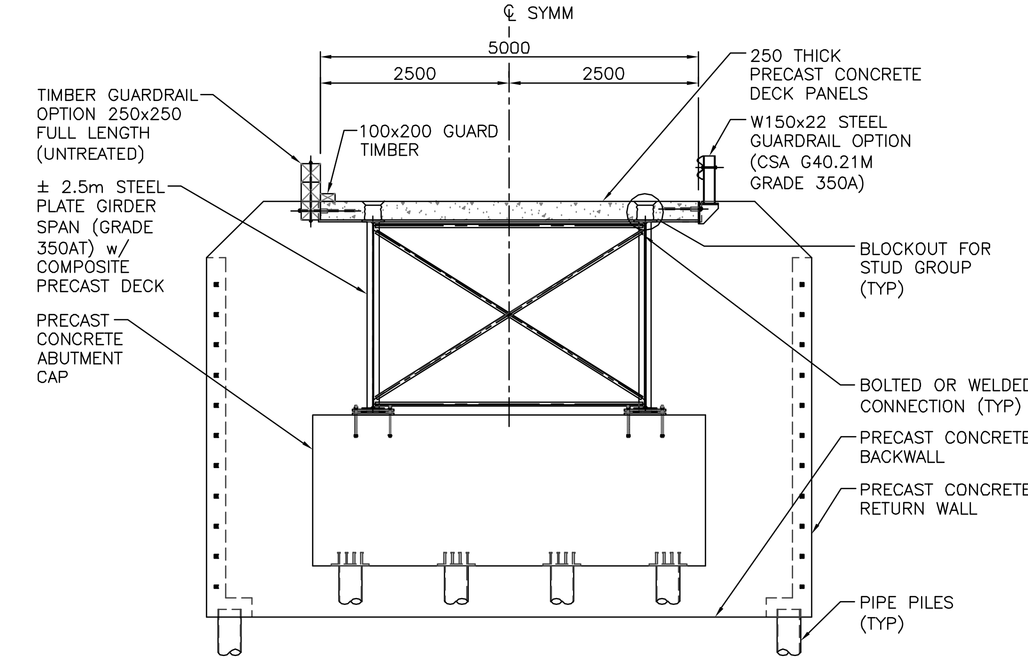
FILE NO.			
Water Crossing - No.1430J.dwg			
PROJECT NO.	DWN	CKD	REV
V33101053	SM	RM	0
OFFICE	DATE		
EBA-VANC	JANUARY 24, 2011		

APPENDIX B

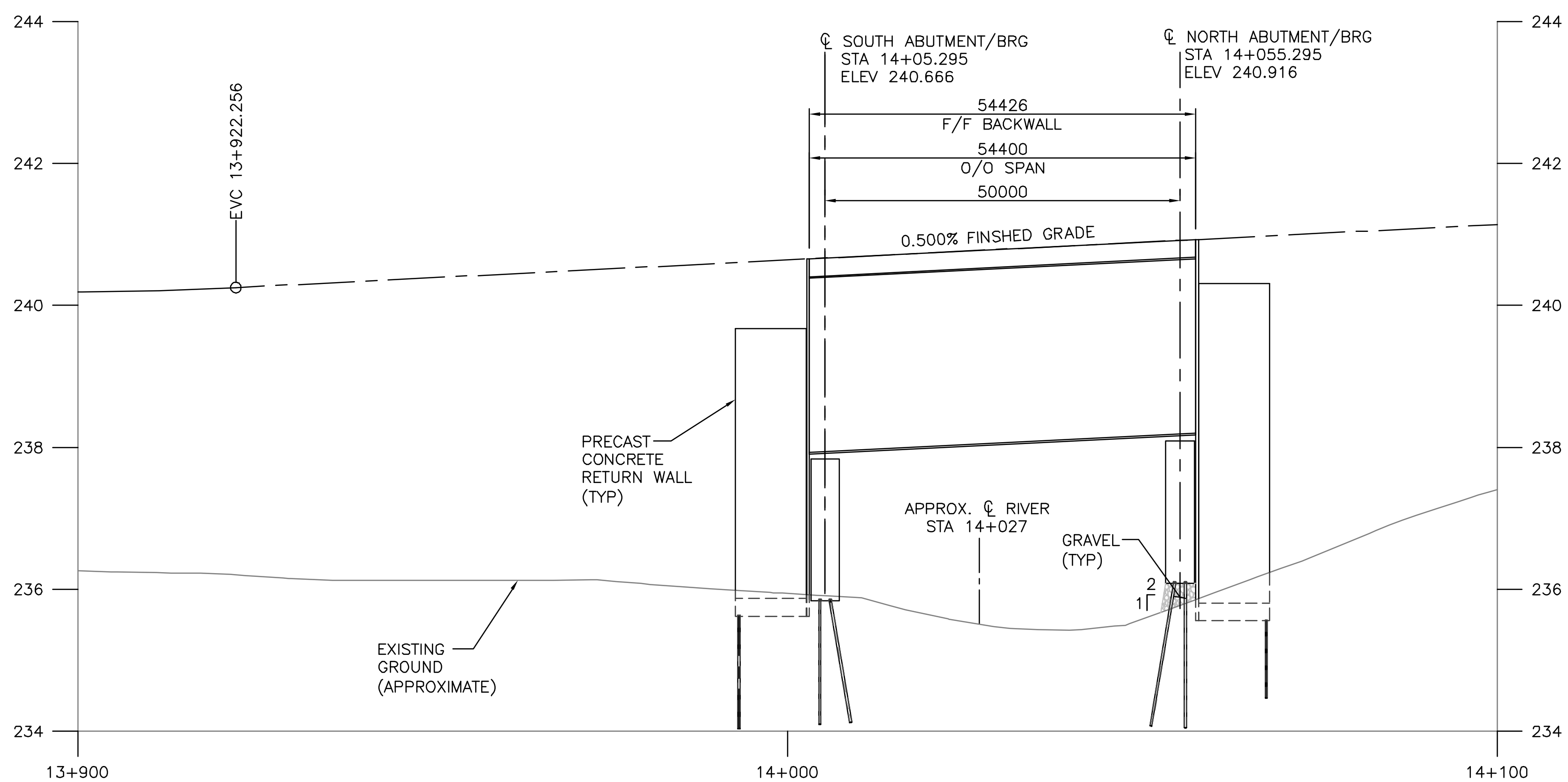
C:\Vancouver\Transportation\V331\Projects\V33101053 - GSA PDR\CADD\Conceptual Design\Civil3D 1st run\Bridge concepts for PDR\Water Crossing - No.1430J.dwg [11x17] April 29, 2011 - 8:08am smatsuda



PLAN
SCALE: 1:500



A SECTION
1:50



ELEVATION
H-SCALE: 1:500
V-SCALE: 1:5000

PRELIMINARY LAYOUT:

- 50m SINGLE SPAN BRIDGE
- 5.1m FILL AT NORTH ABUTMENT
- 4.7m FILL AT SOUTH ABUTMENT
- 10m LONG PRECAST CONCRETE RETURN WALLS
- BRIDGE SET AT 0.500% GRADE MATCHING ROAD DESIGN
- ONE LANE STRUCTURE

PROPOSED BRIDGE GENERAL ARRANGEMENT PRODUCED BY FOCUS CORPORATION – EDMONTON DECEMBER, 20, 2010

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

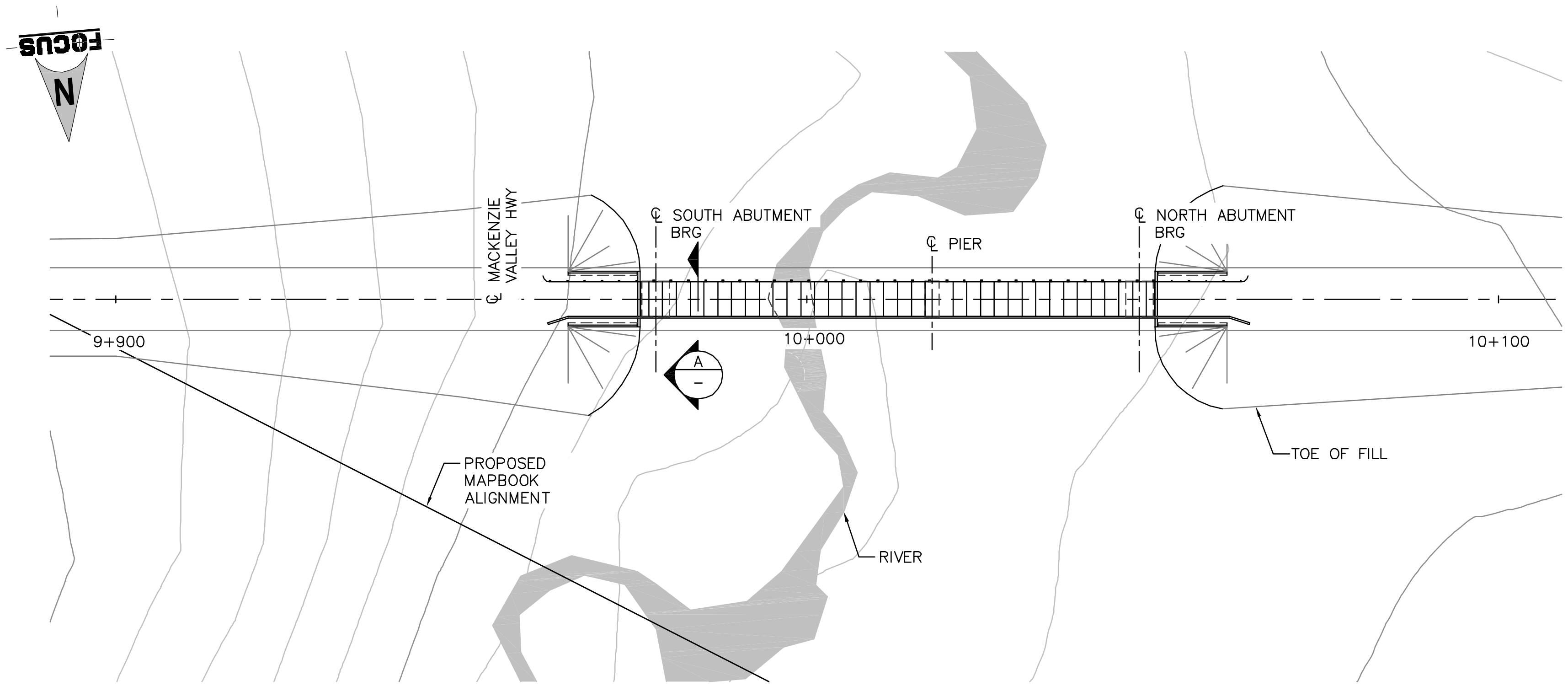
Bridge Concept
Crossing No. 1470F - 1479km

PROJECTION	DATUM
Scale 1:150 (1 0 1 3m)	
FILE NO. Water Crossing - No.1470F.dwg	

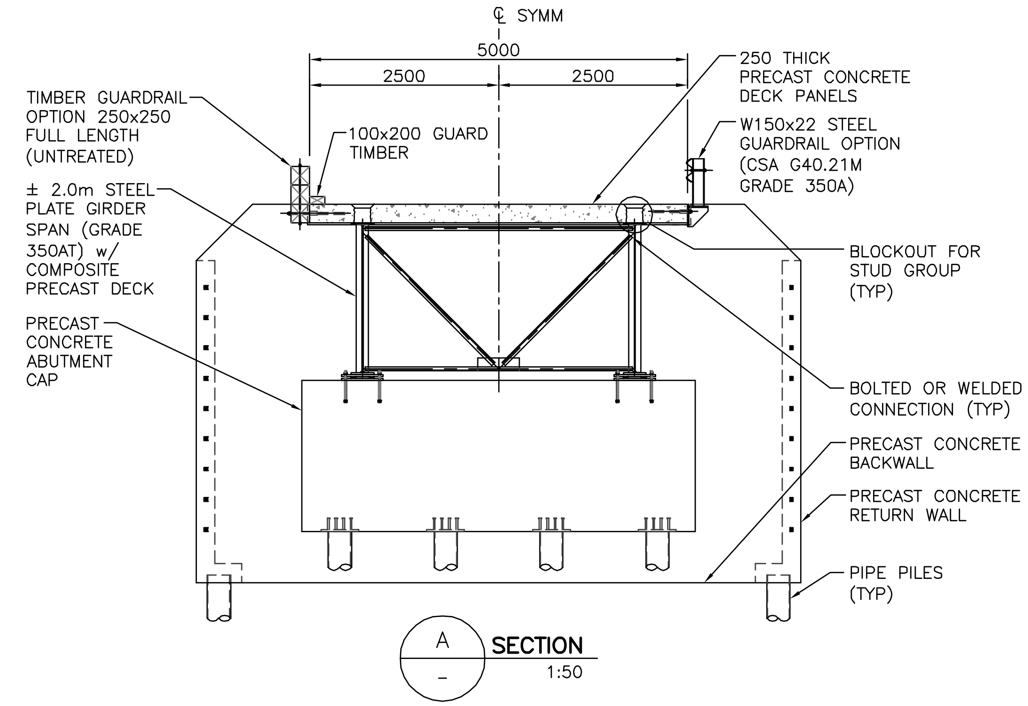
PROJECT NO.	DWN	CKD	REV
V33101053	SM	RM	0
OFFICE: EBA-VANC	DATE: JANUARY 24, 2011		

APPENDIX B

Q:\Vancouver\Transportation\V331\Projects\V33101053 - GSA PDR\CADD\Conceptual Design\Civil3D 1st run\Bridge concepts for PDR\Water Crossing - No.1470F.dwg [11x17] January 26, 2011 - 8:56am smatsuda



PLAN
SCALE: 1:500



SECTION
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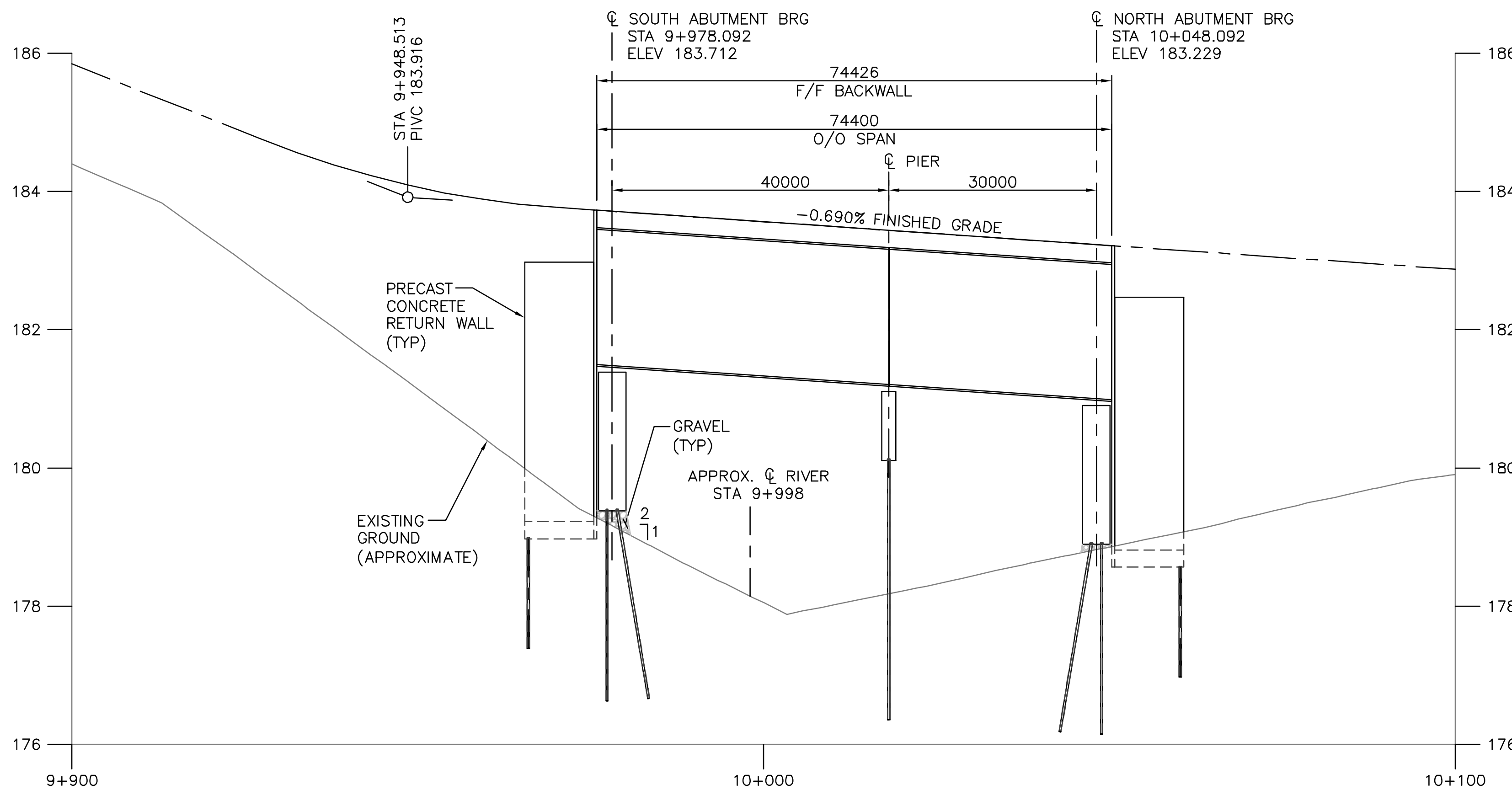


ELEVATION
H-SCALE: 1:500
V-SCALE: 1:5000

PRELIMINARY LAYOUT:
- 70m BRIDGE WITH 40-30 SPANS
- 4.35m FILL AT NORTH ABUTMENT
- 4.45m FILL AT SOUTH ABUTMENT
- 10m LONG PRECAST CONCRETE RETURN WALLS
- BRIDGE SET AT -0.500% GRADE MATCHING ROAD DESIGN
- ONE LANE STRUCTURE

PROPOSED BRIDGE GENERAL ARRANGEMENT PRODUCED BY
FOCUS CORPORATION - EDMONTON DECEMBER, 20, 2010

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Bridge Concept
Crossing No. 1480F - 1489km

PROJECTION	DATUM
Scale 1:150 (1 0 1 3m)	

FILE NO.
Water Crossing - No.1480F.dwg

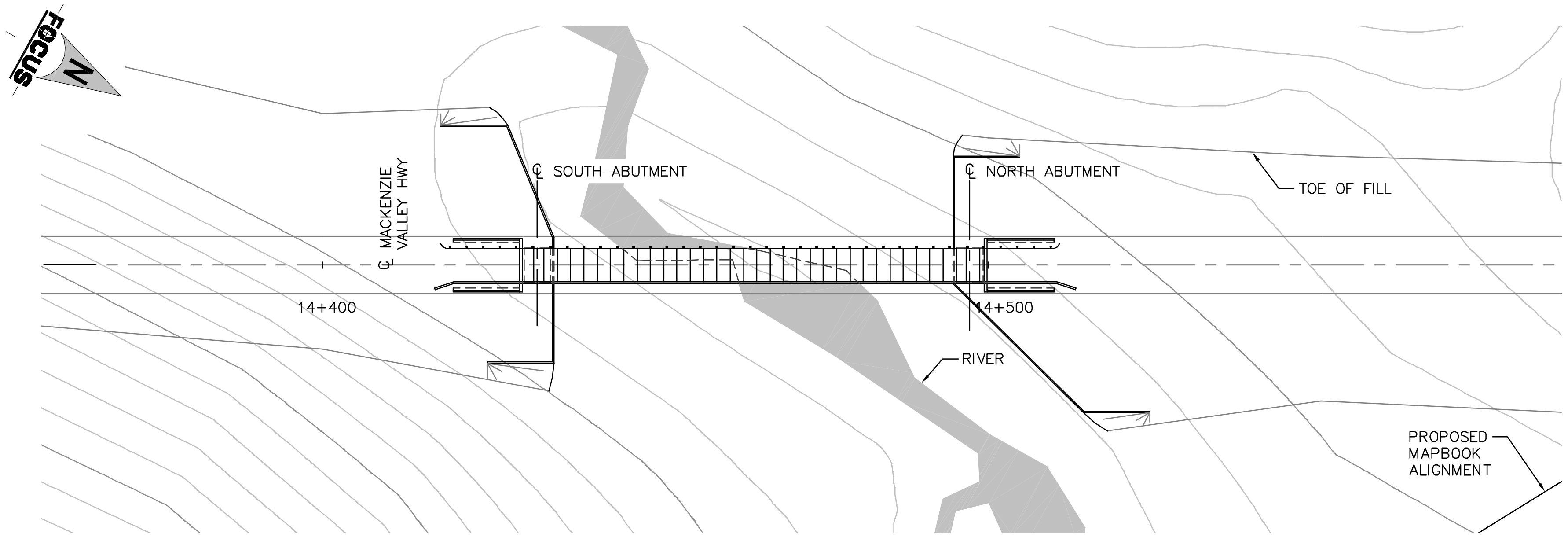
PROJECT NO.	DWN	CKD	REV
V33101053	SM	RM	0

OFFICE	DATE
EBA-VANC	JANUARY 24, 2011

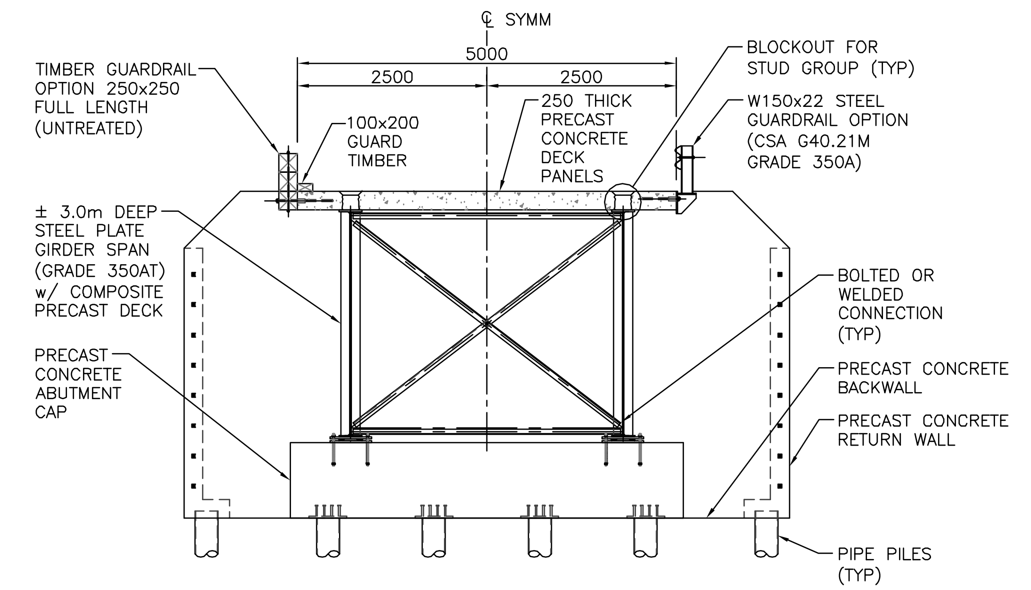
Northwest Territories
Nehtruh - EBA

APPENDIX B

C:\Vancouver\Transportation\V331\Projects\V33101053 - GSA PDR\CADD\Conceptual Design\Civil3D 1st run\Bridge concepts for PDR\Water Crossing - No.1480F.dwg [11x17] January 26, 2011 - 8:58am smatsuda



PLAN
SCALE: 1:500



A – SECTION
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NOTE:
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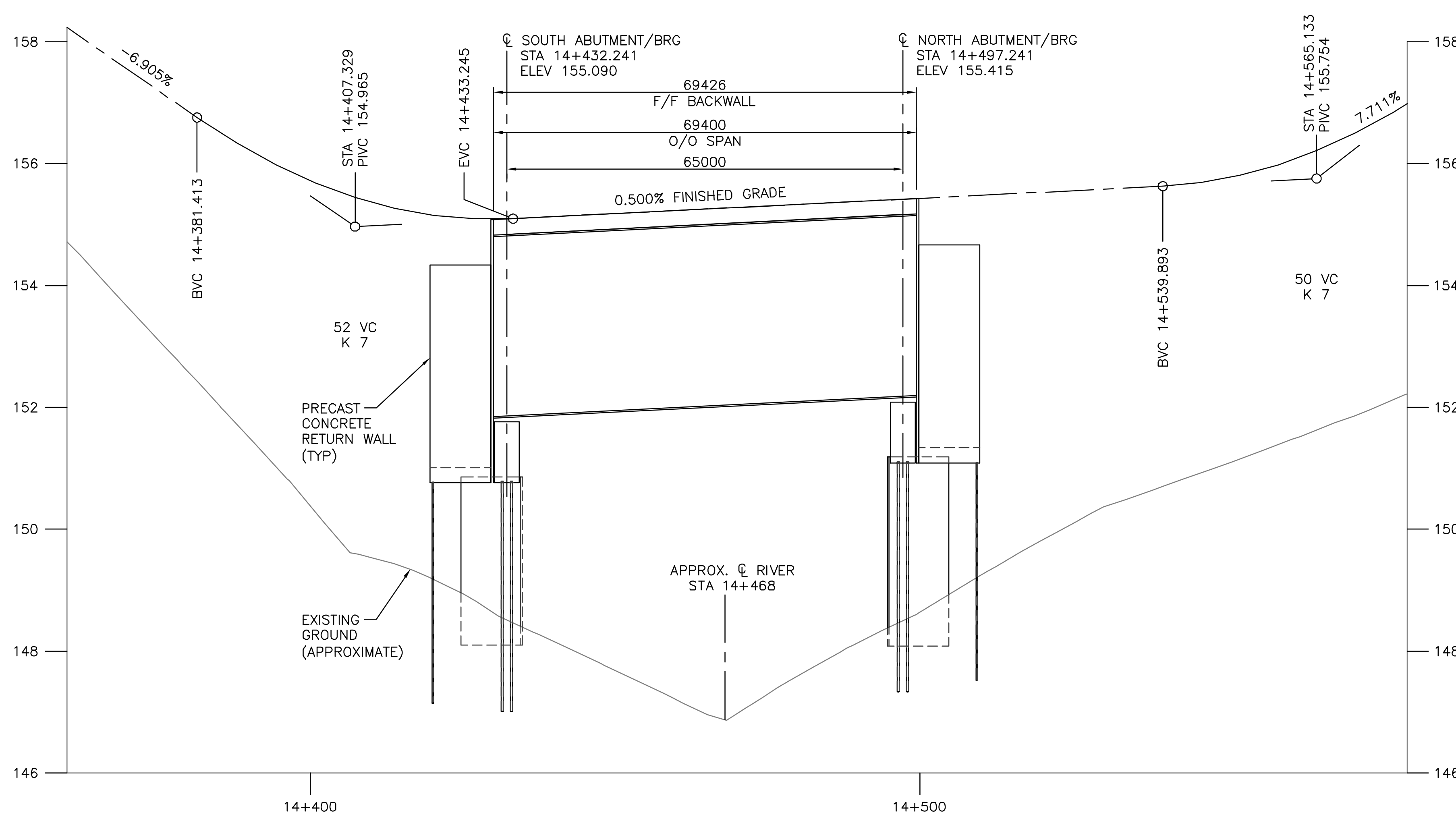

ELEVATION
H-SCALE: 1:500
V-SCALE: 1:5000

PRELIMINARY LAYOUT:
- 65m SINGLE SPAN BRIDGE
- 6.7m FILL AT SOUTH ABUTMENT UTILIZING BINWALL
- 7m FILL AT NORTH ABUTMENT UTILIZING BINWALL
- 10m LONG PRECAST CONCRETE RETURN WALLS
- BRIDGE SET AT 0.500% GRADE MATCHING ROAD DESIGN
- SINGLE LANE BRIDGE

PROPOSED BRIDGE GENERAL ARRANGEMENT PRODUCED BY
FOCUS CORPORATION – EDMONTON DECEMBER, 20, 2010

MACKENZIE VALLEY HIGHWAY
GWICH'IN SETTLEMENT AREA

Bridge Concept
Crossing No. 1490A - 1494km

PROJECTION	DATUM
Scale 1:150 (1 0 1 3m)	

FILE NO.
Water Crossing - No.1490A.dwg

PROJECT NO.	DWN	CKD	REV
V33101053	SM	RM	0

OFFICE	DATE
EBA-VANC	JANUARY 24, 2011

Northwest Territories
Nehtruh - EBA

APPENDIX B

APPENDIX C

APPENDIX C CONSULTATION DOCUMENTS

Gwich'in land, culture & economy for a better future.

Announcing Upcoming Mackenzie Valley Highway Gwich'in Settlement Area Consultations

– May 2010 Project Overview –

The Gwich'in Tribal Council has prepared this 'backgrounder' for residents, government agencies, and the public to announce upcoming consultations on the Mackenzie Valley Highway (the Highway). The idea of building an all-weather Highway from Inuvik to Wrigley originated in the 1960s and a Notice of Intent for the Expropriation of Gwich'in Lands for the Proposed Mackenzie Highway has been identified in Schedule XVII (17) of the *Gwich'in Comprehensive Land Claim Agreement.*

Over the decades, a number of initiatives have been completed in support of the Highway. In the 1970s, Public Works Canada surveyed a route, developed preliminary concepts, and prepared engineering and environmental studies. In April 1992, with the signing of the *Gwich'in Comprehensive Land Claim Agreement*, a Highway corridor was designated within the Gwich'in Settlement Area. Following that significant decision, the Government of Northwest Territories, Department of Transportation (DOT) revitalized the Highway project and in 1999 delivered a report entitled *Mackenzie Valley Highway Extension: Environmental Scoping Report*.

In 2010, a Memorandum of Understanding (MOU) has been signed between the Gwich'in Tribal Council (GTC) and DOT to set the terms for the completion of a project description report (PDR) to construct the section of the Highway that goes through the Gwich'in Settlement Area (GSA). In launching this new chapter in development of the Highway, the work completed in 1970s and 1990s has been reconsidered by Gwich'in leadership and DOT. The GTC and DOT are looking at route options in 2010 that follow the proposed Mackenzie Gas Pipeline route. In the long term view, the 145 kilometre MGP corridor (within the GSA) offers some distinct advantages over the 1970s highway route. Ultimately, the GTC's view is to establish a single Transportation corridor which reduces the overall environmental impact to the land. This approach results in a transportation, utility, and communication infrastructure (highway, pipeline, fibre optic cable) in a single development corridor protects the land, wildlife habitat, traditional land use, and cultural values. As well, during the MGP studies, a wealth of recent, high quality environmental, social, and economic information was gathered and closely scrutinized with the prospect of building the pipeline. Much of that information will be useful for designing and building the Highway.

While past studies have focused on planning (feasibility, scoping, etc.) the field assessments and consultations that are beginning in spring 2010 are being carried out with the intent of obtaining regulatory approval to construct the Highway. The GTC would like to advise community residents that the engineers and scientists will be receiving instructions and guidance from the GTC for the conduct of their activities. They will, to the greatest extent possible, use the information available from previous reports commissioned by Public Works Canada, DOT, and Mackenzie Gas Project. The consultant team, lead by Mackenzie Aboriginal Corporation (MAC), will focus their research on studying the items that have not been studied before. MAC has engaged the northern transportation, engineering, environmental, consultation, and regulatory expertise of Nehtruh-EBA Consulting Ltd., a Registered Gwich'in Business, to complete the PDR consultations and information gathering starting in May 2010. The GTC, MAC, and Nehtruh-EBA are setting up consultations for May 25 to May 28, 2010.

Meetings will be held in the communities on the following days. Notices will be posted with places and times.

Fort McPherson	Tsiigehtchic	Aklavik	Inuvik
Tuesday, May 25	Wednesday, May 26	Thursday, May 27	Friday, May 28

You are encouraged to come to the meetings to discuss the project with GTC representatives and the project team.

- There will be a presentation and an opportunity to talk in smaller groups and one-on-one.
- There will be project maps and a discussion of the timing of field studies.
- There will be opportunities to voice your opinions and ask questions, and technical team members present to respond to your questions.
- More importantly, the project team needs the information you provide to help identify appropriate approaches for Highway stream crossings, potential material sources, potential sensitive areas, and other parts of the Highway that might require particular care and further investigation.

At this stage of the process, the 2010 plans for the Highway are just beginning and there is a lot of work that needs to be completed before application submission in March 2011. The goal is to produce a PDR and a Preliminary Highway Design in the next 10 months. Community input is very important to this project. This Highway project is being proposed to benefit the communities, so we would like to hear from you what is important, what needs to be considered in a plan to build the Highway. We want to know if you have any questions or concerns.

Do you have questions about the project or next week's consultations?

For more information, please phone Phillip Edwards, Project Manager, Gwich'in Tribal Council at (867) 952-2661 or Sandra Lukas-Amulung, Project Manager, Nehtruh-EBA at (403) 723-6895.

Lastly, if you cannot attend one of the May 2010 meetings, but would like to submit written comments, please email or fax them to the attention of Phillip Edwards, GTC Project Manager at (867) 952-2661 / eagleeyesurveys@northwestel.net or Sandra Lukas-Amulung, Project Manager, Nehtruh-EBA, at (403) 203-3301 / slukasamlung@eba.ca.

MACKENZIE ABORIGINAL CORPORATION

Nehtruh - EBA

Gwich'in land, culture & economy for a better future.

Announcing Upcoming Mackenzie Valley Highway Gwich'in Settlement Area Consultation

– June 2010 Project Overview –

The Gwich'in Tribal Council has prepared this 'backgrounder' for residents, government agencies, and the public to announce upcoming consultations on the Mackenzie Valley Highway (the Highway). The idea of building an all-weather Highway from Inuvik to Wrigley originated in the 1960s and a Notice of Intent for the Expropriation of Gwich'in Lands for the Proposed Mackenzie Highway has been identified in Schedule XVII (17) of the *Gwich'in Comprehensive Land Claim Agreement.*

Over the decades, a number of initiatives have been completed in support of the Highway. In the 1970s, Public Works Canada surveyed a route, developed preliminary concepts, and prepared engineering and environmental studies. In April 1992, with the signing of the *Gwich'in Comprehensive Land Claim Agreement*, a Highway corridor was designated within the Gwich'in Settlement Area. Following that significant decision, the Government of Northwest Territories, Department of Transportation (DOT) revitalized the Highway project and in 1999 delivered a report entitled *Mackenzie Valley Highway Extension: Environmental Scoping Report*.

In 2010, a Memorandum of Understanding (MOU) has been signed between the Gwich'in Tribal Council (GTC) and DOT to set the terms for the completion of a project description report (PDR) to construct the section of the Highway that goes through the Gwich'in Settlement Area (GSA). In launching this new chapter in development of the Highway, the work completed in 1970s and 1990s has been reconsidered by Gwich'in leadership and DOT. The GTC and DOT are looking at route options in 2010 that follow the proposed Mackenzie Gas Pipeline route. In the long term view, the 145 kilometre MGP corridor (within the GSA) offers some distinct advantages over the 1970s highway route. Ultimately, the GTC's view is to establish a single Transportation corridor which reduces the overall environmental impact to the land. This approach results in a transportation, utility, and communication infrastructure (highway, pipeline, fibre optic cable) in a single development corridor protects the land, wildlife habitat, traditional land use, and cultural values. As well, during the MGP studies, a wealth of recent, high quality environmental, social, and economic information was gathered and closely scrutinized with the prospect of building the pipeline. Much of that information will be useful for designing and building the Highway.

While past studies have focused on planning (feasibility, scoping, etc.) the field assessments and consultations that are beginning in spring 2010 are being carried out with the intent of obtaining regulatory approval to construct the Highway. The GTC would like to advise community residents that the engineers and scientists will be receiving instructions and guidance from the GTC for the conduct of their activities. They will, to the greatest extent possible, use the information available from previous reports commissioned by Public Works Canada, DOT, and Mackenzie Gas Project. The consultant team, lead by Mackenzie Aboriginal Corporation (MAC), will focus their research on studying the items that have not been studied before. MAC has engaged the northern transportation, engineering, environmental, consultation, and regulatory expertise of Nehtruh-EBA Consulting Ltd., a Registered Gwich'in Business, to complete the PDR consultations and information gathering starting in May 2010.

Meeting will be held in the community of Tsiigetchic on the following day. Notices will be posted with place and time.

Tsiigetchic, NT – Tuesday, June 22, 2010

You are encouraged to come to the meetings to discuss the project with GTC representatives and the project team.

- There will be a presentation and an opportunity to talk in smaller groups and one-on-one.
- There will be project maps and a discussion of the timing of field studies.
- There will be opportunities to voice your opinions and ask questions, and technical team members present to respond to your questions.
- More importantly, the project team needs the information you provide to help identify appropriate approaches for Highway stream crossings, potential material sources, potential sensitive areas, and other parts of the Highway that might require particular care and further investigation.

At this stage of the process, the 2010 plans for the Highway are just beginning and there is a lot of work that needs to be completed before application submission in March 2011. The goal is to produce a PDR and a Preliminary Highway Design in the next 10 months. Community input is very important to this project. This Highway project is being proposed to benefit the communities, so we would like to hear from you what is important, what needs to be considered in a plan to build the Highway. We want to know if you have any questions or concerns.

Do you have questions about the project or next week's consultations?

For more information, please phone Phillip Edwards, Project Manager, Gwich'in Tribal Council at (867) 952-2661 or Sandra Lukas-Amulung, Project Manager, Nehtruh-EBA at (403) 723-6895.

Lastly, if you cannot attend the June 2010 meeting, but would like to submit written comments, please email or fax them to the attention of Phillip Edwards, GTC Project Manager at (867) 952-2661 / eagleeyesurveys@northwestel.net or Sandra Lukas-Amulung, Project Manager, Nehtruh-EBA, at (403) 203-3301 / slukasamlung@eba.ca.

MACKENZIE ABORIGINAL CORPORATION

Nehtruh - EBA

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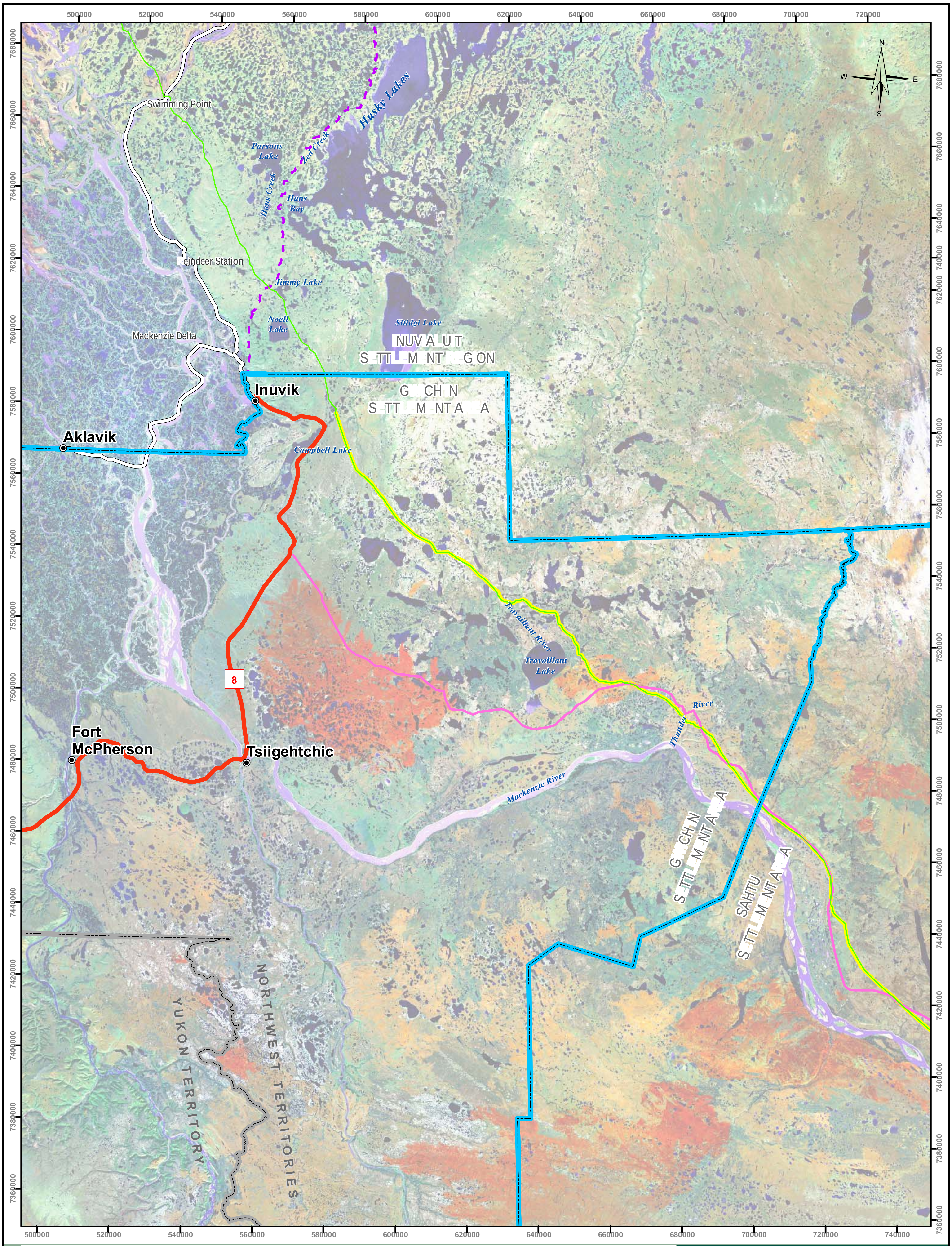

G ND

- Communities
- Mackenzie Highway Concept (May 2010)
- PWC 1974 Highway Concept Route
- Mackenzie Gas Pipeline Corridor
- Dempster Highway (NWT HWY 8)
- Public Winter Road
- Proposed Inuvik to Tuktoyaktuk Highway (2009)
- Settlement Area Boundary
- Territorial Boundary

NOT S
Base data source:
J. D. Mollard and Associates Limited. (February 2008). Location of the Proposed Mackenzie Highway Extension.
NTS 1:250,000

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P OJ CT ON: UTM Zone 8	DATUM: NAD83
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Northwest Territories

Nehtruh - EBA

igure 1

Gwich'in land, culture & economy for a better future.

Announcing Upcoming Mackenzie Valley Highway Gwich'in Settlement Area Consultations

Presentation o Project Description

– March 2011–

The Gwich'in Tribal Council and the Department of Transportation have prepared this project 'backgrounder' for residents, organizations, and government agencies to announce the upcoming consultations on the Mackenzie Valley Highway within the Gwich'in Settlement Area.

The GTC and DOT have been working on your behalf, and have developed a description for the construction of the proposed Mackenzie Valley Highway. The Highway will serve as the backbone for a single Transportation Corridor for transportation, utility, and communication infrastructure will reduce the overall environmental impact to the land while protecting wildlife habitat, traditional land use, and cultural values.

The consultant team, led by Mackenzie Aboriginal Corporation (MAC), has engaged the northern transportation, engineering, environmental, consultation, and regulatory expertise of Nehtruh-EBA Consulting Ltd., a Registered Gwich'in Business, who has been conducting Project Description Report (PDR) consultations and gathering information since May 2010.

Consultations sessions previously held in the communities (May/July and November 2010), included presentations on the highway construction process and discussions about its location and design. The November session also included a discussion of how community input was being considered in the project description.

Today the preliminary design and the Project Description Report are almost complete, have been reviewed by the Gwich'in Tribal Council, the Gwich'in Social and Cultural Institute and members of the Renewable Resources Councils, and are almost ready for submission to the Mackenzie Valley Environmental Impact Review Board.

Further consultation meetings are scheduled to discuss the proposed Mackenzie Valley Highway Project. Meeting schedules and locations are shown below. Notices will be posted in each community with the venue and time.

Aklavik Monday, March 1	Tsiigehtchic Tuesday, March 1	nuvik ednesday, March 1	ort McPherson Thursday, March 1

You are encouraged to come to the meetings to discuss the project with GTC representatives and the project team. The meetings will provide an opportunity to:

- View a presentation about the proposed Mackenzie Valley Highway Project
- See how the input and guidance received in the first and second rounds of consultation was incorporated in the Project Description Report.
- Listen to the explanation of the plan for next steps to move the project to regulatory review.
- Provide any remaining suggestions, and to ask any remaining questions. Technical team members and the GTC will be available to respond to your inquiries.

Do you have questions about the project or the upcoming consultations?

For more information about the project or to submit written questions or comments, please contact one of the following:

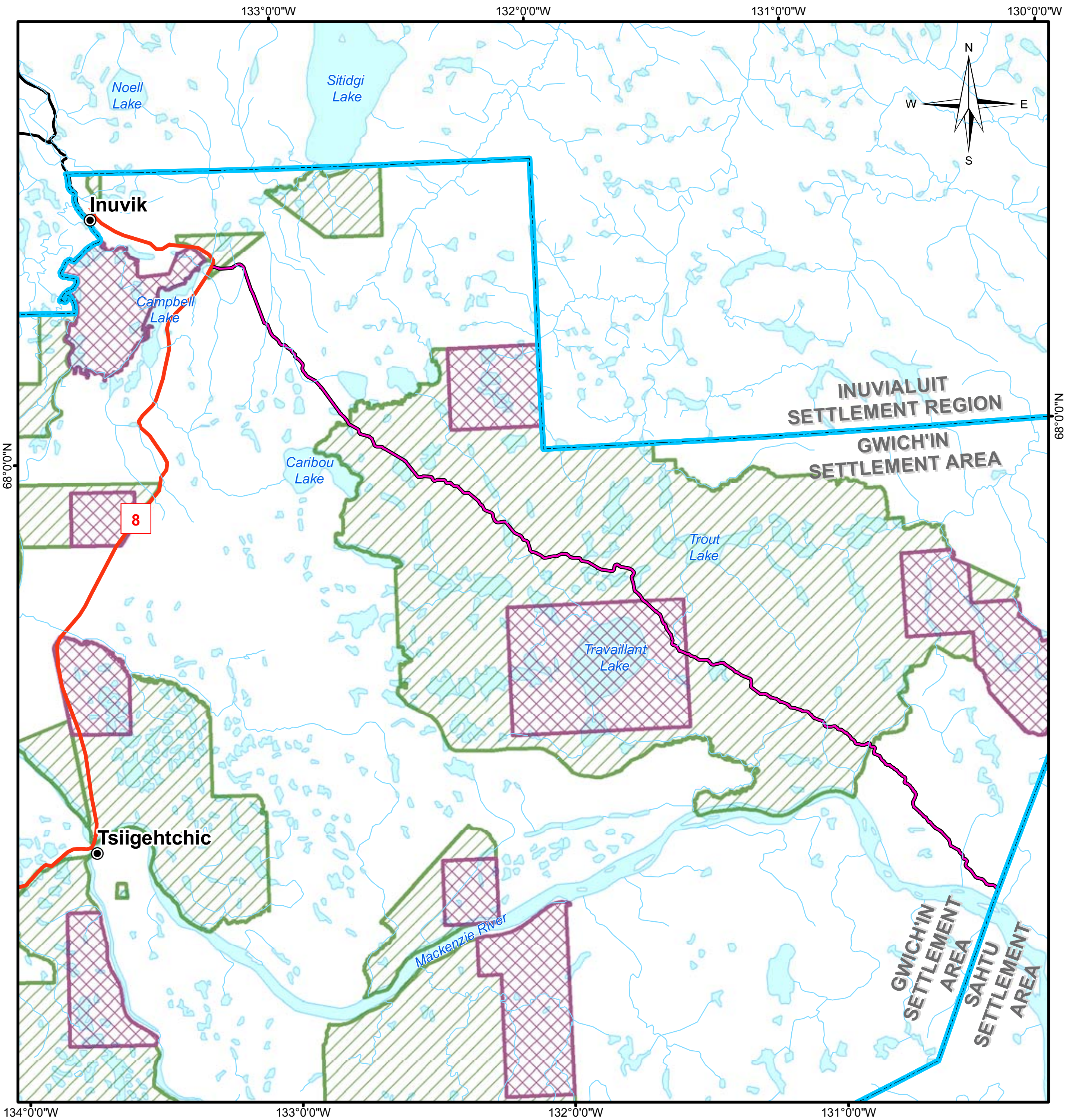
Phillip Edwards
Gwich'in Tribal Council
Phone: (902) 270-2313
email: eagleeye@eastlink.ca

Barrie Robb
Mackenzie Aboriginal Corporation
Phone: (403) 218-7112
Fax: (403) 998-4463
email: brobb@flint-energy.com

Robyn McGregor
Nehtruh-EBA Consulting Ltd.
Phone: (403) 723-3269
Fax: (403) 203-3301
email: rmcgregor@eba.ca

MACKENZIE ABORIGINAL CORPORATION

Nehtruh - EBA



LEGEND

- Communities
- MVH Concept - December 2010
- Dempster Highway (NWT HWY 8)
- Public Winter Road
- Settlement Area Boundary
- River
- Waterbody

Gwich'in Lands

- Surface and Subsurface Rights
- Surface Rights

NOTES

Base data source: NTS 1:250,000
Gwich'in Land Use Planning Board. (April 2010).
Draft Gwich'in Land Use Plan Revisions.
Gwich'in Land Use Planning Board. (August 2003).
Nanh' Geenjit Gwitr'it Tigwaa'in Working for the Land:
Gwich'in Land Use Plan.
Alignment is considered preliminary and is subject to change

STATUS
ISSUED FOR REVIEW

MACKENZIE VALLEY HIGHWAY GWICH'IN SETTLEMENT AREA

General Location of the Highway Corridor

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:900,000
10 5 0 10
Kilometres

FILE NO.
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PROJECT NO.	DWN	CKD	APVD	REV
V33101053	BA	MS	RM	0

OFFICE	DATE
EBA-RIV	February 17, 2011

Northwest Territories
Nehtruh - EBA

Figure 3.0-2

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MACKENZIE VALLEY HIGHWAY
MAY 2010 COMMUNITY MEETINGS

The Gwich'in Tribal Council and the Government of Northwest Territories, Department of Transportation invite residents, organizations, and agencies to participate in community meetings to be held May 25th to May 28th, 2010.

MEETINGS WILL INCLUDE:

- **A presentation about the Mackenzie Valley Highway Project 2010**
- **The proposed routing (including project maps)**
- **Timeline of project activities, including field studies**

The GTC and Project Consultants will be available to respond to questions and receive comments before, during, and after the presentation. Also, there will be opportunities to talk in smaller groups and one-on-one.

MEETING LOCATIONS AND TIMES:

All meetings include 5:00 p.m. Supper and 6:00 p.m. Project Presentation, with Discussion to follow.

May 25th, 2010: **Fort McPherson -** Fort McPherson Community Complex

May 26th, 2010: **Tsiigehtchic -** Community Council Chambers

May 27th, 2010: **Aklavik -** Sittichinli Recreation Complex

May 28th, 2010: **Inuvik -** Midnight Sun Recreation Complex

If you require further information, please contact:

Phillip Edwards, Gwich'in Tribal Council at (867) 952-2661

or Sandra Lukas-Amulung, EBA at (403) 723-6895.

Nehtruh - EBA

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The Gwich'in Tribal Council and the GNWT Department of Transportation invite you to

MACKENZIE VALLEY HIGHWAY
MAY 2010 COMMUNITY MEETINGS

May 25th, 2010 – Fort McPherson
Fort McPherson Community Complex

May 26th, 2010 – Tsiigehtchic
Community Council Chambers

May 27th, 2010 – Aklavik
Sittichinli Recreation Complex

May 28th, 2010 – Inuvik
Midnight Sun Recreation Complex

5:00 p.m. Meal followed by 6:00 p.m. Presentation &Discussion

Everyone is welcome to attend!

Gwich'in land, culture & economy for a better future.

The Gwich'in Tribal Council and the GNWT
Department of Transportation invite you to

MACKENZIE VALLEY HIGHWAY
SPRING 2010 COMMUNITY MEETING

June 22nd, 2010

Tsiigehtchic Gymnasium

5:30 p.m. Supper, followed by a
6:30 p.m. Presentation & Discussion

Everyone is welcome to attend!

Nehtruh - EBA

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MACKENZIE VALLEY HIGHWAY COMMUNITY MEETING

The Gwich'in Tribal Council and the Government of Northwest Territories Department of Transportation invite residents, organizations, and agencies to participate in a community meeting to discuss the proposed Mackenzie Valley Highway.

The meeting will include:

- **A presentation about the Mackenzie Valley Highway Project, 2010**
- **Discussion of the proposed routing and project maps**
- **Timeline of project activities, including summer 2010 field studies**

<u>Place:</u> **Tsiigehtchic Gymnasium**

<u>Time:</u> **TUESDAY, JULY 27, 2010**

5:30 p.m. Community Supper – Everyone is Welcome!

6:30 p.m. Project Presentation and Discussion

The GTC and the project consulting team will be available to respond to questions and receive comments before, during, and after the presentation. There will be opportunities to talk in smaller groups and one-on-one.

If you require further information, please contact:

Phillip Edwards, Gwich'in Tribal Council at (867) 952-2661

OR Sandra Lukas-Amulung, EBA at (403) 723-6895

Nehtruh - EBA

The Gwich'in Tribal Council and the GNWT Department of Transportation invite you to

Mackenzie Valley Highway November 2010 Community Meetings

Tuesday November 23, 2010 – Aklavik
Community Complex
5:00 pm supper followed by meeting

Wednesday November 24, 2010 – Inuvik
Permafrost Room, Mackenzie Hotel
2:00 pm with refreshments

Thursday November 25, 2010 – Tsiigehtchic
Gymnasium
5:00 pm supper followed by meeting

Friday November 26, 2010 – Fort McPherson
Hamlet Council Chambers
5:00 pm supper followed by meeting

Presentation & Discussion
Everyone is welcome to attend!

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MACKENZIE VALLEY HIGHWAY NOVEMBER 2010 COMMUNITY MEETINGS

The Gwich'in Tribal Council and the Government of Northwest Territories, Department of Transportation invite residents, organizations, and agencies to participate in a second round of community meetings to be held November 23 to November 26, 2010.

THE MEETINGS WILL INCLUDE:

- **An overview presentation about the Mackenzie Valley Highway Project**
- **A summary of comments heard at the first round of meetings**
- **A timeline of project activities and further project details**

The GTC and their project consultants will be available to respond to questions and receive comments before, during, and after the presentation. Also, there will be opportunities to talk in smaller groups and one-on-one.

MEETING LOCATIONS AND TIMES:

All meetings include a supper or light refreshments followed by a project presentation.

Tues. Nov. 23, 2010:	**Aklavik -** Sittichinli Recreation Complex. 5:00 pm
Wed. Nov. 24, 2010:	**Inuvik –** Permafrost Conference Room, Mackenzie Hotel. 7:00 pm
Thurs. Nov. 25, 2010:	**Tsiigehtchic –** Gymnasium. 5:00 pm
Fri. Nov. 26, 2010:	**Fort McPherson –** Hamlet Council Chambers. 5:00 pm

If you require further information, please contact:

Phillip Edwards, Gwich'in Tribal Council at (902) 270.2313

Robyn McGregor, Nehtruh-EBA at (403) 723.3269, or

Barrie Robb, Mackenzie Aboriginal Corporation at (403) 998-4463

Nehtruh - EBA

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MACKENZIE VALLEY HIGHWAY COMMUNITY MEETINGS MARCH 14-18, 2011

The Gwich'in Tribal Council (GTC) and the GNWT Department of Transportation invites residents, organizations, and agencies to participate in community meetings to discuss the proposed Mackenzie Valley Highway.

The meetings will include:

- A presentation of the Mackenzie Valley Highway draft Project Description Report.
- A review of the input and guidance received during previous consultations
- A discussion on the next steps in the regulatory review process

The GTC and their project consultants will be available to respond to questions and receive comments before, during, and after the presentation.

MEETING SCHEDULES AND LOCATIONS:

Monday, March 14th at 5:30 pm: **Aklavik -** Sittichinli Hall

Tuesday, March 15th at 5:30 pm: **Tsiigehtchic –** Gymnasium

Wednesday, March 16th at 5:30 pm: **Inuvik** – Lost Patrol Room, Midnight Sun Complex

Thursday, March 17th at 5:30 pm: **Fort McPherson –**Recreation Complex Hall

*** Participants are invited to attend supper at 5:30 pm, followed by the presentation.**

If you require further information, please contact:

Phillip Edwards, Gwich'in Tribal Council at (902) 270-2313

Barrie Robb, Mackenzie Aboriginal Corporation at (403) 998-4463

Robyn McGregor, Nehtruh-EBA at (403) 723-3269

Nehtruh - EBA

Don't leave pipeline in the ground

READERS Write

Gwich'inat Eenjit Gàdatr'igwijilchch Gidilii
Gwich'in Tribal Council

Mackenzie Valley Highway Project – May 2010 Consultations
Meeting Attendance Log

Date: May 25, 2010
Time: 11:00 am
Meeting: Fort McPherson Elders & Leadership

Name	Organization / Company
Stephen Stewart	
[illegible]	
Effie J. Snowshoe	Elders Council
Alice Stoi	Elders Council
Mabel Peterson	Elders Council
Anita Koe	Designated Gwich'in Organization
Alison Greenland	GSCI
Bertha Francis	Translator
Liz Wright	[illegible]
Frank [illegible]	
[illegible]	Elders council
Glenn [illegible]	[illegible]
[illegible]	[illegible]
Robert McGregor	[illegible]

Gwich'inat Eenjit
Gádatr'igwijilchii Gidilii
Gwich'in Tribal Council

Mackenzie Valley Highway Project – May 2010 Consultations
Meeting Attendance Log

Date: May 25, 2010

Time: 11:00 am

Meeting: Fort McPherson Elders / Leadership

Name	Organization / Company
Phillip [illegible]	GTC
[illegible] Ross	NTC
GORDON GRAHAM	DOT, ENV, ENR, MTA

Gwich'inat Eenjit Gádatr'igwijilchii Gidilii

Gwich'in Tribal Council

Mackenzie Valley Highway Project – May 2010 Consultations
Meeting Attendance Log

Date: MAY 25 2010

Time: 6:00PM

Meeting: FORT McPHERSON

	Name	Organization / Company
1	Bruce [illegible]	DOT (Ft. McPherson)
2	Phillip Edwards	GTC
3	Gordon [illegible]	Nehtruh-EBA
4	William [illegible]	[illegible]
5	[illegible]	[illegible]
6	Jude Skye-Koe	Grade 2 Student
7	[illegible]	
8	John E. [illegible]	
9	Shawn [illegible]	
10	Rosie McPherson	
11	[illegible]	
12	[illegible]	
13	Donna Koe	

Gwich'inat Eenjit
Gàdatr'igwijilchei Gidilii
Gwich'in Tribal Council

Mackenzie Valley Highway Project – May 2010 Consultations
Meeting Attendance Log

Date: May 25, 2010

Time: 6 pm

Meeting: Fort McPherson

	Name	Organization / Company
14	[illegible]	Aurora College
15	Phillip Kaye	Housing Assn
16	[illegible]	
17	[illegible]	
18	[illegible]	
19	[illegible]	
20	[illegible]	
21	Dennis Wright	
22	Peter J Kay	R R C
23	[illegible]	
24	[illegible]	[illegible]
25	[illegible]	[illegible]
26	[illegible]	[illegible]

Gwich'inat Benjit
Gùdatr'igwijiłchei Giilii
Gwich'in Tribal Council

Mackenzie Valley Highway Project – May 2010 Consultations
Meeting Attendance Log

Date: May 15, 2010

Time: 6 PM

Meeting: Fort McPherson

	Name	Organization / Company
27	[illegible]	Hamlet of FtMc
28	Cousen Greenland	Hamlet McPherson
29	Angus Charlie	Hamlet McPherson
30	[illegible]	McPherson
31	Phillip Edwards	GTC
32	Bernie Robb	MNC
33	Gurdev Jaggal	DOT-GNWT
34	Sandra Lukas-Amulung	Nehtruh-EBA
35	Glenn Rudman	Nehtruh-EBA
36	Robyn McGregor	Nehtruh-EBA
37		
38		
39		

APPENDIX D

APPENDIX D CONSULTATION SUMMARY TABLES

Comments and Questions from Tsiigehtchic - Mackenzie Valley Highway, GSA					
Theme	Question/Comment	Consultation Session: July 27, 2010	Community Nov 25, 2010	Community Mar 15, 2011	Consideration of Comments
MVH (practical considerations)	Remediation plans for the highway will be needed?	1			Of most significance is remediation or restoration of temporary facilities and borrow sites after construction. These will be undertaken in accordance with the applicable legislation and guidelines.
	Will borrow pits for the highway be permanent or temporary?	1			Most of the borrow sites will be temporary sites for construction only. During the detailed design stage, it is possible that three or four of the sites will be selected based on their location relative to permanent maintenance facilities and volume, quality and type of material available to remain as permanent or as long-term borrow sources for future maintenance of the Highway.
	We would be better off with the Mackenzie Highway as the Dempster Highway is often closed in the winter.	1			Comment noted.
	It is difficult to speak with any confidence that the highway will be constructed.	1			Comment noted.
	There is lots of information available about the land from the previous studies.	1			Previous studies completed along and in the vicinity of the corridor have been used to provide information for the Highway.
	The alignment of the pipeline corridor was changed several times so should be also be suitable for the proposed highway.	1			Comment noted.
	If the highway is constructed what will be the effect on the Dempster Highway?	1		1	No changes are planned for the Dempster Highway.
	Forget about the pipeline; concentrate on the highway.	1			Comment noted. The proposed pipeline and the Highway are separate projects.
	Will the highway be constructed before the pipeline?	1			The proposed pipeline and the Highway are separate projects.
	Will there be funding available from the federal government to construct the highway?	1			Federal funding is being requested by the GTC and the GNWT to construct the Highway.
	The highway would help gain easier access to the pipeline for construction and maintenance.	2			Comment noted.
	Will the highway and the pipeline be constructed side by side?	1			If the proposed pipeline and highway are both constructed then they would share the same Transportation Corridor.
	There will be a need to locate lots of borrow material to build the road.	1			13 potential borrow material locations within the GSA have been identified during the preliminary design stage for the Highway (see Section 6 of the Project Description Report).
	Permafrost could be a problem.	1			Comment noted. Further studies regarding permafrost and other ice related ground conditions will be required at the detailed design stage.
	Make sure the highway is constructed to the correct dimensions at the start, e.g., full width. Do not plan on building a narrow highway with the intention of widening the highway at a later date. This is costly and inefficient. Get it right from the start.	1	1		Comment noted.

Comments and Questions from Tsiigehtchic - Mackenzie Valley Highway, GSA

Theme	Question/Comment	Consultation Session: July 27, 2010	Consultation Session: Community Nov 25, 2010	Consultation Session: Community Mar 15, 2011	Consideration of Comments
MVH (practical considerations)	Bridges are better than culverts, especially in the long-term.	1			Comment noted. The width and nature of the water crossings ultimately dictates the best structure to use. Seven major bridges and 135 culverts or minor bridges are currently identified in the preliminary design for the Highway.
	It is better to build bridges to minimize the impacts on permafrost rather than opening trenches and putting in culverts.	1	1		Comment noted.
	Consideration of dust control measures and the potential for pollution from chemicals such as calcium chloride and magnesium chloride close to Travaillant Lake need to be incorporated into the highway design at the early stages. Chip seal and/or pavement should be considered.	1			Consideration is being given to dust control methods other than Calcium or Magnesium Chloride.
	Once all the studies for the highway are completed when will construction start?	1			Timing of construction is dependent on approvals and availability of funding.
	Where will the project start first, GSA or Wrigley		1		Construction of the Highway in the GSA will begin from both the north and the south limits of the project. Segments of the Highway in other regions will be constructed at the same time depending on the availability of funding.
	Is this project going to affect funding for the Inuvik to Tuktoyaktuk Segment?		1		The Highway and the Inuvik to Tuktoyaktuk highway are separate projects. It is not anticipated that the funding for the Inuvik to Tuktoyaktuk highway will be affected by the Highway.
	Suggest you start from the north, not in Wrigley, as Wrigley were the ones that stopped the construction in the 70's.		1		Comment noted. Construction of the Highway in the GSA will begin from both the north and the south limits of the project. Segments of the Highway in other regions will be constructed at the same time depending on the availability of funding.
	Suggest focus on reconstruction of the Dempster as a priority over the new highway.		1		Comment noted.
	How large are the construction camps?		1		The construction camps are not anticipated to be larger than 50 person camps.
	Borrow pits were left open in the past (no reclamation) and are often too deep. Suggest they are managed better on this project.		1		Comment noted. When activities are complete in temporary borrow sites, the sites will be managed according to the applicable regulations and guidelines.
	How long are the bridges (in imperial not metric)?		1		Bridge concepts are outlined in Section 6 of this Project Description report.
	Is there going to be one contractor constructing all seven bridges?		1		It is not known at this early stage of the project exactly how the contracts for the highway and bridge construction will be awarded.
	Drainage from borrow sources should not flow directly into the lakes. This is part of pit management.		1		Comment noted. This is discussed in Section 11 of the Project Description Report.
	Where will the maintenance facilities be and how many?		1		Distances of between 50 and 100 km are currently being considered as appropriate. This would mean there would likely be three maintenance camps within the GSA.
	What is the highway sideslope? (3:1)		1		The preliminary design sideslope is 3:1 for all sections of the highway.

Comments and Questions from Tsiigehtchic - Mackenzie Valley Highway, GSA					
Theme	Question/Comment	Consultation Session			Consideration of Comments
		July 27, 2010	Community Nov 25, 2010	Community Mar 15, 2011	
MVH (practical considerations)	What will be the cost associated to the whole Highway?			1	Construction cost estimates are included in Section 6 of the PDR.
	How will the Highway be maintained? Main camps?			1	Location for maintanence camps will be determined at design stage.
	It would be good to have a representative from gas plant explain if piece to Inuvik will be paved. Pavement would stop leaks from happening.			1	Comment noted.
	Where does the Highway meet with the Dempster?			1	The Mackenzie Vallry Highway will meet with the Dempster Highway at Campbell Creek.
	Not worried about Highway but about pipeline and its associated work.			1	Comment noted.
Society	It will be easier and perhaps more cost effective to pursue traditional activities in the corridor area with a highway in place.	2			Comment noted.
	The highway will allow more people to use the land. This is not necessarily a good thing.	1			Comment noted. It is recognized that easier access to the land may be have positive and negative effects on the land. The appropriate use of enforcement and guidance by regulators and the Gwich'in leadership will be required.
	With the highway open there will be opportunities for hunting, trapping and other traditional pursuits. People will need to respect the areas that have been traditionally used by others. We already see people encroaching upon other people's areas.	1			Please see comment above.
	What are the main benefits of the highway to the people of Tsiigehtchic?	1			The primary benefit of the proposed highway to the people of Tsiigehtchic is believed to be a shorter transport route to and from southern Canada. This in turn will lead to reduced living costs. Tourism opportunities are expected to increase and the construction and maintenance of the highway will create jobs within the GSA. Please see Section 12 of the Project Description Report.
	The highway will open up the area to non-Gwich'in people.	1			Comment noted.
	Heritage sites along the proposed highway corridor have already been recorded by the Gwich'in Social and Cultural Institute for the pipeline.	1			The recorded heritage sites and recorded traditional knowledge locations have been reviewed as part of the preliminary design and will need to be considered further at the detailed design stage of the highway.
	The alignment that follows the proposed pipeline is preferable over the 1970s proposed highway route.	1			Comment noted.
	The Government of Northwest Territories said that we had to agree in the land claim to the proposed 1970s highway alignment but we don't have rights to all the land.	1			Comment noted.
	The interests of Canada will be upheld by the federal government, whether the Gwich'in agree to the highway or not.	1			Comment noted.
	There will be negative cultural and social impacts. Needs to be good management of the land by the people.	1			Comment noted.
	Many people need to use Travaillant Lake, not just the Andre family.	1			Comment noted. It is recognized that Travaillant Lake and its surrounding area is an important location and has been used by many people in the past.
	No development in the conservation areas but this can be changed if Tsiigehtchic say so.	1			Comment noted. Addressed inSsection 10 and 11 and in this Appendix

Comments and Questions from Tsiigehtchic - Mackenzie Valley Highway, GSA					
Theme	Question/Comment	Consultation Session			Consideration of Comments
		July 27, 2010	Community Nov 25, 2010	Community Mar 15, 2011	
Society	It's up to the Gwich'in people to ensure the right people are hired to manage the land.	1			Comment noted.
	Suggest training be carried out in the Gwich'in Settlement area rather than training requiring travel to Fort Smith.		1		Comment noted.
	What are we doing now for training? How do we prepare our people to fill the future employment positions?		2		The types of employment opportunities that will be created by the proposed highway are included in Section 12 of Project Description Report.
	This highway will benefit everyone and the preference is to do business in the NWT rather than the Yukon.		1		Comment noted.
	The highway will be good because we won't get stuck on the Dempster due to weather.		1		Comment noted.
	How are the heritage value sites being dealt with?			1	The Highway is designed to minimize the footprint and stay away from heritage value sites.
Economy	Do you think funding should be spent on other projects relating to the Dempster, such as paving, replace the culvert at Frog Creek with a bridge (it is very dangerous and will fail soon), and weigh scales to be located south of Fort McPherson?		1		The current operation/maintenance and any plans for upgrades on the Dempster Highway will be maintained.
	Start looking into the benefits now such as training for truck drivers and use of gravel resources.		1		Comment noted.
	Tourism is currently not good and the highway may allow for more tourism and other business opportunities including big game hunting provided appropriate permits are in place.	2			Increased tourism is considered to be one of the benefits of the Higway.
	Start training people now for the opportunities that the highway will bring.	2			Comment noted.
	One of the main benefits will be the benefit of long-term work opportunities in the area.	1			Comment noted.
	The best thing for the Gwich'in people to do is position ourselves in a way that the Gwich'in people will benefit from an economic standpoint rather than a traditional values standpoint.	2			Comment noted.
	The highway will allow NWT people to spend their money in NWT and have easier access to B.C. and Alberta.	1			Comment noted.
	Gwich'in Tribal Council and Access Agreements need to be considered in connection with the highway	1			DOT and the GTC will discuss aspects such as land tenure, contracting, royalties and other items as the project develops.
	Ensure that the Gwich'in are offered jobs and training opportunities linked to the highway.	1			Comment noted.

Comments and Questions from Tsiigehtchic - Mackenzie Valley Highway, GSA					
Theme	Question/Comment	Consultation Session			Consideration of Comments
		July 27, 2010	Community Nov 25, 2010	Community Mar 15, 2011	
Environment	Development today has everyone watching it so it is done properly. We should support it because it will not be like development in the past.		1		Comment noted.
	Suggest homework on illness related to the use of Calcium and Magnesium Chloride for dust control.		1		Options for dust control other than Calcium and Magnesium Chloride are being considered in the development of the Highway.
	The Gwich'in Land Use Planning Board are the people to be contacted about all things connected with the land. The land use plan is there to provide protection of the land, when and where it is required. The revised Plan will speak more to conservation, special management areas and to where people can and cannot go on the land.	1			The relevant land designations in the Gwich'in settlement area (and Land Use Plan) have been noted and special consideration is being given to the area around Travaillant Lake.
	What demands will be put on current infrastructure with regard to construction and operation of the highway and what will be done about, e.g., garbage, waste, spills?	1			Demands on current infrastructure within the GSA will need to be considered more fully as the project is developed. Construction and operation of the Highway and potential spills of hazardous materials will require appropriate plans.
	Protection of the land and water, particularly around Travaillant Lake is very important.	1			Protection of the land and water along the Highway alignment is an important consideration for the project and further information is included in the Project Description Report (Section 11).
	The fish population is very important in Travaillant Lake.	1			Please see comment above.
	The highway will make it easier for the pipeline to be built and that will disturb/damage the land.	1			Comment noted. The proposed pipeline and the Highway are separate projects.
	How can pollution be controlled?			1	Mitigative measures for spills and other pollution are discussed in Section 11 of the PDR.
	Watch for David Lake as is good for fishing			1	Comment noted. Discussed in Section 10 of the PDR
	James Creek has good rock material.			1	Comment noted.
Consultation	Suggest the Land Use Planners attend the meetings.		1		Comment noted. The community meetings are open for anyone to attend.
	Suggest the GSCI attend the meetings.		1		Comment noted.
	What does Inuvik think of the project? I would like to hear what they said at the meetings.		1		The comments and questions recorded at all the consultation meetings in each of the GSA communities are included in the Project Description Report.
	I support this highway to be built and agree with the consultation meetings.		1		Comment noted.
	I know some of the contractors down the Mackenzie Valley had to scale down.		1		Comment noted.
	I am all for the Mackenzie Valley Highway. Look at the positives, the long-term permanent opportunities.		1		Comment noted.
	Will the pipeline be constructed before or after the highway?		1		The proposed pipeline and the Highway are separate projects.
	People who have worked around development all their lives support this development.		1		Comment noted.

Comments and Questions from Tsiigehtchic - Mackenzie Valley Highway, GSA					
Theme	**Question/Comment**	**Consultation Session**			**Consideration of Comments**
		July 27, 2010	**Community Nov 25, 2010**	**Community Mar 15, 2011**	
Other	Traditional Knowledge (TK) should be added to the list of key considerations in the MVH presentation.	1			Traditional knowledge will be added to the list of key considerations in future presentations and has been included in the Project Description Report (Section 8.3)
	The Gwich'in Land Use Plan should be mentioned in consultation presentations.	1			Comment noted.
	Fort McPherson people want to hear what Tsiigehtchic people have to say.	1			The comments and questions recorded at all the consultation meetings in each of the GSA communities are included in the Project Description Report.
	Will you be identifying agencies that need to be consulted?	1			A number of agencies were identified at an early stage of the project that needed to be contacted about the project. These are included in Section 9 of the Project Description Report.
	Perhaps the oil company should contribute money to the highway.	1			Comment noted.
	Are there toll roads any where in the provinces?	1			Examples are Highway 407 in Ontario and the Confederation Bridge between Prince Edward Island and New Brunswick.
	Will the winter road alignment between Wrigley and Fort Good Hope be the highway route?	1			In some locations.
	Is the new highway from Wrigley to Fort Good Hope definitely going to happen?	1			It is part of the overall development of the Mackenzie Valley Highway extension, as is the Highway within the GSA.
	The top leadership should be present at these consultation meetings (Gwich'in Tribal Council, development corporations).	1			Comment noted.
	The $500,000 earmarked for the Tsiigehtchic arena was diverted to the highway project.	1			Comment noted.
	What is Nehtruh-EBA?	1		1	Nehtruh-EBA Consulting Ltd. is a Gwich'in registered business that practices engineering and environmental consulting. Nehtruh-EBA is one of the consultants participating in the development of the project description for the Highway. It was hired by MAC as a result of a competitive process
	The Inuvik to Tuk road had alternate routes suggested. Will this highway have alternate routes suggested in the Project Description Report (PDR)?	1			Minor alternates to the alignment through a proposed Transportation Corridor have been considered.
	When the oil company hauls equipment on the highway, who will fix the highway?	1			The proposed pipeline and the Highway are separate projects. Damage to the Highway by future developments will be handled as for all public highways.
	The extension of the highway to and beyond Wrigley was over challenging terrain but it was constructed well and I have no complaints.	1			Comment noted.

Comments and Questions from Inuvik - Mackenzie Valley Highway, Gwich'in Settlement Area						
Theme	**Question/Comment**	**Consultation Session**				**Consideration of Comments**
		Inuvik May 28, 2010	**Inuvik Chief and RRC Nov 24, 2010**	**Inuvik Community Nov 24, 2010**	**Inuvik Community Mar 16, 2011**	
MVH (practical considerations)	General questions and discussion preceded the presentation.	1				
	Will the Highway be built and maintained like the Dempster?	1				The Highway will be similarly maintained, but constructed with newer knowledge and methods regarding working in permafrost.
	Is there enough gravel/material available in the GSA to build the Highway?	1				Approximately 13 locations have been identified for borrow material for construction of the Highway in the GSA (see Section 6, Development Summary of this Project Description Report). Ample granular material has been identified for the construction of the Highway.
	What does the pipeline group think about this?	1				The proposed pipeline and the Highway are separate projects.
	Are the consultants going to physically check out the proposed route through environmental and engineering work?	1			1	Two field reconnaissance trips were completed along the proposed alignment in 2010. Further field studies will be required as the project progresses to the detailed design stage.
	How long will the Project Description Report (PDR) preparation take?	1				The Project Description Report will be completed for the GSA component of the highway by June 2011.
	Will the NWT's regulatory review under John Pollard affect the Highway review and approval process? Will that help streamline the process?	1				It is not known.
	Will maps and presentation be available on a website?	1				No. Updates and other information are available on the websites of the Department of Transportation, the GTC and the Mackenzie Aboriginal Corporation.
	What sort of process will be used to clear the Right-of-Way? Manual or mechanical?		1			It is likely that both will be used.
	How wide is the cleared Right-of-Way?			1		The cleared Right-of-Way for the proposed highway will be approximately 60 m wide.
	When do you anticipate construction will start?		1			Timing of construction is dependent on approvals and availability of funding.
	Has there been any indication of oil/gas potential in any preliminary seismic work?		1			Preliminary seismic work in the region has not been considered in the development of the Project Description Report.
	How will culverts be managed? How will they be cleared of ice and blockage in the spring? Perhaps heat trace or other technologies.		1	1		Proven and effective maintenance practices will be undertaken in the management of the Highway. This includes sizing and positioning of culverts to avoid or minimize blockages, and steaming/clearing of ice in the early spring should blockages occur.
	Will the construction be mainly in the winter?		1		1	Following preliminiary studies the construction will most likely start in the winter and continue in the summer and fall months, following a break in the spring.
	Which will be built first, the Inuvik to Tuktoyaktuk segment of the segment in the GSA?			1		Timing of the construction of any segment of the Highway from Wrigley to Tuktoyaktuk is dependent on approvals and funding availability.
	Does the new highway in the Mackenzie Valley replace all of the winter roads?			1		Yes with the exception of the public winter roads to Deline and Colville Lake.
	Are the borrow sources identified? Will they be all weather and permanent, or open only in the winter?			1		Most of the borrow sites will be temporary sites for construction only. It is likely that three or four of the sites will be selected based on their location relative to permanent maintenance facilities and volume, quality and type of material available to remain as permanent or as long-term borrow sources for future maintenance of the Highway.

Comments and Questions from Inuvik - Mackenzie Valley Highway, Gwich'in Settlement Area

Theme	Question/Comment	Consultation Session: Inuvik May 28, 2010	Consultation Session: Inuvik Chief and RRC Nov 24, 2010	Consultation Session: Inuvik Community Nov 24, 2010	Consultation Session: Inuvik Community Mar 16, 2011	Consideration of Comments
MVH (practical considerations)	What is the size of the corridor for the pipeline and the highway?			1		The size of the overall Transportation Corridor is not yet defined.
	Can we put private signs indicating no access close to the highway?			1		Provision of signs on the Highway is the same on other public highways, at the edge of the Right-of-Way with the approval of the Department of Transportation. Such signs to indicate no access to Gwich'in private lands could likely be erected at the edge of the Right-of-Way (similar to signs on the Dempster Highway).
	Construction with frozen material may not be best. It is difficult to compact.			1		Comment noted.
	The rate of permafrost melt is increasing. Are there any new technologies that can be used to prevent this?			1		Thicker embankment and use of geotextile over thaw sensitive ground has been incorporated into the preliminary design for the Highway.
	Regarding construction materials and time, how will it overlap with the pipeline construction?				1	If the two projects proceed at the same time, the proponents for the Highway and the pipeline will have discussions to address how to stage construction to avoid activities at the same time in the same area.
	Material sources identified for the MGP (Imperial), are they going to be shared?				1	Yes
	Why develop and sign contracts if in the end it costs more than originally planned?				1	Contracts are based on estimates and historic information. Contracts are developed under ideal conditions idea and so sometimes they can go over or under budget.
	Why 3 and a half years for construction?				1	The construction schedule and project timetable is presented and discussed in Sections 6 and 7 of the PDR.
	3 and half years include GSA or all alignment?				1	Construction for all the pieces would be developing at same time, in parallel.
	Will the construction be going north and south?				1	Construction will go north and south using Little Chicago as start point.
	How large will the camp area be?				1	Construction camps will likely be 150 person and will include other temporary facilities such as maintenance shops and fuel storage. The physical area or footprint will be defined in later more detailed stages of the project development.
	Will there be roads built to the borrow sources?				1	Access to temporary borrow sources for construction will be via winter roads. This is discussed in Section 6.0 of the PDR.
	How long will the working days be?				1	It could be 24 hours working days. In total the Highway will create 20 to 30 jobs yearly.
	What about ownership – if pipeline uses Highway's R.O.W., will they charged?				1	No, both the Highway and the pipeline will have their own, separate rights-of-way within the Transportation Corridor.
	Can the seismic lines be used?				1	If it the cutline in the right place yes, but in many cases the cutlines are in places that do not match the proposed alignment.
	Have surveys and studies been done for the 1974 alignment as well?				1	Within the development of this PDR, only for the portions east and south of Travaillant Lake.

Comments and Questions from Inuvik - Mackenzie Valley Highway, Gwich'in Settlement Area						
		Consultation Session				
Theme	Question/Comment	Inuvik May 28, 2010	Inuvik Chief and RRC Nov 24, 2010	Inuvik Community Nov 24, 2010	Inuvik Community Mar 16, 2011	Consideration of Comments
Society	What are the travel distances to Yellowknife and Edmonton with the Highway, compared to now?	1				The distance from Inuvik to Yellowknife along the proposed highway will be approximately 1,640 km. The distance from Inuvik to Edmonton via Whitehorse is approximately 3,200 km. The distance from Inuvik to Edmonton using the proposed new highway will be approximately 2,500 km, a difference of about 700 km.
	The land around Travaillant Lake and other areas really needs the voice of the people of Tsiiqehtchic who live closest to it.	1				Three community meetings have been held in Tsiigehtchic regarding the proposed highway; July 2010, November 2010 and March 2011.
	The highway corridor should not be seen as a new idea. It appears in the *Gwich'in Comprehensive Land Claim Agreement* Schedule 17.	1				Comment noted.
	Will compensation be set up for Trappers/Hunters for the Highway-related uses of the land?	1				Should compensation be required then the appropriate available regulations and guidance will be followed.
	Compensation for trapping, hunting, harvesting, gathering for traditional medicines must also reflect the loss of such overall due to increased availablility or ease of access to the land by others.					Please see comment above.
	The GTC needs to ensure that infrastructure and enforcement mechanisms are in place that can enforce the land claim agreement and restrict access.	1				Comment noted.
	The highway could bring potential for access to fishing sites, hunting and other.		2			Comment noted. It is recognized that easier access to the land may be have positive and negative effects on the land. Access is managed through the GTC Land Management and Control Guidelines, the Gwich'in Land Use Plan and other applicable rules and regulations.
	What are some of the long-term jobs that will result from the future highway operation?			1		The types of employment opportunities that will be created by the Highway are included in Section 12 of Project Description Report.
	What are we doing now for training for these jobs? How will we prepare our people to fill these positions?			1		The types of employment opportunities that will be created by the Highway are included in Section 12 of Project Description Report. There are currently no training programs in place that are specific to the proposed highway.
	What is happening now to guarantee the future jobs to aboriginal people?			1		Further consideration can be given to this question as the project progresses through the assessment and regulatory process. GNWT and the GTC will work together on this issue.
	Claim says land amount is never to decrease. How will this be addressed?				1	The process of future land ownership for the Highway will be in accordance with Section 23 and Schedule XVII of the Land Claim Agreement
	Land claim says the total area of land will not decrease, even when expropriated. It talks about negotiation-swap from identified crown lands; about contracting negotiations with the government. It states economic opportunities must be provided to the Gwich'in.				1	Comment Noted; the PDR notes this is a GTC-GNWT issue to resolve
	How will the project be managed? Will the construction be tender, negotiated with aboriginals, sole sourced?				1	A short construction period is planned for. The method of contracting is yet to be determined.

Comments and Questions from Inuvik - Mackenzie Valley Highway, Gwich'in Settlement Area						
		Consultation Session				
Theme	Question/Comment	Inuvik May 28, 2010	Inuvik Chief and RRC Nov 24, 2010	Inuvik Community Nov 24, 2010	Inuvik Community Mar 16, 2011	Consideration of Comments
Economy	What will the Highway cost to build?	1				The construction cost estimates are included in Section 6.0 of the PDR.
	Why isn't GNWT considering the cost to construct the Inuvik to Tuktoyaktuk Highway in the costs? Why only Inuvik to Wrigley?	1				Costs for both are being considered as separate projects.
	There may be an economic opportunity for clearing, selective harvesting of lumber, etc.		1			Comment noted.
	There are many reports available on oil, gas and mineral resources in the area. This information could be used to demonstrate that the highway will provide access to these resources.		1			Comment noted.
	The government doesn't have money for the Deh Cho Bridge. How are we going to find funding for this project?			1		Federal funding is being sought for the construction of the Highway.
	Will there be royalties charged and paid on future access to resources?			1		The GTC and the Department of Transportation will be undertaking discussions on such topics as land tenure and royalties.
	The highway could bring potential for tourism and associated business opportunities. This could be one of the spin-off elements that is used for promoting the highway to the federal government.		1			Comment noted. This benefit has been included in the Project Description Report.
Environment	What will be done about major stream crossings?	1				Seven bridges are currently proposed for the Highway in the GSA to cross major rivers. See Section 6, Development Summary of this Project Description Report. Culverts will be sized accordingly for smaller water crossings.
	Will it be hilly or mountainous?	1				The Highway is located within the Anderson Plain Division of the Interior Plains Region. The Anderson plain is predominantly an upland area with topography that is generally 300 m above sea level (Hardy, 1986). Relief along the Highway varies from flat to gently undulating plain in the south to undulating and rolling moraine plain further north.
	Will the pipeline and the road cross rivers and streams at the same location?	1				Near to each other but not specifically at the same location.
	Will the Mackenzie Gas Pipeline's designated 1km corridor exist if the pipeline is not built?	1				We don't know. The pipeline and the Highway are separate projects.
	Will the consultants examine rare plants?	1				Initial overview of vegetation has been undertaken in the development of this Project Description Report. The available information on rare plant from the Mackenzie Gas Project is discussed in Section 10.0 of the Project Description Report.
	What fieldwork will be done?	1				Further fieldwork will be required as the project progresses and this will likely include assessments on wildlife, fish, birds, heritage resources, vegetation, water quality and quantity as well as engineering assessments, e.g., for the proposed bridge crossings.
	Will there be field work or a fly by in winter to see the winter season?	1				In later stages of the project development winter field work will be undertaken.
	Will you measure "before" water quality conditions so contamination of any water can be identified after the highway is constructed, for example, by putting calcium on the road (calcium chloride for dust control)?	1				Depending on the outcome of the environmental and regulatory processes, baseline water sampling at key locations along the Highway may be recommended or required.

Comments and Questions from Inuvik - Mackenzie Valley Highway, Gwich'in Settlement Area						
		Consultation Session				
Theme	Question/Comment	Inuvik May 28, 2010	Inuvik Chief and RRC Nov 24, 2010	Inuvik Community Nov 24, 2010	Inuvik Community Mar 16, 2011	Consideration of Comments
Environment	No sampling or limited fish sampling on these field works.	1				No fish sampling was completed for the preliminary assessment of the Highway but future fish studies will be required by the environmental assessors and regulators as the project progresses.
	Environmental Screening - Is there funding secured yet to do this?		1			Funding is currently designated to take the Highway to the completion and submission of the Project Description Reports.
	What will be used for dust control?		1			Different dust control measures are being considered for the Highway including calcium chloride and different road surfacing materials.
	The road to Tuktoyaktuk passes closely to Husky Lakes. Are we concerned for something similar in the GSA?			1		All of the communities in the GSA have mentioned Travaillant Lake several times at meetings. This is clearly a culturally and environmentally important area and must be given special consideration.
	Are the streams that are crossed fish bearing?			1		At this stage of the project all the streams and rivers crossed by the Highway are assumed to be fish-bearing but further field studies will be undertaken as the project progresses to detailed design.
	Does the highway change the conservation zone, and does this need to be negotiated?			1		It is not anticipated that the designated conservation zone around the Travaillant Lake area will need to change. The Gwich'in Land Use Plan does make provision for a highway through the GSA and the Gwich'in Land Use Planning Board will play an important role in determining the potential effects of the Highway.
	How will migration of animals particularly caribou, be dealt with?				1	Conditions established in Land Use plan will be put in place during construction. The planned Highway alignment, as much as possible, will try to stay away from long term use areas of wildlife.
	Worried because all lakes in area are interconnected. Even though it brings economic improvements and creates jobs, how is monitoring tourist use and garbage going to be enforced? Highway is bigger than pipeline and over land not underground. 1974 alignment avoided many of the interconnected lakes.				1	Comment noted. Access is managed through the GTC Land Management and Control Guidelines, the Gwich'in Land Use Plan and other applicable rules and regulations. This is discussed in Section 11 of the Project Description Report.
	An option for access control is a management plan for the corridor between communities and RRC. DFO example between Big Lake and 177 gravel source.				1	Comment noted.
	Does route take into account areas to be avoided?				1	Yes.
Consultation	Gwich'in Land and Water Board or Mackenzie Land and Water Board because the project is transboundary?	1				It is understood that the Project Description Report for the Highway will most likely be submitted to the Mackenzie Valley Land and Water Board.
	The GRRB, DGO, GRC, and Elders committee meet with each other separately. The Highway is a development that would open access to the country. This is a concern that should be discussed in another meeting.	1				Comment noted.
	Why are the Gwich'in not included in the process for Inuvik to Tuk Hwy? Consultation on Inuvik-Tuk Highway project should have included Gwich'in.	1				The Inuvik to Tuktoyaktuk Highway is a separate project from this Highway.
	Agreements to build the highways should have been between Inuvialuit, Gwich'in, and GNWT not the Town.	1				Comment noted.
	We will do everything we can to block or kill the Inuvik to Tuktoyaktuk Highway project if we are not included.	1				Comment noted.
	The Inuvik to Tuktoyaktuk Highway construction already started without approvals.	1				The Inuvik to Tuktoyaktuk Highway is a separate project from this Highway.

Comments and Questions from Inuvik - Mackenzie Valley Highway, Gwich'in Settlement Area						
		Consultation Session				
Theme	Question/Comment	Inuvik May 28, 2010	Inuvik Chief and RRC Nov 24, 2010	Inuvik Community Nov 24, 2010	Inuvik Community Mar 16, 2011	Consideration of Comments
Consultation	What was the earlier meeting for and why was there not just one meeting?			1		The meeting planned for 6:00 pm on November 24, 2010 was for community leaders including Elders, the Renewable Resource Council and Designated Gwich'in Organization.
	Have the Elders been consulted?			1		The Elders were not able to attend the consultation meeting scheduled in May 2010. The meeting scheduled for November 24 at 6:00 pm was for the Inuvik leadership including Elders. Some of the Elders attended the community meeting held later that evening at 7:00 pm.
	The information presented here and the announcment of the meetings should be translated into Gwich'in and read over the CBC radio. Many people listen to the radio more than they read the newspapers.			1		Comment noted.
	The Nihtaht Renewable Resource Council was not contacted and should be in the future.			1		Comment noted.
	Any government funded projects have to involve the RRC.			1		Comment noted.
	Is the pipeline buried?			1		The proposed pipline is a separate project.
	Have you talked to the proponents of the pipeline to "piggy-back" on the project? Does the MGP want to join forces?			1		The proposed pipline is a separate project.
	Did the RRC give permission to do the field program? Any research that goes on has to directly involve the RRC.			1		A permit was obtained from the Gwich'in Land Administration. Comment noted.
	Do you have all permits?				1	No, this is just the beginning of process. The PDR is only first step.
	Have you met with RRCs? Are comments publicly accessible?				1	Yes. The Consultant Team met with selected RRC's on January 31 and February 1, 2011. Phillip Edwards, Project Manager for the GTC met or made contact with individual RRC's in the communities in the second week of February 2011.
	Have there been funding discussions with the Federal Government?				1	DOT has informed the Federal Government about the required $ amounts. The PDR provides the Federal government with better estimates, and shows to them we have support from the community.
	Is the PDR a public document?				1	The PDR will become a public document when it is submitted to the Mackenzie Valley Land and Water Board for approval.
	Can PDR be changed once is public?				1	At present time the Highway is only a preliminary design. The PDR still needs to go through various approvals. Yes, opportunities for comment will be through the regulatory screening and review process.
	How are other regions reacting?				1	The other regions are in support of the Highway. Similar work to develop PDR's for the Highway is underway in each of the Sahtu and Deh Cho.
	Leadership only listens to money. The PDR and details are not clear for people.				1	Comment noted.
	Are there opportunities to comment?				1	There are opportunities to comment through the regulatory screening and review process.
	The difference between the Mackenzie Highway and the Dempster is the previous wasn't built with a regulatory process; this only includes a lot of consultation.				1	Comment noted.

Comments and Questions from Fort McPherson - Mackenzie Valley Highway, GSA							
Theme	**Question/Comment**	**Consultation Session**					**Consideration of Comments**
		Fort McPherson Elders & Leadership May 25, 2010	**Fort McPherson Community May 25, 2010**	**Elders and Leaders Nov 26, 2010**	**Community Nov 26, 2010**	**Community Mar 17, 2011**	
MVH (practical considerations)	The highway will take some time and money to build.	1					The construction cost estimates and schedule are included in Section 6.0 of the PDR.
	How far is the route?	1					The length of the Highway through the GSA is approximately 181 km. The proposed highway route from the Dempster (just south of Inuvik) to the end of the existing all weather highway at Wrigley is approximately 800 km
	The project and land is ours (Gwich'in).	1					Comment noted.
	Who will maintain the road and who will pay for it?	1					Federal funding will be required to construct the Highway. Once constructed, the Highway, will be maintained by the Government of Northwest Territories.
	How far is the highway route from Inuvik to the B.C. and Alberta borders?		1				The distance from Inuvik to the NT/BC border via the MVH and Hwy 7 is approximately 1370 km. The distance from Inuvik to the NT/AB border via the MVH is approximately 1530 km.
	Will the highway be part of the national highway system? Will national funding be available?		2				The Highway will become part of the national highway system. Federal funding will be required to construct the highway.
	How much will it cost to build the highway?		1				The construction cost estimates and schedule are included in Section 6.0 of the PDR.
	How long will it take to construct the highway? When will it be ready?		1	1			The construction cost estimates and schedule are included in Section 6.0 of the PDR.
	Where would construction start, from the north or south?		1				Construction of the Highway in the GSA will begin from both the north and the south limits of the project. Segments of the Highway in other regions will be constructed at the same time depending on the availability of funding.
	What would be constructed first, the pipeline or the highway?		1				The Highway and pipeline are separate projects. At this stage it is unknown which project would be constructed first as neither project has received full approval to date.
	If the highway was built first this would assist Imperial Oil who would need to recognize the contribution of the highway to their pipeline project.		1				Comment noted.
	How long would the highway be from the Gwich'in/Sahtu border to Fort Good Hope?		1				The distance along the Highway from the Gwich'in/Sahtu boundary to Fort Good Hope is approximately 155 km.
	Will the highway be constructed only in the summer months?		1				Construction is discussed in Section 6 of the Project Description Report.
	The highway will probably be easier to build than the Dempster.		1				Comment noted. The proposed alignment for the Highway includes some challenging terrain but detailed terrain information and improved construction techniques are more readily available today than they were for the construction of the Dempster Highway.
	Where will the granular material for the highway come from and will there be enough?		1				Approximately 13 locations have been identified for borrow material for construction of the Highway in the GSA (see Section 6, Development Summary of this Project Description Report). Ample granular material has been identified for the construction of the Highway.
	There has been gold mining activity in the Travaillant Lake area in the past.	1					Comment noted.
	How many bridges are proposed? (7)			1			Seven bridges are currently proposed for the Highway in the GSA. See Section 6, Development Summary of this Project Description Report.

Comments and Questions from Fort McPherson - Mackenzie Valley Highway, GSA							
		Consultation Session					
Theme	Question/Comment	Fort McPherson Elders & Leadership May 25, 2010	Fort McPherson Community May 25, 2010	Elders and Leaders Nov 26, 2010	Community Nov 26, 2010	Community Mar 17, 2011	Consideration of Comments
MVH (practical considerations)	Why is there a change in the alignment east of the Travaillant Lake (moves away from the pipeline) from km 1385 to 1400?			1			To access terrain that is more preferrable for construction of the Highway.
	Does the highway follow the pipeline route?			1			In general, the proposed alignment for the Highway and pipeline share the same corridor.
	Suggest including one bridge across the Peel (on the Dempster) in the project.			1			The comment is noted; however a bridge across the Peel does not currently form part of the scope of MVH project.
	Changing the route from the 1970's route means it will be further to travel from Fort McPherson along the Dempster to get to the new highway. This is a concern. Travel distance should be shorter for Fort McPherson Residents.		1	1			The distances to places like Edmonton and Calgary from Fort McPherson using the proposed MVH will be shorter than when using the Dempster Highway. Also, to keep the footprint of development through the Mackenzie Valley to a minimimum it is preferred that the Highway and the pipeline be located in a common corridor rather than additional land being used for a separate highway route.
	Will the highway construction share the same gravel sources as the pipeline construction?			1			Based on the preliminary assessment of the gravel sources it is anticipated there is enough material available for both the highway and the pipeline, if both projects proceed. In some cases they are common sources.
	Who owns the available information about the gravel sources?			1			Much of the preliminary information for the material sources is available in the public environment.
	Suggest 50 km maximum distance between maintenance camps. Suggest three.			1	1		Comment noted for consideration during detailed design. Distances of between 50 and 100 km are currently being considered as appropriate.
	When will you submit this for approval?			1			Development of Project Description Reports for all segments of the Mackenzie Valley Highway are inprorgess. It is anticipated that these will all be completed in the fall of 2011. At that time, an overall submission for approval is anticipated to be made.
	How do the bridges compare to the bridge at Eagle Plains on the Dempster Highway?			1			The bridge at Eagle Plains on the Dempster Highway is a single span approximately 30 m long. It is smaller than the bridges proposed for the segment of the Mackenzie Valley Highway in the GSA.
	Are there borrow sources on private lands? Suggest using the sources on private lands first.			1			Land tenure of borrow sources is identified in Section 6.0 of the PDR.
	How will the clearing be done? Suggest manual slashing so that selective timber harvesting could be done, firewood could be provided to the elders. The materials are consider biomass and could be used as an alternate energy source.				1		The details of how to clear the vegetation will be decided during the detailed design stage. However, salvaging usuable timber (for construction or firewood) is common best practice.
	Has any of the team "walked the alignment"? Suggest doing so because you have to get a sense of what the terrain is from the ground level.				1		To date there have been two field reconnaisance trips along the proposed alignment by engineering and environmental specialists to assess the terrain, vegetation, streams and wildlife, and one field reconnaisance trip by an archaeologist to assess archaeological potential of the proposed highway alignment. Further fieldwork, surveys and assessments will be required in many disciplines as the project progresses.
	How will airports be integrated to Highway?					1	This is discussed in Section 6 of the PDR. Specific locations will be identified in the detailed design stage of the project development.
	What kind of dust control will be implemented?					1	New products are being considered such as EZstreet and Infracrete. This is discussed in Section 6 and 11 of the PDR.

Comments and Questions from Fort McPherson - Mackenzie Valley Highway, GSA							
		Consultation Session					
Theme	**Question/Comment**	**Fort McPherson Elders & Leadership May 25, 2010**	**Fort McPherson Community May 25, 2010**	**Elders and Leaders Nov 26, 2010**	**Community Nov 26, 2010**	**Community Mar 17, 2011**	**Consideration of Comments**
Society	Is there an Access and Benefits Agreement between GTC and DOT for this project?			1	1		Comment Noted.
	Who has the contract to do the work on the PDR?			1			The Mackenzie Aboriginal Corporation is the prime consultant retained by the GTC to undertake the development of the Project Description Report. Nehtruh-EBA Consulting Ltd. is a subconsultant to the Mackenzie Aboriginal Corporation to provide engineering and environmental services in the development of the Project Description Report.
	Benefits of the road are opportunities for business, education and training.			1			Comments are noted and these topics are included in the PDR.
	Do the benefits include maintenance and operations jobs?			1			Yes, some of the anticipated benefits of the highway include the creation of construction and maintenance jobs.
	Suggest building partnerships with Arctic College and the Federal Government for Training.				1		Comment noted.
	We need to consider the social impact of the highway in the future.	1					Consideration of the social effects of the highway are included in this Project Description Report (Section 11).
	Safety concerns. If the highway and pipeline are together then there is an increased risk of someone blowing up the pipeline.	1					Comment noted.
	It is up to the Gwich'in people to decide if the highway goes ahead - nobody else.	1					Comment noted.
	I would like to see the highway built.	1	1				Comment noted.
	How will the new highway affect the existing Dempster Highway? There shouldn't be a trade-off between building the new highway and decommissioning or reducing maintenance on the Dempster Highway.	1	2			1	There is no intention to decommision the Dempster Highway. The proposed highway and the existing Dempster Highway will allow for easier access to southern Canada and both will be maintained accordingly.
	Are the pipeline and highway projects tied into together (is one dependent on the other)?		1				The proposed highway and pipeline projects are independent of each other.
	What is the difference in distance between driving the Dempster Highway to Edmonton and driving the proposed new highway to Edmonton?		1				The distance from Inuvik to Edmonton via Whitehorse is approximately 3,200 km. The distance from Inuvik to Edmonton using the proposed new highway will be approximately 2,500 km, a difference of about 700 km.
	The highway will be important for both the Sahtu and Gwich'in.	1					Comment noted.
	Developing the highway and pipeline together is good for safety. If something happens to the pipeline then there will be good access to the pipeline from the highway.	1					Comment noted, although the proposed pipeline and highway are separate projects.
	The highway will be important for the younger generation.	1					Comment noted.
	Non Gwich'in companies benefiting from our land, what assurance we have jobs created by the highway will go to the Gwich'in?					1	In accordance with the Gwich'in Comprehensive Land Claim Agreement.
	Expropriation is giving up land, Campsites. How will this be addressed?					1	Expropriate of lands will be in accordance with Section 23 and Schedule XVII of the Land Claim Agreement.

Comments and Questions from Fort McPherson - Mackenzie Valley Highway, GSA							
		Consultation Session					
Theme	Question/Comment	Fort McPherson Elders & Leadership May 25, 2010	Fort McPherson Community May 25, 2010	Elders and Leaders Nov 26, 2010	Community Nov 26, 2010	Community Mar 17, 2011	Consideration of Comments
Society	Contractors need to have environmental monitors. Development corporation is the leg of everything we do, that way we all benefit from it, that doesn't happen with private contractors. This group is not Gwich'in – individuals benefit – the way to stop this is to control with Development Corporation.					1	Comment noted.
	We know what happened with Alaska pipeline, we can't let people coming from south go hunting and do what they want on our land.					1	Comment noted. Access to Gwich'in lands is addressed in Section 6 of the PDR
	Every development that happens in our region we take to heart, it has social impacts and also benefits. We have concerns with youth and how it is going to affect them, but also opportunity to get trained and produce jobs.					1	Comment noted.
	A lot of changes over last few years, effects of development in our communities are visible. Cancer, water concerns – we need to think seriously about these things. Elders council in Yellowknife concerned about water, how much is going to be used? How is this going to affect?					1	Water use for construction and operation is discussed in Section 11 of the PDR.
Economy	The highway will help provide employment.	1					Comment noted. Employment created by the highway is covered in Sections 11 and 12 of this PDR.
	We have no experience of building a pipeline but we have lots of experience of building roads.	1					Comment noted.
	The highway has the potential to bring in tourists and provide a circular route for tourists all within Canada.	1					Comment noted and covered in Section 12 of the PDR
	Is there a benefit package for the Gwich'in people associated with highway project?	1					Comment noted.
	Training needs to be started now to prepare people for the jobs that the highway construction and maintenance will bring to the area.	1					Comment noted.
	Will employment and training be considered as part of the Project Description Report (PDR)?		1				Suggested opportunities for employment and training in the future are discussed in Section 12 of this Project Description Report.
	What kind of employment positions will be available during the construction of the highway?		1				There will be many types of employment positions created during highway construction and operation that require different levels of expertise and training. These are discussed in Section 12 of the PDR.
	We don't want to see just Inuvialuit construction companies building the highway.	1					Comment noted.
	Are there advantages to coordinating the highway and pipeline construction in terms of funding?		1				The Highway and the Pipeline are independent projects.

Comments and Questions from Fort McPherson - Mackenzie Valley Highway, GSA							
		Consultation Session					
Theme	Question/Comment	Fort McPherson Elders & Leadership May 25, 2010	Fort McPherson Community May 25, 2010	Elders and Leaders Nov 26, 2010	Community Nov 26, 2010	Community Mar 17, 2011	Consideration of Comments
Environment	It will be best to keep the pipeline and highway routes within the same footprint.	1					Comment noted. The intention of the single transportation and infrastructure corridor is to minimize the footprint, should both projects proceed.
	I don't agree with the highway and pipeline routes being together.		1				Comment noted.
	The water has to continue to flow to allow the fish to survive. Stream crossings must be done right.	1					Comment noted.
	More studies will be required along the proposed highway route before it can be built.	1					Yes, as the project progresses through assessment and regulatory processes more detailed studies, involving many different disciplines, will be required.
	The area around Travaillant Lake is protected land (see "Working for the Land. Gwich'in Land Use Plan"). The proposed highway and pipeline cross an area designated as conservation land in the Gwich'in Land Use Plan.	1	1				The relevant land designations in the Gwich'in settlement area have been noted and special consideration is being given to the Heritage Conservation Zone around Travaillant Lake to minimize the development through this area.
	We want to minimize the footprint of the highway. The highway will likely give rise to spur lines being constructed.	1					Temporary winter roads will be constructed to material sources near the Highway alignment. Permanent access roads from the Highwya will not be built unless the necessary approvals to access the land and to access the Highway are in place.
	Several of the lakes north and south of the proposed pipeline route contain trout.	1					Comment noted. Mitigation measures will be implemented.
	If the highway follows the pipeline route then many of the concerns will be the same as they were for the pipeline route. A lot of useful information already exists.	2					Comment noted. Available information produced for the proposed pipeline was reviewed and considered in the development of the Project Description Report.
	Last summer non-aboriginal truck was hauling and had no monitor on board when contract says it should.					1	Comment noted.
	Do you know anything about calcium? People pick berries around highway, does calcium affect berries? Especially when it runs in the creeks.					1	Methods of dust control other than Calcium and Magnesium Chloride are discussed in the PDR.
	Calcium kills trees, small amounts add up to real damage to nature and cause cancer.					1	Comment noted.
	How much does it cost to buy calcium, bring up here and put in? Experiment with only water.					1	Comment noted.
	Trappers and hunters will be eyes and ears (bodies in place) and become comfort.					1	Comment noted.

Comments and Questions from Fort McPherson - Mackenzie Valley Highway, GSA							
		Consultation Session					
Theme	Question/Comment	Fort McPherson Elders & Leadership May 25, 2010	Fort McPherson Community May 25, 2010	Elders and Leaders Nov 26, 2010	Community Nov 26, 2010	Community Mar 17, 2011	Consideration of Comments
Consultation	Communication about this project with and between the communities and aboriginal peoples is important.	1					Comment noted. A summary of the consultation for the development of the Project Description Report is included in this document.
	We need a vision for the future. Where do we want to be 50 years from now?	1					This question is probably best directed towards the Gwich'in Tribal Council and their long-term plans for the GSA.
	Fort McPherson people should meet with Tsiigehtchic people as part of a consultation meeting to discuss this project. This land is more theirs than it is ours (consider the logistics of such a meeting).	2	2				Comment noted.
	Many Elders who knew the highway route are now deceased. There are some Elders in Tsiigehtchic who know that highway area well.	1					Comment noted.
	You need to listen to the people of the land to avoid making mistakes in building the road (mistakes were made with the Dempster Highway).	1	1				The purpose of the community consultations was to listen to what comments and questions people have about the project. Local knowledge about the land can be very useful for a project of this size.
	It is not to be said that the Gwich'in people are in favour of the pipeline just because the pipeline and highway routes are the same.	1	1				Comment noted. The proposed pipeline and highway are separate projects.
	Early consultation is a good thing.		1				Comment noted. Consultations were started within five weeks of the PDR contract being issued.
	Talk to school children about the highway project. They will be needing jobs in the coming years.		1				Comment noted.
	Please use the sound system that we have here to help those who are hard of hearing.		1				Comment noted.
	Where will you be having other consultation meetings?		1				The consultations were held in Fort McPherson, Tsiigehtchic, Inuvik and Aklavik.
	When are you coming back to Fort McPherson to consult further?		2				Consultations were held for this project in May and November of 2010, and March of 2011.
	The notes from these meetings will need to be reviewed by us to ensure our comments have been noted and have been interpreted correctly.	1					Comment noted. Summary notes from individual consultations were distributed by the GTC to each community shortly after each consultation.
	Who is going to benefit when the Oil/Gas proponents utilize the highway once it is built?			1			The Highway will be available for use as a public road.
	Groceries could be bought in Tsiigehtchic in the future. This is a benefit.			1			Comment noted.
	If you build the highway first, will the pipeline contribute to the cost of the road construction, the maintenance, other?			1	1	1	The two projects are independent.
	Will there be compensation for impact to lakes, rivers and trapping?			1			Will be in accordance with the applicable legislation.
	Business opportunities that can be planned for include monitors, cooks, cleaners, surveyors, maintenance operators and other.				1		Comment noted. Many different employment opportnities will be generated by the construction and management of the highway.

Comments and Questions from Fort McPherson - Mackenzie Valley Highway, GSA							
		Consultation Session					
Theme	Question/Comment	Fort McPherson Elders & Leadership May 25, 2010	Fort McPherson Community May 25, 2010	Elders and Leaders Nov 26, 2010	Community Nov 26, 2010	Community Mar 17, 2011	Consideration of Comments
Consultation	The Andre Family could be consulted directly about the area around Travaillant Lake.			1			Members of the Andre family have been present at some of the community consultation meetings.
	Suggest talking to Willy Simon, Donald Modeste, Victor Simon. They used to trap in the area.			1			Comment noted.
	What is the guarantee that the highway will go through?			1			There are no guarantees that the proposed highway will be constructed.
	Who will approve the highway?			1			The proposed highway will go through environmental screening. It is expected that the screening will be done by the Mackenzie Valley Land and Water Board (MVLWB) and that the project may go to the Mackenzie Valley Environmental Impact Review Board.
	Surprised that Tsiigehtchic did not express concerns about the highway being in the areas of popular fishing lakes west of Travaillant Lake.				1		Members of the Tsiigehtichic community have made specific suggestions with regard to the proposed highway passing close to Travaillant Lake and the interconnected water bodies in that area.
	Suggest describing an example of culvert size (like Frog Creek on the Dempster). It will be easier for elders to understand.				1		Comment noted.
	Suggest providing maps and background information to be left in the communities. As well, the presentations and maps could be put on memory sticks and available for hand out.				1		Maps and information handouts were provided to communities at each of the consultation meetings. Additional materials are available through the GTC.
	Suggest a one page briefing or status report be prepared by GTC and made available to be read on the radio.				1		Comment noted.
	Suggest making a presentation at the assembly in Fort McPherson (usually in June).				1		Comment noted.
	There was a resolution in support of the highway that was passed at the general assembly. Suggest getting a copy of that.				1		Comment noted
	Next meeting could also be a lunch meeting.				1		Comment noted.
	Development has both good and bad. Suggest taking the positive in hand, manage the negative and it will all work out.				1		Comment noted.
	What are other communities saying? Maybe it would be good to do one big meeting.					1	Comments from consultation meetings in other communities are included in Appendix D of the PDR.
	Heard comment on radio that said project was still in the studies phase. There has been studying since 60's. Maybe time to move on. It is a good thing the highway will create more than 7 jobs, that it will reduce costs and times, and I am not worried about environmental protection as Gwich'in are already doing it….project should get going. What about financing, what are the possibility for the Gwich'in?					1	There might be private-public opportunities for financing. The additional studies are required to identify sources, quality and length; where to place camps, crossings locations, bridges and piers. It is detailed work that needs to be completed.

Comments and Questions from Fort McPherson - Mackenzie Valley Highway, GSA							
		Consultation Session					
Theme	Question/Comment	Fort McPherson Elders & Leadership May 25, 2010	Fort McPherson Community May 25, 2010	Elders and Leaders Nov 26, 2010	Community Nov 26, 2010	Community Mar 17, 2011	Consideration of Comments
Other	Will the bridge construction across the Peel River be delayed because of the highway project?		1				The development of the Mackenzie Valley Highway does not delay other priorities currently on the Department of Transportation's capital plan.
	The initial talks about the Dempster Highway started in the 1950s. It took a long time to build.		1				Comment noted.
	Where does the proposed pipeline go south of Norman Wells?		1				The proposed pipeline continues to Wrigley and then further south.
	Who's going to pay for the pipeline? I don't agree with the proposed pipeline project.		1				The pipeline and the Highway projects are not related. Comment noted.
	What stage are consultations at with the Sahtu?	1					The development of the Project Description Report for the segments in the Sahtu began in July 2010 in the Tulita District, and in November 2010 in the K'ahsho Got'ine District.
	The [NWT Pollard] review of the regulatory process may delay progress of the highway.		1				Comment noted. The current regulatory process is described in Section 4
	Why build a road to Tuktoyaktuk when it will not be there in 40 years due to a rise in sea level?	1					Comment noted.

Comments and Questions from Aklavik - Mackenzie Valley Highway, Gwich'in Settlement Area

Theme	Question/Comment	Consultation Session						Consideration of Comments
		Aklavik Elders May 27, 2010	Aklavik Chief and Council, RRC May 27, 2010	Alkavik Community May 27, 2010	Aklavik Elders Nov 23, 2010	Alkavik Community Nov 23, 2010	Aklavik Community Mar 14, 2011	
MVH (practical considerations)	It is better to use one footprint for both the highway and the pipeline than two use separate routes.	1						Comment noted.
	Most of the Aboriginal leaders are saying that the pipeline and highway routes should share a corridor.		1					Comment noted.
	The route around Travaillant Lake will raise many issues.	1						The relevant land designations in the Gwich'in Settlement Area have been noted and special consideration is being given to the Heritage Conservation Zone around Travaillant Lake to minimize the development through this area.
	This is a large project. Will you have the PDR ready in ten months?	1						The Project Description Report is anticipated to be complete by June 2011.
	Are you sure you are going to get the money to construct the highway?		1					Federal funding will be required to construct the Highway. Once constructed, the Highway, will be maintained by the Government of Northwest Territories.
	Who will pay for the highway? If there's no money to pay for the highway, why do all the planning work?		1					Please see comment above. Also, for a project of this size it is usually necessary to establish a number of project details before seeking funding, including establishing if there is local support for the project.
	How much will it cost to build the highway?		1					The construction cost estimate is included in Section 6.0 of the PDR.
	What happens if the funding bodies say "no" to the your funding applications?		1					If the funding bodies say "no" to the proposed highway but there is still widespread support for the highway then there will be further attempts to win the support of the funders.
	The people of Tsiigehtchic wanted the pipeline route moved east (around Travaillant Lake) so it's likely the highway route will need to follow the new route.		1					The preliminary design for the proposed highway is based on alignment being east of Travaillant Lake.
	Will the pipeline and highway be 'tied' together as one route and one project?		1					The proposed pipeline and highway are separate projects
	If everybody supports the highway project how long would it be before construction of the highway started?		1					Timing of the construction is dependent on approvals and availability funding.
	There is some muskeg along the route.		1					Comment noted.
	There is lots of information available from the work that was completed for the proposed pipeline route.		2					Comment noted. Available information produced for the proposed pipeline was reviewed and considered in the development of the Project Description Report.
	How will the road be constructed? South to north or north to south?							Construction of the Highway in the GSA will begin from both the north and the south limits of the project. Segments of the Highway in other regions will be constructed at the same time depending on the availability of funding.
	With the new highway in place, how long will the drive be from Inuvik to Edmonton?		1	1				The distance from Inuvik to Edmonton via Whitehorse is approximately 3,200 km. The distance from Inuvik to Edmonton using the proposed new highway will be approximately 2,500 km, a difference of about 700 km.
	Will the highway require any bridges?		1					Seven bridges are currently proposed for the Highway in the GSA. See Section 6, Development Summary of this Project Description Report.

Comments and Questions from Aklavik - Mackenzie Valley Highway, Gwich'in Settlement Area								
		Consultation Session						
Theme	Question/Comment	Aklavik Elders May 27, 2010	Aklavik Chief and Council, RRC May 27, 2010	Alkavik Community May 27, 2010	Aklavik Elders Nov 23, 2010	Alkavik Community Nov 23, 2010	Aklavik Community Mar 14, 2011	Consideration of Comments
MVH (practical considerations)	How will you select the Gwich'in people that will help with the reconnaissance? There are certified monitors within each community that should be considered.		1					Gwich'in Environmental and Wildlife Monitors were selected for the reconnaissance work in conjunction with the Gwich'in Tribal Council.
	What costs more, a bridge or a culvert?		1					It really depends on the nature of the crossing and the height of the fill required at each location.
	When constructing the highway you should make sure you don't make the mistakes that were made when the Dempster Highway was built		1					The purpose of the community consultations was to listen to what comments and questions people have about the project. Local knowledge about the land can be very useful for a project of this size.
	Will the highway be constructed before the pipeline?			1				The proposed pipeline and highway are separate projects.
	Once all the studies for the highway are completed will construction start?			1				Timing of the construction is dependent on approvals and availability funding.
	The proposed highway route is better than the 1970s route.			1				Comment noted.
	How long will it take to construct the highway? Some of us may not be alive to see it!			2				The construction cost estimates and schedule are included in Section 6.0 of the PDR.
	Who will be undertaking a reconnaissance in the helicopters?			1				Road and bridge engineers, biologists, an archaeologist and Gwich'in Wildlife Monitors were involved in the field reconnaissance of the proposed highway alignment.
	There was a previously proposed highway route that came towards/closer to Tsiigehtchic. Was there an agreement on that route at the time?		1					The route closer to Tsiigehtchic was probably the proposed 1970s route. It is now believed that the proposed pipeline and Highway should share the same corridor to help minimize the footprint.
	The Tribal Council needs to give permission for the land to be used for the highway.		1					Comment Noted.
	Do you have enough gravel to build the road?		1					Approximately 13 locations have been identified for borrow material for construction of the Highway in the GSA (see Section 6, Development Summary of this Project Description Report). Ample granular material has been identified for the construction of the Highway.
	Which borrow sources will be the main ones used?					1		Most of the borrow sites will be temporary sites for construction only. It is likely that three or four of the sites will be selected based on their location relative to permanent maintenance facilities and volume, quality and type of material available to remain as permanent or as long-term borrow sources for future maintenance of the Highway.
	The highway will help in monitoring and regulating the pipeline construction.					1		Comment noted.
	Location of Maintenance Camps will need to be considered. They could be the type of infrastructure like that at Eagle Plains on the Dempster Highway. The first one could be within 60 to 100 km of the Dempster Highway. A facility could also be located near Travaillant Lake to help with monitoring of access.					2		Comment noted and the location will be determined in the detailed design. Distances of between 50 and 100 km are currently being considered as appropriate.

Comments and Questions from Aklavik - Mackenzie Valley Highway, Gwich'in Settlement Area								
		Consultation Session						
Theme	Question/Comment	Aklavik Elders May 27, 2010	Aklavik Chief and Council, RRC May 27, 2010	Alkavik Community May 27, 2010	Aklavik Elders Nov 23, 2010	Alkavik Community Nov 23, 2010	Aklavik Community Mar 14, 2011	Consideration of Comments
MVH (practical considerations)	How much material is available from the smaller borrow sources?					1		13 potential borrow material locations within the GSA have been identified during the preliminary design stage of the proposed highway (see Section 6 of the Project Description Report). The smallest of these is estimated to contain approximately 250,000 cubic metres of material.
	Where will the construction camps be located, and what size will they be?					1		Construction camps will likely be located within or near the borrow sources, or at locations that will be used for future maintenance camps. Camps are not expected to be larger than 150 person camps.
	How many bridges are there? How large are the bridges and how does that compare to the one on the Dempster Highway at Eagle Plains?					1		Currently there are seven major bridges and 135 culverts or minor bridges identified for the Highway.
	What sort of material will be used on the approaches to the bridges? For dust control?					1		Calcium and Magnesium Chloride are materials commonly used for dust control. Other materials are also being considered. (Section 6.0 of the Project Description Report)
	When the highway is complete, is there a chance that the bridges will be expanded to two lanes?					1		This will really depend on traffic volumes.
	It might be an opportunity for land corporations to negotiate with the pipeline groups to invest in the highway and build the bridges to two lanes to start with, and prepare for future construction.					1		Comment noted.
	Little Chicago staging area could be used jointly for the construction in the GSA and in the Sahtu.					1		Comment noted.
	What will be the vehicle volumes on the Highway taking into consideration the future pipeline work?						1	The traffic volumes forecasted for the Highway are 50 vehicles per day. There will be peaks during construction of the pipeline.
	What will be the cost associated to the bridges?						1	Construction cost estimates for the bridges are provided in Section 6 of the PDR.
	How close will the pipeline be to the Highway?						1	There will be a buffer of trees between the Highway and the Pipeline where possible.
	Have the quantity and quality of borrow materials been tested?						1	There is preliminary information at each of the material sources. Quality, quantity, presence of ice and other elements will need to be confirmed in the next stages of the project development through geotechnical investigation at each of the potential borrow sources.
	Where does the Highway start? Where is Kilometre "0"						1	Kilometre "0" is in the Nortwest Territories - Alberta border.
	What will be the width of the road?						1	8.5 m (two lanes plus shoulder each side)
	Where are the gravel sources located?						1	The location of potential materials sources are shown in the figures included in Section 6 of the PDR.
	Will all the material to be used be gravel?						1	Yes, all material will be gravel.

Comments and Questions from Aklavik - Mackenzie Valley Highway, Gwich'in Settlement Area

Theme	Question/Comment	Consultation Session						Consideration of Comments
		Aklavik Elders May 27, 2010	Aklavik Chief and Council, RRC May 27, 2010	Alkavik Community May 27, 2010	Aklavik Elders Nov 23, 2010	Alkavik Community Nov 23, 2010	Aklavik Community Mar 14, 2011	
MVH (practical considerations)	Will there be any shelters, pull-out areas or camps?						1	Yes. All monitoring sections, camps, pull-up and shelters will be determined at design stage.
	When will the Highway detailed work be conducted?						1	The detail field and design work will be undertaken as soon as funding is available.
	What will be the cost of hauling materials from the sources?						1	Construction cost estimates are provided in Section 6 of the PDR.
Society	There was once a plan to build a highway to Aklavik through the 'Roads to Resources Program'.		1					Comment noted.
	Will the highway interfere with traditional uses of the land such as traplines?			1				There is potential for the Highway to affect traplines or perhaps provide better access to them.
	There is a potential that the highway will allow others to use the land currently used by the Andre family from Tsiigehtchic.			1				Comment noted.
	Allen Firth has a cabin at the north end of the highway corridor (Campbell Lake).			1				Comment noted.
	The highway will be good for the younger people as the way of life has changed.			1				Comment noted.
	The additional camps and workers needed to construct the highway may lead to more alcohol and drug abuse.			1				Comment noted.
	How will you deal with individuals who use the area for traditional camps / other uses?		1	1				Through the processes outlined in the Land Claims Agreement.
	Heritage values would have to be negotiated, and may result in re-routing of the proposed highway.					1		Comment noted.This is an issue to be addressed in detailed design stages.
	What type of training should we consider today for future opportunities in operating the highway?				1			The types of employment opportunities that will be created by the proposed highway are included in Section 12 of Project Description Report.
	How will young people know about this project? Have you gone to the schools and present this? Would like to see this being presented to them as they will be the generation working on it in the future.						1	The discussion at the meeting presented the idea of making a special presentation for schools and encourage youth to complete school by talking about future opportunities in this field. This comment is noted.
	Traditional uses are important, with the Highway in place people will want to built cabins.						1	Comment noted. Access to Gwich'in Lands will be controlled by GTC as noted in PDR
Economy	There will be opportunities for tourism and business ventures with the highway, e.g., around Travaillant Lake.	1						Comment noted.
	We are still living with the impact of the Beaufort oil and gas project that promised us training and employment but it never happened.	1						Comment noted
	Access and benefits discussions that include training and employment need to start now.	1						DOT and the GTC will discuss aspects such as land tenure, contracting, royalties and other items as the project develops.
	We need jobs and training opportunities to be part of this project.	1		1				Comment noted

Comments and Questions from Aklavik - Mackenzie Valley Highway, Gwich'in Settlement Area								
		Consultation Session						
Theme	Question/Comment	Aklavik Elders May 27, 2010	Aklavik Chief and Council, RRC May 27, 2010	Alkavik Community May 27, 2010	Aklavik Elders Nov 23, 2010	Alkavik Community Nov 23, 2010	Aklavik Community Mar 14, 2011	Consideration of Comments
Economy	If a road passes through a traditional camp will there be compensation?		1					The process to address this will be in accordance to the Gwich'in Comprehensive Land Claim Agreement.
	Traplines and camps may be established along the proposed route now simply to take advantage of any compensation package available when the highway is constructed.		1					Comment noted.
	The highway may bring opportunities for increased tourism in the area and help improve the local economy.		1					Comment noted.
	If the highway is constructed will local people be hired?			1				It is anticipated that employees will be hired from the local, available and qualified workforce.
	Ensure that the Gwich'in are offered jobs and training opportunities linked to the highway.		1					Please see comment above.
	What type of economic opportunities will be provided by the highway to the communities?				1			Tourism and business opportunities are expected to increase and the construction and maintenance of the Highway will create jobs within the GSA. Please see Section 12 of the Project Description Report.
	It is important to create jobs behind this project as the pipeline work does not include Aklavik.						1	Comment noted.
Environment	Lots of aboriginal people go out on to the land to hunt. If the highway is constructed then there may be over-harvesting of animals along the highway corridor with nobody to regulate that hunting.		1					Comment noted.
	More trophy hunters may come into the area to hunt animals.		1					Comment noted.
	What will the environmental effects be of the highway? Water is an important consideration. We had these concerns for the proposed pipeline and we have the same concerns for the highway.		1					Section 11 of the Project Description Report provides information on the potential environmental effects of the Highway. The protection of water resources is one area that will be given careful consideration. Wildife, including fish and birds, and vegetation all have to be considered too.
	Monitors will be needed for the environmental work associated with the highway construction. You need to start training these people now.		2					Comment noted.
	The highway will provide easy access to the land. This may be detrimental to the land and wildlife.		1	1				Comment noted.
	There are woodland caribou (blue-nose) in the area of the proposed highway.		1					Comment noted.
	You will need to consider climate change and changes in permafrost when you construct the highway.		1					Comment noted.
	The importance of water has to be considered along the road route as stream crossings can lead to erosion and additional sediment in the streams.		1					Section 11 of the Project Description Report provides information on the potential environmental effects of the Highway.
	Caribou are hunted in the area of the proposed highway route.			1				Comment noted.

Comments and Questions from Aklavik - Mackenzie Valley Highway, Gwich'in Settlement Area

Theme	Question/Comment	Consultation Session						Consideration of Comments
		Aklavik Elders May 27, 2010	Aklavik Chief and Council, RRC May 27, 2010	Alkavik Community May 27, 2010	Aklavik Elders Nov 23, 2010	Alkavik Community Nov 23, 2010	Aklavik Community Mar 14, 2011	
Environment	What level of environment study has been carried out?					1		Two reconnaissance field trips by specialists were completed in 2010. Additional work using topographical maps of the proposed highway alignment has been completed and previous studies of the same alignment have been reviewed. Additional field and desk-top studies will be required as the project progresses.
	Will the highway be built like the Dempster was or will more studies be done to minimize the impacts on the land, the water and the animals?			1	1			More studies will be done.
	Keep in mind the cumulative effect of dust and noise through out the construction process.						1	Comment noted.
	Monitoring wildlife in camp sites must be enforced. It is a big project with big volumes that can potentially have major impacts. Not enough with education and training.						1	Comment noted.
	With Highway, monitoring stations can be set up to follow up on pipeline work. Land Claim Agreement allows us to "watch" big areas.						1	Comment noted.
	The monitoring could be set up with 2 or 3 committees taking care of shorter sections of the Highway						1	Comment noted.
Consultation	Speak to the Andre family in Tsiigetchic as they know and use the area around Travaillant Lake.		1	1				Members of the Andre family have been present at some of the community consultation meetings.
	Have the Dehcho approved the highway?		1					The preliminary work for the Highway in the Dehcho has started.
	There is often a difference between the scientific knowledge that is collected and the Traditional Knowledge that is passed along. This should be kept in mind.		1					Comment noted.
	Is there a website available with information about the proposed highway?		1					Information is available on the websites of the GTC, the Department of Transportation and the Mackenzie Aboriginal Corporation.
	What concerns about the proposed highway were raised in Fort McPherson?		1					All of the comments and questions recorded at meetings in Fort McPherson are provided in the Project Description Report.
	Was there good attendance at the Fort McPherson meeting?		1					Approximately 12 Elders were present at each of the lunchtime meetings held in May and in November 2010. Approximately 29 local people were present at the evening community meeting held in May and four people were present at the evening meeting held in November.
	Talk to the school children about the highway project.			1				Comment noted.
	You could make a video of your presentation and have it available for the general public and schools.			1				Comment noted.
	Have you spoken to the Sahtu yet about the highway project?			1				Work on the Project Description Reports for the Highway in the Sahtu Settlement Area is currently underway.
	You will need to speak to people in all the areas where the highway will be located.			1				Comment noted.
	This consultation process is important. Consultation did not happen in the 70s when the PWC route was proposed.	1						Comment noted.

Comments and Questions from Aklavik - Mackenzie Valley Highway, Gwich'in Settlement Area								
		Consultation Session						
Theme	Question/Comment	Aklavik Elders May 27, 2010	Aklavik Chief and Council, RRC May 27, 2010	Alkavik Community May 27, 2010	Aklavik Elders Nov 23, 2010	Alkavik Community Nov 23, 2010	Aklavik Community Mar 14, 2011	Consideration of Comments
Consultation	The Gwich'in Social and Cultural Institute has a book on the Andre family.		1					Comment noted.
	Can the Elders be taken out to the proposed route to see it?			1				The GTC are considering this for later stages of the project development.
	Is there general support for this highway from the other communities and from the Sahtu?				1			Generally, there is support for the highway from the other communities and similar comments and questions are being heard from all the communities. These are discussed in section 9 of the PDR.
	It was suggested that only one meeting be planned in the community next time, rather than two.				1			Comment noted.
	What are the next steps to keep project moving?						1	Complete the PDR's in the other regions to submit as one project to the Mackenzie Valley Land and Water Board.
	Prepare a document that can be used in schools to show business opportunities related to Highway.						1	Comment noted.
	Do a presentation of the Highway project in career fairs to show the students the opportunities that exist.						1	Comment noted.
Other	Who sits on the Board of the Mackenzie Aboriginal Corporation?		1					Information about the Mackenzie Aboriginal Corporation is available on their website.

THE FOLLOWING COMMENTS AND QUESTIONS HAVE BEEN ADDRESSED IN THE PROJECT DESCRIPTION REPORT

McGregor, Robyn

From: gsci Executive Director <gsciexecutivedirector@learnnet.nt.ca>
Sent: Tuesday, March 01, 2011 5:23 PM
To: McGregor, Robyn
Cc: Lukas-Amulung, Sandra
Subject: Mackenzie Highway Heritage Map

Follow Up Flag: Follow up
Flag Status: Flagged

Good afternoon Robyn,
Thank-you for the opportunity to review the Gwich'in culture/heritage features map for the Mackenzie Valley Highway PDR. I believe it should be included in the report. I do have several comments about heritage features:

1. Not all Gwich'in named places within proximity to the highway are included as features. Named places are important intangible heritage features. Missing names include (I may miss some): the large valley north of Campbell Lake, Lost Reindeer and North Caribou Lakes have names, the small lake east of Caribou Lake that the road snakes around is named, most of the lakes between Trout Lake and Travaillant Lake near the highway are named.
2. There are no traditional trails on the map. Traditional trails are key heritage features and offer both intangible and tangible heritage values, and they often indicate an increased likelihood of finding buried archaeological remains.
3. Traditional harvesting areas for caribou and berries are not shown on the map. These features may have a different heritage value than trails and named features.

The GSCI considers the area along the route to be a gap in digitized and recorded heritage information, for such traditional use features as cabins, camp sites, harvest locations, and others.

Take care,
Sharon

>»Sharon Snowshoe, Executive Director
>»Gwich'in Social and Cultural Institute
>»Ph: (867)952-2524 Fax: (867)952-2238
>»
>»
>» Original Message

>»Good morning Sharon,
>»
>>>Attached is the map that has been prepared to indicate where
»Gwich'in
>»traditional / heritage values occur in relation to the proposed
>»Highway alignment. The Highway project team proposes to publish
»this
>»map in the Project Description Report as a letter-sized (8.5x11)
>»figure.
>»
>»As you will be aware, the GSCI Cultural Resource Spatial Data
>»identified various types of features - fish, burial sites,
»etc.

>»I would direct your attention to a choice we made about the data.
»In
>>>the legend, we consolidated these labels and we have applied the
>»generic term 'traditional / heritage value' as a further measure of
>»protection.
>»
>»Please advise if GSCI approves this map for use in the PDR, which
>>>will become a publicly available document. If GSCI identifies any
>»concerns or has recommendations about the map, we can make
>revisions
>»as needed. The PDR is going to go through internal project team
>»reviews beginning in a couple of days and the process is expected
>to
>>>be complete within the month of February. During this time, the
>»option exists to remove the map altogether if the GSCI requests
>that
>»it not be published.
>»
>»We look forward to hearing from you about this figure in the next
>>day
>»or so, if possible.
>»
>»Best regards,
>»
>>>Sandra
>»
>»Sandra Lukas-Amulung
>»Senior Arctic Regulatory Consultant
>>>p. 403.723-6895 • f. 403.203.3301
>»c. 403.369.6048
>»e. slukasamulung@eba.ca
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>»Nehtruh-EBA Consulting Ltd.
>»Riverbend Atrium One, 115, 200 Rivercrest Drive SE Calgary, Alberta
>»T2C 2X5 • CANADA
>»
>»CREATING AND DELIVERING BETTER SOLUTIONS [http://www.eba.ca/
>»]www.eba.ca

McGregor, Robyn

From:	McGregor, Robyn
Sent:	Friday, February 18, 2011 9:34 AM
To:	McGregor, Robyn
Subject:	FW: Update
Attachments:	2011 PDR MV highway NRRC.xls

From: Barrie Robb {mailto:BRobb@flint-energy.com]
Sent: Thursday, February 17, 2011 9:51 AM
To: McGregor, Robyn
Subject: Fw: Update

From: Phillip Edwards <phillipedwards@hotmail.com>
To: Barrie Robb
Cc: Wanda McDonald <wmcdonald@gwichin.nt.ca>
Sent: Thu Feb 17 09:29:13 2011
Subject: Update

Good morning,
I am on my way up to Fort McPherson this AM. Just to give you a quick update, Wanda and I did have a sit down yesterday afternoon. We reviewed the Progress Report #18 and also reviewed the comments from Inuvik RRC. Not sure if Wanda sent you the attached document? These are the comments from Inuvik RRC.

I had a couple of quick meetings also with Fort McPherson RRC members and the band Chief. They are all for the project, no further comments. They just mentioned you all had a good workshop a couple of weeks ago in Inuvik. I will meet with the RRC president and the DGO president today in Fort McPherson.

As for Inuvik, I did speak to Chief Herbert Blake. He also has no further comments. All he mentioned was ACCESS and FINANCING. 2 topics that he brought up in the Inuvik workshop.

I will email you once the McPherson meetings are completed.

Phillip

Mackenzie Highway-GSA PDR
Questions from PDR bb.

1	Explain the difference in Permit Classes? A B C..	Where does Consolation Stop at what type of water license??
2	4.3-Harvesters compensation "on-going' explain?	
3	4.8-DFO to determine suitable compensation as they may know to what extent disturbance an damages might be?	
4	6.2-Whats behind the single lane bridges? Where does this come from? What's the cost difference as to putting in proper double lane brigdes?	Safety!! How is Liable?? During?after Construction?
5	Table 6.4-1 Cross section drawing of the proposed highway? Is it going tobe wide enough? Is this standard? In what year will we go back to widen as we are now doing to the Dempster highway?	
6	To what extent will you use Lakes as winter roads for access?	Other than winter roads to extract lake water?
7	Has the cost of using a road surface agent been determined? i.e. polymer cold mix, EZ street and InfraCrete.	Will this be extra?
8	Recorded Heritage sites, what's the plan if you need borrow materials from a Heritage site that in the middle of a borrow site?	
9	Are there any migration route through this area that u are aware of?	
10	Did you address all the Gwich'in traditional fishing harvesting sites and did you ask the Gwich'in Participants?	
11	Compensation package for people how traditionally use, how decides ?	
12	At what point does DFO kick in and what authority do they have and do they represent that Territorial or Federal Governments?	
13	PWNHC permit # 2010-0016 to take preliminary field assessments of Archaeology? What did they find? Is it on-going? What roll does the GSCI play in these studies?	
14	The information you received from the MGP studies are 100% as you are using a large portion of their data from field studies, did you find and different or did you do your own studies?	
15	Grizzly Bear Dens have you identified then and is there any in the highway corridor?	
16	DFO have they done any of their own fish studies along the proposed route?	

Wildlife and Environment Monitors they SHOULD be the
responsibility of the GRRB or the local RRC's as this will be a
sentive issue. ILA hires/trains their own Monitors and charge-out
day rates are very high, so either the GRRB or the collective RRC's
17 hire/train and negotiate rates for Monitoring.
Monitors have the Authority to stop activity if they deem an act
or violation has been committed.

When will you place the top layer on the road during winter
18 construction or summer?

In some detail can you explain restoration for borrow sites? If
19 some sites need more restoration than others what the plan?

Other activity after the Highway is constructed and others need
20 borrow sites, as will be the case, what the Process??

Is there any information on the geological interests along the
21 transboundary between the GSA & Sahtu?

Page 11-5 ...earlier in the PDR you mentioned there will be
Geotexile layed on the ground before any borrow material is
22 deposited, now you say...where need..can you explain?

Do you have a plan for keeping general public off the road during
23 construction?

You spoke of Alien plants etc. being introduced to the area, would
the seed mix you lay down in land reclamation be alien as they are
not from this part of the country? And what is in this mystery seed
24 mix? Where does it come from?

Cleaning equipment prior to use to avoid transfer of non-native or
25 invasive plant species...explain

26 Habitat Edges...explain.

The Dempster Highway is suppose to have a no-hunting corridor
will the MVH have the same or is up to ea. Land Claim group to
27 decide?

Page 11.5.5-again do you where the bear dens are? 11.5.7-1 has
the answer as you do not know where if any of Bear dens...this is
most sensitive because if there are any Dens along route you will
28 just burry them? Bears usually re-use the same Den yearly.
The ILA have a map of all the known bear dens in their settlement
area, does the Gwichin have the same?

Page 11.6.2 here you say you will determine the type of crossing
to best fits. Explain as you have draws to that already show what
29 the plan calls for?
Will DFO have a say it this decision?

Page 11.6.5 Calls for the company to hire Monitors, this cannot
be...the company will dictate to the Monitor as to what the
favorable report should say, if there ever is an incident with
30 Environment or Wildlife.

Monitors have to be separate from companies and the Monitors
represent the Gwichin Participants NOT the companies....we have
Legal means to make sure this does not happen.
Page 11-8, table 11.7-1 Potential effects on Communities; Cost of
living, did you guys do an actual survey and analysis or just used
31 someone else data and predictions?
Page 13-1 half way down the page, Individually no significant
32 effects are anticipated..explain??

Page 13-9 Gwichin Conservation Zones does not apply to the
33 future exploration and development, can you explain? And why?

Last Page-Spill contingency plan? Do you have one other than just
idea's? You have a table of Contents can we have a copy of the
34 plan as this is an outstanding issues that will not go away.

In closing I enjoyed reading most of the PDR I found answers later
in the PDR that I have Q's at the beginning.
There is still an enormous amount of Environment work that
needs to be done, when will you start and do you have a plan for
these studies?
I still strongly disagree with single lane bridges, I feel you are
nickel and diming here... SAFETY is pivotal, when the pipeline
loads start rolling north with supplies, there will be problems in
meeting deadlines as the highway is not sufficient to handle the
activity.

Mashii

Bert Bullock-Nihtat Renewable Resource Council Member

McGregor, Robyn

From: Phillip Edwards <phillipedwards@hotmail.com>
Sent: Saturday, February 19, 2011 11:55 PM
To: McGregor, Robyn
Cc: Barrie Robb; Wanda McDonald
Subject: Fort McPherson comments - Feb. 17/11
Attachments: McPherson Feb. 17, 2011.xls

Attached are the comments from the meeting with DGO and RRC.

Phillip

Mackenzie Valley Highway - GSA PDR
Questions from PDR - Fort McPherson, NT
Thurs., February 17, 2011
DGO President, Johnny Kaye
Elder's Rep., Effie Snowshoe
RRC President, Mary Rose Tetlichi

1. Look at the big picture, how will it affect the whole GSA?

2. As long as the contractor or GTC can give the communities that sense of comfort, we support the project.
3. Access and Benefits. How will the GSA benefit?
4. Harvester's: How can you prove that certain Trapper's claim certain areas? Ownership of land, ownership of trappline's. What's the process,
what's the approval process?
Consult with Elder's. Consult.with current and past leader's.
5. Migration routes:
What's going to happen when caribou migrates through that area?
How are we protecting Fish Lakes?
6. Worker's fishing after hours during construction. How the land, lakes and other important areas going to be managed and protected.
During and after construction. No guns, no fishing
7. Inuvialuit: In the past groups travelling south to attend Cross Cultural Programs. is there any such programs proposed with this project?
8. More training needs to take place now. Sooner rather than later. Even though the funding is not yet obtained, we still need the
training opportunities.
9. Is Inuvialuit PDR approved? What stage are they at in their road project?
10. Are we fastracking the PDR?

11. Promote out territory in the PDR? We read that the highway would shorten driving distances to Edmonton, why not mention distances and advantages in travelling to Yellowknife or Hay River (for example)
12. Pit mgmt plans. Good example of not managing pits properly, Frog Creek.
13. Highway will encourage Cross Cultural Gatherings.
14. Feel comfortable with project. Feel we are prepared.
15. Resource Revenue Sharing.
16. Highway will promote Cross Cultural meetings and consultations.
17. Build on past agreements. Kodiak project for example.
18. West Delta Golder is McPherson Gwich'in Business capable of carrying out similar work to this PDR project.
How did Nehtruh EBA get the work?
19. Build it, go ahead and do it.
20. Effie agrees with it too.
21. * Would like to be given fair opportunity to bid on section of work.
What is going to be "set-aside" work?
22. Use GNWT process for advertising projects.

How do we distribute work throughout GSA? Equal opportunity and responsibility for each GSA community.

23. Negotiated contracts.
24. What process are they planning on using to obtain contractors?
25. Access and Benefits:

McGregor, Robyn

From: Phillip Edwards <phillipedwards@hotmail.com>
Sent: Monday, February 21, 2011 9:37 AM
To: McGregor, Robyn
Cc: Barrie Robb; Wanda McDonald
Subject: Tsiigehtchic comments: PDR
Attachments: Tsiigehtchic Feb. 18, 2011.xis

Robyn,
Attached are the comments from the meeting with Tsiigehtchic RRC and DGO.

Phillip

Mackenzie Valley Highway - GSA PDR
Questions from PDR - Tsiigehtchic, NT
Friday, February 18, 2011
RRC Coordinator, Anna Mae McLeod
RRC President, John Norbert
Alestine, GSCI

1. Would like an executive summary of the report. 3 to 4 pages, summarized description to distribute to the councils and community residents.
Plain language, provide comments to each major point in the glossary.
2. Alestine mentioned GSCI reviewed report and provided a letter of support.
3. Small contractors, would they get equal opportunities? Make sure contractor equipment is up to date, current. Safe and reliable.
4. Every contractor is required to complete drug and alcohol testing.
5. Traivallant Lake: touchy; conservation zone
6. Identify fish lakes
7. borrowing sources: explosives, granular materials. Make sure fish lakes are protected.
8. RCMP. Did they carry out any surveys to see what impact this type of project would have to the communities. Infrastructure impact.

9. Plain language report, RRC would like a summary to distribute to council members and residents.
10. Door to door survey is required to inform community residents about the report.
11. Culverts, has there been sufficient studies to guarantee design and location. More info on design approach.
12. Monitors: are you hiring? Are they going to be Gwich'in? Would like to see Environmental, Water and Wildlife monitors.
13. Special zones, conservation zone. Make sure GLWB has reviewed sections.
14. Emphasis on Moose and Caribou migration. Future vegetation growth, this area will be attracting to animals.
15. Research and permit licensing.
16. People need to start training for future. Why are programs in place now? Identify $ for training programs.

17. Request training in local communities, instead of having to travel to Fort Smith for example.
Conduct studies to see the impacts of having to complete training elsewhere.
Request younger generation to attend meetings.
18. * Submit reports/summary of all meetings. (eg. Inuvik Workshop end of January) Can the councils receive a summary of them meetings?
19. Rengleng River and Frog Creek culverts. These areas should have been "bridges" instead of culverts.
20. Don't need construction camps too close to communities.
21..Security and camps is important. Security check stops, check points.
22. Land Use mgmt plans. Would the highway be blocked off during construction?
23. McPhoo and Aklavik, what are they saying? There's word they don't want to be a part of the project, "it's an Arctic Red area".
24. Overflow areas. There's several areas on Dempster Highway these past few years.

25. Burial sites near Traivallant Lake. Anna Mae would like to locate these. Anna Mae's grandfather.
26. Maps for trapp lines - 2004/2005. Please review. Group trapping areas.
27. Paved through Traivallant Lake.
28. Request an Imperial Oil representative to attend next round of meetings.
29. Trapping areas: Tribal Council (Land Claims). If you are not in an area for 2 years, then the area is "wide open".

Deal with the Gwich'in collectively on determining who's trapping areas are claimed.

McGregor, Robyn

From: Phillip Edwards <phillipedwards@hotmail.com>
Sent: Tuesday, February 22, 2011 9:47 AM
To: McGregor, Robyn
Cc: Barrie Robb; Wanda McDonald; Phillip Edwards
Subject: RE: Aklavik comments: PDR
Attachments: Aklavik Feb. 21, 2011.xls

Subject: RE: Aklavik comments: PDR
Date: Tue, 22 Feb 2011 09:38:52 -0700
From: RMcGregor©eba.ca
To: phillipedwards(ahotmail.com

Hi Phillip,
Can you add the attachment please and thanks.
R,.

Robyn V. McGregor, M.Sc., P.Eng. I Senior Transportation Engineer & Principal Consultant
p. 403.723.3269 I **c.** 403.861.6114 I **f.** 403.203.3301
rmcaretior eba.ca

EBA, A Tetra Tech Company I Transportation Practice
Riverbend Atrium One, 115, 200 Rivercrest Drive SE I Calgary, AB T2C 2X5 I **www.eba.ca**

S please consider the environment before printing this email

From: Phillip Edwards [mailto:phillipedwards@hotmail.com]
Sent: Tuesday, February 22, 2011 9:15 AM
To: McGregor, Robyn
Cc: Barrie Robb; Wanda McDonald; Phillip Edwards
Subject: RE: Aklavik comments: PDR

Aklavik comments and questions attached.

Phillip

Subject: RE: Tsiigehtchic comments: PDR
Date: Tue, 22 Feb 2011 08:23:10 -0700
From: RMcGregor@leba.ca
To: phillipedwardsPhotmail.conn
CC: brobb(aflint-enerqy.com; wmcdonaldOgwichin.nt.ca

Thanks Phillip
I have the notes from lnuvik, Fort McPherson and Tsiigehtchic

R.

Robyn V. McGregor, M.Sc., P.Eng. I Senior Transportation Engineer & Principal Consultant
p. 403/23.3269 I **c.** 403.861.6114 I **f.** 403203.3301
rmcgrecior@eba.ca

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Riverbend Atrium One, 115, 200 Rivercrest Drive SE I Calgary, AB T2C 2X5 I **www.eba.ca**

Mackenzie Valley Highway - GSA PDR
Questions from PDR - Aklavik NT
Monday, February 21, 2011
Chief, Danny Greenland
RRC, Richard Ross
GTC Board Member, James Edwards
RRC, Fanny Greenland
RRC Coordinator, Jeremy Mosher

1. What stage is the project at now? What are the next steps?
2. Too many single lane bridges.
3. Once the construction begins, there would be a lot of "whining" and complaining about Hunting and Trapping.

People from different communities would be trapping in other trapper's areas. (Mgmt of lands)
4. Once constructed, the Mackenzie Valley Highway would be open all the time. There wouldn't be any road closures similar to Dempster.
5. "Where do we sign; get the project going".
6. Not enough time to review and provide comments. It's un-professional to expect us to provide comments in that short time period.
7. We didn't receive an update or summary of the Workshop held Jan. 31st.
8. Tuk Access Road to gravel source. Any major problems? Is there any major settling due to thaw in granular material?
9. What stage is the Tuk Road in?
10. What stage is the pipeline in now? How would the 2 projects play out? Need updates to make sure we are prepared.
11. Where are the training dollars? How long do we wait before it's too late? Need the funding for training now.

McGregor, Robyn

From: Liz Gordon <lgordon@Gwichin.nt.ca>
Sent: Friday, April 15, 2011 4:44 PM
To: McGregor, Robyn
Cc: Mardy Semmler
Subject: Mack Highway PDR Review
Attachments: GTC Mack Highway PDR rev Apr 11.docx

Follow Up Flag: Follow up
Flag Status: Flagged

Attached please find the Comments for the Mackenzie Highway PDR.

Liz Gordon
Lands and Resources Officer(Trainee)
Gwich'in Tribal Council
(867) 777-7912
(867) 777-7919
lgordon@gwichin.nt.ca

April 15, 2011

To Whom it May Concern:

Re: Project Description Report for the Construction of the Mackenzie Valley Highway for the Gwich'in Settlement Area

As the Lands and Resources Officer Trainee with the GTC, I have the Project Description Report (PDR) for the construction of the Mackenzie Valley Highway for Gwich'in Settlement Area dated January 2011 and have the following comments:

- It states on page 6-24 that there will be over 135 culverts but does not clearly state a number and where they will be, including what size culvert?
- It states on Table 6.9.1-1 the volumes required for granular resources. The GTC notes that the Mackenzie Gas project have identified the same sites and volumes they will be extractingfrom the same sites. Is there enough material for both?? Have you thought about the cumulative effects of this??
- The GTC will require Pit Management Plans for each quarry identified for use prior to extracting from the quarries.
- There is mention of doing a bear den site survey on page 11-9; the GTC will require the numbers of dens identified and a map of where they are including species, active or inactive, etc?
- Will a bird nesting sites survey be completed? Need to see a map of where they are located, species??
- If the pipeline crosses the road, will they have to tear up the road to access the pipeline to complete maintenance??
- Where will the water come from for the construction of the road? Where will the water come from for the camps? What percentage of water will you take from these lakes? Can the lake handle that volume? What species of fish are in these lakes? Will there be a filter on the intake pipe for water? The amount should be reduced from 10% to 5% total max allowable water from a lake. Has it been considered if the MGP will be taking from the same lakes during construction and the possible cumulative effects of both??
- There is nowhere in the PDR about the GTC Land and Resources Department and the review process that the GTC will also require prior to issuing authorizations to access Gwich'in Private Lands?
- On page 11-20 it talks about waste management and it states that the bags will be hauled to an incinerator at an off-site location in Inuvik? Where and who owns that incinerator?
- Is there approval to use Inuvik's landfill for the garbage disposal?

- On page 10-23 there is talk about the Woodland Caribou which is listed as Threatened under SARA, which can become endangered if limiting factors are not reversed, what mitigation measures will be in effect for the woodland caribou so that they do not become on the endangered list?
- What is the lifetime of a culvert?
- What will be the lifetime of the bridges?
- Need to see a fish management plan for the lakes closest to the road, especially near the Travaillant lake area.
- This road will make it easier to access the caribou near the caribou lakes and Travaillant lake area when they are crossing, will there be a closure plan in place for this?

These are some comments that I have considered during my initial review of the PDR. If you have any questions, please call me at 867/777-7912.

Thank you,

Liz Gordon
Lands and Resources Officer Trainee

----- Original Message -----
From: Allen Firth
To: Phillip Edwards
Sent: Monday, February 14, 2011 7:50 PM
Subject: RE: When are you in town?

Hi Philip,

Other than the previous questions and comments on the attachment I sent you, the Nihtat RRC members have no other comments on the PDR.
I asked Jozef Carnogursky (President, Nihtat RRC) if we need to have a meeting with you, and he was of the opinion that we all agreed that this is a good project for the region and should be moved forward, so we don't have to meet.
If you could relay the questions and concerns on to the contractor, for answers, and get them to send them back to me, that would be OK.

Thanks,

Allen Firth.

From: Phillip Edwards [mailto:eagleeye@eastlink.ca]
Sent: February 14, 2011 11:05 AM
To: Allen Firth
Subject: Re: When are you in town?

Hi Allan,
I will be arriving in Inuvik on Wed., Feb. 16th. If you'd like, I can be available from 3:30pm until the evening. Whatever works for you and the council. I am there to assist in reviewing the report and compiling all comments/questions. As for answers to them, that's for the contactor (Mackenzie Aboriginal Corporation).

Phillip
(902)565-5177
----- Original Message -----
From: Allen Firth
To: Phillip Edwards
Sent: Monday, February 14, 2011 1:39 PM
Subject: When are you in town?

Hi Philip,

When will you be back up this way? If I know your schedule then we can possibly pick a time for you to meet with the Nihtat RRC.
Thanks,

Allen Firth,
Nihtat RRC Coordinator.

APPENDIX E

APPENDIX E WILDLIFE SPECIES OCCURRING OR POTENTIALLY OCCURRING WITHIN THE STUDY AREA

Appendix E - Wildlife Species Occurring or Potentially Occurring Within the Study Area

Common Name	Scientific Name	Conservation Status		
		NWT	SARA	COSEWIC
Birds[1]				
Greater White-fronted Goose	*Anser albifrons*	Secure	-	Not Assessed
Snow Goose	*Chen caerulescens*	Secure	-	Not Assessed
Canada Goose	*Branta canadensis*	Secure	-	Not Assessed
Tundra Swan	*Cygnus columbianus*	Secure	-	Not Assessed
American Wigeon	*Anas americana*	Secure	-	Not Assessed
Mallard	*Anas platyrhynchos*	Secure	-	Not Assessed
Northern Shoveler	*Anas clypeata*	Secure	-	Not Assessed
Northern Pintail	*Anas acuta*	Sensitive	-	Not Assessed
Green-winged Teal	*Anas crecca*	Secure	-	Not Assessed
Canvasback	*Aythya valisineria*	Secure	-	Not Assessed
Ring-necked Duck	*Aythya collaris*	Secure	-	Not Assessed
Greater Scaup	*Aythya marila*	Secure	-	Not Assessed
Lesser Scaup	*Aythya affinis*	Sensitive	-	Not Assessed
Surf Scoter	*Melanitta perspicillata*	Sensitive	-	Not Assessed
White-winged Scoter	*Melanitta fusca*	Sensitive	-	Not Assessed
Long-tailed Duck	*Clangula hyemalis*	Sensitive	-	Not Assessed
Common Goldeneye	*Bucephala clangula*	Secure	-	Not Assessed
Red-breasted Merganser	*Mergus serrator*	Secure	-	Not Assessed
Spruce Grouse	*Falcipennis canadensis*	Secure	-	Not Assessed
Willow Ptarmigan	*Lagopus lagopus*	Secure	-	Not Assessed
Rock Ptarmigan	*Lagopus muta*	Secure	-	Not Assessed
Sharp-tailed Grouse	*Tympanuchus phasianellus*	Secure	-	Not Assessed
Red-throated Loon	*Gavia stellata*	Secure	-	Not Assessed
Pacific Loon	*Gavia pacifica*	Secure	-	Not Assessed
Common Loon	*Gavia immer*	Secure	-	Not At Risk
Horned Grebe	*Podiceps auritus*	Secure	No Status	Special Concern
Red-necked Grebe	*Podiceps grisegena*	Secure	-	Not At Risk
Osprey	*Pandion haliaetus*	Secure	-	Not Assessed
Bald Eagle	*Haliaeetus leucocephalus*	Secure	-	Not At Risk
Northern Harrier	*Circus cyaneus*	Secure	-	Not At Risk
Sharp-shinned Hawk	*Accipiter striatus*	Secure	-	Not At Risk
Northern Goshawk	*Accipiter gentilis*	Secure	-	Not At Risk
Red-tailed Hawk	*Buteo jamaicensis*	Secure	-	Not At Risk
Rough-legged Hawk	*Buteo lagopus*	Secure	-	Not At Risk
Golden Eagle	*Aquila chrysaetos*	Secure	-	Not At Risk
Merlin	*Falco columbarius*	Secure	-	Not At Risk
Gyrfalcon	*Falco rusticolus*	Secure	-	Not At Risk

Appendix E - Wildlife Species Occurring or Potentially Occurring Within the Study Area

Common Name	Scientific Name	Conservation Status		
		NWT	SARA	COSEWIC
Peregrine Falcon	*Falco peregrinus anatum/tundrius*	Sensitive	No Status	Special Concern
Sandhill Crane	*Grus canadensis*	Secure	-	Not Assessed
Black-bellied Plover	*Pluvialis squatarola*	Sensitive	-	Not Assessed
American Golden-Plover	*Pluvialis dominica*	Sensitive	-	Not Assessed
Semipalmated Plover	*Charadrius semipalmatus*	Secure	-	Not Assessed
Lesser Yellowlegs	*Tringa flavipes*	Sensitive	-	Not Assessed
Solitary Sandpiper	*Tringa solitaria*	Undetermined	-	Not Assessed
Spotted Sandpiper	*Actitis macularius*	Secure	-	Not Assessed
Whimbrel	*Numenius phaeopus*	Sensitive	-	Not Assessed
Hudsonian Godwit	*Limosa haemastica*	Sensitive	-	Not Assessed
Semipalmated Sandpiper	*Calidris pusilla*	Sensitive	-	Not Assessed
Least Sandpiper	*Calidris minutilla*	Sensitive	-	Not Assessed
Baird's Sandpiper	*Calidris bairdii*	Secure	-	Not Assessed
Pectoral Sandpiper	*Calidris melanotos*	Secure	-	Not Assessed
Dunlin	*Calidris alpina*	Sensitive	-	Not Assessed
Stilt Sandpiper	*Calidris himantopus*	Undetermined	-	Not Assessed
Long-billed Dowitcher	*Limnodromus scolopaceus*	Sensitive	-	Not Assessed
Wilson's Snipe	*Gallinago delicata*	Undetermined	-	Not Assessed
Red-necked Phalarope	*Phalaropus lobatus*	Sensitive	-	Not Assessed
Red Phalarope	*Phalaropus fulicaria*	Sensitive	-	Not Assessed
Parasitic Jaeger	*Stercorarius parasiticus*	Undetermined	-	Not Assessed
Long-tailed Jaeger	*Stercorarius longicaudus*	Undetermined	-	Not Assessed
Bonaparte's Gull	*Larus philadelphia*	Secure	-	Not Assessed
Mew Gull	*Larus canus*	Secure	-	Not Assessed
Herring Gull	*Larus argentatus*	Secure	-	Not Assessed
Glaucous Gull	*Larus hyperboreus*	Secure	-	Not Assessed
Sabine's Gull	*Xema sabini*	Secure	-	Not Assessed
Arctic Tern	*Sterna paradisaea*	Secure	-	Not Assessed
Great Horned Owl	*Bubo virginianus*	Secure	-	Not Assessed
Snowy Owl	*Bubo scandiacus*	Secure	-	Not At Risk
Northern Hawk Owl	*Surnia ulula*	Secure	-	Not At Risk
Great Grey Owl	*Strix nebulosa*	Secure	-	Not At Risk
Short-eared Owl	*Asio flammeus*	Sensitive	Special Concern (Schedule 3)	Special Concern
Belted Kingfisher	*Ceryle alcyon*	Secure	-	Not Assessed
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Secure	-	Not Assessed
American Three-toed Woodpecker	*Picoides dorsalis*	Secure	-	Not Assessed

Appendix E - Wildlife Species Occurring or Potentially Occurring Within the Study Area

Common Name	Scientific Name	Conservation Status		
		NWT	SARA	COSEWIC
Northern Flicker	*Colaptes auratus*	Secure	-	Not Assessed
Alder Flycatcher	*Empidonax alnorum*	Secure	-	Not Assessed
Say's Phoebe	*Sayornis saya*	Undetermined	-	Not Assessed
Northern Shrike	*Lanius excubitor*	Secure	-	Not Assessed
Gray Jay	*Perisoreus canadensis*	Secure	-	Not Assessed
Common Raven	*Corvus corax*	Secure	-	Not Assessed
Horned Lark	*Eremophila alpestris*	Secure	-	Not Assessed
Tree Swallow	*Tachycineta bicolor*	Secure	-	Not Assessed
Bank Swallow	*Riparia riparia*	Secure	-	Not Assessed
Cliff Swallow	*Petrochelidon (Hirundo) phyrrhonota*	Secure	-	Not Assessed
Barn Swallow	*Hirundo rustica*	Sensitive	-	Not Assessed
Boreal Chickadee	*Poecile hudsonica*	Sensitive	-	Not Assessed
Gray-headed Chickadee	*Poecile cincta*	May Be At Risk	-	Not Assessed
Ruby-crowned Kinglet	*Regulus calendula*	Secure	-	Not Assessed
Townsend's Solitaire	*Myadestes townsendi*	Secure	-	Not Assessed
Gray-cheeked Thrush	*Catharus minimus*	Secure	-	Not Assessed
Swainson's Thrush	*Catharus ustulatus*	Secure	-	Not Assessed
American Robin	*Turdus migratorius*	Secure	-	Not Assessed
Varied Thrush	*Ixoreus naevius*	Undetermined	-	Not Assessed
American Pipit	*Anthus rubescens*	Sensitive	-	Not Assessed
Bohemian Waxwing	*Bombycilla garrulus*	Secure	-	Not Assessed
Tennessee Warbler	*Vermivora peregrina*	Secure	-	Not Assessed
Orange-crowned Warbler	*Vermivora celata*	Secure	-	Not Assessed
Yellow Warbler	*Dendroica petechia*	Secure	-	Not Assessed
Magnolia Warbler	*Dendroica magnolia*	Secure	-	Not Assessed
Yellow-rumped Warbler	*Dendroica coronata*	Secure	-	Not Assessed
Palm Warbler	*Dendroica palmarum*	Secure	-	Not Assessed
Blackpoll Warbler	*Dendroica striata*	Sensitive	-	Not Assessed
Northern Waterthrush	*Seiurus noveboracensis*	Secure	-	Not Assessed
Common Yellowthroat	*Geothlypis trichas*	Secure	-	Not Assessed
Wilson's Warbler	*Wilsonia pusilla*	Secure	-	Not Assessed
American Tree Sparrow	*Spizella arborea*	Sensitive	-	Not Assessed
Chipping Sparrow	*Spizella passerina*	Secure	-	Not Assessed
Savannah Sparrow	*Passerculus sandwichensis*	Secure	-	Not Assessed
Fox Sparrow	*Passerella ilia*	Secure	-	Not Assessed
Song Sparrow	*Melospiza melodia*	Undetermined	-	Not Assessed
Lincoln's Sparrow	*Melospiza lincolnii*	Secure	-	Not Assessed

Appendix E - Wildlife Species Occurring or Potentially Occurring Within the Study Area

Common Name	Scientific Name	Conservation Status		
		NWT	SARA	COSEWIC
White-throated Sparrow	*Zonotrichia albicollis*	Sensitive	-	Not Assessed
Harris's Sparrow	*Zonotrichia querula*	Sensitive	-	Not Assessed
White-crowned Sparrow	*Zonotrichia leucophrys*	Secure	-	Not Assessed
Dark-eyed Junco	*Junco hyemalis*	Secure	-	Not Assessed
Red-winged Blackbird	*Agelaius phoeniceus*	Secure	-	Not Assessed
Lapland Longspur	*Calcarius lapponicus*	Secure	-	Not Assessed
Smith's Longspur	*Calcarius pictus*	Undetermined	-	Not Assessed
Snow Bunting	*Plectrophenax nivalis*	Secure	-	Not Assessed
Rusty Blackbird	*Euphagus carolinus*	May Be At Risk	Special Concern (Schedule 1)	Special Concern
Pine Grosbeak	*Pinicola enucleator*	Secure	-	Not Assessed
White-winged Crossbill	*Loxia leucoptera*	Secure	-	Not Assessed
Common Redpoll	*Carduelis flammea*	Secure	-	Not Assessed
Hoary Redpoll	*Carduelis hornemanni*	Undetermined	-	Not Assessed
Amphibians				
Wood Frog	*Lithobates sylvatica*	Secure	-	Not Assessed
Mammals[2]				
Arctic Shrew	*Sorex arcticus*	Secure	-	Not Assessed
Cinereus Shrew	*Sorex cinereus*	Secure	-	Not Assessed
Snowshoe Hare	*Lepus americanus*	Secure	-	Not Assessed
Arctic Ground Squirrel	*Spermophilus parryii*	Secure	-	Not Assessed
Red Squirrel	*Tamiasciurus hudsonicus*	Secure	-	Not Assessed
Beaver	*Castor canadensis*	Secure	-	Not Assessed
North American Deer Mouse	*Peromyscus maniculatus*	Secure	-	Not Assessed
Neoarctic Brown Lemming	*Lemmus trimucronatus*	Secure	-	Not Assessed
Neoarctic Collared Lemming	*Dicrostonyx groenlandicus*	Secure	-	Not Assessed
Northern Bog Lemming	*Synaptomys borealis*	Secure	-	Not Assessed
Meadow Vole	*Microtus pennsylvanicus*	Secure	-	Not Assessed
Northern Red-backed Vole	*Myodes rutilus*	Secure	-	Not Assessed
Root Vole	*Microtus oeconomus*	Secure	-	Not Assessed
Taiga Vole	*Microtus xanthognathus*	Secure	-	Not Assessed
Common Muskrat	*Ondatra zibethicus*	Secure	-	Not Assessed
North American Porcupine	*Erethizon dorsata*	Secure	-	Not Assessed
Coyote	*Canis latrans*	Secure	-	Not Assessed
Gray Wolf	*Canis lupus*	Secure	-	Not At Risk
Arctic Fox	*Vulpes lagopus*	Secure	-	Not Assessed
Red Fox	*Vulpes vulpes*	Secure	-	Not Assessed
American Black Bear	*Ursus americanus*	Secure	-	Not At Risk

Appendix E - Wildlife Species Occurring or Potentially Occurring Within the Study Area

Common Name	Scientific Name	Conservation Status		
		NWT	SARA	COSEWIC
Grizzly Bear	*Ursus arctos*	Sensitive	Not Assessed	Special Concern
American Marten	*Martes americana*	Secure	-	Not Assessed
American Mink	*Neovison vison*	Secure	-	Not Assessed
Ermine	*Mustela erminea*	Secure	-	Not Assessed
Least Weasel	*Mustela nivalis*	Secure	-	Not Assessed
North American River Otter	*Lontra canadensis*	Secure	-	Not Assessed
Wolverine	*Gulo gulo*	Sensitive	No Status	Special Concern
Canada Lynx	*Lynx canadensis*	Secure	-	Not At Risk
Barren-ground Caribou	*Rangifer tarandus groenlandicus*	Sensitive	-	Not Assessed
Woodland Caribou (Boreal)	*Rangifer tarandus caribou*	Sensitive	Threatened (Schedule 1)	Threatened
Moose	*Alces americanus*	Secure	-	Not Assessed

(Cornell Lab of Ornithology and the American Ornithologists' Union 2010; COSEWIC 2010; ENR 2010; Government of Canada 2010; Sibley 2003; Banfield 1977; ENR 2005)

APPENDIX F

APPENDIX F COMMUNITY DATA

Aklavik - Statistical Profile

POPULATION

	Aklavik	Northwest Territories
Population (2009)		
Total	645	43,439
Males	352	22,476
Females	293	20,963
0 - 4 Years	58	3,352
5 - 9 Years	42	3,039
10 - 14 Years	49	3,053
15 - 24 Years	131	7,234
25 - 44 Years	178	13,900
45 - 59 Years	123	9,033
60 Yrs. & Older	64	3,828
Aboriginal	591	21,889
Non-Aboriginal	54	21,550
Population Dependency Ratio (2009)		
< 15 Yrs.	0.34	0.31
60 Yrs. & Older	0.15	0.13
Historical Population		
1996	756	41,741
1997	739	41,625
1998	736	40,802
1999	714	40,638
2000	706	40,480
2001	687	40,844
2002	674	41,665
2003	638	42,561
2004	624	43,301
2005	629	43,399
2006	616	43,198
2007	637	43,545
2008	642	43,720
2009	645	43,439
Ave. Annual Growth Rate (96-09)		
Total Population	-1.2	0.3
< 15 Yrs.	-4.4	-1.7
60 Yrs. & Older	-0.7	4.1
Population Projections		
2014	628	45,662
2019	619	47,724
2024	602	49,430

VITAL STATS

	Aklavik	Northwest Territories
Number of Births		
1998	13	678
1999	2	659
2000	7	673
2001	12	613
2002	11	635
2003	6	701
2004	8	698
2005	13	712
2006	8	687
2007	13	725
Teen Births		
1998	2	82
1999	-	83
2000	-	84
2001	1	70
2002	3	72
2003	2	72
2004	1	86
2005	6	68
2006	-	73
2007	1	65
Number of Deaths		
1997	6	138
1998	5	146
1999	5	162
2000	6	156
2001	11	163
2002	5	169
2003	6	202
2004	5	153
2005	5	148
2006	4	182
Cause of Death		
Injury Deaths (inc. suicides)		
1996	1	34
1997	1	24
1998	-	24
1999	2	36
2000	1	31
2001	2	31
2002	-	24
2003	-	36
2004	1	23
2005	-	21

	Aklavik	Northwest Territories
Suicides		
1996	1	4
1997	1	6
1998	-	7
1999	2	15
2000	1	7
2001	2	8
2002	-	8
2003	-	10
2004	-	11
2005	-	4

HOUSEHOLDS & FAMILIES

	Aklavik	Northwest Territories
% of Households with 6 or More People		
1981	27.3	13.9
1986	21.1	11.5
1991	16.3	9.8
1996	14.0	8.6
2001	9.1	7.2
2004	10.5	7.0
2006	6.8	6.2
2009	7.0	6.7
Family Structure (2006)		
Total Family Structure	145	10,875
Husband-Wife	45	5,555
Common-law	45	2,990
Lone Parent	55	2,330
% Lone-Parent Families	37.9	21.4
Tenure (2009)		
Total	228	14,522
Owned	77	7,623
Rented	151	6,899
% Owned	33.8	52.5
% of Households in Core Need		
1996	23.9	19.7
2000	32.7	20.3
2004	32.3	16.3
2009	36.0	19.0

CRIME

	Aklavik	Northwest Territories
Violent Crimes		
1999	51	2,042
2000	54	1,984
2001	61	2,000
2002	48	2,375
2003	57	2,849
2004	70	2,942
2005	51	2,715
2006	71	2,717
2007	62	3,044
2008	65	2,834

	Aklavik	Northwest Territories
Property Crimes		
1999	70	2,376
2000	80	2,395
2001	51	2,135
2002	55	2,527
2003	81	3,053
2004	62	3,187
2005	62	2,899
2006	64	2,680
2007	35	2,484
2008	44	2,314
Other Criminal Code		
1999	103	5,628
2000	125	7,190
2001	143	8,417
2002	121	8,629
2003	138	10,052
2004	175	11,988
2005	188	12,932
2006	194	12,117
2007	170	13,246
2008	196	13,684
Federal Statutes		
1999	-	477
2000	6	415
2001	7	432
2002	3	655
2003	9	595
2004	9	632
2005	11	742
2006	5	534
2007	6	665
2008	6	752
Traffic		
1999	12	398
2000	6	327
2001	6	441
2002	5	547
2003	5	633
2004	7	759
2005	8	881
2006	7	829
2007	8	813
2008	16	1,002
Violent Crime Rate (per 1,000 persons)		
1999	71.8	50.2
2000	76.5	49.0
2001	89.4	49.0
2002	71.3	57.0
2003	88.9	66.9
2004	112.7	67.9
2005	81.2	62.6
2006	114.3	62.9
2007	98.6	69.9
2008	101.2	64.8

	Aklavik	Northwest Territories
Property Crime Rate (per 1,000 persons)		
1999	98.6	58.5
2000	113.3	59.2
2001	74.8	52.3
2002	81.7	60.7
2003	126.4	71.7
2004	99.8	73.6
2005	98.7	66.8
2006	103.1	62.0
2007	55.6	57.0
2008	68.5	52.9

INCOME SUPPORT

	Aklavik	Northwest Territories
Beneficiaries (monthly average)		
2000	156	3,040
2001	101	2,412
2002	77	2,190
2003	101	2,142
2004	101	2,058
2005	86	1,911
2006	97	1,912
2007	111	2,024
2008	111	2,067
2009	156	2,402
Cases (monthly average)		
2000	83	1,502
2001	54	1,202
2002	42	1,118
2003	57	1,111
2004	57	1,110
2005	51	1,051
2006	52	1,060
2007	58	1,121
2008	60	1,172
2009	82	1,415
Payments ($000)		
2000	431	10,657
2001	292	8,840
2002	233	8,700
2003	353	8,946
2004	391	9,270
2005	328	8,610
2006	369	8,534
2007	453	9,783
2008	567	12,048
2009	745	14,534

TRADITIONAL ACTIVITIES (2003)

	Aklavik	Northwest Territories
Hunted & Fished (%)	49.3	36.7
Trapped (%)	21.1	5.9
Households Consuming Country Food (Half or More) (%)	56.9	28.4

ABORIGINAL LANGUAGES

	Aklavik	Northwest Territories
% Aboriginals that Speak an Aboriginal Language		
1984	23.8	59.1
1989	21.8	55.6
1994	28.1	50.1
1999	18.7	45.1
2004	19.3	44.0

EDUCATION

	Aklavik	Northwest Territories
% with High School Diploma or More		
1986	27.0	51.6
1989	41.1	59.8
1991	37.8	59.9
1994	38.9	63.2
1996	48.4	63.5
1999	39.7	66.1
2001	43.3	64.8
2004	37.6	67.5
2006	38.6	67.0
Employment Rates (2006)		
Less than High School Diploma	31.5	42.2
High School Diploma or Greater	63.6	81.6

LABOUR FORCE

	Aklavik	Northwest Territories
Participation Rate		
1986	59.0	74.5
1989	61.2	74.9
1991	66.3	78.2
1994	55.1	77.2
1996	63.4	77.2
1999	64.6	78.3
2001	57.1	77.1
2004	57.7	75.6
2006	54.5	76.5
Unemployment Rate		
1986	37.3	11.2
1989	47.5	13.2
1991	36.9	11.3
1994	36.2	14.8
1996	25.4	11.7
1999	33.6	13.7
2001	26.9	9.5
2004	26.3	10.4
2006	22.9	10.4

	Aklavik	Northwest Territories
Employment Rate		
1986	37.0	66.2
1989	32.1	65.0
1991	41.8	69.3
1994	35.1	65.7
1996	48.4	68.2
1999	42.9	67.5
2001	41.8	69.8
2004	42.5	67.8
2006	42.0	68.6
Selected Employment Rates (2006)		
Males	39.1	70.1
Females	46.3	66.7
Aboriginal	40.0	52.2
Non-Aboriginal	62.5	82.8
15-24	21.7	49.8
25-34	53.8	76.2
35-44	66.7	81.4
45-54	53.8	81.9
55-64	50.0	67.7
65 & Over	20.0	16.4
Labour Force Activity (2006)		
Population 15 & Over	440	31,140
Employed	185	21,350
Unemployed	55	2,475
Not in the Labour Force	195	7,310
Potential Available Labour Supply (2004)		
Number of Unemployed	74	2,454
% Do Rotational	78.4	70.3
% Male	63.5	64.4
% Aboriginal	98.6	77.3
% Less than High School Diploma	75.7	52.3
Labour Force Profile (2006)		
% Gov't, Health, Social Serv, Educ	50.0	37.3
% Goods Producing	14.6	17.2
% Other Industries	33.3	43.9
Annual Work Pattern (2005)		
% Worked	63.6	81.2
% Worked More than 26 weeks	53.6	75.5

PERSONAL INCOME

	Aklavik	Northwest Territories
Total Income ($000)		
1997	8,050	827,162
1998	8,422	852,225
1999	8,828	886,962
2000	8,928	921,079
2001	10,127	1,058,019
2002	10,306	1,148,300
2003	8,780	1,199,686
2004	9,368	1,246,589
2005	9,953	1,297,842
2006	10,675	1,384,602
% Change in Total Inc. (1997-2006)	32.6	67.4
Average Personal Income ($)		
1997	19,167	33,666
1998	21,055	34,378
1999	22,070	35,650
2000	22,320	36,220
2001	24,700	39,186
2002	25,137	42,047
2003	24,389	42,572
2004	26,022	44,080
2005	25,521	46,170
2006	27,372	48,396
Employment Income ($000)		
1997	5,833	713,328
1998	6,033	724,431
1999	6,514	772,452
2000	6,692	805,159
2001	7,999	935,854
2002	7,915	1,016,653
2003	6,470	1,058,922
2004	6,858	1,101,853
2005	7,427	1,145,168
2006	7,947	1,208,376
% Change in Emp. Inc. (1997-2006)	36.2	69.4
Average Employment Income ($)		
1997	18,816	33,364
1998	20,803	33,476
1999	21,013	35,450
2000	22,307	36,187
2001	23,526	38,497
2002	23,985	41,428
2003	23,107	41,904
2004	25,400	43,969
2005	24,757	45,843
2006	27,403	47,856

	Aklavik	Territories
Percent Taxfilers Less than $15,000		
1997	57	35
1998	53	34
1999	53	33
2000	50	32
2001	46	29
2002	44	28
2003	44	28
2004	47	27
2005	49	26
2006	46	25
Percent Taxfilers More than $50,000		
1997	10	26
1998	10	25
1999	13	28
2000	13	28
2001	15	31
2002	15	34
2003	14	35
2004	17	36
2005	18	38
2006	18	40

FAMILY INCOME

Average Family Income		
1997	36,478	66,367
1998	41,044	68,948
1999	42,625	70,463
2000	44,781	71,864
2001	51,606	80,225
2002	51,141	87,143
2003	50,371	88,244
2004	50,387	91,362
2005	53,140	96,171
2006	55,813	101,622
Percent Families Less than $30,000		
1997	50.0	28.5
1998	43.8	27.0
1999	43.8	26.3
2000	50.0	26.2
2001	37.5	20.8
2002	41.2	19.4
2003	35.7	20.3
2004	40.0	20.2
2005	40.0	19.0
2006	37.5	18.0

	Aklavik	Northwest Territories
Percent Families More than $75,000		
1997	11.1	38.7
1998	12.5	38.9
1999	12.5	40.6
2000	18.8	41.6
2001	25.0	47.4
2002	23.5	50.4
2003	14.3	50.7
2004	13.3	52.7
2005	20.0	55.3
2006	18.8	57.1

PRICES

2005 Living Cost Diff. (Edm = 100)	162.5	..
2004 Food Price Index (YK = 100)	183.5	..

ENVIRONMENT

Average Temperature (°C)		
January 2003	-28.6	..
January 2004	-29.5	..
January 2005	-24.1	..
January 2006	-31.9	..
January 2007	-25.0	..
July 2003	13.9	..
July 2004	14.6	..
July 2005	11.4	..
July 2006	14.6	..
July 2007	15.9	..

SYMBOLS

- zero or too small to be expressed
.. not available
x data suppressed

SOURCES & NOTES

Population

Population and Historical Population: NWT Bureau of Statistics, GNWT. Estimates are calculated by allocating the demographic components of growth, down to a community level. Sex, age and ethnicity estimates developed by NWT Bureau of Statistics.

Population Dependency Ratio: NWT Bureau of Statistics, GNWT. Ratios for < 15 years refer to the number of people less than 15 years of age divided by the number of people between the ages of 15 and 59. Ratios for 60 years and older refer to the number of people 60 years of age or older divided by the number of people between the ages of 15 and 59.

Average Annual Growth Rate: NWT Bureau of Statistics, GNWT. Average annual growth rate (AAGR) is calculated as:

$$AAGR = \left(\sqrt[13]{\frac{Pop_{2009}}{Pop_{1996}}} - 1\right) * 100$$

Population Projections: NWT Bureau of Statistics, GNWT. Population projections incorporate assumptions regarding fertility, mortality & migration patterns. These assumptions are reflective of historical patterns, as well as recent trends observed for the Northwest Territories.

Vital Stats

Number of Births: Health Statistics Division, Statistics Canada.

Teen Births: Health Statistics Division, Statistics Canada. Refers to births to women aged 19 or less.

Number of Deaths: Health Statistics Division, Statistics Canada.

Cause of Deaths: Health Statistics Division, Statistics Canada. Injury deaths are deaths due to accidents, homicide and suicides.

Household & Families

Percent of Households with 6 or More People: Census, Statistics Canada (1981, 1986, 1991, 1996, 2001 & 2006); NWT Bureau of Statistics, GNWT (2004 and 2009). A household refers to an occupied private dwelling.

Family Structure: Census, Statistics Canada. Refers to the classification of census families into husband-wife couples, common-law couples, and lone parent families.

Tenure: NWT Bureau of Statistics, GNWT. Refers to whether some member of the household owns or rents the dwelling.

Percent of Households in Core Need: NWT Bureau of Statistics, GNWT. If a household has any one housing problem (suitability, adequacy, or affordability) or a combination of housing problems, *and* the total household income is below the Community Core Need Income Threshold, the household is considered to be in core need. The core need income threshold is an income limit for each community that represents the amount of income a household must have to be able to afford the cost of owning and operating a home or renting in the private market without government assistance.

Crime

Incidents in a particular detachment may include incidents from surrounding communities.

Violent Crimes: Canadian Center for Justice Statistics, Statistics Canada. Refers to incidences of homicides, attempted murder, assaults (including sexual assaults), abduction and robbery.

Property Crimes: Canadian Center for Justice Statistics, Statistics Canada. Includes but is not limited to incidences of breaking & entering, theft, position of stolen goods and fraud.

Other Criminal Code: Canadian Center for Justice Statistics, Statistics Canada. Includes but is not limited to incidences of offensive weapons, bail violation, disturbing the peace and mischief (property damage).

Federal Statutes: Canadian Center for Justice Statistics, Statistics Canada. Includes but is not limited to incidences of possession and trafficking of drugs.

Traffic: Canadian Center for Justice Statistics, Statistics Canada. Includes but is not limited to incidences of dangerous operation of motor vehicle and impaired operation of motor vehicle.

Violent Crime Rates (per 1,000 persons): NWT Bureau of Statistics, GNWT. Rates are determined using population estimates developed by the NWT Bureau of Statistics.

Property Crime Rates (per 1,000 persons): NWT Bureau of Statistics, GNWT. Rates are determined using population estimates developed by the NWT Bureau of Statistics.

Income Support

Note: Due to program changes in 2007, data prior to this year is not directly comparable.

Beneficiaries (monthly average): Department of Education Culture & Employment, GNWT. Refers to the monthly average number of recipients of income support and their dependents, if any, over the year.

Cases (monthly average): Department of Education Culture & Employment, GNWT. Refers to the monthly average number of people requesting and receiving social assistance over the year.

Payments ($000): Department of Education Culture & Employment, GNWT. Refers to the total amount of payments over the year. Payments are recorded for the month for which assistance was received.

Traditional Activities

Hunted & Fished (%): NWT Bureau of Statistics, GNWT. Refers to the percent of people 15 years of age or older that hunted or fished during the year.

Trapped (%): NWT Bureau of Statistics, GNWT. Refers to the percent of people 15 years of age or older that trapped during the year.

Households Consuming Country Food: NWT Bureau of Statistics, GNWT. Refers to the percent of households reporting that half, most or all (50% or more) of the meat or fish consumed is harvesting in the NWT.

Aboriginal Languages

Percent of Aboriginal that Speak an Aboriginal Language: NWT Bureau of Statistics, GNWT. Refers to the percent of aboriginal people 15 years of age or older that can speak an aboriginal language well enough to carry on a conversation. Aboriginal languages include Inuktitut, Inuvialuktun, Inuinnaqtun, Dogrib, Cree, Chipewyan, North Slavey, South Slavey, and Gwich'n.

Education

Percent with High School Diploma or More: Census, Statistics Canada (1986, 1991, 1996, 2001 & 2006); NWT Bureau of Statistics, GNWT (1989, 1994, 1999 and 2004). Refers to the percent of population 15 years of age or older that have a high school diploma.

2006 Employment Rates: NWT Bureau of Statistics, GNWT. Refers to the employment rate for two groups of people: those who do not have a high school certificate, and those with at least a high school certificate. Employment rate refers to the percentage of persons 15 years of age and over who are working at a job.

Labour Force

Census, Statistics Canada (1986, 1991, 1996, 2001 & 2006); NWT Bureau of Statistics, GNWT (1989, 1994, 1999 and 2004).

Participation Rate: The percentage of persons 15 years of age and over who are in the labour force. See below for definition of labour force.

Unemployment Rate: The percentage of the labour force that was unemployed during the week prior to the survey. See below for definition of labour force.

Employment Rate: The percentage of persons 15 years of age and over who were employed during the week prior to the survey.

Employed: Refers to persons who during the week prior to the survey: (i) did any work at all, excluding housework, maintenance around the home and volunteer work; or (ii) were absent from their job or business because of vacation, illness, on strike or locked out, etc.

Unemployed: Refers to persons who during the week prior to the survey: (i) were without work, had actively looked for work in the previous four weeks and were available for work; or (ii) had been on temporary lay-off and expected to return to their job; or (iii) had definite arrangements to start a new job within the next four weeks.

Labour Force: Refers to persons who were either employed or unemployed during the week prior to the survey.

Not in the Labour Force: Refers to persons who do not participate in the labour force, they are neither employed or unemployed.

Potential Available Labour Supply: Refers to those persons who are unemployed. They can be classified into various categories, including, those who want to do rotational work, gender, ethnicity, or level of schooling.

Annual Work Pattern: Work pattern measures the amount of work over a given year. Worked in 2005 refers to the percent of people 15 years of age or older who worked in 2005, while worked more than 26 weeks refers to the percent of workers who worked more than 26 weeks in the year. The weeks need not be consecutive.

Personal Income

Small Area and Administrative Data Division, Statistics Canada. Data is based upon filed tax returns.

Total Income ($000): Refers to total money income received from all sources.

Average Personal Income ($): Refers to the average money income received from all sources.

Employment Income ($000): Refers to total income received by persons 15 years of age and over for any employment.

Average Employment Income ($): Refers to average income received by persons 15 years of age and over for any employment.

Percent Tax-filers Less Than $15,000: Refers to the percent of tax-filers who report they are making less than $15,000.

Percent Tax-filers More Than $50,000: Refers to the percent of tax-filers who report they are making more than $50,000.

Family Income

Small Area and Administrative Data Division, Statistics Canada. Data is based upon filed tax returns. Refers to the total income of a family; it is the sum of the total incomes of all members of that family.

Average Family Income ($): Refers to the average money income received from all sources for the family as a whole.

Percent Families Less Than $30,000: Refers to the percent of families who report they are making less than $30,000.

Percent Families More Than $75,000: Refers to the percent of families who report they are making more than $75,000.

Environment

Average Temperature (°C): Environment Canada. Calculated as the mean daily temperatures, averaged over the reference month. The mean daily temperature is the average between the daily maximum and minimum.

Prices

Living Cost Differentials: Price Division, Statistics Canada.

Food Price Index: NWT Bureau of Statistics, GNWT.

Inuvik - Statistical Profile

POPULATION

	Inuvik	Northwest Territories
Population (2009)		
Total	3,586	43,439
Males	1,817	22,476
Females	1,769	20,963
0 - 4 Years	294	3,352
5 - 9 Years	278	3,039
10 - 14 Years	248	3,053
15 - 24 Years	569	7,234
25 - 44 Years	1,190	13,900
45 - 59 Years	705	9,033
60 Yrs. & Older	302	3,828
Aboriginal	2,254	21,889
Non-Aboriginal	1,332	21,550
Population Dependency Ratio (2009)		
< 15 Yrs.	0.33	0.31
60 Yrs. & Older	0.12	0.13
Historical Population		
1996	3,461	41,741
1997	3,361	41,625
1998	3,313	40,802
1999	3,317	40,638
2000	3,324	40,480
2001	3,395	40,844
2002	3,550	41,665
2003	3,571	42,561
2004	3,628	43,301
2005	3,657	43,399
2006	3,651	43,198
2007	3,600	43,545
2008	3,577	43,720
2009	3,586	43,439
Ave. Annual Growth Rate (96-09)		
Total Population	0.3	0.3
< 15 Yrs.	-1.4	-1.7
60 Yrs. & Older	4.7	4.1
Population Projections		
2014	3,815	45,662
2019	3,988	47,724
2024	4,118	49,430

VITAL STATS

	Inuvik	Northwest Territories
Number of Births		
1998	71	678
1999	58	659
2000	68	673
2001	52	613
2002	48	635
2003	79	701
2004	65	698
2005	67	712
2006	63	687
2007	68	725
Teen Births		
1998	10	82
1999	7	83
2000	6	84
2001	6	70
2002	6	72
2003	13	72
2004	11	86
2005	3	68
2006	9	73
2007	6	65
Number of Deaths		
1997	9	138
1998	17	146
1999	10	162
2000	15	156
2001	15	163
2002	16	169
2003	20	202
2004	19	153
2005	17	148
2006	20	182
Cause of Death		
Injury Deaths (inc. suicides)		
1996	5	34
1997	1	24
1998	2	24
1999	-	36
2000	8	31
2001	4	31
2002	4	24
2003	2	36
2004	2	23
2005	4	21

	Inuvik	Northwest Territories
Suicides		
1996	1	4
1997	-	6
1998	1	7
1999	-	15
2000	2	7
2001	-	8
2002	2	8
2003	1	10
2004	-	11
2005	-	4

HOUSEHOLDS & FAMILIES

	Inuvik	Northwest Territories
% of Households with 6 or More People		
1981	10.3	13.9
1986	9.5	11.5
1991	7.3	9.8
1996	7.6	8.6
2001	6.4	7.2
2004	6.0	7.0
2006	6.0	6.2
2009	4.5	6.7
Family Structure (2006)		
Total Family Structure	885	10,875
Husband-Wife	355	5,555
Common-law	290	2,990
Lone Parent	240	2,330
% Lone-Parent Families	27.1	21.4
Tenure (2009)		
Total	1,280	14,522
Owned	432	7,623
Rented	848	6,899
% Owned	33.8	52.5
% of Households in Core Need		
1996	13.4	19.7
2000	11.0	20.3
2004	13.1	16.3
2009	19.5	19.0

CRIME

	Inuvik	Northwest Territories
Violent Crimes		
1999	226	2,042
2000	214	1,984
2001	234	2,000
2002	298	2,375
2003	294	2,849
2004	321	2,942
2005	409	2,715
2006	383	2,717
2007	335	3,044
2008	281	2,834
Property Crimes		
1999	248	2,376
2000	259	2,395
2001	282	2,135
2002	293	2,527
2003	328	3,053
2004	373	3,187
2005	425	2,899
2006	370	2,680
2007	296	2,484
2008	303	2,314
Other Criminal Code		
1999	778	5,628
2000	836	7,190
2001	895	8,417
2002	1,386	8,629
2003	1,633	10,052
2004	1,539	11,988
2005	1,625	12,932
2006	2,032	12,117
2007	1,940	13,246
2008	1,681	13,684
Federal Statutes		
1999	46	477
2000	25	415
2001	35	432
2002	68	655
2003	33	595
2004	56	632
2005	50	742
2006	81	534
2007	59	665
2008	61	752
Traffic		
1999	38	398
2000	30	327
2001	44	441
2002	57	547
2003	32	633
2004	43	759
2005	57	881
2006	35	829
2007	45	813
2008	71	1,002
Violent Crime Rate (per 1,000 persons)		
1999	68.2	50.2
2000	64.5	49.0
2001	68.8	49.0
2002	84.6	57.0
2003	83.6	66.9
2004	90.7	67.9
2005	116.5	62.6
2006	111.0	62.9
2007	97.7	69.9
2008	78.6	64.8

	Inuvik	Northwest Territories
Property Crime Rate (per 1,000 persons)		
1999	74.9	58.5
2000	78.1	59.2
2001	83.0	52.3
2002	83.1	60.7
2003	93.3	71.7
2004	105.4	73.6
2005	121.0	66.8
2006	107.3	62.0
2007	86.5	57.0
2008	84.7	52.9

INCOME SUPPORT

	Inuvik	Northwest Territories
Beneficiaries (monthly average)		
2000	283	3,040
2001	201	2,412
2002	169	2,190
2003	170	2,142
2004	158	2,058
2005	152	1,911
2006	155	1,912
2007	148	2,024
2008	141	2,067
2009	143	2,402
Cases (monthly average)		
2000	150	1,502
2001	105	1,202
2002	90	1,118
2003	93	1,111
2004	86	1,110
2005	81	1,051
2006	85	1,060
2007	82	1,121
2008	83	1,172
2009	86	1,415
Payments ($000)		
2000	1,135	10,657
2001	878	8,840
2002	833	8,700
2003	935	8,946
2004	860	9,270
2005	794	8,610
2006	858	8,534
2007	755	9,783
2008	864	12,048
2009	885	14,534

TRADITIONAL ACTIVITIES (2003)

	Inuvik	Northwest Territories
Hunted & Fished (%)	32.6	36.7
Trapped (%)	7.2	5.9
Households Consuming Country Food (Half or More) (%)	30.1	28.4

ABORIGINAL LANGUAGES

	Inuvik	Northwest Territories
% Aboriginals that Speak an Aboriginal Language		
1984	35.2	59.1
1989	26.5	55.6
1994	25.3	50.1
1999	24.8	45.1
2004	17.6	44.0

EDUCATION

	Inuvik	Northwest Territories
% with High School Diploma or More		
1986	58.7	51.6
1989	67.5	59.8
1991	66.4	59.9
1994	70.0	63.2
1996	69.3	63.5
1999	71.9	66.1
2001	70.8	64.8
2004	73.1	67.5
2006	68.8	67.0
Employment Rates (2006)		
Less than High School Diploma	43.2	42.2
High School Diploma or Greater	83.2	81.6

LABOUR FORCE

	Inuvik	Northwest Territories
Participation Rate		
1986	81.4	74.5
1989	81.7	74.9
1991	79.6	78.2
1994	82.4	77.2
1996	76.7	77.2
1999	82.4	78.3
2001	79.5	77.1
2004	80.9	75.6
2006	79.8	76.5
Unemployment Rate		
1986	8.0	11.2
1989	5.7	13.2
1991	10.5	11.3
1994	16.4	14.8
1996	11.0	11.7
1999	9.8	13.7
2001	6.4	9.5
2004	7.5	10.4
2006	11.2	10.4

	Inuvik	Northwest Territories
Employment Rate		
1986	74.9	66.2
1989	77.1	65.0
1991	71.0	69.3
1994	68.9	65.7
1996	68.5	68.2
1999	74.4	67.5
2001	74.4	69.8
2004	74.9	67.8
2006	71.0	68.6
Selected Employment Rates (2006)		
Males	74.7	70.1
Females	67.8	66.7
Aboriginal	57.9	52.2
Non-Aboriginal	89.4	82.8
15-24	46.8	49.8
25-34	82.6	76.2
35-44	82.2	81.4
45-54	81.1	81.9
55-64	74.1	67.7
65 & Over	30.8	16.4
Labour Force Activity (2006)		
Population 15 & Over	2,570	31,140
Employed	1,825	21,350
Unemployed	230	2,475
Not in the Labour Force	515	7,310
Potential Available Labour Supply (2004)		
Number of Unemployed	155	2,454
% Do Rotational	65.2	70.3
% Male	52.3	64.4
% Aboriginal	83.9	77.3
% Less than High School Diploma	30.3	52.3
Labour Force Profile (2006)		
% Gov't, Health, Social Serv, Educ	41.7	37.3
% Goods Producing	14.4	17.2
% Other Industries	43.4	43.9
Annual Work Pattern (2005)		
% Worked	82.7	81.2
% Worked More than 26 weeks	76.5	75.5

PERSONAL INCOME

	Inuvik	Northwest Territories
Total Income ($000)		
1997	61,148	827,162
1998	65,470	852,225
1999	72,841	886,962
2000	74,981	921,079
2001	89,961	1,058,019
2002	98,176	1,148,300
2003	103,237	1,199,686
2004	105,532	1,246,589
2005	105,147	1,297,842
2006	110,582	1,384,602
% Change in Total Inc. (1997-2006)	80.8	67.4
Average Personal Income ($)		
1997	33,053	33,666
1998	34,277	34,378
1999	36,060	35,650
2000	36,576	36,220
2001	40,706	39,186
2002	43,829	42,047
2003	43,744	42,572
2004	44,907	44,080
2005	45,916	46,170
2006	47,665	48,396
Employment Income ($000)		
1997	51,797	713,328
1998	56,232	724,431
1999	63,825	772,452
2000	65,485	805,159
2001	79,815	935,854
2002	87,457	1,016,653
2003	91,533	1,058,922
2004	93,880	1,101,853
2005	93,365	1,145,168
2006	97,057	1,208,376
% Change in Emp. Inc. (1997-2006)	87.4	69.4
Average Employment Income ($)		
1997	32,373	33,364
1998	33,273	33,476
1999	35,656	35,450
2000	36,381	36,187
2001	39,125	38,497
2002	42,250	41,428
2003	43,176	41,904
2004	44,705	43,969
2005	45,544	45,843
2006	47,345	47,856

	Inuvik	Territories
Percent Taxfilers Less than $15,000		
1997	35	35
1998	33	34
1999	31	33
2000	30	32
2001	24	29
2002	24	28
2003	27	28
2004	26	27
2005	24	26
2006	24	25
Percent Taxfilers More than $50,000		
1997	25	26
1998	26	25
1999	28	28
2000	28	28
2001	32	31
2002	37	34
2003	35	35
2004	37	36
2005	38	38
2006	40	40

FAMILY INCOME

Average Family Income		
1997	60,043	66,367
1998	64,908	68,948
1999	67,094	70,463
2000	67,644	71,864
2001	77,417	80,225
2002	85,280	87,143
2003	87,461	88,244
2004	87,750	91,362
2005	89,233	96,171
2006	95,392	101,622
Percent Families Less than $30,000		
1997	30.7	28.5
1998	28.0	27.0
1999	25.0	26.3
2000	27.2	26.2
2001	20.2	20.8
2002	20.7	19.4
2003	21.3	20.3
2004	21.3	20.2
2005	19.1	19.0
2006	17.4	18.0

	Inuvik	Northwest Territories
Percent Families More than $75,000		
1997	33.3	38.7
1998	37.3	38.9
1999	38.8	40.6
2000	39.5	41.6
2001	46.1	47.4
2002	48.9	50.4
2003	50.0	50.7
2004	50.0	52.7
2005	52.1	55.3
2006	54.3	57.1

PRICES

2005 Living Cost Diff. (Edm = 100)	147.5	..
2004 Food Price Index (YK = 100)	140.5	..

ENVIRONMENT

Average Temperature (°C)		
January 2003	-27.1	..
January 2004	-28.6	..
January 2005	-22.2	..
January 2006	-26.8	..
January 2007	-23.1	..
July 2003	14.2	..
July 2004	14.5	..
July 2005	9.8	..
July 2006	14.2	..
July 2007	15.5	..

SYMBOLS

- zero or too small to be expressed
.. not available
x data suppressed

SOURCES & NOTES

Population

Population and Historical Population: NWT Bureau of Statistics, GNWT. Estimates are calculated by allocating the demographic components of growth, down to a community level. Sex, age and ethnicity estimates developed by NWT Bureau of Statistics.

Population Dependency Ratio: NWT Bureau of Statistics, GNWT. Ratios for < 15 years refer to the number of people less than 15 years of age divided by the number of people between the ages of 15 and 59. Ratios for 60 years and older refer to the number of people 60 years of age or older divided by the number of people between the ages of 15 and 59.

Average Annual Growth Rate: NWT Bureau of Statistics, GNWT. Average annual growth rate (AAGR) is calculated as:

$$AAGR = \left(\sqrt[13]{\frac{Pop_{2009}}{Pop_{1996}}} - 1 \right) * 100$$

Population Projections: NWT Bureau of Statistics, GNWT. Population projections incorporate assumptions regarding fertility, mortality & migration patterns. These assumptions are reflective of historical patterns, as well as recent trends observed for the Northwest Territories.

Vital Stats

Number of Births: Health Statistics Division, Statistics Canada.

Teen Births: Health Statistics Division, Statistics Canada. Refers to births to women aged 19 or less.

Number of Deaths: Health Statistics Division, Statistics Canada.

Cause of Deaths: Health Statistics Division, Statistics Canada. Injury deaths are deaths due to accidents, homicide and suicides.

Household & Families

Percent of Households with 6 or More People: Census, Statistics Canada (1981, 1986, 1991, 1996, 2001 & 2006); NWT Bureau of Statistics, GNWT (2004 and 2009). A household refers to an occupied private dwelling.

Family Structure: Census, Statistics Canada. Refers to the classification of census families into husband-wife couples, common-law couples, and lone parent families.

Tenure: NWT Bureau of Statistics, GNWT. Refers to whether some member of the household owns or rents the dwelling.

Percent of Households in Core Need: NWT Bureau of Statistics, GNWT. If a household has any one housing problem (suitability, adequacy, or affordability) or a combination of housing problems, *and* the total household income is below the Community Core Need Income Threshold, the household is considered to be in core need. The core need income threshold is an income limit for each community that represents the amount of income a household must have to be able to afford the cost of owning and operating a home or renting in the private market without government assistance.

Crime

Incidents in a particular detachment may include incidents from surrounding communities.

Violent Crimes: Canadian Center for Justice Statistics, Statistics Canada. Refers to incidences of homicides, attempted murder, assaults (including sexual assaults), abduction and robbery.

Property Crimes: Canadian Center for Justice Statistics, Statistics Canada. Includes but is not limited to incidences of breaking & entering, theft, position of stolen goods and fraud.

Other Criminal Code: Canadian Center for Justice Statistics, Statistics Canada. Includes but is not limited to incidences of offensive weapons, bail violation, disturbing the peace and mischief (property damage).

Federal Statutes: Canadian Center for Justice Statistics, Statistics Canada. Includes but is not limited to incidences of possession and trafficking of drugs.

Traffic: Canadian Center for Justice Statistics, Statistics Canada. Includes but is not limited to incidences of dangerous operation of motor vehicle and impaired operation of motor vehicle.

Violent Crime Rates (per 1,000 persons): NWT Bureau of Statistics, GNWT. Rates are determined using population estimates developed by the NWT Bureau of Statistics.

Property Crime Rates (per 1,000 persons): NWT Bureau of Statistics, GNWT. Rates are determined using population estimates developed by the NWT Bureau of Statistics.

Income Support

Note: Due to program changes in 2007, data prior to this year is not directly comparable.

Beneficiaries (monthly average): Department of Education Culture & Employment, GNWT. Refers to the monthly average number of recipients of income support and their dependents, if any, over the year.

Cases (monthly average): Department of Education Culture & Employment, GNWT. Refers to the monthly average number of people requesting and receiving social assistance over the year.

Payments ($000): Department of Education Culture & Employment, GNWT. Refers to the total amount of payments over the year. Payments are recorded for the month for which assistance was received.

Traditional Activities

Hunted & Fished (%): NWT Bureau of Statistics, GNWT. Refers to the percent of people 15 years of age or older that hunted or fished during the year.

Trapped (%): NWT Bureau of Statistics, GNWT. Refers to the percent of people 15 years of age or older that trapped during the year.

Households Consuming Country Food: NWT Bureau of Statistics, GNWT. Refers to the percent of households reporting that half, most or all (50% or more) of the meat or fish consumed is harvesting in the NWT.

Aboriginal Languages

Percent of Aboriginal that Speak an Aboriginal Language: NWT Bureau of Statistics, GNWT. Refers to the percent of aboriginal people 15 years of age or older that can speak an aboriginal language well enough to carry on a conversation. Aboriginal languages include Inuktitut, Inuvialuktun, Inuinnaqtun, Dogrib, Cree, Chipewyan, North Slavey, South Slavey, and Gwich'n.

Education

Percent with High School Diploma or More: Census, Statistics Canada (1986, 1991, 1996, 2001 & 2006); NWT Bureau of Statistics, GNWT (1989, 1994, 1999 and 2004). Refers to the percent of population 15 years of age or older that have a high school diploma.

2006 Employment Rates: NWT Bureau of Statistics, GNWT. Refers to the employment rate for two groups of people: those who do not have a high school certificate, and those with at least a high school certificate. Employment rate refers to the percentage of persons 15 years of age and over who are working at a job.

Labour Force

Census, Statistics Canada (1986, 1991, 1996, 2001 & 2006); NWT Bureau of Statistics, GNWT (1989, 1994, 1999 and 2004).

Participation Rate: The percentage of persons 15 years of age and over who are in the labour force. See below for definition of labour force.

Unemployment Rate: The percentage of the labour force that was unemployed during the week prior to the survey. See below for definition of labour force.

Employment Rate: The percentage of persons 15 years of age and over who were employed during the week prior to the survey.

Employed: Refers to persons who during the week prior to the survey: (i) did any work at all, excluding housework, maintenance around the home and volunteer work; or (ii) were absent from their job or business because of vacation, illness, on strike or locked out, etc.

Unemployed: Refers to persons who during the week prior to the survey: (i) were without work, had actively looked for work in the previous four weeks and were available for work; or (ii) had been on temporary lay-off and expected to return to their job; or (iii) had definite arrangements to start a new job within the next four weeks.

Labour Force: Refers to persons who were either employed or unemployed during the week prior to the survey.

Not in the Labour Force: Refers to persons who do not participate in the labour force, they are neither employed or unemployed.

Potential Available Labour Supply: Refers to those persons who are unemployed. They can be classified into various categories, including, those who want to do rotational work, gender, ethnicity, or level of schooling.

Annual Work Pattern: Work pattern measures the amount of work over a given year. Worked in 2005 refers to the percent of people 15 years of age or older who worked in 2005, while worked more than 26 weeks refers to the percent of workers who worked more than 26 weeks in the year. The weeks need not be consecutive.

Personal Income

Small Area and Administrative Data Division, Statistics Canada. Data is based upon filed tax returns.

Total Income ($000): Refers to total money income received from all sources.

Average Personal Income ($): Refers to the average money income received from all sources.

Employment Income ($000): Refers to total income received by persons 15 years of age and over for any employment.

Average Employment Income ($): Refers to average income received by persons 15 years of age and over for any employment.

Percent Tax-filers Less Than $15,000: Refers to the percent of tax-filers who report they are making less than $15,000.

Percent Tax-filers More Than $50,000: Refers to the percent of tax-filers who report they are making more than $50,000.

Family Income

Small Area and Administrative Data Division, Statistics Canada. Data is based upon filed tax returns. Refers to the total income of a family; it is the sum of the total incomes of all members of that family.

Average Family Income ($): Refers to the average money income received from all sources for the family as a whole.

Percent Families Less Than $30,000: Refers to the percent of families who report they are making less than $30,000.

Percent Families More Than $75,000: Refers to the percent of families who report they are making more than $75,000.

Environment

Average Temperature (°C): Environment Canada. Calculated as the mean daily temperatures, averaged over the reference month. The mean daily temperature is the average between the daily maximum and minimum.

Prices

Living Cost Differentials: Price Division, Statistics Canada.

Food Price Index: NWT Bureau of Statistics, GNWT.

Fort McPherson - Statistical Profile

POPULATION

	Fort McPherson	Northwest Territories
Population (2009)		
Total	791	43,439
Males	420	22,476
Females	371	20,963
0 - 4 Years	52	3,352
5 - 9 Years	75	3,039
10 - 14 Years	70	3,053
15 - 24 Years	130	7,234
25 - 44 Years	203	13,900
45 - 59 Years	144	9,033
60 Yrs. & Older	117	3,828
Aboriginal	738	21,889
Non-Aboriginal	53	21,550
Population Dependency Ratio (2009)		
< 15 Yrs.	0.41	0.31
60 Yrs. & Older	0.25	0.13
Historical Population		
1996	915	41,741
1997	887	41,625
1998	861	40,802
1999	861	40,638
2000	828	40,480
2001	831	40,844
2002	807	41,665
2003	816	42,561
2004	808	43,301
2005	812	43,399
2006	807	43,198
2007	812	43,545
2008	813	43,720
2009	791	43,439
Ave. Annual Growth Rate (96-09)		
Total Population	-1.1	0.3
< 15 Yrs.	-3.2	-1.7
60 Yrs. & Older	2.7	4.1
Population Projections		
2014	771	45,662
2019	756	47,724
2024	728	49,430

VITAL STATS

	Fort McPherson	Northwest Territories
Number of Births		
1998	12	678
1999	16	659
2000	14	673
2001	9	613
2002	15	635
2003	20	701
2004	11	698
2005	3	712
2006	12	687
2007	12	725
Teen Births		
1998	1	82
1999	1	83
2000	2	84
2001	2	70
2002	3	72
2003	2	72
2004	-	86
2005	-	68
2006	2	73
2007	1	65
Number of Deaths		
1997	7	138
1998	9	146
1999	7	162
2000	5	156
2001	5	163
2002	5	169
2003	2	202
2004	5	153
2005	4	148
2006	6	182
Cause of Death		
Injury Deaths (inc. suicides)		
1996	3	34
1997	1	24
1998	4	24
1999	2	36
2000	1	31
2001	1	31
2002	2	24
2003	-	36
2004	2	23
2005	1	21

	Fort McPherson	Northwest Territories
Suicides		
1996	-	4
1997	-	6
1998	1	7
1999	1	15
2000	-	7
2001	-	8
2002	-	8
2003	-	10
2004	1	11
2005	1	4

HOUSEHOLDS & FAMILIES

	Fort McPherson	Northwest Territories
% of Households with 6 or More People		
1981	36.0	13.9
1986	26.5	11.5
1991	23.7	9.8
1996	15.4	8.6
2001	14.6	7.2
2004	14.5	7.0
2006	11.3	6.2
2009	11.2	6.7
Family Structure (2006)		
Total Family Structure	200	10,875
Husband-Wife	70	5,555
Common-law	40	2,990
Lone Parent	90	2,330
% Lone-Parent Families	45.0	21.4
Tenure (2009)		
Total	268	14,522
Owned	120	7,623
Rented	148	6,899
% Owned	44.8	52.5
% of Households in Core Need		
1996	37.5	19.7
2000	35.8	20.3
2004	32.7	16.3
2009	28.0	19.0

CRIME

	Fort McPherson	Northwest Territories
Violent Crimes		
1999	92	2,042
2000	81	1,984
2001	61	2,000
2002	105	2,375
2003	113	2,849
2004	103	2,942
2005	132	2,715
2006	100	2,717
2007	109	3,044
2008	135	2,834
Property Crimes		
1999	87	2,376
2000	81	2,395
2001	62	2,135
2002	91	2,527
2003	111	3,053
2004	97	3,187
2005	116	2,899
2006	56	2,680
2007	76	2,484
2008	81	2,314
Other Criminal Code		
1999	260	5,628
2000	146	7,190
2001	260	8,417
2002	428	8,629
2003	446	10,052
2004	444	11,988
2005	685	12,932
2006	486	12,117
2007	476	13,246
2008	699	13,684
Federal Statutes		
1999	10	477
2000	7	415
2001	12	432
2002	55	655
2003	27	595
2004	10	632
2005	13	742
2006	9	534
2007	11	665
2008	30	752
Traffic		
1999	25	398
2000	11	327
2001	11	441
2002	28	547
2003	26	633
2004	26	759
2005	25	881
2006	35	829
2007	29	813
2008	63	1,002
Violent Crime Rate (per 1,000 persons)		
1999	106.6	50.2
2000	98.2	49.0
2001	73.8	49.0
2002	131.9	57.0
2003	142.5	66.9
2004	128.6	67.9
2005	164.6	62.6
2006	125.6	62.9
2007	130.2	69.9
2008	166.1	64.8

	Fort McPherson	Northwest Territories
Property Crime Rate (per 1,000 persons)		
1999	100.8	58.5
2000	98.2	59.2
2001	75.0	52.3
2002	114.3	60.7
2003	140.0	71.7
2004	121.1	73.6
2005	144.6	66.8
2006	70.4	62.0
2007	94.8	57.0
2008	99.6	52.9

INCOME SUPPORT

	Fort McPherson	Northwest Territories
Beneficiaries (monthly average)		
2000	140	3,040
2001	71	2,412
2002	34	2,190
2003	42	2,142
2004	34	2,058
2005	30	1,911
2006	33	1,912
2007	37	2,024
2008	27	2,067
2009	52	2,402
Cases (monthly average)		
2000	72	1,502
2001	39	1,202
2002	22	1,118
2003	27	1,111
2004	21	1,110
2005	19	1,051
2006	22	1,060
2007	25	1,121
2008	20	1,172
2009	31	1,415
Payments ($000)		
2000	348	10,657
2001	187	8,840
2002	117	8,700
2003	141	8,946
2004	132	9,270
2005	124	8,610
2006	143	8,534
2007	163	9,783
2008	185	12,048
2009	280	14,534

TRADITIONAL ACTIVITIES (2003)

	Fort McPherson	Northwest Territories
Hunted & Fished (%)	37.4	36.7
Trapped (%)	12.9	5.9
Households Consuming Country Food (Half or More) (%)	78.4	28.4

ABORIGINAL LANGUAGES

	Fort McPherson	Northwest Territories
% Aboriginals that Speak an Aboriginal Language		
1984	27.2	59.1
1989	30.8	55.6
1994	23.7	50.1
1999	27.4	45.1
2004	22.7	44.0

EDUCATION

	Fort McPherson	Northwest Territories
% with High School Diploma or More		
1986	26.2	51.6
1989	34.2	59.8
1991	33.7	59.9
1994	34.4	63.2
1996	41.9	63.5
1999	43.3	66.1
2001	41.1	64.8
2004	38.1	67.5
2006	43.0	67.0
Employment Rates (2006)		
Less than High School Diploma	23.9	42.2
High School Diploma or Greater	66.7	81.6

LABOUR FORCE

	Fort McPherson	Northwest Territories
Participation Rate		
1986	51.0	74.5
1989	55.1	74.9
1991	62.4	78.2
1994	60.7	77.2
1996	65.3	77.2
1999	67.0	78.3
2001	59.4	77.1
2004	57.1	75.6
2006	58.8	76.5
Unemployment Rate		
1986	24.5	11.2
1989	39.9	13.2
1991	28.6	11.3
1994	34.5	14.8
1996	22.1	11.7
1999	28.5	13.7
2001	20.6	9.5
2004	39.9	10.4
2006	28.4	10.4

	Fort McPherson	Northwest Territories
Employment Rate		
1986	38.5	66.2
1989	33.1	65.0
1991	44.6	69.3
1994	39.7	65.7
1996	50.8	68.2
1999	47.9	67.5
2001	48.1	69.8
2004	34.3	67.8
2006	42.1	68.6
Selected Employment Rates (2006)		
Males	39.0	70.1
Females	47.3	66.7
Aboriginal	37.1	52.2
Non-Aboriginal	90.0	82.8
15-24	17.2	49.8
25-34	52.6	76.2
35-44	63.6	81.4
45-54	60.0	81.9
55-64	53.8	67.7
65 & Over	12.5	16.4
Labour Force Activity (2006)		
Population 15 & Over	570	31,140
Employed	240	21,350
Unemployed	95	2,475
Not in the Labour Force	235	7,310
Potential Available Labour Supply (2004)		
Number of Unemployed	132	2,454
% Do Rotational	97.0	70.3
% Male	65.2	64.4
% Aboriginal	98.5	77.3
% Less than High School Diploma	75.0	52.3
Labour Force Profile (2006)		
% Gov't, Health, Social Serv, Educ	41.8	37.3
% Goods Producing	22.4	17.2
% Other Industries	29.9	43.9
Annual Work Pattern (2005)		
% Worked	67.5	81.2
% Worked More than 26 weeks	50.6	75.5

PERSONAL INCOME

	Fort McPherson	Northwest Territories
Total Income ($000)		
1997	9,187	827,162
1998	9,741	852,225
1999	9,807	886,962
2000	10,221	921,079
2001	12,059	1,058,019
2002	13,755	1,148,300
2003	13,771	1,199,686
2004	15,390	1,246,589
2005	15,873	1,297,842
2006	16,083	1,384,602
% Change in Total Inc. (1997-2006)	75.1	67.4
Average Personal Income ($)		
1997	20,880	33,666
1998	20,726	34,378
1999	21,793	35,650
2000	23,230	36,220
2001	25,123	39,186
2002	26,971	42,047
2003	27,002	42,572
2004	30,176	44,080
2005	31,124	46,170
2006	31,535	48,396
Employment Income ($000)		
1997	6,739	713,328
1998	7,232	724,431
1999	7,205	772,452
2000	7,853	805,159
2001	9,480	935,854
2002	10,766	1,016,653
2003	10,722	1,058,922
2004	12,212	1,101,853
2005	12,565	1,145,168
2006	12,121	1,208,376
% Change in Emp. Inc. (1997-2006)	79.9	69.4
Average Employment Income ($)		
1997	19,821	33,364
1998	20,089	33,476
1999	20,014	35,450
2000	21,814	36,187
2001	23,700	38,497
2002	25,633	41,428
2003	26,151	41,904
2004	30,530	43,969
2005	29,221	45,843
2006	31,897	47,856

	Fort McPherson	Northwest Territories
Percent Taxfilers Less than $15,000		
1997	52	35
1998	55	34
1999	51	33
2000	48	32
2001	44	29
2002	41	28
2003	45	28
2004	43	27
2005	41	26
2006	39	25
Percent Taxfilers More than $50,000		
1997	9	26
1998	11	25
1999	11	28
2000	14	28
2001	15	31
2002	16	34
2003	18	35
2004	22	36
2005	22	38
2006	22	40

FAMILY INCOME

Average Family Income		
1997	40,163	66,367
1998	38,915	68,948
1999	40,740	70,463
2000	43,274	71,864
2001	49,352	80,225
2002	57,248	87,143
2003	52,350	88,244
2004	62,138	91,362
2005	63,519	96,171
2006	61,348	101,622
Percent Families Less than $30,000		
1997	47.4	28.5
1998	50.0	27.0
1999	50.0	26.3
2000	47.4	26.2
2001	38.1	20.8
2002	33.3	19.4
2003	36.4	20.3
2004	38.1	20.2
2005	33.3	19.0
2006	38.1	18.0

	Fort McPherson	Northwest Territories
Percent Families More than $75,000		
1997	15.8	38.7
1998	10.0	38.9
1999	15.0	40.6
2000	15.8	41.6
2001	23.8	47.4
2002	23.8	50.4
2003	22.7	50.7
2004	33.3	52.7
2005	23.8	55.3
2006	23.8	57.1

PRICES

2005 Living Cost Diff. (Edm = 100)	152.5	..
2004 Food Price Index (YK = 100)	163.1	..

ENVIRONMENT

Average Temperature (°C)		
January 2003	-30.8	..
January 2004	-30.5	..
January 2005	-24.4	..
January 2006	-29.4	..
January 2007	-21.7	..
July 2003	15.2	..
July 2004	16.3	..
July 2005	11.5	..
July 2006	15.3	..
July 2007	16.4	..

SYMBOLS

- zero or too small to be expressed
.. not available
x data suppressed

SOURCES & NOTES

Population

Population and Historical Population: NWT Bureau of Statistics, GNWT. Estimates are calculated by allocating the demographic components of growth, down to a community level. Sex, age and ethnicity estimates developed by NWT Bureau of Statistics.

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Average Annual Growth Rate: NWT Bureau of Statistics, GNWT. Average annual growth rate (AAGR) is calculated as:

$$AAGR = \left(\sqrt[13]{\frac{Pop_{2009}}{Pop_{1996}}} - 1 \right) * 100$$

Population Projections: NWT Bureau of Statistics, GNWT. Population projections incorporate assumptions regarding fertility, mortality & migration patterns. These assumptions are reflective of historical patterns, as well as recent trends observed for the Northwest Territories.

Vital Stats

Number of Births: Health Statistics Division, Statistics Canada.

Teen Births: Health Statistics Division, Statistics Canada. Refers to births to women aged 19 or less.

Number of Deaths: Health Statistics Division, Statistics Canada.

Cause of Deaths: Health Statistics Division, Statistics Canada. Injury deaths are deaths due to accidents, homicide and suicides.

Household & Families

Percent of Households with 6 or More People: Census, Statistics Canada (1981, 1986, 1991, 1996, 2001 & 2006); NWT Bureau of Statistics, GNWT (2004 and 2009). A household refers to an occupied private dwelling.

Family Structure: Census, Statistics Canada. Refers to the classification of census families into husband-wife couples, common-law couples, and lone parent families.

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Hunted & Fished (%): NWT Bureau of Statistics, GNWT. Refers to the percent of people 15 years of age or older that hunted or fished during the year.

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Participation Rate: The percentage of persons 15 years of age and over who are in the labour force. See below for definition of labour force.

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Employed: Refers to persons who during the week prior to the survey: (i) did any work at all, excluding housework, maintenance around the home and volunteer work; or (ii) were absent from their job or business because of vacation, illness, on strike or locked out, etc.

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Percent Tax-filers Less Than $15,000: Refers to the percent of tax-filers who report they are making less than $15,000.

Percent Tax-filers More Than $50,000: Refers to the percent of tax-filers who report they are making more than $50,000.

Family Income

Small Area and Administrative Data Division, Statistics Canada. Data is based upon filed tax returns. Refers to the total income of a family; it is the sum of the total incomes of all members of that family.

Average Family Income ($): Refers to the average money income received from all sources for the family as a whole.

Percent Families Less Than $30,000: Refers to the percent of families who report they are making less than $30,000.

Percent Families More Than $75,000: Refers to the percent of families who report they are making more than $75,000.

Environment

Average Temperature (°C): Environment Canada. Calculated as the mean daily temperatures, averaged over the reference month. The mean daily temperature is the average between the daily maximum and minimum.

Prices

Living Cost Differentials: Price Division, Statistics Canada.

Food Price Index: NWT Bureau of Statistics, GNWT.

Tsiigehtchic - Statistical Profile

POPULATION

	Tsiigehtchic	Northwest Territories
Population (2009)		
Total	136	43,439
Males	67	22,476
Females	69	20,963
0 - 4 Years	15	3,352
5 - 9 Years	11	3,039
10 - 14 Years	14	3,053
15 - 24 Years	32	7,234
25 - 44 Years	32	13,900
45 - 59 Years	x	9,033
60 Yrs. & Older	24	3,828
Aboriginal	129	21,889
Non-Aboriginal	x	21,550
Population Dependency Ratio (2009)		
< 15 Yrs.	0.56	0.31
60 Yrs. & Older	0.33	0.13
Historical Population		
1996	168	41,741
1997	169	41,625
1998	165	40,802
1999	188	40,638
2000	192	40,480
2001	198	40,844
2002	212	41,665
2003	209	42,561
2004	202	43,301
2005	189	43,399
2006	181	43,198
2007	175	43,545
2008	154	43,720
2009	136	43,439
Ave. Annual Growth Rate (96-09)		
Total Population	-1.6	0.3
< 15 Yrs.	-2.9	-1.7
60 Yrs. & Older	5.5	4.1
Population Projections		
2014	124	45,662
2019	110	47,724
2024	95	49,430

VITAL STATS

	Tsiigehtchic	Northwest Territories
Number of Births		
1998	5	678
1999	5	659
2000	3	673
2001	3	613
2002	5	635
2003	4	701
2004	4	698
2005	7	712
2006	5	687
2007	2	725
Teen Births		
1998	1	82
1999	1	83
2000	-	84
2001	1	70
2002	1	72
2003	-	72
2004	1	86
2005	2	68
2006	-	73
2007	-	65
Number of Deaths		
1997	-	138
1998	-	146
1999	1	162
2000	1	156
2001	2	163
2002	1	169
2003	4	202
2004	2	153
2005	-	148
2006	2	182
Cause of Death		
Injury Deaths (inc. suicides)		
1996	-	34
1997	-	24
1998	-	24
1999	1	36
2000	1	31
2001	1	31
2002	-	24
2003	-	36
2004	-	23
2005	-	21

	Tsiigehtchic	Northwest Territories
Suicides		
1996	-	4
1997	-	6
1998	-	7
1999	-	15
2000	-	7
2001	1	8
2002	-	8
2003	-	10
2004	-	11
2005	-	4

HOUSEHOLDS & FAMILIES

	Tsiigehtchic	Northwest Territories
% of Households with 6 or More People		
1981	40.0	13.9
1986	16.7	11.5
1991	12.5	9.8
1996	-	8.6
2001	16.7	7.2
2004	13.3	7.0
2006	16.7	6.2
2009	18.6	6.7
Family Structure (2006)		
Total Family Structure	35	10,875
Husband-Wife	20	5,555
Common-law	10	2,990
Lone Parent	10	2,330
% Lone-Parent Families	28.6	21.4
Tenure (2009)		
Total	59	14,522
Owned	28	7,623
Rented	31	6,899
% Owned	47.5	52.5
% of Households in Core Need		
1996	38.5	19.7
2000	61.7	20.3
2004	30.1	16.3
2009	18.6	19.0

CRIME

	Tsiigehtchic	Northwest Territories
Violent Crimes		
1999	..	2,042
2000	..	1,984
2001	..	2,000
2002	..	2,375
2003	..	2,849
2004	..	2,942
2005	..	2,715
2006	..	2,717
2007	..	3,044
2008	..	2,834
Property Crimes		
1999	..	2,376
2000	..	2,395
2001	..	2,135
2002	..	2,527
2003	..	3,053
2004	..	3,187
2005	..	2,899
2006	..	2,680
2007	..	2,484
2008	..	2,314
Other Criminal Code		
1999	..	5,628
2000	..	7,190
2001	..	8,417
2002	..	8,629
2003	..	10,052
2004	..	11,988
2005	..	12,932
2006	..	12,117
2007	..	13,246
2008	..	13,684
Federal Statutes		
1999	..	477
2000	..	415
2001	..	432
2002	..	655
2003	..	595
2004	..	632
2005	..	742
2006	..	534
2007	..	665
2008	..	752
Traffic		
1999	..	398
2000	..	327
2001	..	441
2002	..	547
2003	..	633
2004	..	759
2005	..	881
2006	..	829
2007	..	813
2008	..	1,002
Violent Crime Rate (per 1,000 persons)		
1999	..	50.2
2000	..	49.0
2001	..	49.0
2002	..	57.0
2003	..	66.9
2004	..	67.9
2005	..	62.6
2006	..	62.9
2007	..	69.9
2008	..	64.8

	Tsiigehtchic	Northwest Territories
Property Crime Rate (per 1,000 persons)		
1999	..	58.5
2000	..	59.2
2001	..	52.3
2002	..	60.7
2003	..	71.7
2004	..	73.6
2005	..	66.8
2006	..	62.0
2007	..	57.0
2008	..	52.9

INCOME SUPPORT

	Tsiigehtchic	Northwest Territories
Beneficiaries (monthly average)		
2000	31	3,040
2001	13	2,412
2002	19	2,190
2003	9	2,142
2004	7	2,058
2005	5	1,911
2006	12	1,912
2007	13	2,024
2008	8	2,067
2009	9	2,402
Cases (monthly average)		
2000	14	1,502
2001	6	1,202
2002	8	1,118
2003	4	1,111
2004	4	1,110
2005	4	1,051
2006	5	1,060
2007	5	1,121
2008	2	1,172
2009	4	1,415
Payments ($000)		
2000	96	10,657
2001	42	8,840
2002	63	8,700
2003	36	8,946
2004	31	9,270
2005	27	8,610
2006	29	8,534
2007	32	9,783
2008	22	12,048
2009	36	14,534

TRADITIONAL ACTIVITIES (2003)

	Tsiigehtchic	Northwest Territories
Hunted & Fished (%)	44.1	36.7
Trapped (%)	13.8	5.9
Households Consuming Country Food (Half or More) (%)	60.2	28.4

ABORIGINAL LANGUAGES

	Tsiigehtchic	Northwest Territories
% Aboriginals that Speak an Aboriginal Language		
1984	74.6	59.1
1989	43.1	55.6
1994	39.8	50.1
1999	31.3	45.1
2004	24.2	44.0

EDUCATION

	Tsiigehtchic	Northwest Territories
% with High School Diploma or More		
1986	43.8	51.6
1989	17.7	59.8
1991	26.3	59.9
1994	37.0	63.2
1996	57.1	63.5
1999	36.9	66.1
2001	40.0	64.8
2004	42.8	67.5
2006	41.7	67.0
Employment Rates (2006)		
Less than High School Diploma	21.4	42.2
High School Diploma or Greater	63.6	81.6

LABOUR FORCE

	Tsiigehtchic	Northwest Territories
Participation Rate		
1986	31.3	74.5
1989	48.1	74.9
1991	61.1	78.2
1994	66.0	77.2
1996	61.9	77.2
1999	61.2	78.3
2001	64.0	77.1
2004	63.4	75.6
2006	60.9	76.5
Unemployment Rate		
1986	40.0	11.2
1989	44.7	13.2
1991	36.4	11.3
1994	34.8	14.8
1996	15.4	11.7
1999	31.7	13.7
2001	12.5	9.5
2004	25.0	10.4
2006	21.4	10.4

	Tsiigehtchic	Northwest Territories
Employment Rate		
1986	25.0	66.2
1989	26.6	65.0
1991	38.9	69.3
1994	43.0	65.7
1996	52.4	68.2
1999	41.7	67.5
2001	60.0	69.8
2004	47.6	67.8
2006	43.5	68.6
Selected Employment Rates (2006)		
Males	41.7	70.1
Females	45.5	66.7
Aboriginal	45.0	52.2
Non-Aboriginal	50.0	82.8
15-24	33.3	49.8
25-34	66.7	76.2
35-44	75.0	81.4
45-54	75.0	81.9
55-64	-	67.7
65 & Over	-	16.4
Labour Force Activity (2006)		
Population 15 & Over	115	31,140
Employed	50	21,350
Unemployed	15	2,475
Not in the Labour Force	50	7,310
Potential Available Labour Supply (2004)		
Number of Unemployed	23	2,454
% Do Rotational	60.9	70.3
% Male	47.8	64.4
% Aboriginal	100.0	77.3
% Less than High School Diploma	60.9	52.3
Labour Force Profile (2006)		
% Gov't, Health, Social Serv, Educ	64.3	37.3
% Goods Producing	14.3	17.2
% Other Industries	28.6	43.9
Annual Work Pattern (2005)		
% Worked	78.3	81.2
% Worked More than 26 weeks	50.0	75.5

PERSONAL INCOME

	Tsiigehtchic	Northwest Territories
Total Income ($000)		
1997	..	827,162
1998	..	852,225
1999	..	886,962
2000	2,549	921,079
2001	2,489	1,058,019
2002	2,714	1,148,300
2003	2,594	1,199,686
2004	3,162	1,246,589
2005	2,702	1,297,842
2006	..	1,384,602
% Change in Total Inc. (1997-2006)	..	67.4
Average Personal Income ($)		
1997	..	33,666
1998	..	34,378
1999	..	35,650
2000	21,242	36,220
2001	22,627	39,186
2002	24,673	42,047
2003	25,940	42,572
2004	26,350	44,080
2005	27,020	46,170
2006	..	48,396
Employment Income ($000)		
1997	..	713,328
1998	..	724,431
1999	..	772,452
2000	1,944	805,159
2001	1,839	935,854
2002	1,947	1,016,653
2003	1,917	1,058,922
2004	2,449	1,101,853
2005	1,974	1,145,168
2006	..	1,208,376
% Change in Emp. Inc. (1997-2006)	..	69.4
Average Employment Income ($)		
1997	..	33,364
1998	..	33,476
1999	..	35,450
2000	19,440	36,187
2001	20,433	38,497
2002	21,633	41,428
2003	21,300	41,904
2004	24,490	43,969
2005	24,675	45,843
2006	..	47,856

	Tsiigehtchic	Territories
Percent Taxfilers Less than $15,000		
1997	..	35
1998	..	34
1999	..	33
2000	50	32
2001	45	29
2002	45	28
2003	40	28
2004	42	27
2005	40	26
2006	..	25
Percent Taxfilers More than $50,000		
1997	..	26
1998	..	25
1999	..	28
2000	-	28
2001	-	31
2002	18	34
2003	20	35
2004	17	36
2005	20	38
2006	..	40

FAMILY INCOME

Average Family Income		
1997	..	66,367
1998	..	68,948
1999	..	70,463
2000	37,240	71,864
2001	..	80,225
2002	45,760	87,143
2003	..	88,244
2004	55,225	91,362
2005	..	96,171
2006	..	101,622
Percent Families Less than $30,000		
1997	..	28.5
1998	..	27.0
1999	..	26.3
2000	60.0	26.2
2001	60.0	20.8
2002	60.0	19.4
2003	-	20.3
2004	50.0	20.2
2005	-	19.0
2006	..	18.0

	Tsiigehtchic	Northwest Territories
Percent Families More than $75,000		
1997	..	38.7
1998	..	38.9
1999	..	40.6
2000	-	41.6
2001	-	47.4
2002	-	50.4
2003	-	50.7
2004	-	52.7
2005	-	55.3
2006	..	57.1

PRICES

2005 Living Cost Diff. (Edm = 100)	152.5	..
2004 Food Price Index (YK = 100)	153.2	..

ENVIRONMENT

Average Temperature (°C)		
January 2003	..	..
January 2004	..	..
January 2005	..	..
January 2006	..	..
January 2007	..	..
July 2003	..	..
July 2004	..	..
July 2005	..	..
July 2006	..	..
July 2007	..	..

SYMBOLS

- zero or too small to be expressed
.. not available
x data suppressed

SOURCES & NOTES

Population

Population and Historical Population: NWT Bureau of Statistics, GNWT. Estimates are calculated by allocating the demographic components of growth, down to a community level. Sex, age and ethnicity estimates developed by NWT Bureau of Statistics.

Population Dependency Ratio: NWT Bureau of Statistics, GNWT. Ratios for < 15 years refer to the number of people less than 15 years of age divided by the number of people between the ages of 15 and 59. Ratios for 60 years and older refer to the number of people 60 years of age or older divided by the number of people between the ages of 15 and 59.

Average Annual Growth Rate: NWT Bureau of Statistics, GNWT. Average annual growth rate (AAGR) is calculated as:

$$AAGR = \left(\sqrt[13]{\frac{Pop_{2009}}{Pop_{1996}}} - 1 \right) * 100$$

Population Projections: NWT Bureau of Statistics, GNWT. Population projections incorporate assumptions regarding fertility, mortality & migration patterns. These assumptions are reflective of historical patterns, as well as recent trends observed for the Northwest Territories.

Vital Stats

Number of Births: Health Statistics Division, Statistics Canada.

Teen Births: Health Statistics Division, Statistics Canada. Refers to births to women aged 19 or less.

Number of Deaths: Health Statistics Division, Statistics Canada.

Cause of Deaths: Health Statistics Division, Statistics Canada. Injury deaths are deaths due to accidents, homicide and suicides.

Household & Families

Percent of Households with 6 or More People: Census, Statistics Canada (1981, 1986, 1991, 1996, 2001 & 2006); NWT Bureau of Statistics, GNWT (2004 and 2009). A household refers to an occupied private dwelling.

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Employment Income ($000): Refers to total income received by persons 15 years of age and over for any employment.

Average Employment Income ($): Refers to average income received by persons 15 years of age and over for any employment.

Percent Tax-filers Less Than $15,000: Refers to the percent of tax-filers who report they are making less than $15,000.

Percent Tax-filers More Than $50,000: Refers to the percent of tax-filers who report they are making more than $50,000.

Family Income

Small Area and Administrative Data Division, Statistics Canada. Data is based upon filed tax returns. Refers to the total income of a family; it is the sum of the total incomes of all members of that family.

Average Family Income ($): Refers to the average money income received from all sources for the family as a whole.

Percent Families Less Than $30,000: Refers to the percent of families who report they are making less than $30,000.

Percent Families More Than $75,000: Refers to the percent of families who report they are making more than $75,000.

Environment

Average Temperature (°C): Environment Canada. Calculated as the mean daily temperatures, averaged over the reference month. The mean daily temperature is the average between the daily maximum and minimum.

Prices

Living Cost Differentials: Price Division, Statistics Canada.

Food Price Index: NWT Bureau of Statistics, GNWT.

APPENDIX G

APPENDIX G FUEL SPILL CONTINGENCY PLAN EXAMPLE

EXAMPLE OF FUEL SPILL CONTINGENCY PLAN
MACKENZIE VALLEY HIGHWAY
GWICHI'IN SETTLEMENT AREA, NORTHWEST TERRITORIES

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1.0 INTRODUCTION AND PROJECT DETAILS

_________________________(the Contractor) has prepared this spill contingency plan for construction activities being undertaken at camps and sites along the Mackenzie Valley Highway alignment within the Gwich'in Settlement Area (GSA), Northwest Territories (the Highway). The plan looks to address the appropriate response capabilities and measures that will be in place to effectively respond to potential spills in the Gwich'in Settlement Area.

1.1 COMPANY NAME, LOCATION AND MAILING ADDRESS

Company name, mailing address, phone, fax, E-mail information will be provided by the Contractor prior to the commencement of any activities, as well as provide a main contact person to whom address all inquiries.

1.2 EFFECTIVE DATE OF SPILL CONTINGENCY PLAN

To be completed by the Contractor.

1.3 LAST REVISIONS TO SPILL CONTINGENCY PLAN

Date and sections updates to be indicted by the Contractor when any changes take place to the present document.

1.4 DISTRIBUTION LIST

The distribution list of the plan and its most recent revisions will be determined by the Contractor. It will include the following: Environmental Health and Safety Manager, Project Engineer, Camp Manager, Contractor, Indian and Northern Affairs Canada, Environmental Protection - Environment Canada, Area Manager - Fisheries and Oceans Canada, Environmental Protection Division - Government of the NWT, Land and Water Board, Gwich'in Organizations.

1.5 PURPOSE AND SCOPE

The purpose of this plan is to outline the Contractor response actions in the case of spills, including a worst case scenario, in the Gwich'in Settlement Area while doing work activities related to the Highway . The plan identifies: key response personnel, roles and responsibilities and equipment and resources for spill response to ensure quick access to all the information when required.

The management plan also details spill response procedures with the goal of minimizing potential health and safety hazards, environmental damage, and clean-up efforts.

1.6 COMPANY ENVIRONMENTAL POLICY

This portion will be completed by the Contractor to include their health and safety policy. It will include the protection of employees, public and environment; legislation compliance; government and public proactive cooperation; mitigation and information/communication goal statements.

The plan will be presented to all working onsite staff during their orientation sessions. All employees and subcontractors will be made aware of the locations of the plan on camps and sites in the GSA. As well, training sessions will be scheduled to ensure employees have an understanding of the steps to be undertaken in the event of a spill. Spill kits storage and contents, spill technologies and responsive methods update information will be communicated to all working personnel.

1.7 PROJECT DESCRIPTION

The purpose of this project is to construct 181 km of all-weather, graveled highway, including an allowance for future installation of fibre optic cable within the highway right-of-way, through the Gwich'in Settlement Area in the Northwest Territories. This part of the proposed Mackenzie Valley Highway extension from Wrigley north to Inuvik would cover the section from Inuvik south to the north boundary of the Sahtu Settlement Area (SSA). When completed, this section of the Highway would be operated and maintained as part of the NWT public highway system.

The construction and operation of the Highway will involve:

- Selecting preferred locations for the Highway alignment, stream crossings, borrow sources, and future installation of a communications fibre optic cable within the Highway right-of-way.
- Developing supporting construction and maintenance infrastructure, including, borrow sources (long-term and temporary), temporary winter access roads, camps, and fuel, equipment and materials staging and storage locations.
- Connecting existing and proposed highways including the Dempster Highway east/southeast of Inuvik and the Mackenzie Valley Highway at the boundary between the GSA and the SSA.
- De-commissioning and restoring temporary borrow sources and access roads.

1.8 SITE DESCRIPTION

Camp site details including geographic location and adjacent communities will be included in this section; this will help identify potential areas affected by potential spills.

Map or maps to be included illustrating the Contractors camp site and equipment location.

1.9 LIST OF HAZARDOUS MATERIALS ON-SITE

List of hazardous materials on-site, the type of storage container, the average and maximum quantities stored and their location to be detailed by the Contractor.

1.10 EXISTING PREVENTATIVE MEASURES

Due to the nature of the materials to be stored on site and the remote location of some camp sites adequate training to all staff and subcontractors is essential.

The estimated fuel requirements for construction of the Highway are in the order of 25M to 30M litres. Fuel storage requirements will be defined for individual sites at the time of preparation of this plan.

Fuel will be delivered in the winter from regional storage hubs to fuel tanks situated along the Highway in the staging and storage areas, in the borrow sources, and in the camps. Fuel resupply to the staging area at Little Chicago will be delivered by barge.

The camp manager or a designated fuel monitor shall conducts daily visual inspections to check for leaks, damage to fuel storage containers, stained or discolored soils around storage areas and adjacent motorized equipment. Spill kits shall be located wherever fuel is stored or used, and a checklist for the inspections will be kept as records in the Contractor's files.

1.11 ADDITIONAL COPIES

Several copies of the plan shall be kept on-site at all times near fuel storage areas. Additional copies distribution will be determined prior to construction activities commencing with additional copies made available by contacting the Contractor directly.

1.12 MEDIA AND PUBLIC INQUIRIES

All inquiries are to be directed to the manager or the Contractor's headquarters office for appropriate channeling. If a reporter or member of the public arrives at the site unexpectedly, the camp manager will make every effort possible to contact the manager or Contractor's headquarter to discuss the situation.

Any news or updates of potential interest to the media or general public, will be noted to the manager so that the Contractor is prepared to deal with inquiries at any time.

If a spill occurred a NWT Spill Report needs to be filled out (see Appendix A). This information is available for the public to view upon request by contacting the NWT Spill Line or by viewing the GNWT Hazardous Materials Spills Database online at http://www.e-engine.ca/eps_spillreport/.

2.0 RESPONSE ORGANIZATION

A flow chart depicting the response organization and applicable alternates, as well as the chain of command for responding to a spill or release shall be detailed by the Contractor prior to commencing any activities. This chart summarizes the duties of various response personnel, contact information (including 24-hour phone numbers) and the location of communications equipment on site. INAC's flow chart of response organization is provided below as an example.

Figure 1: Flow chart of response organization

3.0 ACTION PLAN

Potential spill sizes and sources, as wells as potential environmental impacts of spill (including worst case scenario) are dependent on the hazardous material on site used by the Contractor. Details shall be provided prior to any activity commencing.

3.1 PROCEDURES

There are three (3) activities that must be taken when a spill occurs. First, there must be a Response, followed by Containment, followed by Recovery. An spill may be as easy to deal with as noticing a valve leaking, putting down some absorbent material and disposing of the used material in a responsible fashion.

This is a very simple scenario but there has been a response, an effort to contain and recovery of the spill. There are intermediary steps within each of the activities and they are identified below. The sequence of the steps is extremely important and will be followed.

However, each potential spill will have its own unique characteristics and the sequence may need to be altered to suit the circumstances. Common sense should prevail.

3.1.1 Procedures for initial actions

3.1.1.1 Step 1 – Identify the Source of the Spill

- Locate the source of the spill.
- Contact the camp manager by radio and notify that you have a spill.
- Assess the immediate hazards of the spill.
- If it is safe and within your capability to do so, shut off the source of the spill.

3.1.1.2 Step 2 – Secure the Area

- Assess spill area and eliminate all sources of ignition.
- Keep the public away from the spill.
- Determine the direction of the spill, how quickly it is migrating and what is causing it to migrate (wind, gravity).
- Determine if human life is in danger and alert the RCMP, the Health Centre, the Volunteer Fire Department and the local Renewable Resource Officer.

3.1.1.3 Step 3 – Initiate the Containment of the Spill

- Deploy the on-site spill containment equipment as required.
- Notify the camp manager of the spill and request assistance if required.
- Erect barriers to minimize the migrating of the spill.
- Notify the Contractor if heavy equipment is required.
- If the spill cannot be contained with the resources available then contact the NWT 24-Hour Spill Line at (867) 920-8130 and request assistance.

3.1.2 Spill Reporting Procedures

3.1.2.1 Step 4 – Reporting the Spill

- When the source of the spill has been shut down and it is reasonably contained, it must be reported to the NWT Spill Line.
- NWT Spill Report forms are included Appendix B.
- Fill out the NWT Spill Report as completely as possible and fax it immediately to (867) 873-6924 or email it to spills@gov.nt.ca. If a fax machine or computer is not available then you must still complete the

NWT Spill Report and telephone the NWT Spill Line at (867) 920-8130 to report the spill.

- You will be required to report to the NWT Spill Line until the spill has been recovered. Depending on the severity of the spill this may take days, weeks or even months.

3.1.3 Procedures for Transferring, Storing, and Managing Spill-related Wastes

Used sorbent materials are to be placed in plastic bags for disposal. Following clean up, any tools or equipment used shall be properly washed and decontaminated, or replaced. Spilled petroleum products and materials used for containment will be placed into empty waste oil containers and sealed for proper disposal at an approved disposal facility.

3.1.4 Procedures for Restoring Affected Areas

Once a spill of reportable size has been contained, the Contractor will consult with INAC or lead agency Inspector assigned to determine the level of cleanup required. The Inspector may require a site specific study to ensure appropriate clean up levels are met. Criteria that may be considered include natural biodegradation of oil, replacement of soil and revegetation.

4.0 RESOURCE INVENTORY

4.1 ON-SITE RESOURCES

Spill kits, booms, sorbent materials, earth moving equipment will be detailed by the Contractor prior to the start of any on site activities.

4.2 OFF-SITE RESOURCES

Contacts listed below will vary on the estimated time needed to reach the site. This list shall be reviewed and updated by the Contractor prior to the start of any on site activities.

- NWT 24-Hour spill line - (867) 920-8130
- Indian and Northern Affairs Canada Inspector (Inuvik) - (867) 777-8901
- Environment Canada (Emergency) Yellowknife - (867) 669-4725
- GNWT Environmental Protection Division - (867) 873-7654
- GNWT Environmental Health Office - (867) 669-8979
- Gwich'in Tribal Council – (867) 777-7900
- Town of Inuvik – (867) 777-8600
- Charter Community of Tsiigehtchic – (867) 953-3201
- Hamlet of Aklavik – (867) 978-2351
- Hamlet of Fort McPherson – (867) 952-2428

- RCMP (Inuvik) - (867) 777-1111
- Inuvik Regional Hospital - (867) 777-8000
- Inuvik Fire Department – (867) 777-2222

5.0 TRAINING PROGRAM

The success of any spill response depends on adequately trained personnel. The level of training has to be tailored to the functions to be performed and the skill levels of the individual.

Exercises are equally important to the success of any spill recovery. The purpose of the Exercises is to reinforce training through hands-on deployment and response to a spill with the available equipment and identify areas for additional training. Exercises may consist of a tabletop exercise or an operational one.

The tabletop version would involve writing up a spill scenario and going through the Spill Contingency Plan to determine its effectiveness. The operational Exercise would involve the actual deployment and testing of the response equipment under a hypothetical spill scenario. It is recommended that a tabletop Exercise be conducted annually. Operational Exercises will be conducted every three years in conjunction with Government agencies.

5.1 OUTLINE OF TRAINING PROGRAM

Greater and broader training amongst all levels of onsite personnel will help produce a higher quality of work and will result in greater opportunities for the Contractor to gain new work and new clients.

The Contractor shall provide and/or support both formal and informal training, on-the-job and classroom training, safety-specific and skill-specific training. Training and skills-assessment shall begin on hiring. New employees will receive basic orientation on safety standards and procedures which are standard procedures for company operations.

Basic Safety Program training, WHMIS, First Aid and Transportation of Dangerous Goods programs will be carried out periodically in house as required. As well, programs in Safety Program Supervision, Hazard Identification and Control and Incident Investigation will be provided to supervisory personnel at minimum, in order that such information and developed procedures can be passed down to all personnel through safety meetings.

Programs such as Light Duty Vehicle Operator, Heavy Equipment Training, Class 3 and Class 1 Driving Courses and Contaminated Soils Courses will be offered as operations require. Many subjects related to new tasks and procedures, or to address newly identified hazards, will be addressed at safety meetings and daily tailgate meetings.

5.2 TRAINING SCHEDULE AND RECORD KEEPING

Employee files will contain records and copies of all training certificates and licenses, both those issued by the Contractor for in-house training, and also licensing and certification provided by government agencies, training institutions and regulators.

1. Employee files will contain personal information including:
2. Driver License Information (including copy of driver's licence)
3. List of Personal Training Certificates (copies of those certificates)
4. Personal Medical History (this may remain sealed in an envelope and returned at end of employment term)
5. Contractor's Base Rules & Policies – Sign off
6. Contractor's Vehicle Policy – Sign off
7. Drug & Alcohol – Sign off
8. Health & Safety and Environmental Management Hand book – Sign off
9. Safety Orientation Acknowledgement Form

A record of On the Job Training shall be signed by a supervisor and the worker to acknowledge task competency and is to be maintained on file within the company.

APPENDIX A

Material Safety Data Sheets (MSDS) for hazardous materials stored on site

The MSDS shall be provided by the Contractor based on the products used for their operations.

APPENDIX B

NWT Spill Report Form (most recent approved version)

http://www.enr.gov.nt.ca/_live/documents/content/NT-NU_Interactive_Spill_Form.pdf

APPENDIX C

Immediately Reportable Spill Quantities

TDG Class	Substance for NWT 24 Hour Spill Line	Immediately Reportable Quantities
1 2.3 2.4 6.2 7 None	Explosives Compressed gas (toxic) Compressed gas (corrosive) Infectious substances Radioactive Unknown substance	Any amount
2.1 2.2	Compressed gas (flammable) Compressed gas (non-corrosive, non-flammable)	Any amount of gas from containers with a capacity greater than 100 L
3.1 3.2 3.3	Flammable liquids	> 100 L
4.1 4.2 4.3	Flammable solids Spontaneously combustible solids Water reactant	> 25 kg
5.1 9.1	Oxidizing substances Miscellaneous products or substances excluding PCB mixtures	> 50 L or 50 kg
5.2 9.2	Organic peroxides Environmentally hazardous	> 1 L or 1 kg
6.1 8 9.3	Poisonous substances Corrosive substances Dangerous wastes	> 5 L or 5 kg
9.1	PCB mixtures of 5 or more ppm	> 0.5 L or 0.5 kg
None	Other contaminants (e.g. crude oil, drilling fluid, produced water, waste or spent chemicals, used or waste oil, vehicle fluids, waste water, etc.)	> 100 L or 100 kg
None	Sour natural gas (i.e. contains H2S) Sweet natural gas	Uncontrolled release or sustained flow of 10 minutes or more