Comprehensive Study Report
Garden River and Fox Lake Access Roads Project

February, 2007

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EXECUTIVE SUMMARY

Background:
In 1958, a road right-of-way was established from the terminus of Highway 58 (at Highway 88 turn-off) to the communities of Garden River and Peace Point within Wood Buffalo National Park of Canada (WBNP). The right-of-way was cleared and used as a winter haul road in the 1960's. The portion within WBNP from Garden River to Peace Point was taken out of service when road access to Peace Point was established from Fort Smith. During the 1980's, the Province of Alberta extended Highway 58, providing all-season access to the community of John D'Or. A winter access road to the community of Fox Lake was constructed and the road to community of Garden River remained a winter road. These roads are currently maintained by the Little Red River Cree Nation.

Project:
The communities of Fox Lake and Garden River are classified as "special access communities" and are basically only accessible by air or winter roads. The Little Red River Cree Nation (LRRCN) is proposing to construct all-weather local access roads that will provide much needed access and will serve the residents of Garden River and Fox Lake. The proposed project consists of the following:

a) the upgrade of 57.8 km of existing summer/winter roads to all-season access roads and the operation of the all-season access road;

b) the removal of existing watercourse crossing structures and the construction and operation of one major span bridge, four span bridge structures, six bridge sized culvert structures and 14 non-bridge sized culvert structures;

c) the construction and operation of 7.0 km of new all-season access road; and

d) the reclamation of approximately 28.85 ha of existing summer/winter road corridors.

Canadian Environmental Assessment Act Requirements:
An all-weather road is a physical work and is defined as a project under the *Canadian Environmental Assessment Act* (CEAA). The proposed project involves the construction of 64.8 km of all-weather local access roads to the communities of Garden River and Fox Lake, both of which presently lack all-season access; therefore, a comprehensive study is required under section 29(b) of the *Comprehensive Study List Regulations*.

A comprehensive study environmental assessment has been conducted and this Comprehensive Study Report (CSR) has been prepared. The responsible authorities (RAs) for this project include Indian and Northern Affairs Canada (INAC –providing funds and Law List triggers) and Parks Canada (PC – Law

List trigger). They are responsible for ensuring that the comprehensive study is conducted, and that a comprehensive study report is provided to the Minister of Environment and the Canadian Environmental Assessment Agency.

Fisheries and Oceans Canada (DFO) and Transport Canada (TC) also trigger the Canadian Environmental Assessment Act for components of this project. They have scoped the project to their regulatory trigger and as such will be conducting separate environmental assessment screenings. They will provide expert advice within their mandate to the RAs for this comprehensive study.

Consultation:
Consultation for this project has taken place since 2001 and has been completed by numerous representatives of the various organizations that have been involved in the project. Consultation with government representatives primarily involved meetings and correspondences with departments and agencies who are potential regulators or who are affected by the proposed project, or who have some regulatory responsibility. Consultation with affected public and LRRCN community members included three open house sessions (February 2002 and April 2004). The February 2002 open houses were held in the communities of Garden River and Fox Lake, the April 2004 open house was held in the community of High Level. Common issues identified at the open houses focused on the timing of the project and concerns about project delays.

Environmental Effects:
Project valued environmental components (VECs) were identified during the initial environment studies in 2001-2003 and were based on discussions with responsible and federal authorities and LRRCN representatives. The environmental effects of the project, proposed mitigation measures, analysis of residual effects and their significance and the need for and requirement of follow-up are identified in the CSR. Specific effects of the project on the VECs that are discussed in the CSR are summarized below

Soils and Landforms:
- changes in soil quality;
- erosion;
- sediment transfer;
- soil compaction and chemistry.

Vegetation:
- habitat loss and alteration;
- change in vegetation quality;
- effects of dust on vegetation;
- non-native plants

Aquatic Resources:

- water quality
  - sediments
  - deleterious substances
  - changes in dissolved oxygen levels
  - change in ph balance in water courses
  - change in temperature
- fish and fish habitat
  - disruption of fish passage;
  - changes in stream morphology;
  - alteration and loss of fish habitat;
  - disturbance of the fish populations;

Wildlife:

- habitat loss fragmentation and alteration;
- disturbance
- wildlife movements;
- change in wildlife condition;
- wildlife mortality and health.

Socioeconomic and Cultural:

- economic development opportunities;
- construction and operation phases;
- forestry development;
- oil and gas exploration;
- tourism and recreation;
- regional employment opportunities;
- mobility and efficiency benefits to residents;
- service delivery;
- education and training;
- police protection;
- child family services and social development;
- health care;
- aboriginal and current use of lands for traditional purposes.

Navigability:

- effects to river traffic by water course structures over the Peace River, Wentzel River and Garden Creek

Accidents and Malfunctions:

- forest fires;
- accidental spills;
- traffic-related contaminants;
- herbicides/pesticides;
- de-icing salts.

Effects of the Environment on the Project:

- erosion of the roadway;
- sedimentation of ditches;
- road subsidence and slumping;
- flooding;

Effects of the Project on Capacity of Renewable Resources:

- fish species;
- vegetation;
- wildlife.

An assessment of cumulative environmental effects indicated that overall, the construction of the all-weather access roads should not have a significant impact on WBNP and adjacent provincial lands. One of the primary reasons for this prediction is that there is currently an existing road right-of-way and corridor. The cumulative effects assessment identified that the window for forestry harvesting (provincial lands) would be extended from 3 months to 8 months but that it was not predicted to impact the annual allowable cut of the forestry companies.

Mitigation:
Key mitigation measures proposed to mitigate or avoid the predicted environmental effects include:

- implementation of temporary sediment and erosion control measures for protection during construction.
- implementation of sediment and erosion control plans for permanent protection;
- implementation of spill contingency planning and response procedures during construction for fuels and other construction chemical
- monitoring to ensure that clearing is confined to areas within the right-of-way
- inspection and monitoring of equipment to ensure free of weeds or non-native species;
- implementation of mechanical methods for clearing of road-way ditches;
- implementation of an aquatic monitoring program to evaluate erosion and sediment control, stream morphology and hydrology, fish passage and fish habitat usage;
- aquatic environmental specialist to inspect all major stream crossings during construction;
- implementation of a hunting education program to address poaching;
- time clearing/grubbing activities associated with right-of-way maintenance to avoid nesting birds and raptors (i.e., between April 15 and July 31);
- incorporation of wildlife passage on the east bank of the Peace River in the design of the Peace River Bridge;
- development and implementation of a boating and public safety plan;
- archaeologist to be on-site to monitor construction locations so as to avoid known areas of archaeological resources;
- development of an environmental management plan that will consist of an environment construction operations plan for the construction/demolition of bridge structures and for the

construction of access roads (earthwork) and erosion and sediment control plans for watercourse crossings and other sensitive wetland areas;

- measures to minimize effects of the environment on the project will be incorporated into bridge design, erosion control plans, construction and operation practices and maintenance;

RA Conclusions: Based on the assessment of the environmental effects, the proposed mitigation measures and the development of an environmental management plan, the RAs have concluded that the project is not likely to cause significant adverse environmental effects.

1.0 Introduction

The following report is a Comprehensive Study Report (CSR) for the development of all-weather access roads to the communities of Fox Lake and Garden River, Alberta (the "Project"). The report has been prepared in accordance with the requirements of the *Canadian Environmental* Assessment Act (CEAA). The responsible authorities (RAs) in relation to the Project are Indian and Northern Affairs Canada and Parks Canada Agency (hereafter Parks Canada).

1.1 Background

The establishment of all-weather road access is an essential component for community development in northern areas, particularly as it relates to community safety and economic issues. The Little Red River Cree Nation people of northern Alberta have long had a vision of developing all-weather road access to the communities of Fox Lake and Garden River since 1958 when a road link to Fort Smith, Northwest Territories was first discussed. In 1958, a right-of-way was cleared from the end of Highway 58 to Garden River and on to Peace Point in Wood Buffalo National Park of Canada (hereafter Wood Buffalo National Park). The portion of the 1958 winter road located in Wood Buffalo National Park was reportedly used for just 2 winters as a timber haul road, before being abandoned in the early 1960s. The right-of-way within Wood Buffalo National Park of Canada, to the east side of Garden River was not reclaimed and has since grown over with pole-sized aspen, jack pine, white spruce and black spruce. Portions of this section of the original right-of-way are still used by trappers and by park staff during snowmobile patrols to the Jackfish River and Garden River warden cabins. However, the portion of the right-of-way located west of Garden River has been upgraded and maintained by the Little Red River Cree Nation as a fair weather road over the years.

In the 1980s, the Highway 58 road extension was examined again, at which time access to the community of Fox Lake was considered. At that time, Highway 58 was extended to the Wentzel River although winter roads still provided the only access to the communities of Fox Lake and Garden River. In 1995 a road link study was conducted that examined the possibility of extending the all-weather road from the Wentzel River thorough Garden River to Peace Point but not to Fox Lake. Although a feasibility study was completed, no road construction was initiated at that time. The communities of the Little Red River

Cree Nation were then visited by the Minister of Indian and Northern Affairs Canada during the summer of 2000. Following further consultation, commitments in principle for construction of all-weather access roads to the communities of Fox Lake and Garden River were made.

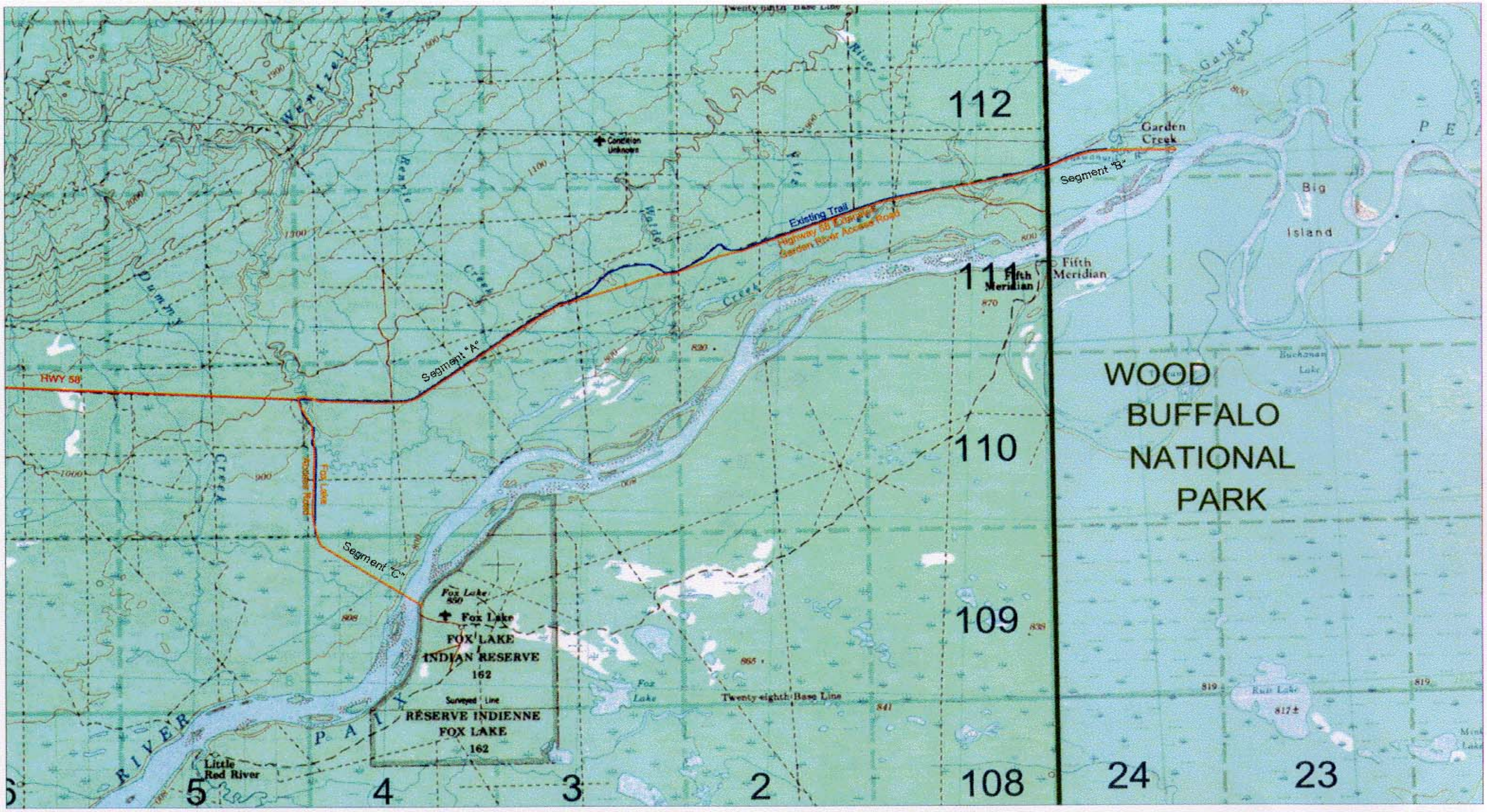
1.2 Project Overview

The Little Red River Cree Nation (LRRCN), the proponent, are proposing to upgrade the winter access roads to the Fox Lake and Garden River communities in northern Alberta to all-season (all-weather) access roads. (See Figure 1). The all-weather access road to Garden River is proposed to consist of an extension of the existing Province of Alberta Highway 58. The road would commence at the current terminus of Highway 58, west of the Wentzel River and ending at the boundary of Wood Buffalo National Park, covering a distance of 43.7 km (Section A). The proposed road would then continue another 7 km into Wood Buffalo National Park, ending at the community of Garden River (Section B). The proposed all-weather access road to the community of Fox Lake (Section C) would involve the upgrade of 7 km of existing winter road and the development of 7.1 km of new road. This road would commence at approximately 0.2 km of the new Highway 58 (west of the Wentzel River) and extend approximately 14.1 km to the west bank of the Peace River. A span bridge structure is proposed to cross the Peace River to reach the community of Fox Lake.

The Garden River segment of the Project requires crossing 8 major watercourse crossings, 11 minor watercourse crossings, and numerous drainages. These watercourses will be crossed using a combination of span bridges and culverts of various sizes. The Fox Lake segment of the project also requires the crossing of a number of watercourses. Three major watercourses, three minor watercourses and numerous drainages will be crossed using a combination of span bridges and culverts of various sizes. In total one major span bridge, four span bridge structures, six bridge sized culvert structures and 14 non-bridge sized culvert structures will be constructed. Existing watercourse crossing structures will be removed.

Construction of the Project will require the development of 28 borrow excavations along the Garden River segment and 10 borrow excavations along the Fox Lake segment of the Project. Each borrow excavation is expected to occupy an area of 400 m^2 on average. Borrow excavations will reclaimed in accordance with Alberta Infrastructure and Transportation requirements. No borrow excavations will be located within Wood Buffalo National Park.

The current alignment of the winter road includes a number of portions that will require reclamation following construction of the all-season road. On the Garden River segment, 7 locations, totaling 26.42 hectares of existing right-of-way will be reclaimed. On the Fox Lake segment, 4 locations totally 2.43



PROJECT	Garden River & Fox Lake Access Roads
TITLE	Existing and Proposed Location of Garden River & Fox lake Access Road

Millennium EMS Solutions Ltd.

LEGEND
- Existing Trail
- Proposed Access Road

NTS Map Obtained From SoftMap Technologies Inc.

	BY	DATE
DRAWN	KY	05/10/18
CHECKED	RB	05/10/18

SCALE: Approximate — Kilometers

PROJ. NO. 05-057

DRAWING NAME

FIGURE 1

hectares will be reclaimed. Existing right-of-way reclamation will be in accordance with Alberta Environment requirements.

The Little Red River Cree Nation will maintain and operate the all-season road. Site preparation and construction is expected to be complete by October 2009. Operation will commence at that time and continue indefinitely. While there are no current plans to decommission the project, consideration has been given to decommissioning in the environmental assessment. Any future related activities (monitoring) are expected to be complete by October 2010.

1.3 Project Need and Purpose

The communities of Fox Lake and Garden River are isolated from the economic activity, social services (e.g. education and training, health care, public safety, child and family services) that is occurring in the region. Without year round access to the region, the high reliance of the communities on social assistance to maintain basic living standards is likely to continue.

As indicated in the project Terms of Reference, "an integral part of community development is the construction and maintenance of an all-weather road access". Currently, all-weather road access does not exist to the communities of Garden Creek and Fox Lake. Development of all-weather road access is considered vital to the continued safety of community residents and the promotion of commercial interests in the region.

1.4 Report Outline

This comprehensive study report documents the results of the federal environmental assessment of the Project. It has been prepared on behalf of the responsible authorities and has been based upon a number of technical and supporting documents prepared for the proponent and the RAs. These include:

- *Little Red River Cree First Nation Feasibility Study* (EXH Engineering Services Ltd. March 2003);
- *An Environmental Assessment of the Proposed Fox Lake and Garden River Access Roads (Highway 58 Extension)* (Westworth Associates Environmental Ltd. 2003 Report completed for EXH Engineering Ltd. and included as Section D of EXH Feasibility Study);
- *Socio-Economic Impact Assessment*. (Applications Management Consulting Ltd. 2002). Report completed for EXH Engineering Ltd. and included as Section B of EXH Feasibility Study.)
- *Proposed Garden River Access Road Borrow Sources And Fox Lake Access Road Project* (Altamira Consulting Ltd. August 2004);

- *Garden River and Fox Lake Access Roads; Supplemental Environmental Assessment* (AMEC Earth & Environmental 2004a);
- *Environmental Assessment Report Ferry Crossing at the Peace River Fox Lake I.R. 162* (AMEC Earth & Environmental 2004b)[1]; and
- *Environmental Assessment Report Peace River Bridge Crossing, Fox Lake I.R. 162* LRRCN and Indian and Northern Affairs Canada (AMEC Earth & Environmental 2005).

In addition to the above-noted reports, the proponent has also provided responses to specific information requests made by the RAs and expert federal authorities (FAs). The CSR has been organized in the following manner:

Introduction
Background information on the Project is presented. An overview of the Project is provided and the need for and purpose of the Project are described. The report organization is outlined.

Environmental Assessment Process
The process for developing this comprehensive study report is described. The nature of federal involvement, including the federal decisions expected in relation to the Project, is outlined. The regulatory and planning context for the Project is outlined, including the identification of the various federal and provincial legislation, regulations, guidelines, policies and agreements. The Terms of Reference for the Comprehensive Study are outlined and the process for reviewing the environmental assessment materials is described.

Scope
The scope of the Project and the environmental assessment, as established by the RAs, is described. The temporal and geographic boundaries employed in the environmental assessment are also described. The methods employed to conduct the assessment are described, including the assessment approach, issues considered and the valued ecosystem components (VECs) selected. The approach employed to examine the potential cumulative environmental effects is also described.

Project Description
The Project is described in both general and specific terms, for the purposes of enabling the identification of environmental effects. Each segment of the Project (Garden River and Fox Lake) is described, along with the necessary accessory works and facilities. The main phases of the Project are described – site preparation, construction, operation and decommissioning. The schedule for implementation is described.

[1] This document was only reviewed by Indian and Northern Affairs, Environment Canada and Fisheries and Oceans Canada

Given the need and purpose described in Section 1, the alternatives to the Project that were considered are outlined and the rationale for the preferred alternative to is described. The alternative means of carrying out the project are identified and the basis for the preferred alternative mean(s) described.

Environment Description

The existing environment is described in both general and specific terms. For the purposes of the environmental assessment, the existing environment is subdivided into biophysical, socio-economic and cultural components and attributes.

Environmental Effects Analysis

The potential environmental effects of the Project are identified. The potential effects have been organized by environmental component and include physical components (air, dust and noise and landforms), biological components (wildlife, vegetation and aquatics/hydrological resources); social and economic components; cultural components, and land use components. The potential environmental effects of accidents and malfunctions are outlined. The effects of the environment on the Project and the effects on renewable resource sustainability are also described. Measures to mitigate those effects are identified and considered, follow-up requirements are described and the potential significance of any adverse residual effects are identified and evaluated.

Cumulative Effects

The approach to identifying and assessing cumulative effects is described. Projects and activities that may contribute to cumulative effects are identified and described, potential cumulative effects identified and measures to mitigate the contribution of the Project to those effects outlined.

Follow-up Program

The activities required for follow-up purposes if appropriate, including any environmental management plan commitments are identified and described. Responsibilities for the follow-up actions are outlined and any reporting requirements described.

Consultation Activities

The consultation activities undertaken in support of the environmental assessment is described. The nature of and results from those activities are described.

Conclusion

The RAs' conclusion on the significance of any residual adverse environmental effects for the Project is presented.

2.0 Environmental Assessment Process

The Comprehensive Study Report (CSR) outlines the environmental assessment process that has been followed to arrive at the preferred alignments for all-season access roads to the Alberta First Nation communities of Garden River and Fox Lake. In support of the CSR a number of environmental studies have been conducted. These environmental studies, covering a range of issues concerning the proposed access roads, have been conducted over a multi-year period. This CSR documents the review of the environmental effects, the significance of the effects, how the effects will be eliminated or minimized (mitigated) and residual effects throughout the project phases as well as including discussion of the potential need for follow up plans. This report also includes a discussion of cumulative environmental effects, proposed applicable mitigation measures, residual effects and an analysis of the significance of these.

2.1 Regulatory and Planning Context

A number of federal and provincial acts, regulations and policies potentially apply to the construction of the proposed all-weather access roads in the Highway 58 study area. As well, certain lands within Wood Buffalo National Park are subject to international conservation agreements or conventions to which the Government of Canada is a party. The following section describes the principal legislation, policies and agreements that were considered in the preparation of the CSR.

Table 2.1 provides a summary of the instruments relevant to those segments of the Project that are located on Provincial Crown Lands. Table 2.2 summarizes those instruments that apply to the portion of the Garden River segment that is located within Wood Buffalo National park (WBNP), as well as any other areas of federal jurisdiction. The Tables also list the required authorizations, approvals and/or permits that are required for the construction and operation of the roads.

Discussion of the requirements of the *Canadian Environmental Assessment Act* follows in Section 2.2.

Table 2.1 – Summary of Applicable Provincial Environmental Legislation, Guidelines, Policies and Agreements

Aspect	Topic	Regulatory Requirements	Purpose	Regulator/Agency	Approvals/Authorization/Permits
Approval to proceed with the project	Environmental Impact Assessment	*Canada-Alberta Agreement for Environmental Assessment Co-operation.*	Requires that the province be contacted to undertake an environmental assessment should both jurisdictions require an environmental assessment.	CEA Agency	The Province of Alberta indicated to the CEA Agency that this project does not trigger their *Environmental Protection and Enhancement Act* but they wish to be involved in the process.
Land Use	Dispositions/Zoning for right-of-way, watercourses, and borrow excavations	*Public Lands Act*	The *Public Lands Act* deals with land administration including the selling and transferring of public land and activities permitted on public land.	Sustainable Resource Development	RDS #11334 is in place for the winter road from the Wentzel River to the western boundary of Wood Buffalo National Park. The RDS will be replaced with a Registered Road Plan. The Road Authority for the section of roadway between Wentzel River and the boundary of WBNP is the Province of Alberta. The Road Authority for the Fox Lake Access Road will be the proponent. An approval (disposition) is required under the *Public Lands Act* for all ice bridges. Dispositions are required for the use of public lands which includes the beds and shores of water bodies Within Alberta's Green Zone, Temporary Field Authorizations are required for borrow sites in use for 3 months or less. For longer term sites, dispositions may be required.
	Staging Areas, Parking/Construction Camps	*Public Lands Act*	The *Public Lands Act* deals with land administration including the selling and transferring of public land and activities permitted on public land.	Sustainable Resource Development	Temporary Field Authorizations are required for construction camps, staging areas and/or parking areas.
Watercourse Crossing construction	Fish Habitat and Water Quality	*Water Act* W-3 RSA 2000 *Water (Ministerial) Regulation* *Code of Practice for Watercourse Crossings* *Fish Habitat Manual (*AT 2002) *Design Guidelines for Erosion and Sediment Control May 2003* *Field Guide for Erosion and Sediment Control for Highways June 2003*	The *Water Act* promotes the conservation and management of Alberta's water resources.	Alberta Environment	Approvals are required for in-stream work (including dredging), for the construction of an ice or snow bridge on the Peace River, Code of Practice for Watercourse Crossings is applicable to the construction of bridge structures (or culverts) greater than 1.5 m in diameter. Alberta Infrastructure and Transportation has published various guidelines for the protection of fish and fish habitat and water quality that is to be adhered to for Alberta Infrastructure and Transportation sponsored projects.

Table 2.1 – Summary of Applicable Provincial Environmental Legislation, Guidelines, Policies and Agreements

Aspect	Topic	Regulatory Requirements	Purpose	Regulator/Agency	Approvals/Authorization/Permits
	Drainage	*Water Act* W-3 RSA 2000 *Water (Ministerial) Regulation* *Design Guidelines for Erosion and Sediment Control May 2003* *Field Guide for Erosion and Sediment Control for Highways June 2003*	The *Water Act* promotes the conservation and management of Alberta's water resources.	Alberta Environment	Notifications under the *Water Act* are required concerning drainage culverts. Natural drainage patterns must be maintained.
	Placing, constructing, installing, maintaining, replacing a snow bridge on the Peace River	*Water Act* W-3 RSA 2000 *Water (Ministerial) Regulation* (AR 205/98, consolidated to AR 379/2003) Schedule 2.	The *Water Act* promotes the conservation and management of Alberta's water resources	Alberta Environment	Approval required under Schedule 2 of the *Water (Ministerial) Regulation* for construction of an ice bridge within the Peace River.
Roadway Construction	Archaeological/Cultural Resources	*Historical Resources Act* RSA 2000, H-9	Protection of archaeological and palaeontological resources and historic sites and resources.	Alberta Community Development	A historical resource impact assessment must be conducted to obtain clearance for this project. Clearance has been granted for the borrow excavations and access road alignments under permit 2004-283 and 2002—174 and WB02-1033
	Vegetation Clearing - Salvageable Timber	*Forest Act* *Timber Management Regulations*	The *Forests Act* prohibits persons from damaging the forest in any way and requires that merchantable timber be salvaged on crown lands.	Sustainable Resource Development	Timber salvage permit is required.
	Revegetation of roadway right-of-way	*Native Plant Revegetation Guidelines for Alberta,* February 2001 *Guidelines for Industrial Development Sites,* September 2003 R&R/03-3	These guidelines provide information on revegetation practices for road ROW.	Alberta Agriculture Food and Development	
	Wetlands Resources	*Water Act* W-3 RSA 2000 *Beyond Prairie Potholes – A Draft Policy for Managing Alberta's Peatlands and Non-settled Area Wetlands* *Public Lands Act., ss 51(1)(a)-(f) and 51 (1.1)*	The *Water Act* promotes the conservation and management of Alberta's water resources, including wetlands. The draft policy provides principles by which wetland management should be guided and recommendations about conservation and drainage. The *Public Lands Act* deals with land administration including the selling and transferring of public land and activities permitted on designated land	Alberta Environment	Wetland protection and resources must be completed in accordance with requirements of the *Water Act* and *Public Lands Act*. Alberta Infrastructure and Transportation requires that contractors abide by the provincial wetland policies.

Table 2.1 – Summary of Applicable Provincial Environmental Legislation, Guidelines, Policies and Agreements					
Aspect	**Topic**	**Regulatory Requirements**	**Purpose**	**Regulator / Agency**	**Approvals / Authorization / Permits**
	Wildlife/Species Protection	*Wildlife Act* *Wildlife Regulations*	The *Wildlife Act* governs the management of wildlife as a Crown resource and enables the hunting and trapping of wildlife. The Act also addresses conservation of species at risk (endangered, threatened).	Sustainable Resource Development	Requires a permit for the removal of beaver dams.
	Soil Conservation	*Soil Conservation Act* Construction Bulletin #11 *Topsoil Conservation Within the Highway Right-of-Way* June 25, 2001 *Environmental Protection and Enhancement Act* E-12 s. 131 *Disposal of Excess Soil Material from Roadways* December 2000 C&R/IL/00-10,	The *Soil Conservation Act* promotes the conservation of soil and topsoil. INFTRA requires that topsoil be salvaged within the right-of-way and that soils be replaced within the right-of-way. It should be noted that placement of excess soil off the right-of-way may be regulated by other acts. For the Fox Lake and Garden River local access roads, excess soil would be used for reclamation. The *Environmental Protection and Enhancement Act* requires an operator to conserve and reclaim specified land and unless exempted by the regulations, obtain a reclamation certificate.	Sustainable Resource Development	
	General Construction Procedures – Environmental Protection	*Environmental Construction Operations Plan (ECO Plan) Framework* July 2001	In accordance with the requirement of this CSR the proponent will develop the ECO Plan in accordance with the framework document and to have that ECO Plan approved by the RAs/FAs and in place during construction. ECO Plans also have third party audit requirements.	Alberta Infrastructure and Transportation	An ECO Plan will be a requirement of for this project. The development, implementation and maintenance of the ECO Plan and ESCPs will be the responsibility of the proponent. The ECO Plan and Erosion Control and Sediment Plan (ECSP) will be developed consistent with and in conformance with the commitments contained in the comprehensive study report.

Table 2.1 – Summary of Applicable Provincial Environmental Legislation, Guidelines, Policies and Agreements					
Aspect	**Topic**	**Regulatory Requirements**	**Purpose**	**Regulator/Agency**	**Approvals/Authorization/Permits**
	Reclamation of borrow excavations and restoration of road right-of-way.	*Environmental Protection and Enhancement Act* E-12 s. 137 (1)(2) *Conservation and Reclamation Regulation s.2* *Alberta Transportation Pre-Disturbance Assessment Procedures for Borrow Construction for Road Construction* May 2002 *Alberta Transportation Post-Disturbance Reclamation Criteria and Assessment Procedures for Borrow Excavations for Road Construction* May 2002 *Native Plant Revegetation Guidelines for Alberta,* February 2001	Borrow excavations developed for road construction must be reclaimed to a land capability equivalent to it pre-disturbance land capability in order to receive a Reclamation Certificate. The objective of re-vegetation is to ensure the establishment and growth of species compatible with the area and intended land use.	Sustainable Resource Development	Right-of-way will be reseeded with the appropriate seed mix as per the conditions of the Public Lands Act RDS or other approvals, dispositions.
	Reclamation of roadway/roadbed that is no longer in use.	*Environmental Protection and Enhancement Act* E-12 s. 137 (1)(2) *Conservation and Reclamation Regulation* s.2 *Environmental Protection Guidelines for Roadways* November 2000 C&R/IL/00-5	Requires that abandoned road right-of-way be reclaimed.	Alberta Environment	In some cases, reclamation certificates may be required.
	Revegetation	*Native Plant Revegetation Guidelines for Alberta,* February 2001 *Guidelines for Industrial Development Sites,* September 2003 R&R/03-3	These guidelines provide information on revegetation practices for road ROW.	Alberta Agriculture Food and Development	
Roadway Restoration	Vegetation	*Environmental Protection and Enhancement Act* E-12 s. 155-167 *Pesticide Sales, Handling, Use and Application Regulation (AR 24/97),*	The *Environmental Protection and Enhancement Act* requires licensed applicators for the use of herbicides for chemical vegetation control.	Alberta Environment	If weed control is completed by chemical means, the applicators require appropriate training and licensing.

Table 2.1 – Summary of Applicable Provincial Environmental Legislation, Guidelines, Policies and Agreements

Aspect	Topic	Regulatory Requirements	Purpose	Regulator / Agency	Approvals / Authorization / Permits
		Pesticide Ministerial Regulation (AR 43/97), Code of Practice for Pesticides			
		Weed Control Act W-5, RSA 2000	Provides provincial and/or local authorities with the tools to control (limit) the growth or spread of plants that are designated as noxious or nuisance weeds.	Agriculture, Food and Rural Development MD of Mackenzie	Penalties may be assessed if the spread or growth of noxious or nuisance weed species in an area is enhanced or encouraged through the development and operation of a project.
Roadway Operation and Maintenance	Vegetation control	*Environmental Protection and Enhancement Act* E-12 s. 155-167 *Pesticide Sales, Handling, Use and Application Regulation (AR 24/97), Pesticide Ministerial Regulation (AR 43/97), Code of Practice for Pesticides*	The *Environmental Protection and Enhancement Act* requires licensed applicators for the use of herbicides for chemical vegetation control	Alberta Environment	Approval required under the *Water Act* for dredging activities within the Peace River.
		Weed Control Act W-5, RSA 2000	Provides provincial and/or local authorities with the tools to control (limit) the growth or spread of plants that are designated as noxious or nuisance weeds.	Municipality	Penalties may be assessed if the spread or growth of noxious or nuisance weed species in an area is enhanced or encouraged through the development and operation of a project. If weed control is completed by chemical means, the applicators require appropriate training and licensing.

Table 2.2 – Summary of Applicable Federal Legislation, Guidelines, Policies and Agreements					
Aspect	**Topic**	**Regulatory Requirements**	**Purpose**	**Regulator/Agency**	**Approvals/Authorization/Permits**
Approval to proceed with funding and issuing regulatory approvals for the project	Environmental Impact Assessment	*Canadian Environmental Assessment Act* S.C. 1992, c.37, s. 5(1)(b), 5(1)(c), *Comprehensive Study List Regulations* *Inclusion List Regulations* *Law List Regulations* *Federal Co-ordination Regulation*	Identifies roles, responsibilities and procedures for environmental assessment of projects carried out by or with the approval or assistance of the Government of Canada.	Canadian Environmental Assessment Agency (CEA Agency) Indian and Northern Affairs Canada (INAC) – Lead RA Parks Canada (PC) – RA Fisheries and Oceans Canada (DFO) – RA Transport Canada (TC) – RA Environment Canada - FA	CSR required. Decision on next steps in the process required from Minister of the Environment
		Canada-Alberta Agreement for Environmental Assessment Cooperation	Requires that the CEA Agency contact the province to undertaken and environmental assessment should both jurisdictions require and environmental assessment.	CEA Agency	The province of Alberta has indicated to CEA Agency that this project does not trigger the *Environmental Assessment Regulation*.
Land Use	Zoning - National Park	*Canada National Parks Act,* 2000, c. 32 *General Regulations* SOR/78-213 s.11(1)	The *National Parks Act* empowers Parks Canada to manage and administer the National Parks. The *General Regulations* outline requirements associated with development within the Parks.	Parks Canada	PC is identified as an RA for this CSR. PC is responsible for issuing a permit under s. 11(1) *General Regulations*. This regulation identifies the requirement for the issuance of a permit for the construction of an all-weather road.
		Wood Buffalo National Park Management Plan (including zoning designations)	The 1984 Management plan includes provisions for the development for the Project C portion of the access road to Garden River. The management plan also indicates that a more effective and suitable administrative arrangement for the community of Garden River is required. The plan requires that negative impacts on the park caused by the settlement be minimized.	Parks Canada	The Management Plan requires environmental and socio-economic assessments for projects within the Park.
	Protected Areas	*Operational Guidelines to the UNESCO World Heritage Convention*	WBNP has been designated as a World Heritage Site. The Operational Guidelines outlines responsibilities associated with maintaining a world heritage site.	UNESCO World Heritage Committee	Monitoring and measuring required.

Table 2.2 – Summary of Applicable Federal Legislation, Guidelines, Policies and Agreements

Aspect	Topic	Regulatory Requirements	Purpose	Regulator/Agency	Approvals/Authorization/Permits
		The Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR Convention on Wetlands).	Intergovernmental treaty adopted in 1971 respecting the conservation and sustainable use of wetlands and highlights the importance of maintaining biodiversity.	Ramsar Secretariat is hosted by IUCN-The World Conservation Union in Gland, Switzerland.	The Peace-Delta wetland (includes the south-east corner of WBNP) is identified as a wetland of international importance.
	Water Quality and Fish Habitat Protection	*Fisheries Act* R.S. 1985, c. F-14, s. 34(1), 37(1) and 20(1).	The Act prohibits the harmful alteration or destruction of fish habitat and requires an authorization to do so; prohibits the deposition of deleterious substances and requires that fish passage be unimpeded.	Fisheries and Oceans Canada (DFO)	Authorizations for watercourse crossings would be required if there is a harmful alteration, disruption or destruction of fish habitat..
	Navigation	*Navigable Waters Protection Act* R.S. 1985, c. N-22, s. 5(1)	The Act prohibits the building or placing of any work in, on, over, under, through or across any navigable water unless an approval has been granted.	Transport Canada	Approval required where navigation may be impacted by the construction of works at a navigable watercourse (Wentzel River, Garden Creek and Peace River).
Road construction	Archaeological/Cultural Resources	Cultural Resource Management Policy	Protection of cultural and heritage resources within National Parks	Parks Canada	No approvals are required. An assessment of heritage and cultural resources within the WBNP has been undertaken.
	Wetlands Protection	Federal Wetlands Policy (Government of Canada 1991)	The policy commits the federal government to wetland conservation in carrying out federal programs.	Environment Canada	Environment Canada has identified itself as a FA on this project and is involved in the review of the CSR.
	Migratory Birds	*Migratory Birds Convention Act* S.C. 1994, c.22 *Migratory Birds Regulations* SOR/87-657, s. 2.	The *Migratory Birds Convention Act* and its regulations prohibit the destruction of migratory birds and migratory birds' habitat.	Environment Canada	Environment Canada has identified itself as a FA on this project and is involved in the review of the CSR.
	Wildlife/Species Protection	*Species at Risk Act* 2002, c.29	The *Species at Risk Act* and its regulations prohibit the destruction of rare, endangered and threatened species and critical habitat.	Environment Canada Parks Canada	Environment Canada has identified itself as a FA on this project. Parks Canada is responsible for this legislation within WBNP.
Roadway Operation and Maintenance	Environmental Protection Measures	Maintenance Agreement between Parks Canada and LRRCN	The maintenance agreement includes provisions so that environmental matters such as waste disposal are taken care of.	Parks Canada	The LRRCN will be responsible for ensuring that the road within WBNP is maintained in accordance with the signed agreement.

2.2 Canadian Environmental Assessment Act Requirements

The *Canadian Environmental Assessment Act* (CEAA) identifies responsibilities and procedures for the assessment of projects that involve the federal government. The CEAA applies when the following key components are present:

- There is a project, defined as an undertaking in relation to a physical work or a physical activity as listed in the CEAA *Inclusion List Regulation;*
- There is a Federal Authority (FA) with a decision to make in respect of the project (i.e., the FA is the proponent, contributes financially to the project, disposes of an interest in the land [sale, lease or other] to enable the project, or issues a permit, licence or approval under one or more of the provisions of the CEAA *Law List Regulations*); and,
- The project is not included on the CEAA *Exclusion List Regulations*.

The proposed project, an all-weather road, is a physical work and is defined as a project under CEAA.

To identify those federal authorities that could have a trigger to conduct an environmental assessment under the CEAA in relation to the project, the CEA Agency sent letters on August 07, 2002 to other government departments (OGDs) including:

- Fisheries and Oceans Canada (DFO)
- Environment Canada (EC)
- Transport Canada (TC) (formerly DFO – CCG)
- Parks Canada (Parks)
- Natural Resources Canada (NRCAN)
- Industry Canada (IC)
- Indian and Northern Affairs Canada (INAC)

The letter requested a determination of interest or responsibility with respect to the project in accordance with the Regulations *Respecting the Co-ordination by Federal Authorities of Environmental Assessment Procedures and Requirements* (Federal Co-ordination Regulations) under the CEAA. The responses from the Federal Authorities with regards to their status pursuant to CEAA included the following:

- Parks, DFO and INAC indicated that they had responsibility with respect to regulatory triggers,
- EC indicated that they had interest with respect to providing expert and specialist advice related to biophysical attributes of the project, particularly as they relate to portions of the *Fisheries Act*, *Species at Risk Act* and the *Migratory Birds Convention Act*, and
- NRCAN and IC indicated that they had no interest or regulatory responsibility with respect to the project.

To ensure co-ordination between federal and provincial authorities, the CEA Agency contacted Alberta through the Director of Environmental Environment, Alberta Environment (AENV) consistent with *Canada-Alberta Agreement for Environmental Assessment Harmonization*. Alberta Environment indicated that the project did not trigger the Alberta Environmental Protection and Enhancement Act (AEPEA) but that they wish to be involved in the environmental assessment process. The CEA Agency has taken on the role of co-ordinating the receipt and dissemination of information between the various RAs and FAs, as well as, input from provincial counterparts.

Following review of a project description, the following federal decisions were identified in relation to the proposed project:

- Funding from the Department of Indian and Northern Affairs Canada (INAC) will be used to construct the access roads;
- An authorization under the *Indian Act* to permit the use of Reserve lands for bridge infrastructure on the south side of the Peace River at Fox Lake will be required from INAC;
- An authorization(s) under Section 35 of the *Fisheries Act* may be required to be issued by the Department of Fisheries and Oceans (DFO);
- An authorization(s) under Section 5(1) of the *Navigable Waters Protection Act* may be required to be issued by Transport Canada for some of the river and watercourse crossings, and
- A permit under the *National Parks General Regulations* (Subsection 11(1)) will be required from Parks Canada to permit the construction of the road within the boundaries of Wood Buffalo National Park.

Given that the project, as described by the LRRCN, meets the definition of a project contained in CEAA and the Government of Canada has agreed to provide financial assistance to the proponent and is likely to exercise regulatory duties (i.e. issuing license permits or approvals for the Project or components thereof) that are included in the Law List Regulations of CEAA, for the purpose of enabling the Project to be carried out, the environmental assessment process provided in CEAA applies.

Given the Project involves the construction, decommissioning or abandonment of an all-season public highway that will be more than 50 km in length and either will be located on a new right-of-way or will lead to a community that lacks all-season public highway access, it is of a type that is described in section 29 (b) in the *Comprehensive Study List Regulations* under CEAA. As such, the comprehensive study provisions of CEAA apply to the project.

TC, after completion of their review of the project description and information provided regarding the above referenced proposed work have identified that the bridge construction works proposed over Garden River, Wentzel River and Peace River will require an approval pursuant to Section 5(1) (a) of the

Navigable Waters Protection Act (NWPA). In accordance with the department's mandate and regulatory responsibility, TC has identified its scope of project to include the following:

> *The construction, operation, maintenance and decommissioning of three bridges over the Garden, Wentzel and Peace Rivers, along with any related works, accesses, storage areas or other undertakings directly associated with these bridge structures.*

As TC's scope of project is not on the *Comprehensive Study List Regulations*, a separate screening will be undertaken.

DFO determined that they would likely be required to exercise regulatory decision-making authority under section 35(2) of the *Fisheries Act*, in regard to some components of the all-season road that could result in the harmful alteration, disruption or destruction of fish habitat.

As an RA, DFO determined, based on its anticipated CEAA triggers, the issuance of authorizations under section 35(2) of the Fisheries Act, that the scope of the project for the purposes of DFO's environmental assessment would be the stream crossings of Peace River, Wentzel River, Waldo Creek and 2 unnamed watercourses including any ancillary works associated with these impacts. As none of these components were on the CEAA Comprehensive Study List Regulations, DFO is conducting a separate screening environmental assessment.

Both DFO and TC support the implementation of a single federal process allowing all RAs to fulfill their respective obligations pursuant to CEAA and will therefore use the documentation generated for the comprehensive study to inform their screening level assessment. DFO and TC have acted as expert FAs for this comprehensive study and have been engaged in the review of the preparation of this CSR.

2.3 Environmental Assessment Process

In response to the Project Description provided by the LRRCN, federal authorities developed a Terms of Reference to guide the comprehensive study. On December 3, 2002, the original Terms of Reference were issued for the project. Environmental, socio-economic and public consultation activities were underway at that time, as well as the feasibility study completed for the LRRCN by EXH Engineering. In late 2003, INAC and Alberta Infrastructure and Transportation (INFTRA) retained AMEC Infrastructure to complete the detailed engineering and design work (including any remaining environmental studies) for the construction of the local access roads to the communities of Fox Lake and Garden River. AMEC Infrastructure retained Millennium EMS Solutions Ltd. to assist in the compilation of the comprehensive study report. Based on environmental and hydro-technical studies undertaken by AMEC Earth & Environmental, it was determined that the project as described in the project description and as initially scoped and identified and referenced in the Terms of Reference was not feasible.

In July 2005 an amended Terms of Reference was issued (Appendix A) that clarified that LRRCN was the project proponent and that the responsibilities regarding Navigable Waters were being transferred from CCG to TC. The time frames, steps and parties involved in the environmental process are summarized in Table 2.3.

Table 2.3: Environmental Assessment Process

Project Component/ Phase	Time Period	Stakeholders/Consultants Involved
Feasibility Study: Technical Project Description Environmental Assessment Public Consultation Archaeological Socio-Economic	September 2001 – August 2003	LRRCN EXH Engineering Ltd. Westworth Associates Environmental Ltd. EBA Engineering Ltd Alberta Western Heritage Inc. Applications Management Consulting Ltd.
Requirement for CSR identified	July 26, 2002	Indian and Northern Affairs Canada and Parks Canada
Terms of Reference for CSR issued	December 3, 2002	Canadian Environmental Assessment Agency
Preliminary Engineering, Detailed Design, Tender Package	December 2003 to present	AMEC Infrastructure Limited
Garden River and Fox Lake Access Roads Supplemental Environmental Assessment	February – December 2004	AMEC Earth & Environmental
Proposed Garden River Access Road Borrow Sources and Fox Lake Access Road Archaeological Assessment	February – December 2004	Altamira Consulting Ltd.
Environmental Assessment Report of the Ferry Crossing at the Peace River Fox Lake I.R. 162	August – December 2004	AMEC Infrastructure Limited AMEC Earth & Environmental
Request for revision to the Terms of Reference	June 13, 2005	LRRCN
Issuance of the revised Terms of Reference	July 25, 2005	CEA Agency
Environmental Assessment Report of the Peace River Bridge Crossing Fox Lake I.R. 162 LRRCN and Indian and Northern Affairs Canada	June – July 2005	AMEC Earth & Environmental
Comprehensive Study Report preparation and submission that included the technical supporting documents as Appendixes	April – August 17, 2005	Little Red River Cree Nation AMEC Infrastructure Limited Millennium EMS Solutions Ltd. AMEC Earth & Environmental Altamira Consulting
Conference Call that indicated that the submission of the CSR with the technical supporting documents was not acceptable and the LRRCN was directed to resubmit a CSR without the Technical Supporting Documents as Appendixes	September 26, 2005	CEA Agency INAC Transport Canada Fisheries and Oceans Canada Parks Canada Environment Canada Millennium EMS Solutions Ltd.
Comprehensive Study Report Review and Preparation	September 27 – October 21, 2005	LCRRN AMEC Infrastructure Limited Millennium EMS Solutions Ltd.
Federal review and development of concordance table	October 2005 – February 2006	CEA Agency INAC Transport Canada Fisheries and Oceans Canada Parks Canada Environment Canada Millennium EMS Solutions Ltd. AMEC
RFA meeting with proponent to discussion	February 13, 2006	LCRRN

Project Component/ Phase	Time Period	Stakeholders/Consultants Involved
concordance table, work plan and next steps		CEA Agency INAC Transport Canada Fisheries and Oceans Canada Parks Canada Environment Canada Millennium EMS Solutions Ltd. AMEC
Subsequent to the drafting of a comprehensive study report by the LRRCN, the RFA's determined that further consolidation of the environmental assessment materials was required and retained Gartner Lee Limited to assist in that consolidation.	March 1, 2006 – May 31, 2006	LCRRN CEA Agency INAC Transport Canada Fisheries and Oceans Canada Parks Canada Environment Canada Gartner Lee

As the environmental assessment of this project commenced prior to October 30, 2003, INAC and PC are proceeding under the *Canadian Environmental Assessment Act (1992)* as opposed to the *Canadian Environmental Assessment Act* (as amended in 2003). Due to the transition clause in section 33 of the *Act to Amend the Canadian Environmental Assessment Act*, environmental assessments of projects that commenced prior to the coming into force of the amended CEA Act are allowed to proceed under the 1992 CEA Act.

3.0 Scope

The CSR was prepared in accordance with the Terms of Reference issued by the RAs. The Terms of Reference identified the scope of the environmental assessment to be conducted in relation to the Project. The scope of the environmental assessment includes both the scope of the project (those project components, undertakings and activities that are the subject of the environmental assessment) and the scope of the assessment (the factors to be considered in the environmental assessment and the scope of those factors, including their temporal and geographic extent). The scope has been established in accordance with Sections 15 and 16 of the *Canadian Environmental Assessment Act*.

Scope of the Project

The scope of the project established for the purposes of this environmental assessment comprises the various components of the project as proposed by the LRRCN. The scope of the project includes the site preparation, construction, operation, maintenance and decommissioning of all components of the all season access roads, including watercourse crossing structures, borrow excavation development, extraction and restoration.

More specifically, the scope includes the following works and activities:

- The upgrade of 57.8 km of existing summer/winter roads to all-season access roads and the operation of the all-season access road;
- The removal of existing watercourse crossing structures and the construction and operation of a number of structures including: one major span bridge, four span bridge structures and 20 culvert structures;
- The construction and operation of 7.0 km of new all-season access road;
- The reclamation of approximately 28.85 ha of existing summer/winter road corridors which were developed as bypasses during wet/poor weather conditions; and
- The decommissioning while not explicitly evaluated has been considered in this comprehensive study.

3.2 Scope of the Assessment

The scope of the assessment of the Project includes the consideration of changes to the environment that may result from the project, including but not limited to consideration of:

- The environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the Project and any cumulative environmental effects that are likely to result from the project in combination with the other projects or activities that have been or will be carried out;
- The significance of the effects;
- Comments from the public that are received in accordance with CEAA and its regulations;
- Measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project;
- A consideration of the need for the project and alternatives to the project;
- The purpose of the project;
- Alternative means of carrying out the project that are technically and economically feasible and the environmental effects of any such alternatives;
- The need for, and the requirements of, any follow-up program in respect of the project; and
- The capacity of the renewable resources that is likely to be significantly affected by the project to meet the needs of the present and those of the future.

Environmental effects is defined under CEAA as: any change that the project may cause in the environment, including any change it may cause to a listed wildlife species its critical habitat or the residences of individuals of that species as those terms are defined in subsection 2(1) of the *Species at Risk Act* (SARA) and any change in the environment that would have an effect on health and socio-economic conditions, physical and cultural heritage, the current use of lands and resources for traditional purposes by aboriginal persons, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance. In addition, consideration is also given to any change to the Project that may be caused by the environment.

3.3 Temporal and Geographic Scope

For assessment purposes, the temporal boundaries for the proposed project are divided into the construction and operational and maintenance periods. Construction is expected to take place over a three to four year period. The design life of the road is 20 years, the design life of the bridges is 70 years and the design life of the watercourse crossing culverts are 50 years.

Spatial boundaries for the assessment areas are specific to each of the identified valued ecosystem components (VECs), based on the expected or predicted interactions between the Project and those VECs and are included in Section 5. The Regional and Local Study Areas for the disciplines are also illustrated in Section 5.

3.4 Cumulative Environmental Effects

The terms of reference indicate that the cumulative effects assessment for the proposed project should:

- Identify past and existing stressors (i.e. human land and watercourse use, resource consumption, habitat fragmentation, pollutants, climate change, exotic species, roads, fire control, other park specific issues, timber berth re-vegetation, land excisions, etc.) on key components of Wood Buffalo National Park (WBNP) that impact on the heritage values of WBNP (i.e. ecological integrity (biological diversity, ecosystem function) and presentation and protection of the park).
- Identify past and existing stressors on lands outside of WBNP that impact on heritage values associated with these lands.
- Discuss the impact of the potential construction of the winter road between Peace Point and Garden River.
- Discuss and attempt to quantify the resulting contribution of the road (i.e. direct loss of habitat, habitat fragmentation and its effects such as habitat avoidance, individual and social disruption of wildlife) to these existing stressors and the resulting cumulative impact to heritage values as described above.
- Discuss and quantify the capacity for renewable resources affected by the construction and operation of the project, to continue to meet the needs of other current and potential future land users.
- Discuss the possibility of increased year-round human activity along the road and its effects to heritage values of the project area.
- Discuss environmental effects to areas outside of the project area as a result of increased access, including opportunities for resource extraction (i.e. heavy oil, gas, forestry), tourism, additional roads) and the possible "islandification" of WBNP.
- Discuss the impacts of proposed road on treaty land entitlement negotiations.
- Identify mitigation measures for the cumulative effects.

- Determine whether the residual impacts of the cumulative effects will adversely impact on the heritage values of WBNP (i.e. ecological integrity, presentation and protection of the site) and its carrying capacity.
- Identify uncertainties and feedback to evaluate the accuracy of the assessment of cumulative effects and any proposed mitigation.

4.0 Project Description

For the purposes of this CSR the proposed project is discussed in three parts: the Highway 58 Extension/Garden River Access Road, the Fox Lake Access Road and the crossing of the Peace River. The details for each portion of the project are outlined in the following subsections. Due to the complexities of the Peace River Crossing the details for this portion of the project are located separately in Section 17.

Alberta Infrastructure and Transportation will remain the Road Authority for the new upgraded road section of roadway between Wentzel River and the boundary of WBNP. Parks Canada will be the road authority for the 7 km within the National Park and it will be maintained in accordance with the requirements of Park Canada's agreement with the LRRCN. The LRRCN will be the Road Authority for the Fox Lake Access Road. The Province of Alberta remains the Road Authority for the extension of Highway 58, and therefore that road will be designed, operated and maintained in accordance with Alberta Infrastructure and Transportation requirements that are applicable for that standard of roadway.

The project is proposed to be undertaken in four stages, as outlined in Table 4.1.

Table 4.1: Project Phases and Activities

Project Stage	Activities
Stage 1 – Predevelopment Site Investigation/Preparation Activities	- Alignment studies - Location surveys - Soil testing - Field survey for cultural and heritage resources - Route centre line location, minor clearing and grubbing - Environmental field investigations - Stream crossing investigations - Consultation - Preparation of environmental reports
Stage 2 – Site Preparation and Construction	- Obtain environmental approvals - Project tender process - Mobilization of equipment, materials and supplies - Use and storage of fuels, other materials - Disposal of wastes generated through construction, at approved sites - Activities associated with the removal and replacement of existing crossing structures

Project Stage	Activities
	- Installation and maintenance of the drainage culverts along the ROW - Cut and fill for roadbed - Establishment and operation of construction staging areas and storage yards - Development and use of borrow excavations - Construction of erosion control measures - Constructions site clean-up and restoration
Stage 3 – Operation and Maintenance of the Works	- Ongoing maintenance of the roadway including grading, repair and resurfacing - Ongoing maintenance of the bridge structures and bridge sized culvert structures - Control of vegetation along the access roads - Snow removal - Heavy equipment operation and transport - Small and large vehicle operation - Dust control measures - Right-of-way clean-up
Stage 4 – Decommissioning	- Decommissioning and reclamation of road that is no longer in use - Decommissioning, abandonment and restoration of any access trails used for construction - Decommissioning and reclamation of borrow sites - Operation of motor vehicles on roads - Operation of heavy equipment on roads

4.1 Highway 58 Extension/Garden River Access Road

The Garden River Access Road segment includes the upgrade of an existing 50.7 km access road from the terminus of Highway 58 to the community of Garden River of which 43.7 km of this road will be located within the Province of Alberta and 7 km within Wood Buffalo National Park (WBNP).

4.1.1 Drainage and Watercourse Crossing Structures

The upgrading of the Garden River Access road (Highway 58) and the construction of the Fox Lake access road is not expected to cause a disruption to the hydrogeologic (groundwater) conditions along either route. Bridge size culverts (with a diameter equal to or greater than 1500 mm) and bridge structures will be provided at all well defined watercourse and river crossings. Minor drainage culverts (with diameters equal to or less than 1400 mm) will be provided at locations where minor drainage courses and low areas along the routes cause a natural concentration of water. These culverts will allow surface water and immediate subsurface water to flow across the roadway, preventing water from ponding along the roadway and minimizing any head differential.

Modern road construction methods typically involve the removal of the upper 0.6 m to 1.0 m of existing surficial materials, which could include substantial silts and decayed organic matter. This excavated material is replaced with appropriately compacted fill material (good quality clay, gravel, etc.) to provide a stable base for the finished road grade.

In addition to 8 major watercourse crossings, there will be eleven minor watercourse crossings and numerous drainage culverts required along the length of the road. The minor watercourse crossings are identified as those where there is no defined channel, were dry at the time of the assessment and that the culvert is less than 1,500 mm in diameter. The minor watercourse crossings are designed to accommodate a 1:25 year stream flow. The sizing of the structures also considers debris passage, winter ice conditions and maintenance requirements. Drainage culvert installations are required to maintain current natural drainage paths and potential runoff. The culverts will minimize drainage redirection and reduce the potential for erosion. The locations of bridge sized watercourse-crossing structures and the minor stream culverts are listed in Table 4.2.

The roadway design is based on RLU-208G-090 standard cross section. This design standard is considered by AT to be appropriate for handling passenger and commercial traffic of up to 200 vehicles per day for movement of goods and services. The RLU-208G-090 standard includes 2, 4.0 m wide lanes and is rated at a 90 km per hour design speed. This design will allow for an 8 m wide gravel surface with 4:1 side slopes, 1 m high grade with 3.0 m flat bottom ditches. The right-of-way will be limited to a 40 m width within the Province of Alberta and to 30 m width within WBNP. The speed will be posted at 80 km per hour.

Table 4.2: Major and Minor Watercourse Crossings for Garden River Access Road

Kilometerage Marker (Location)	Watercourse Name	Watercourse Description[1]	Westworth (2005) Site #	Type[2]	Proposed Crossing Structure
Km 3+100	Wentzel River INFTRA Bridge File 76302	Class C, Tributary to Peace River, supports sport fish, navigable.	1	Type 2	Major 3 span bridge to be located 300 m upstream of the existing crossing structure. There will be two piers within the riverbed and the existing bridge crossing will be decommissioned.
Km 4+900	Unnamed	Non-visible channel, dry at time of assessment	2	Type 3	1 – 1200 mm culvert
Km 5+900	Unnamed	Intermittent	3	Type 3	1 – 1200 mm culvert
Km 6+100	Unnamed	Non-visible channel, dry at time of assessment	4	Type 3	1 – 1200 mm culvert
Km 7+100	Unnamed	Non-visible channel, dry at time of assessment	5	Type 3	1 – 1200 mm culvert
Km 9+255	Unnamed INFTRA Bridge File 81942	Tributary to the Wentzel River, low potential for sport fish, potential for forage fish.	6	Type 3	CSP 1- 2700 mm
Km 10+500	Unnamed	Non-visible channel, dry at time of assessment	7	Type 3	1 – 1200 mm culvert

Kilometerage Marker (Location)	Watercourse Name	Watercourse Description[1]	Westworth (2005) Site #	Type[2]	Proposed Crossing Structure
Km 11+800	Unnamed	Non-visible channel, dry at time of assessment	8	Type 3	1 – 1200 mm culvert
Km 13+880	Rennie Creek INFTRA Bridge File 81938	Class C stream, forage fish	9	Type 3	CSP 3 – 2700 mm
Km 16+000	Unnamed	Non-visible channel, dry at time of assessment	10	Type 3	1 – 1200 mm culvert
Km 17+000	Unnamed	Non-visible channel, dry at time of assessment	11	Type 3	1 – 1200 mm culvert
Km 19+100	Unnamed	Non-visible channel, dry at time of assessment	12	Type 3	1 – 1200 mm culvert
Km 21+500 to 21+800	Unnamed	Non-visible channel, dry at time of assessment	13	Type 3	3 – 1200 mm culverts
Km 22+656	Unnamed INFTRA Bridge File 81943	Tributary of Waldo Creek, unmapped water body, forage fish.	14	Type 3	Corrugated Steel Pipe (CSP) 1 - 2400 mm
Km 24+355	Waldo Creek INFTRA Bridge File 81939	Unmapped, forage fish, low potential for sport fish.	15	Type 3	Steel Plated Corrugated Steel Pipe (SPCSP) 1-3990 mm
Km 27+000	Unnamed	Second Order Tributary of Waldo Creek, Class C, low potential for fish	16	Type 3	1 – 1200 mm culvert
Km 29+505	Fitz Creek INFTRA Bridge File 81940	Class C, forage fish potential, low sport fish potential	17	Type 3	CSP 3 - 2700 mm
Km 40+403	Pakwanutik River INFTRA Bridge File 79359	Class C, forage fish potential, low sport fish potential	18	Type 2	Standard bridge 3 – 12.8 m spans
Km 48+851	Garden Creek INFTRA Bridge File 79356	Class C, support sport fish., navigable	19	Type 2	Standard bridge 3 – 12.8 m spans

1. From Westworth Environmental Associates Ltd. 2003
2. Refers to type as per Alberta Code of Practice for Watercourse Crossings

4.1.2 Borrow pits

Borrow pits are excavations which provide earth borrow for constructing the roadway embankment. They are typically located at 1.5-2 km intervals along the roadway with a minimum of 40 m buffer zone between the borrow pit and the roadway right-of-way, and for the purposes of this assessment the average size of a borrow excavation is assumed to be 200 m by 200 m in size, including other associated infrastructure such as access roads. Authorization required from provincial regulators are obtained by the proponent and salvage of topsoil and reclamation of all disturbed areas are strictly controlled in order to meet the conditions of authorizations. Within WBNP no borrow pits will be constructed as the required earth borrow will be imported from excavations located outside (west) of the park boundary as required by Parks Canada. A pre-disturbance investigation and post-assessment will be undertaken.

4.1.3 Gravel pits

Gravel pits are operated by private companies or government on private property or on crown lands and are separate from the roadway construction contract. Gravel pit development and reclamation is regulated by Alberta Sustainable Resource Development and Alberta Environment.

Earth borrow from along the roadway as well as common excavation obtained from excavation within the roadway right-of-way is used to construct the roadway embankment therefore only surfacing gravel is required to construct the roadway. Typically surfacing gravel would be placed at a rate of 500 cubic meters/km, which equates to approximately 31,000 cubic meters of gravel. Opening a gravel pit to supply this small amount of gravel would not be cost effective.

Roadway construction contracts in Alberta require the Contractor to supply gravel to the project from either the owners existing gravel pit (Optional Source) or from private sources where the Owner does not have an existing source in close proximity to the project. In the case of Garden River/Fox Lake Access Roads there is no existing source therefore the work will be completed under a "Contractor Supply of Gravel with no Option" scenario. No gravel pits will be developed specifically for the construction of the Garden River/Fox Lake Access Roads. Gravel is delivered from existing gravel pit operations to the project and used to surface the roadway. In addition Heavy Rock Rip Rap will be supplied to the project from existing sources obtained by the Contractor for use in stabilizing inlets and outlets of culverts as well as headslopes on the clear span bridges.

4.1.4 Bypasses

There are existing bypasses located on provincial lands that will be reclaimed during construction activities in accordance with the requirements of Alberta Environment's *Environmental Protection Guidelines for Roadways*.

Table 4.3: Borrow Locations – Garden River Access Road

Kilometerage Marker	Location Adjacent to Right-Of-Way
3+700	South
4+200	North
6+500	North
8+000	North
8+800	South
10+700	South
11+000	North
12+500	North
12+500	South
14+000	North
15+000	North
15+500	South
16+500	South

Kilometerage Marker	Location Adjacent to Right-Of-Way
18+000	South
25+300	South
27+500	North
31+700	North
31+700	South
32+000	North
34+500	North
34+500	South
37+000	North
38+000	North
39+500	South
40+000	South
41+550	South
42+300	South
42+300	North

Table 4.4: Location and Area of Existing Right-of way to be Reclaimed – Garden River Access Road

Kilometerage Marker	Side of Road	Approximate Area (ha)
3+000	Right	2.24
3+200	Left	0.18
8+700	Right	0.97
17+400	Right	0.41
21+000	Left	14.66
27+000	Left	5.06
47+000	Left	2.90
Total		26.42

4.2 Fox Lake Access Road

The Fox Lake Access Road segment includes the construction of a 14.1 km length of an all-weather access road. The access road is located just east of the Wentzel River from km 2.2 on the Garden River Access road, south to the Peace River.

4.2.1 Drainage and Watercourse Crossing Structures

There are three major watercourse crossings, three minor watercourse crossings and numerous drainage culverts required for this access road. The minor watercourse crossings would be those where the culvert is less than 1500 mm in diameter, and are not considered to support fish. Table 4.5 provides a listing of the proposed crossing structures required for this access road.

At the present time, there is an existing winter road right-of-way that is 15 m in width from km 0 to km 7.0. This right-of-way will be widened to 40 m. There is no road corridor or right-of-way from km 7.0 to km 14.1. The Fox Lake Access Road will be constructed to the same standard as the Garden River Access Road.

Table 4.5: Major and Minor Watercourse Crossing Structures for the Fox Lake Access Road

Kilometerage Marker (Location)	Watercourse Name	Watercourse Description[A]	Site #	Type[B]	Proposed Crossing Structure
Km 3+123	Unnamed	Tributary to Wentzel, potential to support sport fish.	30[A]	Type 3	1- 2700 mm CSP culvert
Km 3+750	Unnamed	Dense wet shrub, no discernable fish habitat	31[A]	Type 3	1 – 1200 mm CSP culvert
Km 6+420	Unnamed	No visible channel	32[A]	Type 3	1 – 1200 mm CSP culvert
Km 7+700	Unnamed	No continuous defined channel, potential for fish presence is low	33[A]	Type 3	3 – 1200 mm CSP culvert
Km 12+488	Dummy Creek	Tributary to Wentzel, potential to support sport fish	34[A]	Type 1	Standard bridge, 1 – 12.8 m span
Km 14	Peace River	Major River	24[C]	Type 1	Major bridge, 10 – 100 m spans

A. From AMEC Earth & Environmental, 2004a
B. Refers to classification according to *Alberta Code of Practice for Watercourse Crossings*

4.2.2 Borrow pits

Borrow excavations will be developed for the sourcing of material(s) for the construction of the sub-base of the roadbed. For the purposes of this assessment the average size of a borrow excavation is assumed to be 200 m by 200 m in size, including other access roads. The sites that have been identified for borrow extraction are located on and immediately adjacent to the right-of-way within the Province of Alberta and are listed in Table 4.6. The borrow excavations and associated infrastructure will be developed and reclaimed to INFTRA requirements. A pre-disturbance investigation and post-assessment will be undertaken.

Table 4.6: Borrow Locations – Fox Lake Access Road

Kilometerage Marker	Location Adjacent to Right-Of-Way
0+600	East
0+700	West
1+600	West
5+500	West
7+000	West
7+000	East
7+100	East
7+500	East
12+700	West
12+700	East

4.2.3 Bypasses

There are some portions of the existing winter road on the Fox Lake Access Road that will require reclamation once the all-season alignment is constructed. The extent of reclamation is less than that required for the Garden River Access Road and is estimated at 2.43 ha. There are existing bypasses located on provincial lands that will be reclaimed during construction activities in accordance with the requirements of Alberta Environment's *Environmental Protection Guidelines for Roadways*

The areas will be recontoured to provide proper drainage and stability and soil compaction will be addressed. Salvaged soils will be replaced in the same sequence as found before disturbance and then revegetated with native species. Table 4.7 provides a list of locations and approximate areas that will be reclaimed.

Table 4.7: Location and Area of Existing Right-of way to be Reclaimed – Fox Lake Access Road

Kilometerage Marker	Side of Road	Approximate Area (ha)
0+000	Left	0.38
1+120	Right	1.05
1+880	Left	0.50
2+750	Right	0.50
Total		2.43

4.3 Site Preparation Activities

Site preparation activities are those activities that are undertaken prior to initiation of construction and serve primarily to assist in development of the final design or to address areas of uncertainty with respect to the design of the facilities. Site preparation activities include further studies and surveys of the proposed alignment. Soil testing and geotechnical investigations will be undertaken at select locations along the alignment to assist in development of the final design. Further field surveys for cultural and heritage resources will also be undertaken prior to construction.

Surveying will include the cutting of a centerline and cross-section offsets, wide enough to provide unobstructed sight lines and to allow access along the right-of-way (ROW) for vehicle and/or geotechnical equipment. The use of an existing right-of-way will help to minimize clearing and grubbing in relation to the centerline establishment. Clearing will take place outside of the breeding season for birds. Survey crews will carry out any garbage, tree cutting would follow generally accepted practices, and the crew will take all necessary precautions to prevent pollution or obstruction of any watercourses.

The limits of clearing will be flagged in advance of any clearing activity. Flagging will occur during surveying and is done to limit the amount of clearing to that which is required for construction of the road and associated facilities. Clearing will involve the removal of trees from the preferred 40 m right-of-way (provincial lands) and 30 m right-of-way (Wood Buffalo National Park) and the borrow sites. Timber will be salvaged according to provincial requirements. Vegetation will be removed by mechanical means, using conventional harvesting techniques and equipment typically employed in Alberta. INFTRA construction standards relevant to clearing will be followed. Primary environmental objective during clearing is to minimize ground disturbance that may result in erosion and sedimentation of wetlands and watercourses.

Grubbing typically involves the removal of all organic material and unsuitable soils above the underlying soils. All stumps, roots, downed timber, humus, root mats and topsoil are removed for all areas of excavations. Grubbing is usually completed using bulldozers to scrape the materials from the underlying soil and to place in piles along the right-of-way. Topsoil will be salvaged where possible. Grubbed materials would be disposed of in accordance with Provincial requirements.

If required, further field investigations will also be undertaken during site preparation. Further investigations at the various stream crossing locations may be undertaken to assist in finalizing any mitigation or compensation plans. Further geotechnical investigations may be required. These may involve the drilling of boreholes or the excavation of test pits along the centerline and offsets to determine subsurface conditions. Some further clearing may also be required. Any such clearing would be undertaken in accordance with established procedures.

Access across watercourses and wetlands during the site preparation activities will be in accordance with any applicable permits and/or requirements. Appropriate environmental protection measures for these activities will be in accordance with Provincial requirements.

The proponent shall continue to consult with stakeholders and relevant federal and provincial departments during the site preparation phase. These consultations will serve to ensure that commitments made in this environmental assessment are being met. The proponent will also document the results of any further investigations and consultations and provide these to the relevant departments and agencies and responsible authorities as required.

4.4 Construction Activities

Construction activities are those activities that are related to or involve the installation of the proposed works. Construction activities typical for road projects of this nature typically involve five categories of activity:

- Site preparation includes those activities associated with preparing the site for road and structure development, such as surveying, clearing and removing any obstructions;
- Roadbed preparation involves those activities that are associated with the construction of the roadbed such as cut and fills and drainage culverts;

- Watercourse Crossing Structures include activities involved in the placement and installation of any bridges or culverts;
- Finishing involves activities related to the final preparation of the facilities to handle traffic including fencing and signing as appropriate;
- Associated Structures and Facilities includes those activities related to the development of temporary facilities such as borrow excavations, access roads, storage or staging areas and disposal areas.

4.4.1 Roadbed Preparation

Earthworks will consist of the cut and fill for the roadbed. The roadbed will be prepared by cutting the high areas and filling the low areas to provide an appropriate vertical alignment. The roadbed is constructed by placing material in layers of a specified thickness, compacting each layer until the desired elevation is achieved. Some 1,284,500 m^3 of material will be excavated along the Garden River segment and some 361,900 m^3 of material along the Fox Lake segment. Roadbed preparation will require the development and use of borrow excavations. Some 732,000 m^3 of borrow excavation is required along the Garden River Segment and 106,700 m^3 of borrow material is required along the Fox Lake segment. The LRRCN and INFTRA will supply borrow for the project. Roadbed preparation is completed using various earth moving machinery such as bulldozers, excavators, graders, loaders and haulers. Compaction is achieved using soil compactors. A total of 20,180 m^3 of surface gravel is required for the Garden River segment of the Project and 5,800 m^3 of surface gravel is required for the Fox lake segment.

4.4.2 Watercourse Crossing Structures

The removal and replacement of the watercourse crossing structures will require the development of temporary detours at all watercourse crossing sites. In most cases the detour will be constructed within the right-of-way although there will be situations where the temporary detour will extend outside of the right-of-way. Contractors will be limited to the terms and conditions in the permits, authorizations and or approvals obtained by the consultant on behalf of the owner. The construction activities will also include the installation of drainage culverts throughout the road alignment. A total of five bridges are proposed to be constructed, with four of the bridges involving the construction of piers in the watercourse. The construction of the bridge foundations will be done so such that impacts to fish habitat and siltation due to construction are minimized. Pier construction will be done in the dry, inside a berm/cofferdam. No instream activity, other than the installation of the berm/cofferdam, will occur during most of the construction period. The majority of watercourses crossings will be accomplished using culverts. Culvert installation usually involves creating a dry work area through constructing temporary stream diversion. This allows the culvert to be properly placed and backfilled. All instream work would be completed during low-flow periods and to avoid interference with fish spawning, incubation and hatching activities. Detailed erosion control plans will be prepared as part of the ECO and ESCP prior to construction and installation of the culvert. For those watercourses where fish passage must be maintained, the culverts will be designed so as to not interfere with fish passage.

4.4.3 Associated Facilities

Construction equipment staging areas or construction camps will be the responsibility of the contractor. The contractor will be required to obtain the necessary permits (i.e., temporary field authorizations) for these facilities, which would be obtained from the provincial Public Lands office. There will be no construction camps, equipment staging areas or borrow excavations sited within Wood Buffalo National Park (WBNP).

A summary of estimated quantities of materials that will be used during construction and areas to be reclaimed for the access roads is provided in Table 4.9.

Site clean-up and restoration activities will also occur during the construction phase. Any borrow excavations established during the construction phase will be reclaimed in accordance with INFTRA requirements.

4.5 Operation and Maintenance Activities

The operation and maintenance of the Garden River Access Road will be in accordance with provincial highway standards. In accordance with Parks Canada requirements, an operation and use agreement for the 7 km of road within the WBNP will be in place. The agreement will include environmental provisions and reporting requirements. The local access road to Fox Lake will be maintained in accordance with the requirements as defined by Alberta Sustainable Resource Development (ASRD).

Maintenance activities associated with this type of road are typically of a minor nature and include the addition of gravel, vegetation control and the removal of debris from culverts. In the winter, the road authority will be responsible for snow removal. De-icing agents such as salt shall not be used on gravel surfaced roads. In the summer, the Road Authority is responsible for grading and gravelling the road surface.

Table 4.9: Summary of Project Construction Activities

Activity	Garden River Access Road	Fox Lake Access Road
Clearing and grubbing	56.9 ha	45.1 ha
Clearing and timber salvage – right-of-way	45.4 ha	11 ha
Clearing and timber salvage – borrow excavation	44 ha	4 ha
Reclamation of existing bypasses and road corridor	26.42 ha	2.43 ha
Common excavation	1,284,500 m^3	361,900 m^3

Activity	Garden River Access Road	Fox Lake Access Road
Borrow excavation	732,000 m^3	106,700 m^3
Geotextile matting	95,000 m^2	30,000 m^2
900 mm centerline culvert	2,050 m	208 m
Topsoil placement	649,200 m^2	267,100 m^2
Seeding, fertilizing and harrowing	65 ha	27 ha
Surface gravel	20,180 m^3	5,800 m^3
1200 mm culvert	11 crossings	3 crossings
2400 mm culvert	1 crossing	-
2700 mm culvert	3 crossings	1 crossing
3990 mm culvert	1 crossing	-
Bridge	3 bridges: Wentzel River, Pakwanutik River and Garden Creek	2 bridges: Dummy Creek and Peace River

4.6 Decommissioning Activities

Decommissioning activities refer to those activities that relate to cessation of operations and/or removal of facilities and works, such that the facility or work can no longer serve the purpose for which it was originally intended. In the case of the Highway 58 Extension and Fox Lake Access Roads Project, there are no current plans for the modification, upgrades or other alterations, or for the decommissioning of the main elements of the Project. The works are designed to operate indefinitely within the expected life spans of each component (i.e. roadway and watercourse crossing structures), and it is anticipated that the lifespan would be extended as required. The typical design life of a road is 20 years, the design life of a bridge structure is 70 years and the design life of a watercourse culvert crossing is 50 years.

The Project's primary works are considered to the Garden River and Fox Lake access roads and associated bridge structures. The Garden River Access Road is an extension of Highway 58 and as such will be owned by the Province of Alberta. The decommissioning of this provincial Highway is currently not contemplated.

The owner of Fox Lake Access Road will be the LRRCN, and therefore the LRRCN will be responsible for decommissioning of the Fox Lake Road. The decommissioning of the Fox Lake Road, including bridges and culverts, is currently not contemplated.

There are a number of existing watercourse crossing structures that will be removed during the construction of the project and replaced with new structures. In addition, construction of the Project will require the creation of a number of borrow excavations to supply material. These excavations will be reclaimed and decommissioned following construction. Decommissioning and reclamation will follow provincial requirements and will involve grading to topsoil placement as appropriate and reseeding.

4.7 Implementation Schedule

The anticipated Project schedule is outlined in Table 4.10.

Table 4.10: Project Schedule

Project Phase	Time Frame
Predevelopment Site Investigation/Preparation Activities	January 2004 – January 2005
Site Preparation and Construction – Roadway	January 2007 -October 2010
Operation and Maintenance of the Works	October 2010- indefinitely
Anticipated Future Related Activities (Monitoring)	To end in October 2011

4.8 Alternatives

Section 16(2) of the *Canadian Environmental Assessment Act* requires that a consideration of project alternative be included in every comprehensive study assessment as follows:

- Alternatives to the project are those functionally different ways of achieving the project need and meeting the project purpose.
- Alternative means are the various ways that are technically and economically feasible, that the project can be implemented or carried out. This could include for example, alternative locations, routes and methods of development, implementation and mitigation.

The project that has been proposed is the construction and operation of an all-season access road, in two segments. The first segment involves 50.7 km of road starting from the terminus of the existing Provincial Highway 58 and extending to the community of Garden River. The final 7 kilometres of this segment are located within Wood Buffalo National Park. The second segment involves the construction of 14.1 km of road starting near the terminus of Provincial Highway 58 (west of Wentzel River) and extending to the west bank of the Peace River. A 1030 m bridge is proposed to cross the Peace River connecting the road with the community of Fox Lake.

4.9 Alternatives To the Project

In 1958, a road right-of-way was established from the terminus of Highway 58 (at Highway 88 turn-off) to the communities of Garden River and Peace Point within Wood Buffalo National Park (WBNP). The right-of-way was cleared and used as a winter haul road in the 1960's. The portion within WBNP from Garden River to Peace Point was taken out of use when road access to Peace Point was established from Fort Smith. During the 1980's, the Province of Alberta extended Highway 58, providing all-season access to the community of John D'Or. A winter access road to the community of Fox Lake was constructed and the road to community of Garden River remained a winter road.

Potential alternatives to the Project include:

- Do nothing;
- Other modes of transportation (e.g. air)
- Upgrading the existing winter roads to all-season roads;

<u>The Do Nothing Option</u>

The do nothing option would involve continuing to utilize the existing winter roads to access the communities of Garden River and Fox Lake. There would not be any action taken to upgrade the existing winter roads to all-season. Air service would be available to access the communities, but would not provide all-season access to the communities. By definition, the do nothing option fails to meet the project need and purpose, as all-season access is not provided to the communities of Garden River and Fox Lake.

When considering alternatives to the project, it is agreed that the "Do nothing" option would have the least impact on the environment for the Fox Lake Road. It should also be recognized that there is an environmental consequence and likely public safety consequence of not improving the culverts, roadside drainages as well as the bridge structures on the Garden River Road. There are numerous vertical cut slopes which do not support vegetation and many of the existing bridges consist of old railway cars or have badly deteriorated. These proposed improvements will address both the environmental and public safety issues.

<u>Other Modes of Transportation</u>

Upgrading of the air access could be considered as an alternative to the project. This would involve upgrading the airstrips at Garden River and Fox Lake to accommodate aircraft during all seasons and weather conditions. Such an alternative would not completely address the communities' need for all of its requirements (e.g. from an economic activity, supply of goods and materials, service delivery, health care and public safety perspective).

<u>Upgrading the existing winter roads to all-season roads</u>

Upgrading the existing winter roads was identified as the preferred alternative on the basis of its ability to meet the needs of the Communities of Garden River and Fox Lake.

4.10 Alternative Means of Carrying out the Project

4.10.1 Introduction

Alternative means of carrying out the Project have included a consideration of the various ways in which all-season road access could be provided to Garden River and Fox Lake. Five options were identified and there locations are provided in Figure 2:

Option 1 – Fort Vermillion Option

This option involves constructing an all-weather access road running in a southwesterly direction and then westerly paralleling the south side of the Peace River, ultimately connecting with Highway 88 approximately 10 kilometers south of the Hamlet of Fort Vermillion. The access to Garden River would follow the existing winter road alignment as an extension to the existing Highway 58 and running easterly to Garden River within Wood Buffalo National Park. The option would require the construction of 153 kilometers of all-weather road (102 kilometers from Fox Lake to Fort Vermillion and 51 kilometers from the east end of the existing Highway 58 to Garden River). In addition to the road construction, four major bridge structures and eight bridge-sized culverts would be required.

Option 2 - John D'Or Prairie Option

This option involves constructing an all-weather access road running in a southwesterly direction for approximately 15 kilometers on the south side of the Peace River, crossing the Peace River and then constructing approximately 35 kilometers of road in a westerly direction on the north side of the Peace River to the community of John D'Or Prairie. The access to Garden River would follow the existing winter road alignment as an extension to the existing Highway 58 and running easterly to Garden River within Wood Buffalo National Park. This option would require the construction of 101 kilometers of all weather road (50 kilometers from Fox Lake to John D'Or Prairie and 51 kilometers from the east end of the existing Highway 58 to Garden River). In addition to the road construction, two major bridge structures and 8 bridge-sized culverts would be required. The Peace River would be crossed via a Ferry crossing.

Option 3 - Highway 58 Extension "A"

This option would involve the construction of an all-weather road commencing at the east end of the existing Highway 58 and would proceed easterly along the existing winter road alignment to the community of Garden River, within Wood Buffalo National Park. The connection to Fox Lake would commence 5.6 kilometers east of the east end of the existing Highway 58 and would proceed south for a distance of 11.4 kilometers to the north shore of the Peace River. The Peace River would be crossed by Ferry during the summer months and by an ice bridge during the winter months. This option would require the construction of approximately 61 kilometers of all-weather road (50 kilometers from the east end of the existing Highway 58 and 11 kilometers to the Peace River). In addition to the road construction, three bridge structures, 10 bridge-sized culverts and one Ferry crossing would be required.

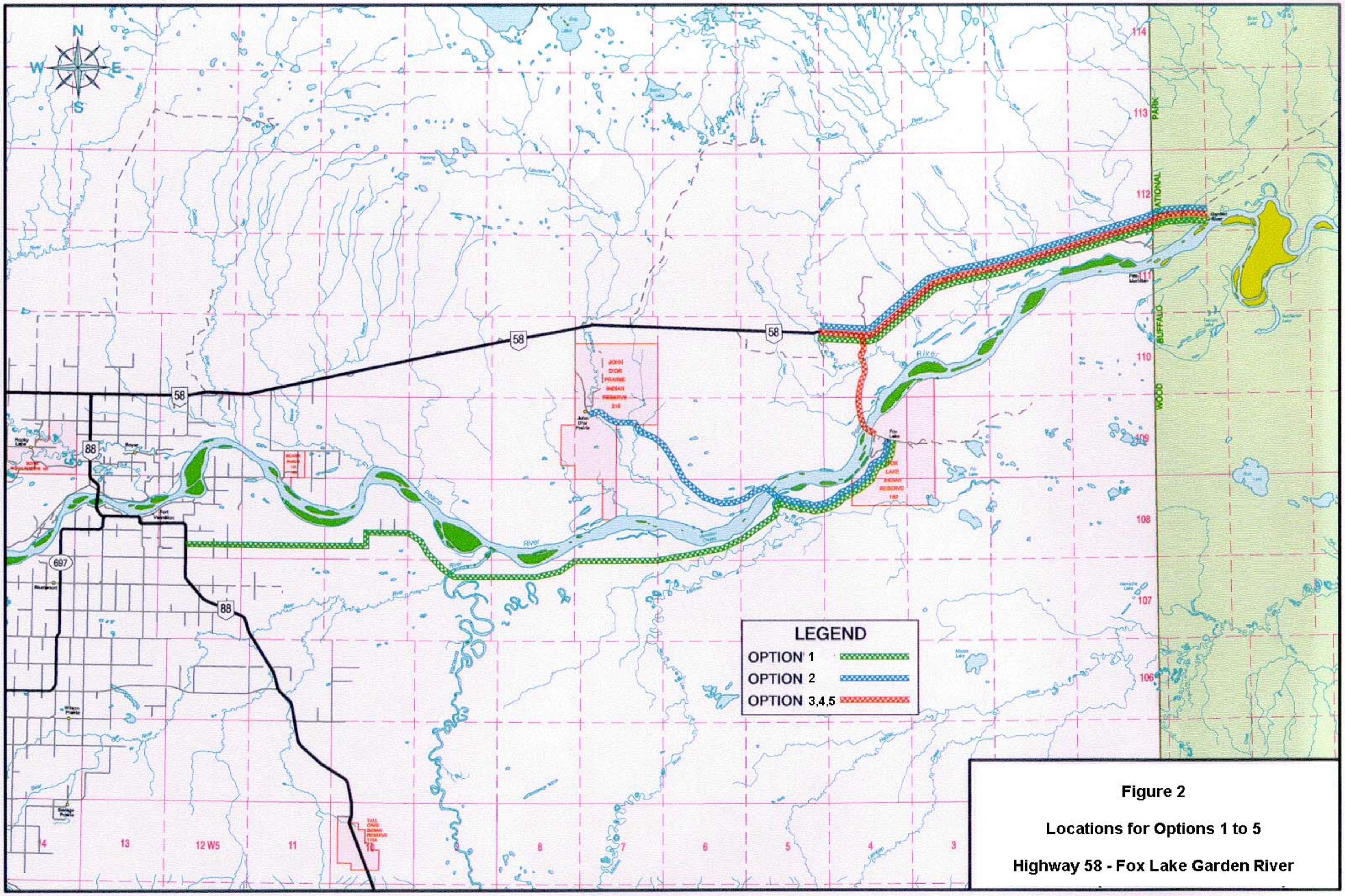


Figure 2

Locations for Options 1 to 5

Highway 58 - Fox Lake Garden River

Option 4 – Highway 58 Extension "B"

This option is similar to Option 3 in that it involves the construction of an all-weather road from the eastern end of the existing Highway 58 along the alignment of the winter road to the community of Garden River, within Wood Buffalo National Park. The alignment of the connection to the community of Fox Lake has been modified to avoid the need for a major crossing of the Wentzel River. The connection to Fox Lake would require 14.1 kilometres of all-weather access road. In total 64.8 kilometers of all-weather access road would be constructed, along with four bridge structures, 6 bridge-sized culverts and a Ferry crossing of the Peace River.

Option 5 – Highway 58 Extension / Peace River Bridge

This option is the same as Option 4, with the exception of the addition of a major bridge crossing of the Peace River. In total 64.8 kilometers of all-weather road would be constructed, along with one major bridge structure, four standard bridge structures and 6 bridge-sized culverts.

4.10.2 Consideration of Options

The decision regarding the preferred alignments and locations of watercourse crossings was based upon engineering feasibility, expected costs, environmental effects, and in agreement with LRRCN communities. A summary of the project alignment alternatives and the key rationale in their consideration is outlined in Table 4.11.

Table 4.11: Project Alignment Alternative Options

Alternative	Description	Rationale
Option 1 - Fort Vermillion Option	• 51 km of road service to Garden River • 102 km of road from Fox Lake to Highway 88 • Four major bridge structures and eight bridge size culverts	• Large travel distances for Community members • Higher construction costs • Higher long term maintenance costs. • Increased impacts to habitat and wildlife due to increased length of road
Option 2 - John D'Or Option	• 51 km of road service to Garden River • 50 km of road from Fox Lake to John D'Or • 50 km of road running parallel to the Peace River, including a crossing of the Peace River ending in John D'Or • Two major bridge structures and eight bridge size culverts and a ferry crossing	• Large travel distances for Community members • Higher construction costs • Higher long term maintenance costs • Increased impacts to habitat and wildlife due to increased length of road
Option 3 – 61.6 km	• 11.4 km of road to the Peace River crossing • 43.2 km of road from the end of Highway 58 to the east boundary of WBNP • 7 km of road from through WBNP to Garden River • Two major bridge structures, one standard bridge and ten bridge size culverts, and a ferry	• Increased impacts to habitat due to the replacement and construction of a new bridge over the Wentzell River • Increased impacts to fish and fish habitat due to the ferry crossing (as per EC and DFO concerns regarding the significant adverse (and unmitigable) impacts of the ferry crossing

Alternative	Description	Rationale
	crossing.	
Option 4 - 64.8 km	• 14.1 km of road to the Peace River crossing • 43.7 km of road from the end of Highway 58 to the east boundary of WBNP • 7 km of road from through WBNP to Garden River • Four standard span bridge structures, six bridge sized culverts, and a ferry crossing.	• Increased impacts to fish and fish habitat due to the ferry crossing (as per EC and DFO concerns regarding the significant adverse (and unmitigable) impacts of the ferry crossing
Option 5- 64.8 km	• 14.1 km of road to the Peace River crossing • 43.7 km of road from the end of Highway 58 to the east boundary of WBNP • 7 km of road from through WBNP to Garden River • One major span bridge structure, four standard span bridge structures and six bridge sized culverts.	• preferred option in May 2005

The three potential methods for crossing the Peace River include:

- Ferry crossing with open water disposal of dredged sediments
- Ferry crossing with upland disposal of dredged sediments, and
- Span bridge

Hydrological and environmental studies conducted by the proponent determined that the construction and operation of the ferry crossing resulted in significant costs and required significant resources associated with the disposal of the dredged sediments. AMEC Infrastructure determined that the costs associated with the acquisition of a vessel that would enable the movement of goods and services to the community of Fox Lake during most of the open water season was a good deal higher than originally estimated in the feasibility studies. Furthermore, DFO and EC indicated that the residual impacts from open water disposal of dredged sediments would not be acceptable (i.e. in violation of the Fisheries Act) and that other solutions would be necessary. The proponent undertook a review of the requirements for the disposal of the dredged sediments to an upland containment structure and determined that the costs were prohibitively higher than the open water disposal option. Due to the prohibitive costs of the upland disposal, this option was no longer considered viable. A comparison of the costs is provided in Table 4.12.

Table 4.12: Comparison of Lifecycle Costs for Ferry Crossing with Open Water Disposal and Upland Disposal of dredged Sediments

Activity / Item	"A" Cost Estimate	Life Cycle Costs (Based on 40 years)
Ferry vessel cost (one time capital cost)	$ 4,000,000	N/a
Open water disposal dredging (yearly)	$ 375,000	$ 18,750,000
Upland storage dredging (yearly)	$ 1,500,000	$ 75,000,000

Ferry operation and maintenance (yearly)	$ 560,000	$ 22,000,000
Ferry totals	$ 6,435,000	$ 116,150,000

The proponent concluded that the construction and operation of a ferry crossing resulted in significant costs (Table 4.12) in addition to significant environmental impacts associated with the disposal of dredged sediments.

Other crossing options that were identified by the proponent included a span bridge. An analysis of the lifecycle costs of a span bridge indicated that they were significantly lower than the cost of the ferry operation. A cost estimate comparing the cost of a ferry and a bridge was prepared including initial and lifecycle costs (Table 4.13)

Table 4.13: Costs associated with the construction of a ferry crossing versus a bridge

Project	"A" Cost Estimate	Life Cycle Costs (Based on 40 years)
Ferry open water disposal	$ 4,935,000	$ 41,150,000
Ferry – Upland disposal	$ 6,060,000	$ 97,400,000
Bridge (70year design life with rehabilitation at 20 – 30 years)	$ 24,000,000	$ 5,000,000

On the basis of environmental effects and economic feasibility, Option 5 was selected as the preferred alternative.

5.0 Environment Description

5.1 Environmental Setting

The following environmental setting description summarizes the technical documents as listed in Section 1.4 of this report. The Highway 58 study area is located in the Boreal Mixedwood ecoregion of the Boreal Forest Natural Region of Alberta. The Boreal Mixedwood ecoregion is divided into 4 natural subregions, 3 of which encompass the proposed road corridor. These include the Central Mixedwood, Dry Mixedwood and Peace River Lowlands natural subregions. Most of the road right-of-way falls within the Central Mixedwood and Dry Mixedwood natural subregions, while a small portion of the road corridor in Wood Buffalo National Park occurs in the Peace River Lowlands subregion.

The Highway 58 study area supports a diverse assemblage of vegetation communities. Forested areas are predominantly deciduous, including aspen with varying degrees of balsam poplar and paper birch in the canopy. White spruce, mixedwood, and jack pine stands also occupy upland areas, while black spruce and tamarack are associated with low lying bog areas, as are willow and bog birch shrubs. Willow and alder shrublands occupy transition areas between wet and drier soils. Sedges, reed grass, and cattails are commonly associated with wet meadow/marshy areas.

Soil characteristics are similar in all 3 natural subregions that occur in the study region. In well-drained upland till sites, soils are composed of Gray Luvisols, while coarse-textured sandy upland sites are characterized by Eutric Brunisols. Gleyed Luvisol and Gleysolic soils characterize forested sites along major river valleys and wet depressions.

Northern Alberta is characterized by a cool continental climate. Winters are long and cold, while the short summers are generally warm. During summer, large contrasts typically occur between day and night temperatures. The typical mean temperature is 13.6 °C, while in winter the typical mean temperature is –17.8 °C. Total precipitation during summer in is 210.8 mm, while in winter it is 86.3-mm. Total annual precipitation is 394.1 mm.

The topography along the road corridor is generally flat to slightly undulating. Elevations along the proposed road corridor vary from 232 – 290 m a.s.l. The Peace River is the major hydrological feature in the study area. Major tributaries to the Peace River that cross the road corridor include the Wentzel River, Pakwanutik River, and Garden Creek. The landscape north of the study area is dominated by the Caribou Mountains; this area is characterized by slightly cooler temperatures and higher summer precipitation than the road study area, and supports a unique assemblage of plant and animal species.

The fauna of Wood Buffalo National Park and the surrounding region is diverse and is described in detail in Section 6.0 of this report; however, a brief summary is provided below. Forty-six species of mammals have been recorded in and around the park. The region supports populations of wood bison, woodland caribou, moose, black bear, grey wolf, lynx, snowshoe hare, beaver, muskrat and mink. Both the wood bison and the woodland caribou are threatened species in Canada under the *Species at Risk Act*.

In the case of avifauna, over 225 species have been recorded in Wood Buffalo National Park and adjacent areas. Some of the species include the endangered whooping crane, threatened peregrine falcon, bald eagle, great grey owl, snowy owl, and willow ptarmigan. The Peace-Athabasca Delta also provides important breeding and staging habitat for a diversity of waterfowl species.

Although herptofauna are not abundant, the Canadian toad, leopard frog and red-sided garter snake may reach their northern limits in the vicinity of the Highway 58 study area. The boreal chorus frog and wood frog are also present in aquatic habitats throughout the region (Russell and Bauer 1993). The northern leopard frog has been listed as special concern under the *Species at Risk Act*.

Fish fauna in Highway 58 study area have been poorly studied to date. However, 36 species (4 of which have been introduced) are known to occur in region including pearl dace, fathead minnow, Iowa darter, ninespine stickleback, inconnu, goldeye, walleye, mountain whitefish, lake whitefish, northern pike, and longnose and white suckers.

5.2 Existing Infrastructure

5.2.1 Garden River Access Road

The existing road right-of-way from the end of Highway 58 to the community of Garden River in Wood Buffalo National Park (WBNP) was established since 1958. During the winter months, the road is maintained as a winter road and during the summer months, the roadway is used as a travel corridor and is used year round by community members and seasonally by logging trucks. However, in the summer months the road is difficult or impassable to travel in wet weather, and is restricted to four-wheel drive vehicles. Included in this right-of-way is a power line that was constructed by ATCO in 2004. The LRRCN Public Works department maintains the roadway and bridges from the end of Highway 58 to the community of Garden River.

Outside of WBNP, the average width of the road corridor right-of-way is approximately 22 m. Within the WBNP the average width is estimated to be 17.5 m. Existing watercourse crossing structures on the Garden River Access road and their current status are listed in Table 4.8.

The average annual daily traffic (AADT) volume in 2000 was 170 vehicles per day for 3 months of the year. Traffic volumes were measured on Highway 58 at Wentzel River. The increase in accessibility from 3 months of the year to 12 months per year to Garden River and 10 months per year to Fox Lake is expected to increase traffic volumes.

5.2.2 Fox Lake Access Road

On the east bank, the residents of Fox Lake use the landing as a boat launch and as a water pump house access road. The existing landing consists of a cleared and compacted granular landing that is approximately 25 m in width and transitions upslope to a narrower 12 m access roadway. An upper staging area is located about 40 m from the waters edge and is approximately 25 square metres in size.

On the west bank, there is an existing ice bridge ramp that consist of a 12 m wide access extending from the upper winter road to the river's edge. There is also a 40 x 25 m staging area located approximately 25 m from the Peace River.

5.3 Data Collection Tools and Methods

5.3.1 Assessment Boundaries

5.3.1.1 Spatial Boundaries

The Highway 58 project was divided into 2 general study areas to meet the requirements of the Terms of Reference. These areas included:

- Wood Buffalo National Park (7 km total) and
- Crown land within the Province of Alberta (57.9 km total).

Background information, fie ld survey data, impact analysis and mitigation planning were summarized and presented separately for each study area to assist with project review. However, because of the proximity of the 2 study areas, wildlife, vegetation and fisheries resources likely do not differ significantly between areas. As a result, information summaries (e.g., species lists) and impact tables were combined where possible to reduce report repetitiveness.

As described earlier, to further facilitate completion of the impact assessment, the proposed road corridor of road on provincial crown land was divided into 2 sections. These included Section A extending 45.4 km from the Wentzel River to the western boundary of Wood Buffalo National Park, and Section C extending 12.5 km from the east-west road corridor to the community of Fox Lake. Within Wood Buffalo National Park, the road corridor (Section B) extends 7 km from the park boundary to the community of Garden Creek.

5.3.1.2 Local and Regional Study Areas

<u>Terrestrial Study Components</u>

The road corridor was also divided into Local and Regional Study Areas to assist with the assessment process. For the terrestrial study components (e.g., wildlife, vegetation and heritage resources), the Local Study Area (LSA) included the existing road and areas immediately adjacent to this corridor that could potentially be physically impacted by road clearing and disturbance. This area extended 1 km on either side of the road centreline. Most of the field surveys for wildlife and vegetation were focused within this area.

The Regional Study Area (RSA) differed between study components. For example, the wildlife RSA extended approximately 25 km from either side of the road and differed considerably from the fish RSA (see below), which was based on watershed boundaries. The vegetation RSA extended 5 km on either side of the road corridor.

The vegetation RSA was selected to take into account potential dispersal of invasive plant species. The wildlife RSA was selected to ensure that any rare or sensitive species that potentially occur in the region would be identified, and also to take into account the movements of species with larger home ranges, such as moose and bison. Moose and bison are known to travel between the road area and the slopes of the Caribou Mountains. As a result, the southeast portion of the Caribou Mountains was included in the

RSA. An area south of the Peace River was also included in the RSA because the river is only considered a partial barrier to wildlife movements, especially during the winter period. See Figures 3 and 4 for local and regional study areas.

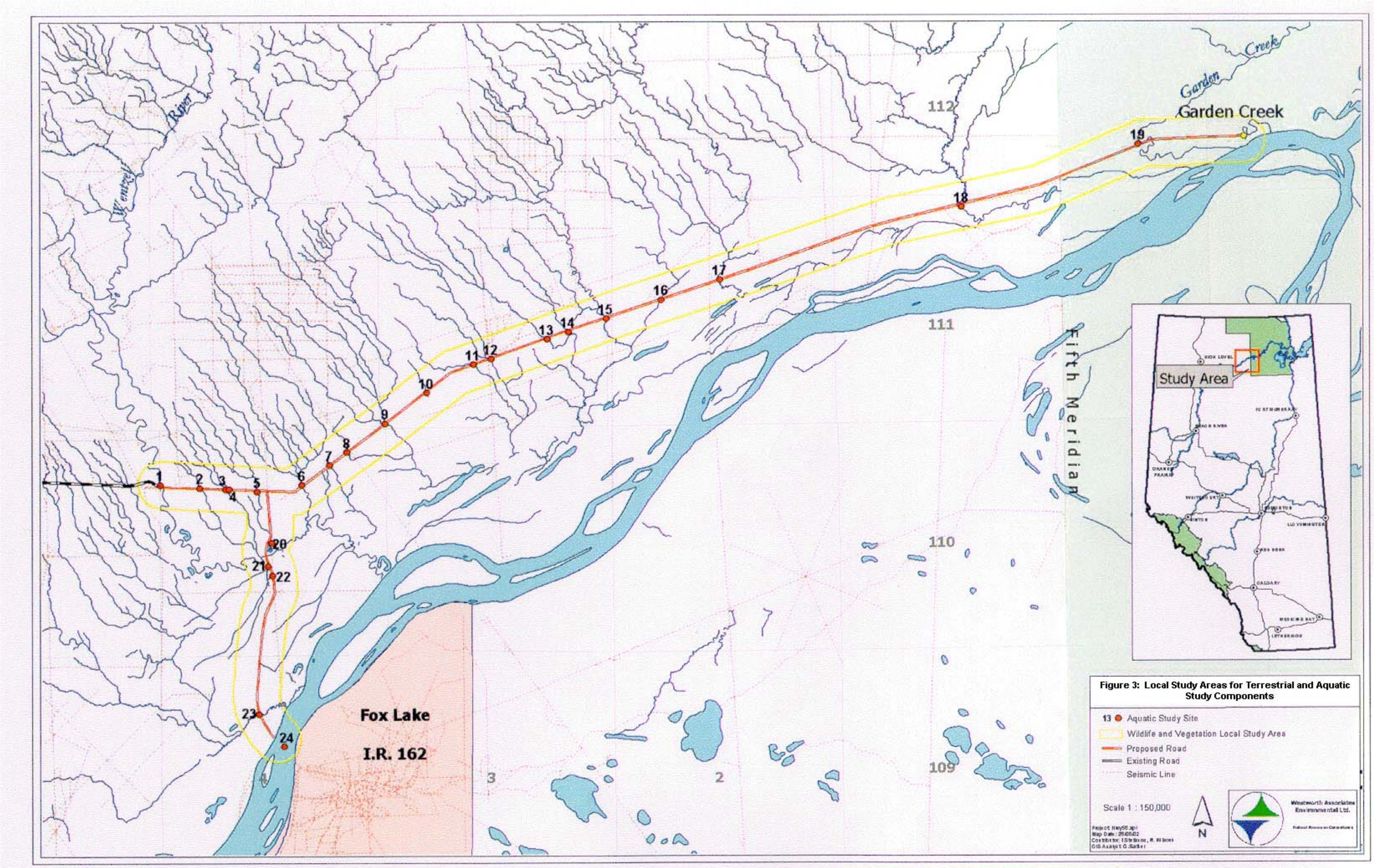
Aquatic Study Components

The fisheries LSA encompasses those watercourses and waterbodies that would be directly affected by the proposed Highway 58 project. Alberta Environment's Code of Practice for Watercourse Crossings (2001) identifies the zone of impact as *"the area of bed and banks of a waterbody that will be altered or disrupted as result of the works and where 90% of the sediment discharged as a result of the works will be deposited"*. For consistency during the environmental assessment, the same LSA was used for fish and fish habitat as for wildlife, vegetation, and soils. It should be noted, however, that the fish and fish habitat LSA is not a continuous entity, but rather is comprised of discrete sections at the proposed road crossing locations. Within the Peace River mainstem, the LSA extends approximately 500 m upstream and 1,800 m downstream of the proposed crossing.

The fisheries RSA was selected to examine the potential effects of the proposed Highway 58 project on regional fish populations. The selection of the RSA considered existing knowledge of the fisheries resources in the area and the likely spatial extent of potential impacts, other than physical land disturbances, that could measurably affect fish populations. The zoogeographical distribution and migration of several fish species found in the watercourses potentially affected by the project also includes the mainstem of the Peace River. Therefore the RSA was defined to include the watersheds crossed by the proposed road, and included the drainages of Dummy Creek, Wentzel River, Waldo Creek, Pakwanutik River, Garden Creek, and the Peace River mainstem from Vermilion Chutes to Boyer Rapids

5.3.1.3 Temporal Boundaries

The temporal boundaries of the project were divided into short-term and long-term impacts. Short-term impacts were associated with the clearing and construction phase of the project, while long-term impacts were associated with the ongoing operation and maintenance of the road following construction. Reclamation of the road was not considered in the long-term assessment, since the road is being constructed to provide permanent access to the communities of Fox Lake and Garden Creek.


Garden Creek
Wentzel River
112
111
110
109
Fifth Meridian
Fox Lake
I.R. 162
3
2
Study Area
Figure 3: Local Study Areas for Terrestrial and Aquatic Study Components
13 Aquatic Study Site
Wildlife and Vegetation Local Study Area
Proposed Road
Existing Road
Seismic Line
Scale 1 : 150,000
N
Westworth Associates Environmental Ltd.

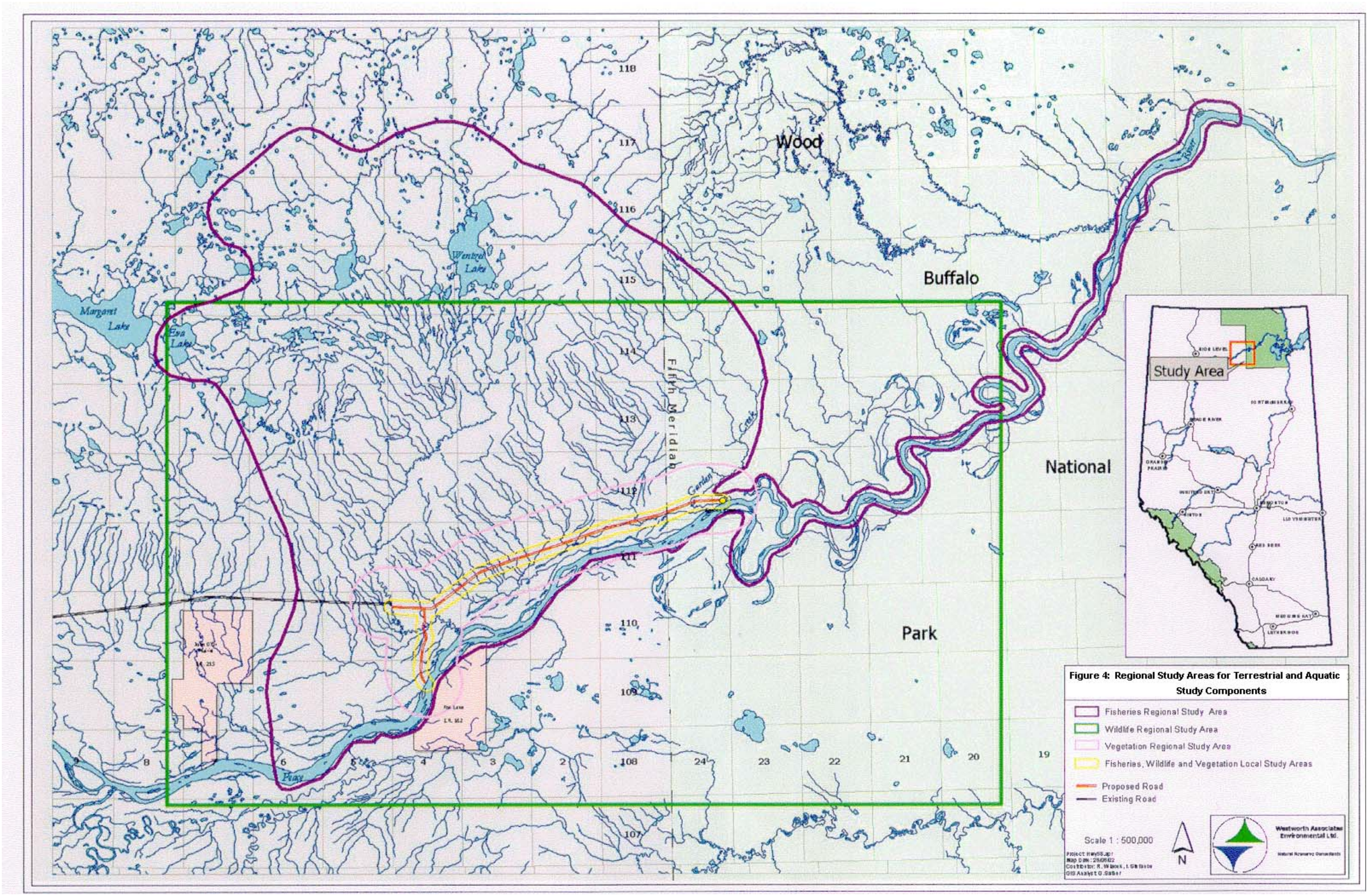


Figure 4: Regional Study Areas for Terrestrial and Aquatic Study Components

5.3.2 Landforms and Soils

5.3.2.1 Review of Existing Information

Existing information on soils in the Highway 58 study area was obtained from several studies, including Lindsay et al. (1959, 1961) and Marshal and Schut (1999).

5.3.2.2 Field Studies

Soil samples were taken at various locations along the proposed road alignment. A 15 cm diameter continuous flight auger was used to drill for samples. Subsoil type samples (as determined by colour or texture changes) were placed into plastic sample bags. Approximate soil moisture and texture was recorded on site using hand testing and the hole characteristics were logged including major changes (i.e., if sufficient material was present to clearly determine profile depths). Samples were returned to the EXH Engineering Services Ltd. laboratory for detailed analysis of soil moisture content and texture.

5.3.3 Vegetation

5.3.3.1 Review of Existing Information

Several vegetation studies and data sources were reviewed during the preparation of this report. Previous assessments along the road corridor provided some site-specific background information (e.g., Reid Crowther & Partners Ltd. 1982, Torchinsky Engineering Ltd. 1995, Westworth Associates Environmental Ltd. 2000a,b) while general vegetation descriptions for Natural Subregions that included the study area were provided by Achuff (1994). Previous vegetation descriptions and mapping for Wood Buffalo National Park included Raup (1935), Scace & Associates Ltd. (1974), Airphoto Analysis Associates Consulting Ltd. (1979), Eccles (1988), Timoney et al. (1997), and Timoney (1998). Information on rare/uncommon plant species occurrence and potential was obtained from the Alberta Natural History Information Centres (ANHIC 2002) rare plant tracking lists and from information/reports of Timoney and Robinson (1993 and 1996). Information on invasive species was obtained from Wein et al. (1992) and Westworth Associates Environmental Ltd. (2000a,b).

5.3.3.2 Habitat Mapping

Prior to conducting field sampling for terrestrial study components (i.e., vegetation and wildlife), vegetation types were delineated in the Local and Regional Study Areas. Vegetation types on provincial crown land were delineated using Alberta Vegetation Inventory data that was obtained from Little Red River Cree Forestry Ltd., Woodlands Division. In contrast, vegetation types in Wood Buffalo National Park were determined primarily through air photo interpretation as well as vegetation inventory data obtained from Parks Canada for Timber Berth 408. However, vegetation inventory data for Timber Berth

408 only provides partial coverage of the Local and Regional Study Areas in Wood Buffalo National Park.

5.3.3.3 Field Surveys

Species composition of the mapped vegetation types was determined using 2 x 2 m survey plots. A reconnaissance survey was also conducted in wetland areas to identify the potential occurrence any rare and sensitive plant species. Several survey plots were established in each vegetation type. Percentage cover of low shrubs, herbs, mosses and lichens was identified in each plot, while the % cover of trees and tall shrubs was determined outside of plots. Each plot location was recorded using a Global Positioning System (GPS). Where possible (i.e., provincial crown land), specimens that could not be identified in the field were collected and later identified by botanists at the Northern Forestry Centre of Natural Resources Canada.

5.3.4 Aquatic Resources

5.3.4.1 Review of Existing Information

A review of existing fisheries information was conducted and included a search of published and unpublished reports, maps, file data and aerial photographs available from government files, consultant and university libraries and the Little Red River Cree Nation. In addition, a number of individuals familiar with the area were also contacted to determine if additional data was available. Fisheries Management Information System (FMIS) maintained by the Fish and Wildlife Division of Alberta Sustainable Resource Development was queried for pertinent fisheries data.

5.3.4.2 Field Surveys

Field surveys were conducted in August 2002 to supplement existing fisheries information in the Highway 58 study area and to obtain site-specific fish and fish habitat data as required by Alberta Environment's Code of Practice for Watercourse Crossings in Alberta (2001).

Specifically, the field surveys were undertaken to:

- Describe aquatic habitat characteristics;
- Describe the availability and quality of fish habitat;
- Identify potentially critical or sensitive habitats (e.g. Spawning, rearing, over-wintering, holding, migration); and
- Document current species composition, relative abundance, and distribution in the areas potentially affected by the proposed project.

Fish populations and fish habitat were sampled at 23 crossings within the watersheds of tributaries to the Peace River and at the proposed summer ferry and winter ice bridge crossing of the Peace River mainstem near Fox Lake.

5.3.4.3 Fish Sampling

Fish presence and fish habitat use was conducted at all sites where water was present. Whenever possible, two fish collection methods (e.g., electrofishing, minnow traps, etc.) were used at every site.

Two minnow traps were set at 2 locations at each site. Trap locations were selected to maximize the likelihood of fish capture (i.e., habitat type, water depth, current velocity, and cover were taken into account).

Beach seining was conducted in open shallow water areas by a 2-person team. One person towed the deep end of the net in the water perpendicular to shore while the second person anchored the other end of the net on shore. When the net was fully extended (e.g., 12 m) or deep water prohibited further deployment, the net was towed upstream with the second person also moving upstream close to the shoreline. Angling was also used to complement other fish capture techniques. Angling gear and techniques used conformed to the provincial, regional and watercourse-specific angling regulations (Alberta Environment 2002). A summary of the fish capture methods used at each sampling site within the fisheries LSA provided in Table 5.1.

Table 5.1 Summary of fish collection methods used at each sampling site in the Highway 58 study area, August 2002.

Site No.	Sampling Methods [1]	Comments
1	EF, AN	Stop net used for electrofishing.
2	N/A	No visible channel, no fluvial material, no water.
3	MT	Only upstream of crossing. No visible channel downstream of channel of crossing.
4	N/A	No visible channel, no fluvial material, no water.
5	N/A	No visible channel, no fluvial material, no water.
6	AN, MT	Too deep to electrofish effectively.
7	N/A	No visible channel, no fluvial material, no water.
8	N/A	No visible channel, no fluvial material, no water.
9	MT	Very low dissolved oxygen.
10	N/A	No visible channel, no fluvial material, no water.
11	N/A	No visible channel, no fluvial material, no water.
12	N/A	No visible channel, no fluvial material, no water.
13	N/A	Wetland/bog, not deep enough to sample.
14	EF, MT	
15	AN, EF, MT	
16	N/A	No visible channel, bog, not deep enough to sample.
17	AN, MT	Too deep to electrofish effectively. Very low dissolved oxygen.
18	MT	
19	AN, MT	Too deep and fast to electrofish effectively.
20 N	N/A	Seepage area, no water.
20 S	N/A	No visible channel, no water.
21	AN, BS, EF, MT	
22	N/A	Not sampled, could not access site.
23	BS, EF	Water too conductive for electrofishing.
24	AN, EF, MT	Shallow fringe habitat downstream of the east landing sampled by electrofishing. Minnow traps used near the west landing.

[1] AN = angling, BS = beach seining, EF= electrofishing, MT = minnow trapping.

5.3.4.4 Fish Habitat Characteristics

Detailed habitat measurements were recorded at all sites following provincial standards procedures outlined in Alberta Infrastructure's *Fish Habitat Manual – Guidelines & Procedures for Watercourse Crossings in Alberta* (1999). Up to 7 transects were established in upstream and downstream areas of the crossings. The following physical information was recorded at each transect:

- Channel width (m), wetted width (m), surface water velocity (m/s), and depths (m) at 25, 50, 75% of wetted width;
- Bed material including % silts/clays/sands, % gravels, % cobbles and % boulders;
- Bank stability, height (m), and slope (% gradient); and
- Fish habitat (e.g., % riffles, % runs, and % pools).

Channel width and wetted widths were measured with a surveyor's tape. Water depths and bank height were measured with a measuring rod. Bank slope was measured with an Abney level or clinometer. Surface water velocity was obtained with a Global Water FP201 Flow Probe. Discharge was then calculated by multiplying mean velocity x wetted width x mean depth. Bed material, bank stability and fish habitat were estimated visually. Water quality (pH), temperature (^{o}C), dissolved oxygen (mg/L), turbidity (NTU) and conductivity (μscm^{-1}) were measured using a Horiba Model U-10 multi-parameter water quality meter. The following parameters were also described for the entire stream length of the upstream and downstream sample sites:

- Cover (%) including the presence of large woody debris, undercut banks, pools, side channels and backwaters, and overstream and instream vegetation;
- Obstructions (e.g., log jams, beaver dams, man-made barriers, etc.) and debris;
- Average maximum riffle and pool depths;
- Aspect and gradient;
- Bed material and compaction level;
- Overall fish habitat (% pool, % riffle, % run); and
- Crown closure (%).

Representative photos were also taken at each site to document habitat types that were present. Site 24 was located on the mainstem of the Peace River. Since the Peace River is large and did not show any differentiated channel units, habitat descriptions were focussed on the shoreline features as well as islands and sandbars. To document habitat types of the Peace River, the river, as well as the shoreline, islands and bars were videotaped from a boat. The videotape was subsequently analyzed and habitat types and important features were determined using the Alberta Infrastructure's *Large River Habitat Classification System* (1999). The bottom of the Peace River was also mapped.

5.3.5 Wildlife

5.3.5.1 Review of Existing Information

Several studies and data sources were reviewed for the preparation of this report. Previous assessments conducted along the road corridor provided some general background information (e.g., Reid Crowther & Partners Ltd. 1982, Torchinsky Engineering Ltd. 1995, Westworth Associates Environmental Ltd. 2000a,b). Detailed information on the occurrence of wildlife species in the study area was obtained from Alberta Sustainable Resource Development (moose, bison and caribou surveys, Biodiversity/Species Observation Database), the Boreal Caribou Committee, the Federation of Alberta Naturalists (bird atlas data), and Parks Canada (bison and moose surveys). Several other published and unpublished reports were also used to augment existing information for both Wood Buffalo National Park and the Province of Alberta.

5.3.5.2 Field Surveys

Several field surveys were conducted to determine the distribution and relative abundance of wildlife species in the Highway 58 study area. Although field sampling methods did not differ among the 3 Road Sections, sampling effort was stratified based on Road Section length. Because the majority of the study area occurs on provincial crown land, sampling effort (i.e., number of survey locations) was higher in this region. Approximately 80% of the sample points were established on provincial crown land (Road Sections A and C), while 20% of the points occurred in Wood Buffalo National Park (Road Section B).

5.3.5.3 Winter Track Counts

Winter track counts were used to determine the occurrence, relative abundance and habitat relationships of mammals (forest carnivores, furbearers, small herbivores and ungulates) in the wildlife LSA. Species of interest included gray wolf, coyote, red fox, wolverine, fisher, marten, weasels, cougar, lynx, snowshoe hare, woodland caribou, bison, moose and deer. In addition, information was collected on the presence of upland game birds (e.g., grouse) in various habitat types.

Surveys were conducted in accordance with standard inventory methods used throughout North America, and involved the use of line-intercept transects. Sample transects varied in length, depending on the area of the representative forest stand, but were a minimum of 400 – 500 m long. Transect length was measured using hip chains and located (start and end points) with a GPS. Observers traversed each transect on foot and recorded the number of sets of tracks and the distance along the transect at each track crossing. Weather and snow conditions (e.g., snow depth, days since last snow fall) were also recorded for each transect. Sampling effort was distributed across the study area and survey sites were stratified based on % cover of habitat types.

The tracks of some related species are not easily distinguishable (RIC 1996). As a result, tracks of these species were combined into species groups. Tracks of the 2 smallest mustelids (least [*Mustela nivalis*] and long-tailed [M. *erminea*] weasels) were combined and analyzed as a single group. Likewise, tracks of ruffed grouse (*Bonasa umbellus*), spruce grouse (*Dendragapus canadensis*) and sharp-tailed grouse (*Tympanuchus phasianellus*) were also combined.

Additional information on furbearers in the region can be obtained from fur trapping data. Alberta Sustainable Resource Development annually compiles fur harvest statistics for the province. These records include information on the number of furbearers harvested on each trapline and region in the province. This information was requested from Alberta Sustainable Resource Development. In contrast, Parks Canada does not currently maintain fur harvest records for Wood Buffalo National Park, although a limited amount of information is collected on wolverines, fishers and lynx, which must be tagged and registered before being sold. Any available information was obtained from Parks Canada.

5.3.5.4 Terrestrial Breeding Bird Surveys

Bird communities in the Local Study Area were characterized using terrestrial breeding bird surveys. These surveys followed standard inventory methods used throughout North America (RIC 1997b). Variable radius point counts were used to determine the presence of bird species in specific habitats, and encounter transects located between point counts were used to document the general occurrence of birds in the study area (Bibby et al. 1992). The combined use of point counts and encounter transects allowed for a detailed assessment of bird communities adjacent to the road corridor.

Point counts were conducted between 0430 hrs and 1000 hrs and were initiated 1 min after arrival at each survey location. Counts were conducted over a 5-min interval and, for each bird detected, the observer recorded bird species, sex, age, flock size, activity, detection type (visual or auditory) and distance from observer. Birds that flew over the habitat but did not appear to be associated with it, as well as other incidental bird observations, were recorded to provide a complete list of bird species occurring in the vicinity of the road corridor. In addition, any other wildlife sightings (e.g., mammals and amphibians) were also recorded. These included visual observations, as well as observations of tracks and scats. Point counts were not conducted during adverse weather conditions (e.g., high winds and rain) that could affect bird activity and the ability of an observer to detect birds. The location of each point count was recorded using GPS.

Sampling effort was distributed across the study area and survey sites were stratified based on % cover of habitat types. Wet muskeg conditions limited access to certain areas, thus affecting the selection of some sampling locations.

5.3.5.5 Water Bird Surveys

Water bird surveys were conducted in conjunction with the terrestrial breeding bird surveys. All wetlands, wet meadows, rivers, creeks and beaver ponds within the Local Study Area were surveyed for water birds, including waterfowl (ducks and geese), grebes, loons, shorebirds, cranes, herons, bitterns, gulls and terns. Survey areas were scanned with binoculars from several locations to determine the species of birds present, as well as number of individuals of each species. Sampling locations were marked using GPS and by recording each location on the project vegetation map.

5.3.5.6 Amphibian Surveys

Amphibian surveys were conducted in conjunction with the terrestrial breeding bird and water bird surveys. Aquatic habitats along the road corridor (e.g., wetlands, wet meadows, and shorelines) were systematically searched for adult and larval frogs and toads, as well as egg masses. In addition, call surveys were conducted in appropriate habitats during the early morning to determine the presence of breeding amphibians. Male amphibians emit unique, species-specific breeding calls during the spring and early summer that can be used for species identification. These calls also provide a rough approximation of the breeding population size (i.e., number of calling individuals).

5.3.6 Cultural Resources

5.3.6.1 Review of Existing Information

A number of data sources were examined to determine the presence of existing historic sites (i.e., trapper's dwellings and traditional use camps) and prehistoric sites (i.e., artifact scatters and campsites) in the Highway 58 study area. A search of the provincial historical site database maintained by Alberta Community Development was conducted. In addition relevant information from archaeological research / reconnaissance studies and Historical Resource Impact Assessments (HRIAs) conducted inside and outside of Wood Buffalo National Park was reviewed.

5.3.6.2 Field Surveys

<u>Site Selection</u>

Prior to in-field inspection of the proposed road corridor, a general overview survey of the route was conducted to determine areas that would have the greatest potential for harbouring cultural resources. These evaluations were based on previous experience in assessing the human habitation potential of boreal forest landscapes in northern Alberta, as well as experience based on the performance of heritage potential models developed for the region (Gibson 2001, 2002). Topographic map data were the principal sources used for heritage potential evaluation.

Heritage potential of each Road Section was evaluated as being either High, Moderate or Low. Each section was also prescribed with an archaeological assessment procedure, the procedures being:

- "No Assessment" indicating no ground assessment recommended;
- "Recon" indicating visual inspection of general landscape for significant inspection localities, if any; and
- "Assess" meaning in-field archaeological assessment recommended.

5.3.6.3 Assessment Procedures

Two teams of surveyors conducted the field inspections and used all-terrain vehicles to access the study area. At the time of the assessment, the road corridor was accessible by truck or car from the Wentzel River crossing eastward to Garden Creek, and vehicle traffic along the road was not uncommon.

General Assessment Procedures

Assessment procedures followed two basic methods. In areas judged to exhibit moderate to high potential for containing heritage resources (as identified during the initial site selection process), pedestrian inspection was undertaken along the road corridor where previous development had provided good subsurface exposure that was not overgrown with vegetation. Along Road Segment B (in Wood Buffalo National Park), such exposure was considered good to excellent because the road corridor had been repeatedly graded, providing numerous dozer cut profile exposures of sandy knolls and ridges. This was particularly the case for the Garden Creek crossing, where blading on both sides of the river precluded any need for shovel testing on the minimal terraces present adjacent to the stream. Along Road Section A, right-of-way exposure was much more variable, particularly as the sandy soil within the park gave way to more silt and sand as the survey progressed to the west.

Road Section C was more difficult to assess since there was no existing road corridor exposure for most of its length. Also, since the proposed road corridor had not been surveyed and marked, critical assessment locations such as stream crossings could only be estimated and could not be shovel tested in detail. Access to the north side of Road Section C was possible by accessing an existing cut line to the Wentzel River. The Wentzel River could not be crossed by the survey team and consequently, only the north end of Road Section C was examined in detail. Access to areas south of the Wentzel River were made by following a long trail starting on the north side of the Peace River south of Jean D'Or Prairie and proceeding by quad eastward to the area across from Fox Lake. Existing trails and a cut line were then followed north to the edge of Dummy Creek. Unfortunately, the exact crossing area could not be determined because it was not flagged. As a result, the general area of Dummy Creek was examined. The section of the proposed road corridor north of Dummy Creek and south of the Wentzel River was not assessed.

Live positional tracking of all survey teams was maintained by GPS with an accuracy greater than ± 10 m. In addition, GPS waypoints were collected at all subsurface test locations (see below) and at locations with significant features.

Subsurface Assessment Procedures

In areas expected to exhibit higher heritage potential (e.g., at stream crossings), shovel testing was undertaken adjacent to and within the estimated location of the proposed road corridor. Shovel tests averaged 40 cm^2 and were excavated to 30-40 cm depth, depending upon when the presumed sterile C horizons were contacted. All fill from tests was screened through 6 mm mesh and all stratigraphic information from test locations was recorded. Test localities were marked on a survey map and GPS co-ordinates were recorded. Digital and conventional photographs were collected of significant features. Any artefacts located during sampling were recorded and collected.

Assessment Description for Road Sections A and C

Road Section A, which includes the existing road corridor from the Wentzel River crossing east to the border of Wood Buffalo National Park, was inspected by 3 individuals on quads. The entire route was travelled as part of a general in-field overview, and selected areas were inspected in detail and shovel tested as required. In general, most localities that required detailed examination were overgrown with vegetation and were shovel tested. Since the actual extent of the proposed widening of the road corridor was not indicated by staking, the expansion perimeter was estimated and testing undertaken up to 10 m back from the edge of the existing road on either side.

At the west end of Road Section A, a series of gravel pits occur along the edge of the Wentzel River. These pits were inspected as they will likely serve as a source of gravel aggregate during road construction. The west side of the Wentzel River was also inspected because previous construction activities in this area may have exposed sites not yet recorded.

The proposed road corridor within Road Section C was not completely field surveyed. The northern portion extending south to the Wentzel River was a relatively straightforward route that follows an existing cut line. However, the portion south of the river could not be assessed because the Wentzel River could not be crossed. The south portion of Road Section C was even more difficult to inspect because it traversed uncut forest and the proposed road corridor has not yet been surveyed. Only the south portion of this route near Dummy Creek was assessed. This assessment was conducted over a broad area as the exact route was not defined. Similarly, assessment of the proposed ferry crossing site could not be undertaken because the exact location had not yet been defined.

Assessment Description for Road Section B

Three individuals completed the assessment of the proposed right-of-way in Wood Buffalo National Park. Once within the park boundary, the terrain character appeared to change significantly from that along the Road Sections located on provincial lands. Low sand ridges and occasional sand hills predominated, and aspen and jack pine became the dominant vegetation along the edge of the road. The existing road grade became wider in extent and appeared to be better maintained than the road to the west outside the park. Large sand profile exposures were observed in several localities along the road corridor and frequent blading of the road perimeter afforded excellent surface visibility on the generally sandy soil.

Assessment of the road corridor continued from the west Park boundary to the airstrip at the community of Garden Creek. Much of the route was inspected by pedestrian walk-over, except for areas that were level and far from water. In addition to regular pedestrian inspection, independent spot checks were made of various localities immediately adjacent to the proposed road corridor, such as sand quarries and vehicle pull-outs. One quad reconnaissance trip was made along a potential alternate route, although no detailed inspection was undertaken in that area.

5.3.7 Traditional Ecological Knowledge

Most of the information in the traditional ecological knowledge component was derived from a traditional ecological knowledge study on critical wildlife habitat in the Caribou Mountains region of Alberta. The methods used in the study were developed in partnership with local Native elders and are purely qualitative. A researcher spent 3 months with the Little Red River Cree Nation, where unstructured open-ended interviews with a variety of traditional ecological knowledge experts were conducted and participant observation was used. The sampling method was purposive. Local community liaisons identified local traditional knowledge experts and mitigated between the researcher and the participants in accordance with local protocol. The liaisons also served as translators where necessary. Interview transcripts were coded and analyzed with the help of the qualitative data analysis program QSR NUD*IST. Mappable interview information and map-overlays were transferred into the ArcView Geographic Information System (GIS) and analyzed.

Traditional ecological knowledge data are primarily observational. Local people constantly observe wildlife movements and changes in the environment, whether they are travelling, hunting, or working. Certain biases are attached to these data which are related to travel routes, preferred hunting seasons, access to lands, as well as the age, lifestyle and occupation of the observer. Because of difficulty in contacting land users within Wood Buffalo National Park, the information collected on traditional ecological knowledge is largely limited to areas outside of the park.

5.4 Valued Ecosystem Components

This section describes the issues scoping and pathway analysis process used to determine valued ecosystem components (VECs). VECs are components of the environment that are valued by society and are the focus of the environmental assessment. Through focusing on directly relevant issues, the environmental assessment process is streamlined.

The environmental effects assessment for the proposed project involved the identification of issues/concerns (or environmental components of concern) related to the project. These issues were initially identified by the proponent. The key environmental issues for biophysical resources were identified based on the following criteria: specific issues related to the project as outlined in the Terms of Reference, a screening process based on previous environmental assessment experience and consultation with project stakeholders, including provincial and federal authorities, and local First Nations communities (Garden Creek and Fox Lake). Table 5.2 is a listing of the issues/concerns (environmental components of concern (ECC)) that were identified for this project.

Following a review of existing information, field data analysis, and stakeholder consultation, several Valued Environmental Components (VECs) were selected to assess the potential impacts of road construction, operation and maintenance on biophysical resources in the Highway 58 study area (Table 5.3). Stakeholder consultation involved open house discussions with First Nation representatives at the communities of Fox Lake and Garden Creek, as well as consultations with provincial and federal wildlife and fisheries biologists and Parks Canada staff. Table 5.3 also includes the spatial scope (where applicable or available) for the assessment of each VEC within the Local Study Area (LSA) and Regional Study Area (RSA).

The temporal scope for the Garden River and Fox Lake local access roads includes short term impacts associated with the construction period and long term impacts associated with operation and maintenance over the design life span. The temporal scope for the Peace River bridge crossing includes short term impacts associated with the construction period and longer term impacts associated with operation and maintenance of the bridge over a 5 year period.

Table 5.2 Environmental Components and Valued Ecosystem Components

Environmental Resources / Components of Concern (CC)	CC Avoided during RoW Selection		Pathway of Concern		Possible Pathways[1]	VEC		Rationale for Inclusion/ Exclusive
	Yes	No	Yes	No		Yes	No	
Atmospheric Environment								
Air Quality		✓	✓		1, 2, 5, 6		✓	Excluded as a VEC – Pathway not a concern, heavy traffic volumes are not anticipated.
Dust From Vehicle Emissions		✓	✓		1, 2, 5, 6		✓	Excluded as a VEC – Pathway not a concern, heavy traffic volumes are not anticipated – however impacts on vegetation from dust/vehicle emissions were assessed.
Climate Change		✓	✓		1, 2, 5, 6		✓	Excluded as a VEC – Pathway not a concern, heavy traffic volumes are not anticipated.
Aquatic Environment								
Water Quality		✓	✓		3, 7	✓		Included as a VEC – Important to ecosystem function and integrity.
Water Quantity (water level)		✓		✓	discharge		✓	Excluded as a VEC – due to presence of existing road corridor
Flathead Chub (forage fish)		✓	✓		3, 7	✓		Included as a VEC - Peace River Mainstem: Most abundant forage fish. Juveniles captured in vicinity of crossing. Garden Creek Watershed: Relatively abundant, higher habitat requirements than the other forage species present.
Finescale Dace (forage fish)		✓	✓		3, 7	✓		Included as a VEC - Dummy Creek Watershed: The only fish species captured at site of proposed crossing. Wentzel River Watershed: Species representative of small bodied forage fish. Waldo Creek Watershed: Species representative of small bodied forage fish. Pakwanutik River Watershed: No fish were captured at crossing sites in watershed. Species representative of small bodied forage fish.
Longnose Sucker (coarse fish)		✓	✓		3, 7	✓		Included as a VEC - Peace River Mainstem: Most abundant coarse fish. Fry captured in the vicinity of the e crossing. Wentzel River Watershed: Fry and juvenile captured in the vicinity of the crossing. Garden Creek Watershed: Ripe adults captured in the creek.
Goldeye (sport fish)		✓	✓		3, 7	✓		Included as a VEC - Peace River Mainstem: Most abundant

Environmental Resources / Components of Concern (CC)	**CC Avoided during RoW Selection**		**Pathway of Concern**		**Possible Pathways[1]**	**VEC**		**Rationale for Inclusion/ Exclusive**
	Yes	**No**	**Yes**	**No**		**Yes**	**No**	
								sport fish. All life stages present within the reach. Garden Creek Watershed: Most abundant sport fish. The creek is probably important for rearing.
Burbot (sport fish)		✓	✓		3, 7	✓		Included as a VEC - Peace River Mainstem: Young-of-the-year captured in the vicinity of the proposed crossing. Relatively sedentary species.
Arctic grayling (sport fish)		✓	✓		3, 7	✓		Included as a VEC - Wentzel River Watershed: Sensitive species, fry captured in the vicinity of the crossing.
Walleye (sport fish)		✓	✓		3, 7	✓		Included as a VEC - Wentzel River Watershed: Spent adult captured near crossing site, valuable sport fish
Northern Pike (sport fish)		✓	✓		3, 7	✓		Garden Creek Watershed: Spent adult captured in the stream, spawning habitat present, valuable sport fish Garden Creek Watershed: Spent adult captured in the stream, spawning habitat present, valuable sport fish.
Endangered Species (cisco)	✓			✓			✓	Excluded as a VEC – found east of the Slave River in lakes only.
Aquatic Invertebrates		✓	✓		3, 7		✓	Excluded as a VEC – due to presences of existing road corridor
Surficial/ sub-surficial flow		✓	✓		3, 7		✓	Excluded as a VEC – due to presences of existing road corridor
Soil Resources								
Soil Quality		✓	✓		1-4, 6-9	✓		Included as a VEC - Important to ecosystem function and integrity, as well as conservation and reclamation planning.
Soil Compaction		✓	✓		1-4, 6-9		✓	Excluded as a VEC – topsoil will be stripped
Topography		✓	✓		1-4, 6-9		✓	Excluded as a VEC – due to presence of existing road corridor
Geology	✓			✓			✓	Excluded as a VEC – due to presence of existing road corridor
Vegetation Resources								
Native Vegetation		✓	✓		1, 3-9	✓		Included as a VEC – identified in Terms of Reference Impacts on vegetation resources from non-native vegetation

Environmental Resources / Components of Concern (CC)	CC Avoided during RoW Selection		Pathway of Concern		Possible Pathways[1]	VEC		Rationale for Inclusion/ Exclusive
	Yes	No	Yes	No		Yes	No	
								were assessed
Sensitive Vegetation		✓	✓		1, 3-9	✓		Included as a VEC - Sensitive to disturbance, preservation value. Important to ecosystem function and integrity. Identified in terms of reference.
Economic Forest Resources		✓	✓		1, 3-9	✓		Included as a VEC - Sensitive to disturbance, preservation value. Important to ecosystem function and integrity.
Rare Plants		✓	✓		1, 3-9	✓		Included as a VEC - Sensitive to disturbance, preservation value. Identified in the terms of reference.
Species at Risk - Plant	✓		✓		1, 3-9		✓	Excluded as a VEC – no listed vegetation species identified.
Wildlife Resources								
Moose (ungulate)		✓	✓		1-9	✓		Included as a VEC - Parks Canada requirement; important harvest species.
Bison (ungulate)		✓	✓		1-9	✓		Included as VEC - Federally and provincially listed species; concern over disease transmission to cattle outside park.
Marten (fur bearer)		✓	✓		1-9	✓		Included as VEC - Important furbearer species; relative high abundance; prefer older coniferous forests.
Caribou		✓	✓		1-9		✓	Excluded as a VEC – no caribou near existing road corridor.
Wolverine		✓	✓		1-9		✓	Excluded as VEC – Occur at low densities - difficult to assess and monitor; prefer older coniferous forests.
Lynx(fur bearer)		✓	✓		1-9	✓		Included as VEC - Important furbearer species; relative high abundance (during peak cycle years); habitat generalist (depending on prey availability.
Ovenbird (forest songbird)		✓	✓		1-9	✓		Included as VEC - Interior forest species; sensitive to edge; mixedwood and deciduous forest specialist; high abundance
Cape May Warbler (forest songbird)		✓	✓		1-9	✓		Included as VEC - Interior forest species; possibly sensitive to disturbance; coniferous forest specialist; moderate abundance in study area.
Grouse (upland bird)		✓	✓		1-9	✓		Included as a VEC - Parks Canada requirement; important harvest species.
Ducks (waterbird)		✓	✓		1-9	✓		Included as a VEC - Parks Canada requirement; important harvest species.
Shorebirds		✓	✓		1-9		✓	Excluded as a VEC due to lack of habitat adjacent to road

Environmental Resources / Components of Concern (CC)	CC Avoided during RoW Selection		Pathway of Concern		Possible Pathways[1]	VEC		Rationale for Inclusion/ Exclusive
	Yes	No	Yes	No		Yes	No	
								corridor.
Wood frogs (amphibians)		✓	✓		1-9	✓		Included as a VEC - sensitive to wetland disturbance, including input of toxic chemicals; high abundance.
Reptiles		✓	✓		1-9		✓	Excluded as a VEC – no known overwintering (red sided garter snake) habitat in vicinity of road corridor. No reptiles observed during field surveys.
Socio Economic / Cultural Resources / Land Use								
Historic and Pre-historic Sites		✓	✓		1-3	✓		Included as a VEC - protection required under provincial and federal policies and acts.
Traditional Land Use		✓	✓		1-9			Included as a VEC - Importance of hunting, trapping, fishing and herb gathering to local communities.
Human Health	✓		✓					Excluded as a VEC – due to presence of existing road corridor.
Navigation		✓	✓		3, 7	✓		Included as a VEC – regulatory requirement.
Land Use		✓	✓				✓	Excluded as a VEC – due to presence of existing road corridor

1. Possible Pathways

1. Construction – Earthworks (excavation and grading)
2. Construction – Base Preparation
3. Construction – Watercourse Structure Removal and Replacement
4. Construction – Site Restoration (topsoil replacement and seeding)
5. Operations - Traffic
6. Operations – Road Maintenance (summer/winter)
7. Operations – Watercourse Crossing Maintenance
8. Reclamation – Current seasonal trail that will be reclaimed upon construction of the roadway
9. Reclamation – Borrow Sites

Table 5.3. Valued Environmental Components (VECs) selected to assess project-related impacts and concerns.

Category		Valued Ecosystem Component	Selection Criteria	Study Area Boundaries	
				Garden River Road	**Fox Lake Road**
Soils		Soil Quality	Important to ecosystem function and integrity, as well as conservation and reclamation planning.	LSA – 1 km on either side of the right-of-way	95 m on either side of right-of-way
Vegetation	Native Plant Communities	Forests, Treed Bogs, Wet Shrub/Bogs	Identified in terms of reference.	LSA – 1 km on either side of right-of-way RSA – 5 km on either side of road corridor	
	Sensitive Communities	Wetland/Riparian Communities	Sensitive to disturbance, preservation value. Important to ecosystem function and integrity. Identified in terms of reference.	LSA – 1 km on either side of right-of-way RSA – 5 km on either side of road corridor	
		Old-Growth Forests	Sensitive to disturbance, preservation value. Important to ecosystem function and integrity;	LSA – 1 km on either side of right-of-way RSA – 5 km on either side of road corridor	
	Rare Plants	Rare Plant Species /Potential	Sensitive to disturbance, preservation value. Identified in the terms of reference.	LSA – 1 km on either side of right-of-way RSA – 5 km on either side of road corridor	95 m on either side of right-of-way
	Economic Forest Resources	White Spruce, Deciduous, Mixedwood, Pine	Resource species (merchantable timber).	LSA – 1 km on either side of right-of-way RSA – 5 km on either side of road corridor	
Aquatic Resources		Water Quality	Important to ecosystem function and integrity as well as reclamation and conservation planning.	LSA – watercourses and waterbodies directly affected by proposed road according to “zone of impact.” RSA – watersheds crossed by the proposed road including drainages of Wentzel River, Waldo Creek, Pakwanutik River and Garden Creek	LSA – 100 m upstream and 300 m downstream of potential crossing sites LSA – zone of impact for the bed and banks of Peace River up to 1650 m downstream of proposed crossing RSA – watersheds crossed by the proposed road including drainages of Dummy Creek and Wentzel River. The lower Peace River from Vermillion Chutes to Peace Point.

Category	Valued Ecosystem Component	Selection Criteria	Study Area Boundaries	
			Garden River Road	Fox Lake Road
Fisheries	Goldeye	Peace River Mainstem: Most abundant sport fish. All life stages present within the reach. Garden Creek Watershed: Most abundant sport fish. The creek is probably important for rearing.	LSA – watercourses and waterbodies directly affected by proposed road according to "zone of impact". RSA – watersheds crossed by the proposed road including drainages of Wentzel River, Waldo Creek, Pakwanutik River and Garden Creek	100 m upstream and 300 m downstream of potential crossing sites LSA – zone of impact for the bed and banks of Peace River up to 1650 m downstream of proposed crossing RSA – watersheds crossed by the proposed road including drainages of Dummy Creek and Wentzel River. The lower Peace River from Vermillion Chutes to Peace Point.
	Burbot	Peace River Mainstem: Young-of-the-year captured in the vicinity of the proposed crossing. Relatively sedentary species.		
	Arctic Grayling	Wentzel River Watershed: Sensitive species, fry captured in the vicinity of the crossing		
	Walleye	Wentzel River Watershed: Spent adult captured near crossing site, valuable sport fish		
	Northern Pike	Garden Creek Watershed: Spent adult captured in the stream, spawning habitat present, valuable sport fish		
Forage Fish	Flathead Chub	Peace River Mainstem: Most abundant forage fish. Juveniles captured in vicinity of crossing. Garden Creek Watershed: Relatively abundant, higher habitat requirements than the other forage species present.	LSA – watercourses and waterbodies directly affected by proposed road according to "zone of impact". RSA – watersheds crossed by the proposed road including drainages of Wentzel River, Waldo Creek, Pakwanutik River and Garden Creek	100 m upstream and 300 m downstream of potential crossing sites RSA – watersheds crossed by the proposed road including drainages of Dummy Creek and Wentzel River.

Category		Valued Ecosystem Component	Selection Criteria	Study Area Boundaries	
				Garden River Road	**Fox Lake Road**
		Finescale Dace	Dummy Creek Watershed: The only fish species captured at site of proposed crossing. Wentzel River Watershed: Species representative of small bodied forage fish. Waldo Creek Watershed: Species representative of small bodied forage fish. Pakwanutik River Watershed: No fish were captured at crossing sites in watershed. Species representative of small bodied forage fish.		
	Coarse Fish	Longnose Sucker	Peace River Mainstem: Most abundant coarse fish. Fry captured in the vicinity of the crossing. Wentzel River Watershed: Fry and juvenile captured in the vicinity of the crossing. Garden Creek Watershed: Ripe adults captured in the creek.	LSA – watercourses and waterbodies directly affected by proposed road according to “zone of impact”. RSA – watersheds crossed by the proposed road including drainages of Wentzel River, Waldo Creek, Pakwanutik River and Garden Creek	100 m upstream and 300 m downstream of potential crossing sites RSA – watersheds crossed by the proposed road including drainages of Dummy Creek and Wentzel River.
Wildlife	Ungulates	Moose	Parks Canada requirement; important harvest species.	LSA – 1 km on either side of right-of-way RSA – 25 km from either side of right-of-way and SE portion of Caribou Mountains and south of Peace River	
		Bison	Federally and provincially listed species; concern over disease transmission to cattle outside park.	LSA – 1 km on either side of right-of-way RSA – 25 km from either side of right-of-way and SE portion of Caribou Mountains and south of Peace River	
	Furbearers	Marten	Important furbearer species; relative high abundance; prefer older coniferous forests.	LSA – 1 km on either side of right-of-way RSA – 25 km from either side of right-of-way	
		Lynx	Important furbearer species; relative high abundance (during peak cycle years); habitat generalist (depending on prey availability).	LSA – 1 km on either side of right-of-way RSA – 25 km from either side of right-of-way	
	Forest Songbirds	Ovenbird	Interior forest species; sensitive to edge; mixedwood and deciduous forest specialist; high abundance.	Within 200 m of right-of-way RSA – 25 km from either side of right-of-way	Within 200 m of right-of-way
		Cape May Warbler	Interior forest species; possibly sensitive to disturbance; coniferous forest specialist; moderate abundance in study area.	Within 200 m of right-of-way RSA – 25 km from either side of right-of-way	Within 200 m of right-of-way

Category		Valued Ecosystem Component	Selection Criteria	Study Area Boundaries	
				Garden River Road	**Fox Lake Road**
	Upland Game Birds	Grouse	Parks Canada requirement; important harvest species.	Within 200 m of right-of-way RSA – 25 km from either side of right-of-way	Within 200 m of right-of-way
	Waterbirds	Ducks	Parks Canada requirement; important harvest species.	Point-count at each recorded waterbody or wetland on right-of-way RSA – 25 km from either side of right-of-way	Point-count at each recorded waterbody or wetland on right-of-way
	Amphibians	Wood Frog	Sensitive to wetland disturbance, including input of toxic chemicals; high abundance.	Wetland sites along right-of-way	
Cultural Resources/ Traditional Land Use		Historic And Prehistoric Sites	Protection required under provincial and federal cultural resources policies and acts.	1 km on either side of right-of-way 28 proposed borrow locations (200 m x 200 m)	10 proposed borrow locations (200 m x 200 m) and crossings at Dummy Creek and Peace River
		Traditional Land Use	Importance of hunting, trapping, fishing and herb gathering to local communities.	LRRCN communities of Fox Lake and Garden River	LRRCN communities of Fox Lake and Garden River
Peace River Bridge Crossing					
Navigability		Navigability	Potential disruption during construction (e.g., coffer dams) Disruption due to existence of piers in river	Not applicable	RSA – Upstream limit – Vermillion Chutes Downstream limit – Peace Point
Sport Fish		Goldeye	Based on consultation with LRRCN	Not applicable	RSA – Upstream limit – Vermillion Chutes Downstream limit – Peace Point
		Burbot	Based on consultation with LRRCN	Not applicable	RSA – Upstream limit – Vermillion Chutes Downstream limit – Peace Point LSA – 1650 m downstream of proposed crossing site
		Walleye	Based on consultation with LRRCN	Not applicable	RSA – Upstream limit – Vermillion Chutes Downstream limit – Peace Point LSA – 1650 m downstream of proposed crossing site

Category	Valued Ecosystem Component	Selection Criteria	Study Area Boundaries	
			Garden River Road	**Fox Lake Road**
	Northern Pike	Based on consultation with LRRCN	Not applicable	RSA – Upstream limit – Vermillion Chutes Downstream limit – Peace Point LSA – 1650 m downstream of proposed crossing site
Vegetation	Riparian Communities	Riparian communities along the Peace River are sensitive to disturbance.	Not applicable	LSA – 1650 m downstream of proposed crossing site
Water Quality	Erosion and Sedimentation Operation of the bridge	Important to maintain existing water quality Potential effects during construction from increased sedimentation Potential effects during construction and operation would be an uncontrolled release of hazardous materials (e.g., fuels, etc.)	Not applicable	LSA – 1650 m downstream of proposed crossing site
Soils	Soil Quality and Erosion	Potential for soil erosion at crossing site during construction	Not applicable	LSA – 1650 m downstream of proposed crossing site

Notes:

1. Vegetation VECs are identified in WAEL (2003) for both access roads. AMEC Earth & Environmental (2004a) assessed impacts associated with rare plants for both accesss roads.
2. Aquatic VECs are identified in WAEL(2003) and AMEC Earth & Environmental (2005).
3. Wildlife VECs for the Garden River and Fox Lake access roads are identified in identified in WAEL(2003) and AMEC Earth & Environmental (2005).
4. Historic and prehistoric VECs for Garden River road are identified in identified in WAEL(2003). Altamira (2004) assessed the proposed borrow locations on the roads.
5. Traditional Land Use is identified in identified in WAEL(2003) for the roads.
6. From AMEC Earth 2005.

A summary of the status and environmental sensitivities associated with each selected VEC is provided below.

Vegetation VECs

Several vegetation VECs were selected for the environmental assessment, including native plant communities, sensitive plant communities, rare plants and economic forest resources. Native plant community VECs included forests, treed bog/fens and wet shrubs/bogs. Sensitive communities included wetland/riparian communities, which are considered sensitive to disturbance and are important for ecosystem function and integrity. Old growth forests were also selected as a sensitive plant community VEC for similar reasons. Rare plant species and economic forest resources (i.e., merchantable timber such as white spruce, aspen, mixedwood and jack pine forests) were also considered VECs.

Aquatic VECs

Water Quality VECs

Key consideration in the selection of water quality as VEC included the potential effects of increased sedimentation, changes in water quality (e.g., pH, temperature, dissolved oxygen levels, etc.) and accidental spills of deleterious substance in the aquatic environment.

Fish VECs

Province-wide declines in walleye, northern pike, and Arctic grayling have led to the development of management and recovery plans for these species. Arctic grayling and bull trout, as well as lake trout, are considered sensitive species, while walleye and northern pike are considered secure at the provincial level.

Goldeye

Goldeye are known from most large rivers in Alberta and the shallow lakes in the Peace- Athabasca Delta. Goldeye occur mostly in turbid lakes and rivers to which environment they are well adapted. Within the Peace River mainstem, their seasonal distribution seem to be associated with highly turbid inflows. Preferred habitats include low velocity areas like snyes, backwaters, and tributary mouths. Goldeye undertake lengthy spring spawning migrations and spawning in the Peace-Athabasca Delta region occurs primarily in the last half of May. Backwaters or pools in turbid rivers are typically selected for spawning. Goldeye are broadcast spawners with semi-buoyant eggs. Based on existing information and surveys conducted in 2002, no critical spawning habitat has been identified in the study area. Goldeye do not exhibit any strong food preference, although in the summer they feed extensively at the surface. Food items range from plankton to insects, fish and terrestrial tetrapods.

Goldeye is considered to be a *secure* species at the provincial level. Goldeye are a popular sport and commercial fish in Alberta. The catch limit in the RSA is 10 per day. Key considerations in the selection of Goldeye as VEC include its status as a sport and commercial fish, its secure status, and its migratory behaviour.

Arctic Grayling

Arctic grayling are found in the Peace, Hay, and Athabasca River drainages in northern Alberta Arctic grayling are confined to cold streams and lakes, and are extremely susceptible to various types of pollution. Spawning occurs in May and early June and fish select small gravel or rock-bottomed tributaries. Arctic grayling do not build nests (redds), however the eggs are forced into the substrate by the caudal movements of spawning fish. This makes the eggs and alevins susceptible to siltation. In the lower Peace River system, critical spawning habitat is likely limited to the upper reaches of cold-water tributaries flowing out of the Caribou Mountains. Arctic grayling were rarely recorded from the Peace River mainstem, which suggests that they have watershed and lake-dwelling populations within the region. Neither the distribution nor the extent of the migrations are known. Their diet consists of aquatic and terrestrial insects, bottom organisms and to a lesser extent, small fish and tetrapods. The schooling behavior encourages competition and intensive feeding. This makes the adults and larger juveniles relatively easy to angle and susceptible to overfishing.

The status of Arctic grayling is sensitive. Populations have declined throughout its range. The main limitations contributing to the decline are overharvest, habitat alterations and limited habitat capacity. Province-wide declines in Arctic grayling have led to the development of a provincial management and recovery plan. The current regulations allow for the capture of 2 Arctic grayling over 35 cm a day. From September 1 to October 31, the limit is zero fish. Key considerations in the selection of Arctic grayling as a VEC include its sensitive status, susceptibility to human activities and its requirements for spring spawning over rocky substrate.

Northern Pike

Northern pike have a circumpolar distribution and are known from most drainages in Alberta. Northern pike prefer relatively shallow, weedy clear water found in lakes, marshes and slow streams and rivers. Spawning occurs in the early spring, often before the ice is completely off the lakes. Typically, shallow marshes or flooded vegetation in shallow bays are selected. Spawning is believed to be restricted to the tributaries of the lower Peace River, including Garden Creek. Other sites in the study area have not been identified, however several larger creeks contain potential pike habitat. It is presumed that biotic and abiotic factors (e.g. low oxygen levels, barriers to movement, food constraints) limit their distribution.

The general status of northern pike in Alberta is secure, although a decline has been observed throughout its range. Province-wide declines in northern pike has led to the development of a provincial management and recovery plan. The status of discrete populations varies between stable and collapsed. The data collected to date do not allow for the classification of the status of the populations in the Highway 58 study area. Northern pike are a valuable sport, subsistence, and commercial fish. Currently the northern pike populations within the RSA are managed as stable-recreational, with a daily catch limit of 3 and a minimum size of 63 cm. Key considerations in the selection of northern pike as a VEC include the unknown status of populations within the Highway 58 study area; sport, subsistence, and commercial fish; and its spawning habitat requirements.

Burbot

Burbot have a circumpolar distribution and are common throughout most of Alberta. This species is found in large and small streams, and in colder parts of lakes. Spawning takes place during the winter from January to April, usually in relatively shallow water over sand or gravel in bays or shoals. Critical spawning habitat was not identified for burbot in the Peace River but likely occurs in some sections of the mainstem or its tributaries. Juveniles prefer rocky substrates commonly found at the mouths of tributaries of the Peace River. It appears that the lower mainstem Peace River is used for rearing and overwintering of all life stages. Adult burbot prey on fish, fish eggs, insects, and terrestrial tetrapods. Burbot is considered to be a secure species at the provincial level. Burbot are an important sport, subsistence, and commercial fish. Currently the catch limit for burbot within the RSA is 10 per day. Although the status of burbot is secure, a key consideration for its selection as a VEC was its importance as a domestic species for local people.

Walleye

Walleye is a cool-water species that occurs in large lakes and rivers in Alberta. General habitat preferences include large, moderately fertile lakes or slow-moving water with low light penetration and abundant food sources. Spawning migrations occur in early spring and spawning takes place in April to May in Alberta, shortly after ice break-up. Spawning generally occurs in inlet streams or over shallow, rocky areas within lakes. No critical spawning habitat has been identified in the LSA. However, ripe and spent individuals were found in larger tributaries (e.g. Cadotte, Wabasca, and Mikkwa rivers) within and outside the RSA. Fry feed on zooplankton and, as the walleye mature, on aquatic insects. The availability of food at the early stages is extremely important, and up to 99% mortality has been recorded between hatching and first feeding. Walleye convert to a piscivorous diet at an early stage, when they are less than 50 mm long. They retain this diet as adults and are one of the top predators in the aquatic food chain. An abundant supply of forage fish is critical for growth and survival.

Growth of walleye in Alberta is relatively slow, compared to southern and eastern locations in Canada and the United States. This is especially true for northern Alberta populations, which mature later at a larger body size.

The general status of walleye in Alberta is secure. Walleye are a high quality food fish that have been heavily harvested in commercial and recreational fisheries for over a century. Consequently, a decline has been observed throughout its range in spite of various efforts to increase their numbers. High angling pressure and illegal harvesting have contributed to most of the declines. These declines in walleye populations have led to the development of a provincial management and recovery plan for this species in Alberta. The data collected to date do not allow for the classification of the status of the populations in the Highway 58 study area. Currently, walleye populations in the Peace River mainstem within the RSA and its tributaries are managed as stable populations with moderate harvest (daily catch limit 3, minimum size 43 cm). Wentzel Lake is managed as trophy fishery for minor harvest (daily catch limit 3, minimum size 43 cm). Key considerations in the selection of walleye as a VEC include its unknown local status and the need to secure spawning and feeding habitats.

Longnose Sucker

The longnose sucker is common throughout Alberta and is a very adaptable species that is found in a variety of habitats. Spawning occurs in the spring over gravel/cobble/rubble bottoms in both streams and wave-swept shallow areas of lakes. The young-of-the-year feed on plankton and small invertebrates. As suckers mature, they switch to benthic food and ingest invertebrates, fish eggs and alevins, plants and detritus. Young suckers are an important diet item for piscivorous species like pike, walleye, and burbot. The status of the longnose sucker in Alberta is secure. The key considerations in the selection of the longnose sucker as a VEC is its importance as a prey species for piscivorous fish.

Flathead Chub

The flathead chub is widespread in Alberta, occurring in occurs primarily in large rivers with elevated seasonal silt loads and turbidity; an environment to which this species is very well adapted. At spawning time, they may enter the turbid tributaries of mainstem rivers. Spawning is assumed to occur in the summer. Flathead chub is predaceous and feeds on insects, small fish, and even small mammals and can attain up to 30 cm length. Sometimes they are abundant and exhibit schooling behavior. The status of the flathead chub in Alberta is secure.

Finescale Dace

The species is known from scattered locations throughout most of the drainages of central and northern Alberta, lakes and slow-flowing creeks. Spawning occurs in the spring under debris cover, while the diet consists of insects, aquatic invertebrates, plankton, and sometimes vegetable matter. Schooling in shallow bays was observed within the study area. The status of the finescale dace in Alberta is *secure*.

Wildlife VECs

Nine wildlife species/groups were selected as VECs, including 2 species of ungulates (bison and moose), 2 species of furbearers (lynx and marten), 4 species/groups of birds (Cape May warbler, ovenbird, ducks and grouse) and 1 species of amphibian (wood frog). Selection criteria for these species are briefly outlined below.

Moose

Moose are an important game species throughout Alberta, including the Highway 58 study area, for both native and non-native hunters. Moose are sensitive to hunting and other human disturbances near road corridors.

Wood Bison

Wood bison are listed as Threatened under the *Species at Risk Act* and (in designated areas only) as At Risk/Endangered. Bison populations in Wood Buffalo National Park are infected with brucellosis and tuberculosis; therefore, the potential movement of bison out of Wood Buffalo National Park is a critical concern for the agricultural industry in the Greater Wood Buffalo Region.

Marten

Marten are one of the most important furbearer species for local trappers in the Highway 58 study area. Marten may be sensitive to crossing large open areas and are dependent on old-growth forests for denning and foraging.

Lynx

Lynx are also an important furbearer species in the Highway 58 study area. Lynx populations are cyclical and vary with the abundance of snowshoe hares. Lynx habitat use is dependent on several factors, the most important of which is prey availability. Secondary factors include the availability of den sites and protective cover. This species may avoid large open areas, but has been observed crossing paved highways. Lynx are listed as Sensitive in Alberta (Alberta Sustainable Resource Development 2000).

Ovenbird

The ovenbird is classified as an interior forest species and thus may be sensitive to habitat fragmentation and associated edge effects. This species occurs in relatively high abundance throughout the Highway 58 study area and breeds in mature mixedwood and deciduous forests.

Cape May Warbler

Like the ovenbird, the Cape May warbler is also classified as an interior forest specialist, suggesting it may be sensitive to habitat fragmentation and associated edge effects. Cape May warblers may also be sensitive to disturbance. This species is moderately abundant in the Highway 58 study area and is dependent on old-growth spruce forests. The Cape May warbler is listed as Sensitive in Alberta (Alberta Sustainable Resource Development 2000).

Grouse

Three species of grouse occur in the Highway 58 study area and include spruce grouse, ruffed grouse and sharp-tailed grouse. Grouse are an important game species throughout Alberta and are also an important prey species for several bird and mammal predators. As suggested by data collected during recent field studies, these species (primarily spruce and ruffed grouse) may be susceptible to road mortality. Sharp-tailed grouse are listed as Sensitive in Alberta.

Ducks

Numerous species of ducks occur in the study region. Although breeding densities are not high in northern Alberta, species abundance and breeding success is closely tied to wetland availability. Collectively, these species are important game species in the Highway 58 study area, and are also important prey species for several bird and mammal predators.

Wood Frog

As with other amphibians, wood frogs are highly dependent on healthy aquatic ecosystems for reproduction and survival. Because of the permeability of their skin, they are also considered important indicators of ecosystem health. Wood frogs are abundant in northern Alberta, including the Highway 58 study area.

Other Potential Species

Several additional species (wolverine and woodland caribou) could have been selected as wildlife VECs based on their status, but were omitted for several reasons. Wolverines are listed as a species of special concern under the *Species at Risk Act*, and as *May be at Risk* by Alberta Sustainable Resource Development. However, because wolverines occur at very low densities, they can not be effectively monitored to assess project-related impacts and associated changes in species abundance or distribution. Consequently, they were not included in the VEC list. Woodland caribou are listed as At Risk/Threatened by Alberta Sustainable Resource Development and as threatened under the *Species at Risk Act* This species primarily occurs in the Caribou Mountains and few sightings have been reported near the proposed road corridor. According to traditional knowledge experts, the historical distribution of this species reached as far south as John D'Or Prairie. However, since construction of the existing road corridor in the 1970s and increased human activity in the region, caribou no longer utilize habitats in this area and are restricted to the slopes and plateau of the Caribou Mountains. Provincially recognized caribou range occurs approximately 10 km north of the proposed road corridor. Consequently, because this species is not likely to occur near the road corridor, it was not included on the VEC list.

6.0 Consultation Activities

Consultation is an important component of the environmental assessment process under the *Canadian Environmental Assessment Act.* Consultation provides an opportunity for potentially affected stakeholders to contribute to and influence project decisions.

In relation to the public concerns, the Terms of Reference required that the proponent describe any concerns that have been raised by various stakeholders about the proposed winter road, and how these concerns are being addressed in the environmental assessment.

The consultation for this project has taken place over a period from 2001 to present and has been undertaken by various representations of numerous organizations.

6.1 Aboriginal Consultations

There have been several consultation events (with members of Tallcree First Nations, Beaver First Nations, Dene Tha First Nations, etc.) for the proposed access road project to identify public concern(s) and allow an opportunity for public feedback.

The purposes of the community meetings were to inform community members of the status of the proposed road and to provide projected time frames for completion. A community information meeting was held in Fox Lake from 10:00 a.m to 12:00 p.m on February 12, 2002 in the library of the school. A second community information meeting was held in the gym of the Garden River school in Garden River on February 12, 2002 at 1:30 to 3:30. Advertisements for the information sessions were posted around each community (i.e. local administration offices, schools, nursing stations, stores etc.) to inform residents of the meetings. The material presented at the meetings included maps of the proposed access roads and ferry crossing and an update on the status of the project. A questionnaire was also available for the public to communicate to the project team. The Chief and approximately 25 community members from Fox Lake and approximately 20 community members from Garden River attended each meeting.

The general response from community members was that an all-weather road would be a welcome opportunity for interaction with other communities. There was optimism regarding the freedom of travel this would offer year round and the chances for youth to be able to play sports with other areas in a year-round schedule. Comments on the questionnaires (EXH Engineering) indicate that the respondents believe it will be a lot more affordable to go to town and shop if they do not have to fly out. Many community members were frustrated with the fact that this all-weather road had been discussed for many years and there was no movement on completion of the road. People at the meeting were interested in knowing when construction would start.

6.2 Other Consultation Activities

A public Open House on April 14, 2004 was organized at the High Level Native Friendship Centre in the Town of High Level. The purpose of the Open House was to allow the public (other than LRRCN) an opportunity to ask questions and provide feedback to the project team on the proposed project.

6.3 Government Consultations

Consultation with government representatives primarily involved meetings and correspondences with departments and agencies who are potential regulators or who are affected by the proposed project, or who have some regulatory responsibility. A summary of consultation with government agencies, stakeholders and regulators is provided in Table 6.1

The government representatives consulted include the Municipal District (MD) of Mackenzie, Alberta Infrastructure and Transportation (INFTRA), Indian and Northern Affairs Canada (INAC), Parks Canada, the Fisheries and Oceans Canada (DFO), Canadian Environmental Assessment Agency (CEAA), Public Works (PWGSC), and Environment Canada (EC).

6.4 Summary of Public Issues and Concerns

The following are the main issues that were identified by the communities:

- Timing of the proposed project - The community members of Fox Lake and Garden River indicated that they are frustrated that funding is still not guaranteed for the project. Community members indicate that they are in favour of the proposed road and that they are interested in learning when construction will begin. They believe that the proposed road is necessary and believe they have a reduced quality of life due to the isolation. This issue was raised at the community meeting in 2002 and the public Open House in 2004.
- Delay of road to Garden River - The Garden River community is concerned that the proposed road and new ferry for Fox Lake may be delay the portion of the proposed project to Garden River. This issue was raised both at the community meeting in 2002 and the public Open House in 2004. This is an issue with the Garden River Access Road.
- MD of Mackenzie not willing to provide funding - The MD indicated that they are in favour of the proposed project, however are not willing to provide funding for construction or operation of the proposed infrastructures. This issue was raised at the community meeting in 2002.

- Awareness of planning process - The people of Garden River feel that they have not been made aware of the overall planning process for the road. One individual commented that they would like more meetings in the communities. This issue was raised at the public open house in 2004.
- Proposed road as a Primary Highway - One individual commented that they believe that the proposed road should be constructed as an extension to Highway 58 and not be downgraded to a private road. This issue was raised at the public open house in 2004.
- Contracting - One individual commented that the contracting should have been an open bid format, to avoid limiting the control of the contract to one Band or organization. This issue was raised at the public open house in 2004.

Table 6.1 Summary of Consultation with Government Agencies and Stakeholders

Date	Agency/ Stakeholder	Purpose	Outcome
August 2001	Parks Canada, DFO	Initiated environmental process with Parks Canada and DFO identified as RAs and Environment Canada identified as an FA.	EA was funded by INAC (but did not self-identify as an RA). Screening not completed.
August 2002	INAC, LRRCN	Project description was completed by the proponent (Little Red River First Nation) in Summer 2002.	INAC, DFO, Parks Canada and Environment Canada identified as triggers or having an interest in the project.
August 2002	CEA Agency	Due to multiple RA's the CEAA requires a lead agency	Determined that CEA Agency would coordinate EA for this project.
December 2002	CEA Agency	Complete and accept a Terms of Reference document for the Environmental Assessment	December 3, 2002 Terms of Reference published.
August 2003	PWGSC, INAC, DFO, Parks Canada, Environment Canada	To identify deficiencies in the environmental assessment report prepared to date.	Development and agreement with Concordance Table (deficiency list).
Nov. 23, 2003	DFO – Coast Guard	To determine Navigability of watercourse crossings along right-of-way	A letter was sent on Nov. 23, 2003 indicating that Wentzel Creek, Garden Creek and Peace River are considered navigable.
Dec. 16, 2003	INAC, PWGSC, LRRCN	Project initialization meeting.	Project was officially awarded to AMEC Earth & Environmental. AMEC was instructed to prepare agreements between LRRCN and AMEC.
Feb 2004	DFO, EC, INAC, Parks Canada, PWGSC	AIL proposed to change the Fox Lake road alignment. The new alignment is slightly longer but it eliminated one crossing of the Wentzel River.	The route was formally accepted in February 2004 by the R/FAs.
Apr. 14, 2004	INAC, PWGSC	To decide how to present CSR based on TOR and Concordance Table	PWGSC and INAC provided a written response outlining the TOR.
Apr. 16,	INAC	Decision required regarding design standard of the proposed roadway.	An RLU-208G-090 design standard will be used for all roadways

Date	Agency/ Stakeholder	Purpose	Outcome
2004			on the project.
Apr. 23, 2004	INAC, PWGSC	Need to confirm TOR for CSR Presentation of Westworth Associates Environmental Ltd. Report.	Agreed that Westworth Associates Environmental Ltd. Report would be provided as reference to AMEC (MEMS) report.
Jul. 6, 2004	CEA Agency, DFO, Parks Canada, INAC, EC and PWGSC	Review project process	CSR review schedule discussed and agreed upon.
Jul. 14, 2004	INAC, LRRCN, INFTRA	LRRCN needs estimates and schedules for timber salvage on the right-of-way so they can plan their forestry operations.	Schedules for clearing are tied to project approvals from CEAA; AMEC provided estimated timber salvage quantities.
Aug. 3, 2004	DFO, PWGSC	Field Reconnaissance of Garden River Access Road	Site visit and project review for DFO review.
Aug. 24, 2004	DFO, PWGSC	Information requirements for Ferry Crossing EA	DFO Information requirements pursuant to *Fisheries Act*.
August 27, 2004	INAC, PWGSC, LRRCN, DFO	Need information on potential direct impacts proposed ferry could be ferry removed from the CSR and presented as a separate project.	Normal ferry operation would not be considered a direct impact; ferry can not be presented as a separate project.
Aug. 27, 2004	INAC, LRRCN, PWGSC	Discussion regarding additional environmental assessment for the proposed ferry and accommodating riparian mammals at bridge crossings.	A decision needs to be made regarding the type of ferry for a design vessel. Riparian mammals will be accommodated by maintaining a low grade line, low traffic volumes and low design speeds.
Aug. 30, 2004	INAC, LRRCN, INFTRA	Decision required regarding design ferry. Discussion on tender schedule and aboriginal content clauses.	Decided to use the larger ferry as design vessel, approval to proceed with EA for ferry crossing, INFTRA will use their standard aboriginal content clause in the contract.
Sept. 24, 2004	PWGSC -Chris Doupe	Information requirements for dredge spoil settling pond – Ferry Crossing	Outlined information requirements
Dec. 15, 2004	PWGSC, DFO, Parks Canada, TC, INAC, CEA Agency	Information meeting – re: status of CSR.	Provision of a complete draft CSR to PWGSC and LRRCN for review. Provision of ferry crossing assessment report to Environment Canada and DFO for comments.

Date	Agency/ Stakeholder	Purpose	Outcome
Apr. 20, 2005	INAC, PWGSC, EC, DFO	Discussed EC's concern with dredging ferry crossing. Discussed DFO's concerns with the dredging activities associated with the ferry.	Open water disposal of dredged material is not an acceptable option.
Apr. 26, 2005	INAC, INFTRA, PWGSC, LRRCN	To discuss the decision by DFO and EC that dredging is not an acceptable option.	LRRCN instructed the Project Consultant (AMEC) to pursue bridge option.
June 13, 2005	LRRCN, CEA Agency	Letter to CEA Agency requesting change to terms of reference, specifically excluding dredging and changing proponent.	Federal authorities determined that the terms of reference did not have to be changed – and that the changing of the proponent to the LRRCN was administrative in nature.
July 25, 2005	INAC	Provided a copy of the July 25, 2005 Terms of Reference	The proponent was instructed that they could prepare the CSR in accordance with the Terms of Reference.
August 17, 2005	LRRCN	Issuance of Comprehensive Study Report preparation and submission that included the technical supporting documents as Appendixes	LRRCN issued hard copies of the CSR report to the Federal RA's and CEA Agency.
August 18, 2005	INAC	Issuance of the revised Terms of Reference to the LRRCN (Appendix A).	Issuance of the revised Terms of Reference
September 26, 2005	CEA Agency, RAs and FAs and LRRCN	Conference Call that indicated that the submission of the CSR with the technical supporting documents was not acceptable and the LRRCN was directed to resubmit a CSR without the Technical Supporting Documents as Appendixes	LRRCN proceeded to reformat the CSR submission without the technical supporting documents as an appendix. LRRCN was also directed to address
October 20, 2005	INAC	Provided a complete copy of the Minutes and comments on the August 17 2005 CSR from the September 26, 2005 meeting to LRRCN	Comments from minutes were incorporated into the CSR.
October 24, 2005	LRRCN	October 2005 CSR submitted to the CEA Agency	October 2005 CSR submitted to the CEA Agency

7.0 Environmental Effects Assessment

7.1 Environmental Assessment Approach / Method

The overall approach to conducting the environmental assessment consisted of completing a number of steps. These steps are depicted in Table 7.1 and described in the following sections.

Table 7.1. Environmental Assessment Framework (From Hegmann et al. 1999)

Basic EIA Steps	Tasks
Scoping	Identify issues of concern
	Select appropriate regional VECs
	Identify spatial and temporal boundaries
	Identify other actions that may affect the same VECs
	Identify potential impacts due to actions and possible effects
Analysis of Effects	Complete the collection of baseline data
	Assess effects of proposed action on selected VECs
	Assess effects of all selected actions on selected VECs
Identification of Mitigation	Recommend mitigation measures
Evaluation of Significance	Evaluate the significance of residual effects
	Compare results against thresholds or land use objectives and trends
Follow-up	Recommend monitoring and effect management

7.1.1 Scoping

The purpose of the scoping exercise was to identify issues, appropriate VECs, the study boundaries, and to conduct a preliminary evaluation of those environmental effects or concerns associated with each VEC. The identification of VECs is described in Section 5

Key project-related issues or concerns for biophysical resources were identified based on the following criteria:

- Specific issues related to the project as outlined in the Terms of Reference;
- A screening process based on previous environmental assessment experience; and,
- Consultation with project stakeholders, including provincial and federal authorities, and local First Nations communities (Garden Creek and Fox Lake).

Specific issues identified by the RAs, which were applied to the entire Highway 58 study area, include:

Landforms

- Identify and assess potential physical changes in landforms, erosion potential, soil compaction, changes in soil structure and organic matter content.
- Assess the potential for long and short-term additions of pollutants (both natural and man-made) to soil and the impacts from such additions.

- Assess potential impacts to landforms of special interest.

Vegetation

- Assess the potential increase in exotic plants from the soil disturbance and linear transportation corridor that the road would provide, and how these exotic plants might impact on native plant species in the proposal area;
- Assess how the removal of vegetation for road construction would effect the overall forest structure and vegetative communities in the proposal area as well as riparian stability and possible instream siltation;
- Assess how the road impacts on shading, litterfall and riparian plant communities; and
- Assess potential changes in species composition or community structure, and effects on rare, endangered or special resource species.

Aquatic Resources

- Assess impacts to shoreline habitat associated with river and stream crossings (e.g., the need for grading, potential for slumping, erosion and sedimentation), and associated loss of fish and fish habitat;
- Assess changes in fish habitat and the fisheries (species composition and distribution, habitat change, changes to aquatic vegetation, time boundaries for spawning / incubation, etc.);
- Assess changes to hydrological factors (surficial and sub-surficial flow patterns, erosion, chemistry, etc.) resulting from confined flows, partial watercourse obstructions, and other activities;
- Assess changes to riparian features including alterations of stream banks and channel morphology;
- Assess impacts of increased fishing pressure on rivers and lakes;
- Identify the potential for long and short-term additions of pollutants (man made and natural) to water and the impacts from such additions including the impacts associated with equipment operation and possible contaminant release;
- Assess the creation of potential migration barriers to fish; and
- Assess the impacts to streambed conditions and substrates from any proposed in-stream work.

Wildlife

- Assess the relationship between increased road access and impacts on the moose population along the Peace River corridor, both from a harvesting (legal and illegal) and wildlife vehicle collision perspective;
- Assess the impact to upland game birds (sharp-tailed grouse, spruce grouse, and ruffed grouse) and waterfowl both from a harvesting and wildlife vehicle collision perspective as a result of the proposed all-season road;
- Assess the effects of habitat change, corridor impairment, habitat fragmentation, and habitat disruption on wildlife (individually and socially) from the development of an all-season road;
- Assess the effects of increased wildlife highway mortality on wildlife populations as presented by the proposed road;
- Assess the effects of increased vehicular access on wildlife / human conflicts as presented by the proposed all-season road;

- Assess the change in species composition and abundance, and any impacts to endangered and special species; and
- Assess the effects of noise on wildlife as a result of developing, using and maintaining the all-season road.

Cultural Resources

Based on existing information, assess the cultural and historic resources potential of the road rights-of-way and potential impacts of the proposed all-weather road project (including gravel extraction areas, construction camps, excavation, soil disturbances, etc.), on cultural and historic resources.

- Assess the level of significant of cultural resource sites already documented along or adjacent to the proposed road corridor that accurately reflects the range and complexity of human history in the region.
- Recommend appropriate mitigation measures to prevent disturbance to known sites.
- Determine how proposed road development will incorporate National Parks cultural resource management policies within the road corridor area.
- Assess the potential effects of road development on traditional users in the area.
- Undertake a consultation program with all First Nations groups to identify potential impacts or conflicts of the proposed all-weather access roads.
- Assess the impacts of proposed all-weather access road development on current aesthetic features (both long term and short term) to visitors and residents inside and outside of Wood Buffalo National Park.

The scoping exercise is completed at the initial stages of a project, however during the course of the environmental assessment process for the access road project, additional issues and VECs have been identified.

7.1.2 Analysis of Effects

Baseline conditions for each resource were collected. Once baseline conditions for the resource were determined and project activities were defined, potential pre-mitigation effects of the construction, operation, and maintenance of the proposed road corridor on water, soil, cultural, vegetation, fish and wildlife resources were assessed. Subsequently, an evaluation was carried out to determine whether environmental protection measures were required to mitigate effects on the VECs.

7.1.3 Mitigation Measures

The CEAA includes the definition of mitigation as, *the elimination, reduction or control of the adverse environmental effects of the project, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other mean*.

The mitigation measures were based on site-specific information, practical options identified from other similar projects, and previous experience with other types road projects.

Recommended mitigation measures were those considered to be technically and economically feasible, and acceptable to all stakeholders, including First Nations.

7.1.4 Evaluation of Significance

In accordance with the *Canadian Environmental Assessment Act*, residual impacts refer to those project related environmental effects that are expected to remain after all technically and economically feasible mitigative measures have been implemented. Residual impacts were assessed by considering the probable effectiveness of proposed mitigation measures for each impact, then reassessing any remaining post-mitigation impacts using the criteria described (Table 7.2). This will assist the Responsible Authorities in determining whether the project is likely to cause significant adverse environmental effects. The severity of the residual effect(s) was rated as being either significant, or insignificant.

Insignificant impacts were determined to be those effects that:

a) Where the project effect in combination with the existing baseline conditions does not result in the exceedance of established provincial or federal guidelines, thresholds or criteria;
b) Where the project effect in combination with existing baseline conditions as well as future (disclosed) project effects does not result in the exceedance of established provincial or federal guidelines, thresholds or criteria;
c) Occur to a population or species in a localized manner over a short period of time similar to natural variation and have no measurable effects on the integrity of the population as a whole; or
d) Have a negligible effect on communities, are of very short duration, are extremely localized and/or affect communities in a manner similar to small random changes due to natural socio-economic fluctuations.

7.1.5 Cumulative Effects

The *Canadian Environmental Assessment Act* requires that an environmental assessment of a project include an assessment of cumulative effects that are likely to result from the project in combination with other existing, proposed, and future projects or activities. To satisfy this requirement, the potential cumulative effects associated with the proposed Highway 58 project were identified and assessed for each biophysical resource.

Table 7.2. Criteria used to assess effects of highway construction, operation and maintenance on water, soil, cultural, vegetation, fish and wildlife resources.

Criteria	Value	Description
Direction	Positive	Net benefit to the resource.
	Neutral	No net benefit or loss to the resource.
	Negative	Net loss to the resource.
Magnitude	Low	Effect is not likely to cause a detectable change in valued resource components.
	Moderate	Effect is likely to cause a detectable change in the valued resource components within the range of ecological sustainability.
	High	Effect could result in changes in valued biophysical components beyond the range of ecological sustainability.
Geographical Extent	Local	Effects are not likely to extend beyond the proposed Local Study Area.
	Regional	Effects are not likely to extend beyond the Regional Study Area.
	Provincial	Effects that extend beyond the Regional Study Area.
Duration	Short-term	Effects occurring during the project construction period.
	Long-term	Effects occurring during road operation and maintenance.
	Persistent	Effects that may persist for a long period of time after project closure.
Frequency	Constant	Effects likely to occur continuously over the life of the project.
	Isolated	Effects confined to a specified time period (e.g., clearing)
	Periodic	Effects likely to occur periodically over the life of the project.
	Occasional	Effects likely to occur intermittently or sporadically.
	Accidental	Effects associated with unplanned, accidental events.
	Seasonal	Effects likely to occur seasonally.
Reversibility	High	Effect can likely be reversed in 1 year or less.
	Moderate	Effect can likely be reversed within 1 generation.
	Low	Effect is likely to extend beyond 1 generation or may be permanent.
Probability of Occurrence	Low	Unlikely.
	Medium	Possible.
	High	Likely.
Scientific Confidence	Low	Confidence in the impact rating is low as a result of incomplete baseline data or a poor understanding of cause-effect relationships.
	Medium	Confidence in the impact rating is limited by either incomplete baseline data or an incomplete understanding of cause-effect relationships.
	High	Confidence in the impact rating is high as a result of sufficient site specific baseline data and a good understanding of cause-effect relationships.

8.0 Physical Components

8.1 Landforms and Soils

8.1.1 Introduction

The Terms of Reference required an assessment of the effects of the project on the physical environment, including:

- Physical changes, erosion potential, soil compaction, changes in soil structure and organic matter content;
- The potential for long and short term additions of pollutants (man made and natural) to the soil and impacts of such additions, and
- Impacts to features of special interest.

8.1.2 Effects Assessment and Mitigation

Determination of the magnitude and significance of project impacts and implications on soil resources cannot be applied simply to this project. The reasoning behind this statement is the cause and effect relation of soils issues during the construction sequence. A good portion of the soil erosion issues can be handled in several ways, each with its own unique situation. The sediment aspect of the impact is tied to erosion control in many instances but this is not an exclusive arrangement.

8.1.2.1 Soil Quality

Soils are naturally thin in northern climates and this is evident in the Highway 58 study area. The soils reconnaissance survey and soil sampling both show the relatively small portion of topsoil in the study area. Preservation of the soil, using low ground pressure equipment, and proper stripping procedures can result in minimal impacts. The best conservation method for the soils resources is to limit disturbance to the minimum area possible. By not disturbing the soil resource, the effect is reduced.

Admixing of topsoil and subsoil is the most likely impact on the soil resources, given the shallow nature of the topsoil throughout most of the Highway 58 study area. The result of admixing is dilution of the topsoil and a general decrease in topsoil quality. The overall effects can be limited if proper stripping and stockpiling procedures are specified, followed and enforced throughout project construction. A second method of degradation is the introduction of invasive weed species and/or the introduction of non-native plant species. Mass wasting will result in soil loss and degradation of the soil due to burial. Consequently, slope stability must be ensured to decrease incidents of mass wasting.

The loss of soil quality can have a drastic effect on revegetation of the road allowance. Native plant species are typically less aggressive and less vigorous than agronomics and weedy species. As such, any degradation of the soil may affect the revegetation time frame, which may result in an increase of sediment transportation and erosion events.

Peat soils are also susceptible to degradation. Typically, degradation occurs through the lowering of water tables or the excavation of pockets of organic materials. Subsidence, oxidation and admixing are all potential risks for peat soils. Once again proper planning and execution of striping and spreading can limit potentials and potential effects of the Highway 58 project.

The RAs will ensure the following mitigation measures:

- Topsoil can be stripped in two lifts (topsoil and subsoil) but in some cases, a single lift may be adequate. Final soil salvage operations should be confirmed with ASRD representatives.
- Soil salvage requirements specific to each section of right-of-way will be developed and implemented.
- The footprint of development will be minimized.
- Back-flooding in soils that are susceptible to drying or becoming hydrophobic will be utilized.
- Spill contingency plan will be implemented as part of the ECO Plan.
- A spill contingency plan and resources will be available to deal with accidents/incidents with hazardous or dangerous goods during operation.
- Topsoil stockpiles will be stabilized with vegetation cover if in place for a long period.
- Organic material will be incorporated into soils deficient in organic matter at time of salvage.
- Construction will be avoided during heavy rains and rapid snowmelt.
- In high moisture areas, operations will be limited to sub-optimal moisture levels.
- Operations in winter months will be conducted in highly moist soils.
- Inspection by a soil specialist will take place during topsoil salvage to ensure that all topsoil is salvaged and to prevent excessive admixing.
- Document actual topsoil depths on the right-of-way and document anticipated volumes. Ensure that soil is salvaged according to *Disposal of Excess Soil Material from Roadways* (Alberta Environment 2000). Have a qualified soils specialist monitor and plan for on site salvage and implementation of requirements identified in pre borrow assessment.
- If solonetzic properties are identified in the soil survey, these soils will be contained to their original location so the there is no transfer of materials.

8.1.2.2 Erosion

Soil erosion can lead to major losses of topsoil and subsoil during the construction and post construction phases of the Highway 58 project. Water erosion is likely to be the main concern with wind erosion playing a minor role. The water erosion potentials will arise from raindrop impact and flowing water. A summary of expected conditions for erosion potential for various sites along the proposed road corridor are listed in Table 8.1

Soils in the project are classed as light soils (sandy to silty in texture and low in organic material with depth) and as such slope and slope lengths will need to be closely monitored to ensure adequate protection is provided. Wind erosion, while less likely to cause a general problem, has the potential to become a dominant local issue in Aeolian soils. Prevailing wind direction and wind speeds will need to be assessed onsite to determine problem or potential problem areas.

Wind erosion has been shown in many situations of being capable of removing 50 to 80 T/ha in a season. The critical times for wind erosion potential will be early in the project during June, July and August window based on data from the Fort McMurray, Peace River and High Level weather stations. Predominant wind directions are from north and northwest. Since most of the proposed alignment is east - west, the impact of the winds should be minimized. In areas of lighter soils and soil stockpile areas, temporary seeding may be required to lower wind erosion effects. This will need to be assessed for the soils types and the adjacent land uses (i.e., logging). The critical situation would be a light soil (sand or silt) adjacent to a long northwest clear-cut block. Potentials for this situation are present for the entire road corridor, as active logging is present throughout the area.

The critical period for water erosion for the Highway 58 will likely occur during June, July and August based on data from the Fort McMurray, Peace River and High Level weather stations (Table 8.2).

Table 8.1 Soil erosion concerns associated with various sites along the Highway 58 study area.

Stations	Concern	Comments
2+300 –3+100	Water Erosion / Mass Wasting	Flow control and ditch stabilization needed, bank stability will need to be ensured, river protection required for sediment trapping.
3+100 – 3+900	Water Erosion / Mass Wasting	Flow control and ditch stabilization needed, bank stability will need to be ensured, protection required to reduce sediment loads to river.
9+100 – 9+400	Slope Stability And Water Erosion	Flow control with off take structures to decrease flow volumes and rates. Wind erosion potential due to straight alignment.
9+400 – 9+950	Water Flow / Erosion	Flow barriers and or geotextile protection likely.
13+500 – 14+000	Side Slope Stability, Water Erosion	Flow control and ditch stabilization needed, bank stability will need to be ensured, protection required to reduce sediment loads to watercourse.
16+000	Side Slope Stability, Water Erosion	Sediment barrier and flow control needed in 3 m fill area.

Stations	Concern	Comments
18+500 – 19+400	Slope Stability, Water Erosion	Catchment ponds may be suited to reduce sediment loads.
23+800 – 24+375	Water Erosion / Mass Wasting	Flow control and ditch stabilization needed, bank stability will need to be ensured, protection required for sediment trapping by water.
24-375 – 24+950	Water Erosion / Mass Wasting	Flow control and ditch stabilization needed, bank stability will need to be ensured, protection required for sediment trapping at water.
25+250 – 25+800	Sheet And Rill Erosion	Flow control and off take ditching.
25+800 – 26+500	Sheet And Rill Erosion	Flow control and off take ditching.
29+450 – 29+650	Sheet And Rill Erosion	Sediment barrier and flow control needed in 3 m fill area.
38+200 – 38+500	Water Erosion / Wind Erosion	Catchment ponds may be suited for area to reduce sediment loads.
40+000 - 40+350	Water Erosion / Mass Wasting	Flow control and ditch stabilization needed, bank stability will need to be ensured, protection required for sediment trapping.
40+350 – 40+600	Water Erosion / Mass Wasting	Flow control and ditch stabilization needed, bank stability will need to be ensured, protection required for sediment trapping.

Table 8.2. Precipitation data for 3 locations in northern Alberta.

Location	June PPT	June PPT (Days)	July PPT	July PPT (Days)	August PPT	August PPT (Days)
Fort McMurray	64	13	79	15	71	13
Peace River	63	13	62	13	51	13
High Level	65	11	61	12	60	11

The second critical period for water erosion will likely occur during the spring melt from May to June. The difference in the 2 peak periods will be the predominant erosion mechanism. Rainfall impact will be the principal issue during the rainfall season while surface flow rates will be critical during the spring breakup.

To address rainfall impact erosion, the use of geo-textile materials may be required on slopes until vegetation is re-established. Given the relatively cool climatic conditions, 2 growing seasons will likely be required until vegetation can effectively reduce and or control erosion. This may be extended an additional season on north facing slopes since shading will reduce solar energy required for seed germination and plant growth.

Erosion prediction models have identified 2 critical thresholds for the Highway 58 project. Assuming that soils are somewhat consistent across the study area, slope and slope length are the 2 main variables. It becomes critical to assess both of these variables as a set to estimate erosion potentials. Using the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to estimate potential impact calculated values arrive at 20 to 50 times the nominal erosion present on the site prior to construction. Under forest cover, average soil losses are in the 1 to 1.5 tonnes per ha. Calculated values from the project investigation place soil loss at the 50 to 80 tonnes per ha as the erosion potential. Thus erosion prevention and planning to reduce erosion impact is essential.

Potential effects would include sheet erosion, rill erosion, gully and stream bank erosion and degradation of soil resources due to the loss of topsoil and sub soil. Of particular concern are fill areas where slopes will be placed using non-compacted surfaces (otherwise vegetation will not establish). A final concern is the concentration of flow in and around bridge structures. Sufficient erosion protection must be placed along the approach areas so as not to compromise the design of the structure.

Slope protection will be critical on sights with the following combinations according to modeling. Slopes of greater than 1.5 % with a length of 100 m or longer, slopes of 1.9 % with lengths of 75 m or longer and all slopes with a gradient of 3% will require some remedial action to reduce erosion potentials.

It is important to note that erosion control is not sediment transport control although the two are definitely linked. Reductions in erosion rates will drastically affect the sediment controls required. The reverse is not true. Sediment control does not necessarily reduce erosion, but it removes the physical evidence of erosion from appearing further downflow or downwind.

To protect against adverse erosion impacts the RAs will ensure:

- For areas of lighter soils and in soil stockpile areas, temporary seeding will be used and erosion control materials will be used.
- A full site plan will be required to fully assess potentials and controls for the erosion that will result from soil disturbance.
- Sediment and erosion control plans developed using the AT Guideline – Sediment and Erosion Control Guideline, will be used as part of the Contract requirements.
- Sediment and erosion controls will be implemented during construction.
- Sediment and erosion control measures will be used at sites with high erosion potential.
- Temporary and permanent erosion and sediment control structures will be implemented and monitored, and reclamation will be monitored.
- Short-term and long-term sediment erosion control structures will be used where applicable during construction and operation of the access roads.

Note: Additional mitigation for erosion control around waterbodies and riparian areas is discussed in Sections 10 and 17.

8.1.2.3 Sediment Transfer

Sediment transfer is tied closely to the erosion control practices that are in place during the construction and post construction phases. Options for sediment control are wide and varied as are the potential impacts from sediment transport. It must always be remembered that erosion prevention will affect sediment control, as loading changes. Unfortunately sediment control does not have the same effect on erosion. Effective sediment control does not reduce erosion in a significant manner. Major effects from sediment transport and deposition include turbidity, siltation and covering of native vegetation with a foreign material. Effects of uncontrolled sediment loading can include: degradation of aquatic habitat, loss of native vegetation, increased erosion potential and weed invasion into low fertility sites.

The RAs will ensure the following mitigation measures:

- Temporary measures require for short-term control in construction areas (i.e., sediment fences)
- long-term structures for preventing continuous source of sediment from reaching a sensitive site. (e.g. rock check barriers in a ditch leading to a stream or permanent erosion control blankets)
- Application of sediment barriers, flow control and the use of settling ponds and check structures for flow reduction will be required at different locations across the construction areas.
- Critical areas will focus around the watercourses and sites where water flows leave the construction site.

8.1.2.4 Soil Compaction

Soil compaction during construction is required for the development of the road structure. Undesirable compaction will occur as a result of equipment operation in and around the construction site, staging areas and borrow locations. Local soils, which are high in silt and clay, will be prone to rutting and surface sealing if construction activities are carried out at improper soil moisture levels.

The effects associated with compaction include: reduced infiltration rates, surface ponding, poor vegetation establishment and increased erosion potentials.

The RAs will ensure the following mitigation measures:

- Use of low ground pressure equipment when ever possible to reduce compaction effects
- Operations shall be restricted to optimal moisture levels
- Treatments ranging from simple deep ripping to the use of a “para-plough” or “roto-spik” in combination with organic soil amendments (e.g., straw, animal manure or green manure plantings) in compacted areas.

8.1.2.5 Soil Chemistry

No unusual soil chemistry issues are expected within the limits of the Highway 58 project. Some pockets of calcareous soils have been identified in the soil survey literature but they appear to be located north and east of the proposed road corridor. Soil reaction levels should not be an issue as the pH in lower soils increases. Given a dilution effect if incorporated, the resulting pH change should not drastically alter nutrient availability or soil structure. The mention of solonetzic properties in the soils reports does lead to caution in these areas if found. The soils issues around the solonetzic profiles reported (less than 1% of area in map sheet) will not be a major concern for the Highway 58 project. The RAs propose that these soils be contained to their original location so that salt materials are not transferred to other locations.

8.1.3 Residual Effect

Residual effects for soils associated with the construction and operation of the project includes soil loss and alteration due to right of way development; borrow excavations and associated haul roads and bypasses. Overall, there are no significant residual effects associated with soils and landforms for the proposed project (see Table 8.3). With the implementation of proper mitigative measures, residual impacts for Fox Lake access road is negative in direction, low in magnitude, local in extent, long-term in duration and moderate in reversibility.

8.1.4 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude that the proposed project is not likely to result in significant adverse environmental effects on landforms and soils.

Table 8.3 **Environmental Assessment of the Potential Effects on Landforms and Soils**

VEC	Potential Effects: Clearing, Infilling, Drainage	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence
Soil Quality	Admixing	Construction, Operation	Negative	Low	Local	Long-term	Isolated	Med	High
	Erosion	Construction, Operation	Negative	Low	Local	Long-term	Isolated	Med	High
	Sediment Transfer	Construction, Operation	Negative	Low	Local	Long-term	Isolated	Med	High
	Soil Compaction	Construction, Operation	Negative	Low	Local	Long-term	Isolated	Med	High

9.0 Vegetation

9.1 Introduction

The Terms of Reference required an assessment of the effects of the project on the physical environment, including:

- The potential increase in exotic plants that the soil disturbances and linear transportation corridor that the road would provide, and how these exotic plants might impact on native plant species in the proposed area
- How the removal of vegetation for road construction would affect the overall forest structure and vegetative communities in the proposed are as well as riparian soil stability and possible instream siltation
- How the road impacts on shading, litterfall, and riparian plant communities,
- Potential changes in species composition or community structure, effects on rare, endangered or special resource species.
- Construction, operations and maintenance of the proposed all-weather access roads can affect the distribution and abundance of vegetation species and communities in the Highway 58 study area. Overall, the road can affect vegetation in several ways, including:
    - Loss or alteration of species and communities (or habitats);
    - Change in vegetation quality (i.e., growth, vigour, and overall health) as a result of pollutants and other airborne particles (e.g., dust); and
    - Invasion of non-native plants, which can compete with native vegetation for essential resources (e.g., sunlight, water, nutrients).

9.2 Habitat Loss/Alteration

9.2.1 Effects Assessment (WBNP)

Wood Buffalo National Park (Road Section B)

Native Vegetation Communities

Expansion of the road corridor from approximately 10 m to 30 m within Wood Buffalo National Park will result in the permanent bss of approximately 20 ha of native vegetation communities. This loss will include deciduous forest (7.3 ha), followed by mixedwood forest (6.4 ha), jack pine forest (5.9 ha), and wet shrub (0.5 ha) (Table 9.1). Treed bog/fen communities will not be affected by road construction. The loss of native vegetation communities through clearing is quite small, representing only 1% of the vegetated areas in the LSA. This loss ranges from 0.3% for wet shrub areas to 2.4% for mixedwood communities.

Table 9.1. Loss of native vegetation communities resulting from expansion of the road corridor in Wood Buffalo National Park.

Vegetation Type	Area Lost (ha)[1]	% Total	% of Type in LSA [2]	% of LSA [3]
Deciduous	7.3	36.3	0.9	0.40
Jack Pine	5.9	29.4	1.2	0.32
Mixedwood	6.4	31.8	2.4	0.35
Treed Bog	0.0	0.0	0.0	0.0
Wet Shrub	0.5	2.5	0.3	0.03
Totals	**20.1**	**100%**	**-**	**1.1%**

[1] This value does not include losses resulting from the existing 10 m wide right-of-way (i.e., baseline conditions).
[2] For each vegetation type, calculated as: (vegetation lost / total area vegetation type in LSA) x 100
[3] Calculated as: (vegetation lost / total vegetated area LSA) x 100
Some additional vegetation losses may occur along the proposed road corridor if infilling or draining of wetlands are required during road construction. The extent of these potential losses is not quantifiable at this time, however, losses are expected to be very low.

The creation of new and wider roads may increase the potential for changes in community structure of vegetation at the forest edge. The effects of increased light and drying will likely be more common on southerly oriented forest edges than northerly ones. These effects, however, are not anticipated to extend into the forest more than a few meters, based on other studies of roads in forested environments. The potential for blow-down is not expected to increase measurably, as winds across narrow roadways are unlikely to gain the strength required to knock down trees. The effect of road edges is thus expected to have only minor effects on structure and functioning of vegetation communities. In contrast the effects of edges created by timber harvest or fires may extend a few hundred meters into the forest interior, and are likely to have far greater impacts on vegetation structure and function.

Much of the proposed road corridor already exists. Therefore, alteration of drainage patterns, water flow, and edge-related effects is likely to have already occurred. The temporary effects of sedimentation during construction are not expected to alter long-term vegetation structure or function of these areas. The incremental impact of the upgraded road, overall, should not have a significant effect on vegetation communities adjacent to the road corridor.

Old-Growth Forest

Loss of old-growth forest within Wood Buffalo National Park cannot be quantified as Alberta Vegetation Inventory information, which includes stand age, does not extend into the park. The total loss of the treed communities along the proposed road corridor within the park is estimated to be 19.6 ha, which represents approximately 1% of the treed area in the LSA. Not all of this may be old-growth forest. Thus, the loss of old-growth communities will comprise <1% of the LSA, and is likely to constitute only a small amount of the total old-growth forest in the region. Additional changes to old-growth forest communities as result of edge-effects (described above) are expected to be small, and confined to the immediate edges of the stands.

Wetland Communities (Wet Meadow/Marsh/Pond, Treed Bog/Fen, Wet Shrub)
Less than 1 ha of the wet shrub vegetation type will be lost within Wood Buffalo National Park. This represents only 0.3% of this community type in the LSA (Table 9.1). Additional alteration to the wet shrub type is also expected to be low, as the road already exists. No loss of treed bogs/fens and wet meadow/marsh/pond communities will occur as a result of the proposed Highway 58 project.

Riparian Communities
As a road to Garden Creek currently exists, riparian habitats along the road corridor have already been affected. Some further loss in riparian communities will occur as a result of widening of the road corridor although this loss is relatively small. In addition, further opening along watercourses will further reduce shading and leaf litter input into aquatic systems. However, few watercourses cross the alignment along Road Section B. As well, the amount of area affected along any particular stream or drainage course is small and is unlikely to affect ecological functioning of the system. The reduction of litter input into the aquatic system will partially be balanced by increased photosynthesis at that section of stream. The impact of the Highway 58 project on the riparian communities is therefore expected to be negative in direction, low in magnitude, local in extent, and long-term in duration (Table 9.2).

Rare Plant Species/Potential
No rare plants have been identified during surveys conducted along this section of the road corridor in Wood Buffalo National Park, and the overall direct loss of areas with high rare plant potential (wetland, riparian, and old-growth communities) is expected to be low within the LSA. Only a short section of the road corridor will be upgraded, and the existing road has already likely reduced the suitability of adjacent habitats for rare plants along the corridor. Widening of the road corridor may increase the depth-of-edge influence over the existing relatively narrow road corridor, and may reduce habitat suitability for rare plants further into adjacent forest stands. The zone of incremental effect, however, is expected to be very narrow (several meters).

Table 9.2. Environmental assessment of the potential effects of clearing and habitat alteration on vegetation VECs in Wood Buffalo National Park .

VEC	Potential Effects: Clearing, Infilling, Drainage	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Native Vegetation	Vegetation Loss	Construction	Negative	Low	Local	Long-term	Constant	Low	High	High
	Habitat Alteration	Construction, Operation	Negative	Low	Local	Short/ Long-term	Periodic-Constant	Low-High	Medium	High
Rare Plants	Vegetation Loss	Construction	Neutral - Negative	Low	Local	Long-term	Constant	Low	Low	Medium
	Habitat Alteration	Construction, Operation	Negative	Low	Local	Short/ Long-term	Periodic-Constant	Low-High	Low	Medium
Old Growth Forest	Vegetation Loss	Construction	Negative	Low	Local	Long-term	Constant	Low	High	High
	Habitat Alteration	Construction Operation	Negative	Low	Local	Short / Long-term	Periodic-Constant	Low-High	Medium	Medium
Wetlands / Riparian	Vegetation Loss	Construction	Negative	Low	Local	Long-term	Constant	Low	High	High
	Habitat Alteration	Construction Operation	Negative	Low	Local	Short/ Long-term	Periodic-Constant	Low-High	Medium	High

9.2.2 Effects Assessment (outside WBNP)

Province of Alberta (Road Sections A and C)

Native Vegetation Communities

Upgrading Road Section A to a 40 m right-of-way will result in the permanent loss of approximately 121 ha of native vegetation. Deciduous forest will account for most of the loss (77.3 ha). Other vegetation communities affected include white spruce forest (13.0 ha), pine forest (12.5 ha), treed bog/fen (8.0 ha), wet shrub (5.9 ha), and to a lesser extent, mixedwood (2.9 ha), and wetlands (1.3 ha) (Table 9.3).

Table 9.3 Loss of native vegetation communities resulting from expansion of the road corridor (to 40 m), Province of Alberta (outside WBNP).

Vegetation Community Type	Road Section A				Road Section C			
	Area Lost (ha) [1]	% Total	% of Type in LSA[2]	% of LSA [3]	Area Lost (ha) [1]	% Total	% of Type LSA[2]	% of LSA [3]
Deciduous	77.3	63.9	1.5	0.73	28.4	67.8	0.6	0.27

Jack Pine	12.5	10.3	1.9	0.12	-	-	-	-
White Spruce	13.0	10.8	1.3	0.12	4.5	10.7	0.4	0.04
Mixedwood	2.9	2.4	0.8	0.03	1.6	3.8	1.0	0.02
Treed Bog/Fen	8.0	6.6	0.6	0.08	5.6	13.4	1.0	0.05
Wet Shrub	5.9	4.9	0.6	0.06	1.8	4.3	0.4	0.02
Meadow	1.3	1.1	1.6	0.01	-	-	-	-
Total	**120.9**	**100%**	**-**	**1.15**	**41.9**	**100%**	**-**	**0.40**

[1] This value does not include vegetation loss resulting from the existing 10 m wide corridor (i.e., baseline conditions).
[2] Calculated as: (vegetation lost / total area vegetation type in LSA) x 100
[3] Calculated as: (vegetation lost / total vegetated area LSA) x 100

Construction of Road Section C will result in the permanent loss of approximately 42 ha of natural vegetation. Deciduous forest will again account for most of the vegetation losses (28.4 ha). Lesser amounts of treed bog/fen (5.6 ha), white spruce (4.5 ha), wet shrub (1.8 ha), and mixedwood (1.6 ha) communities will also be cleared (Table 9.3). The loss of native vegetation associated with Road Sections A and C is small, accounting for only approximately 1.5% of the vegetated areas in the LSA. The loss of specific community types in the LSA varies from 1.0% for wet shrub to 2.1% for deciduous. Some additional vegetation loss may occur along the proposed corridor if infilling or draining of wetlands are required during road construction. The extent of these potential losses is not quantifiable at this time, however, losses are expected to be low.

Creation of new and wider roads may increase the potential for changes in community structure of vegetation at the forest edge. Species composition and relative abundance may change; species requiring shaded, humid conditions may likely decrease in abundance while those which prefer higher light and drier conditions may become more common. Disturbance-adapted and non-native plant species may also become more common (see Exotics impact section below). The effects of increased light and drying will likely be more common on southerly oriented forest edges than northerly ones. These effects, however, are not anticipated to extend into the forest more than a few meters, based on other studies of roads in forested environments. The potential for blow-down is not expected to increase measurably, as winds across narrow roadways are unlikely to gain the strength required to knock down trees. The effect of road edges is expected to have only minor effect on structure and functioning of vegetation communities. In contrast, the effects of edges created by timber harvest or fires may extend a few hundred meters into the forest interior, and are likely to have far greater impacts on vegetation structure and function. The potential effects of erosion and sedimentation on wetlands is discussed in the wetland/riparian communities assessment (below).

Wetland Communities (Wet Meadow/Marsh/Pond, Treed Bog/Fen, Wet Shrub)

The road expansion project will result in the loss of 22.6 ha of wetland communities in the Province of Alberta, 15.2 ha along Road Section A, and 7.4 ha along Road Section C (Table 9.3). Most wetland loss is associated with treed bog and wet shrub communities. Some loss of meadow communities will occur along Road Section A. Ten ponds, wet sedge meadows, and cattail marshes occurring along this section may be directly impacted by road construction These wetlands vary in size from very small to large complexes, and 6 are associated with watercourses. The loss associated with the meadow community is approximately 1.3 ha, although this may be underestimated as some meadow communities are too small to accurately map. Total loss of wetland communities represents less than 3% of wetlands in the LSA.

In addition to direct losses, the proposed project may have indirect effects on wetlands, including bogs/fens along the proposed alignments. Bogs/fens and other wetlands are very sensitive to alteration of local water levels and regional hydrological regimes. Linear developments through and adjacent to bogs/fens and other wetlands have the potential to interrupt local groundwater flow and surface drainage patterns, and could potentially result in alteration of species composition and distribution of plant communities in adjacent habitat. Erosion and sedimentation into wetland areas during the construction/reclamation period may cover submergent and emergent vegetation, having a temporary, localized affect on primary productivity. The magnitude of the impact will depend on wetland type, size, and extent of disturbance.

Riparian Communities

As much of the roadway currently exists from Fox Lake to the Wood Buffalo National Park border, riparian habitats have already been adversely impacted. Some further loss in riparian communities will occur as a result of widening of the right-of-way and creation of new roadway along Road Section C, although this loss will be relatively small. In addition, further opening along watercourses may further reduce shading and leaf litter input into aquatic systems. Again, the amount of area affected along any particular stream will be small and is unlikely to effect ecological functioning of the system. The reduction of litter input into the aquatic system will partially be offset by increased photosynthesis at that section of stream. Erosion and sedimentation into riparian areas during the construction/reclamation period may cover submergent and emergent vegetation, having a temporary, localized affect on primary productivity. Stream banks along the alignment are unlikely to have stability/slumping problems during construction and operation phases of stream crossings that would further affect vegetation cover.

Old-Growth Forest

Widening of the right-of-way and construction of new road alignments will result in the permanent loss of 41 ha of old-growth forest communities along Road Section A, and 23.8 ha along Road Section C.

Deciduous forest will constitute the majority of old-growth lost along both road sections (26.3 ha, 64% Road Section A, 20.5 ha, 86% Road Section C). Some loss of old-growth jack pine (9.7 ha), white spruce (4.2 ha), and treed bog/fen (0.8 ha) will also occur along Road Section A, while a small amount of white spruce (3.3 ha) will occur along Road Section C. The percentage of each old-growth type removed from the LSA (Road Sections A and C combined) varies from 0.7% for jack pine to 10.6% for white spruce. Overall, the loss of old-growth forest communities represents approximately 0.6% of the LSA. Additional changes to old-growth forest communities are likely to occur as result of edge-effects (previously described), however these are expected to be small, and confined to the immediate edge of stands. Loss and alteration of old-growth forest as a result of the proposed road project is considered to be negative in direction, low in magnitude, local in extent, and long-term in duration (Table 9.4)**.**

Table 9.4. Loss of old-growth forest communities resulting from proposed Highway 58 project (to 40 m), Province of Alberta.

Vegetation Community Type	Road Section A				Road Section C			
	Area Lost (ha) [1]	% Total	% of Type in LSA[2]	% of LSA [3]	Area Lost (ha) [1]	% Total	% of Type LSA[2]	% of LSA [3]
Deciduous	26.3	64.1	1.2	0.24	20.5	86.1	1.0	0.19
Jack Pine	9.7	23.7	0.7	0.09	0	0	0	0
White Spruce	4.2	10.2	5.9	0.01	3.3	13.9	4.7	0.03
Treed Bog/Fen	0.8	2.0	4.0	0.01	0	0	0	0
Total	**41.0**	**100.0**	**-**	**0.35**	**23.8**	**100.0**	**-**	**0.22**

[1] This value does not include habitat loss resulting from the existing 10 m wide right-of-way (i.e., baseline conditions).
[2] Calculated as: (habitat lost / total area habitat type in LSA) x 100
[3] Calculated as: (habitat lost / total vegetated area LSA) x 100

Rare Plant Species/Potential

Two rare plant species were identified during vegetation surveys along Road Section A and both were associated with wetland communities (sedge meadow and wet shrub). These locations may be affected by the proposed road corridor depending upon the final alignment choice. In addition, the direct loss of areas considered to have relatively high rare plant potential is 86.6 ha. Widening of the road corridor may also increase the depth-of-edge influence over the current narrow roadway, and may reduce habitat suitability for rare plants further into forest stands. The zone of incremental effect, however, is expected to be very narrow (a few meters).

Merchantable Timber

Merchantable timber will be lost as a result of the proposed Highway 58 project. Approximately 17.5 ha of merchantable white spruce, 105.7 ha of deciduous, 12.5 ha of jack pine, and 4.5 ha of mixedwood will be permanently taken out of production. This represents only a small proportion of forest resources within Forest Management Unit F6.

Table 9.5 Environmental assessment of the potential effects of clearing and alteration on vegetation VECs, Province of Alberta .

VEC	Potential Effects Clearing, Infilling, Drainage	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Native Vegetation	Vegetation Loss	Construction	Negative	Low	Local	Long-term	Constant	Low	High	High
	Habitat Alteration	Construction, Operation	Negative	Low	Local	Short/ Long-term	Periodic-Constant	Low-High	Medium	High
Rare Plants	Species Loss	Construction	Neutral/ Positive	Low	Local	Long-term	Constant	Low	Low	Medium
	Habitat Alteration	Construction, Operation	Negative	Moderate	Local	Short/ Long-term	Periodic-Constant	Low-High	Low	Medium
Old-Growth Forest	Vegetation Loss	Construction	Negative	Low	Local	Long-term	Constant	Low	High	High
	Habitat Alteration	Construction, Operation	Negative	Low	Local	Short/ Long-term	Periodic-Constant	Low-High	Medium	Medium
Wetlands	Vegetation Loss	Construction	Negative	Low	Local	Long-term	Constant	Low	High	High
	Habitat Alteration	Construction, Operation	Neutral-Negative	Low	Local	Short/ Long-term	Periodic-Constant	Low-High	Medium	High
Forest Resources	Timber Loss	Construction	Negative	Low	Local	Long-term	Constant	Low	High	High

9.2.3 Mitigation (All Road Sections)

The RAs will ensure the following mitigation measures to avoid or minimize the impacts of habitat loss resulting from the proposed Highway 58 project.

- Loss of native vegetation will be minimized where possible restricting right-of-way clearing to minimal acceptable standards. The road corridor will be reduced from 40 m to 30 m within Wood Buffalo National Park.
- Trees shall be felled away from the main body of the forest during the clearing process will also reduce additional habitat losses. It will also reduce the potential for creation of canopy gaps that may lead to increased edge-effects, loss of rare plants, and minimize the introduction of non-native plants.
- Utilize an alignment that avoids the known rare plant locations, and minimizes disturbance to areas of high rare plant potential. Further rare plant surveys once the final alignment has been selected will be undertaken.
- Any merchantable timber along the proposed road corridor will be salvaged.
- Vegetation will be salvaged prior to clearing, transferred to a temporary nursery and used to reclaim native vegetation and wildlife habitat
- Draining/infilling of wetlands adjacent to the construction site will be avoided. Local drainage and groundwater flow patterns will be maintained, particularly in bog/fen areas as these are sensitive to hydrological changes.
- Access roads and staging areas will be designed to minimize disturbance to native habitat, particularly vegetation communities that are considered to be sensitive or have significant ecological value (e.g., wetlands, old-growth forests). Access roads and staging areas that remove native vegetation will be reclaimed to its original condition in a timely fashion.
- Abandoned roadway sections will also be reclaimed back to the original vegetation type where feasible, or natural regeneration will be encouraged such that sustainable vegetation communities can become re-established.
- Revegetation of rights-of-way and other disturbed surfaces will include appropriate native seed mixes for the boreal forest regions as outlined by the Native Revegetation Guidelines for Alberta, and will include some rapidly establishing species. Sandy soils along the road corridor may be more difficult to revegetate as they hold little water and are susceptible to erosion following disturbance. Special reclamation measures, such as mulching, may be required to reduce erosion and improve revegetation on sandy soils.
- Impacts to wetlands can be largely mitigated by an alignment that avoids or minimizes disturbance to wetland areas. Where the alignment impacts on wetlands, the use of "best construction practices" sedimentation and erosion control techniques, including reclamation of right-of-ways and stream banks, will largely reduce the associated negative effects on wetland vegetation. The inclusion of willow stakes in stream bank restoration is required to provide bank stability and shorten the regeneration period.
- Soil handling guidelines identified for the reduction of project-specific effects on soil quality/quantity resulting from soil erosion, admixing, contamination, and compaction will facilitate the re-establishment of vegetation and forest resources on reclaimed sites.

- In accordance with provincial and federal wetland policies, a "no net loss" strategy will be implemented for wetland habitat (excluding treed bog/fens) affected by the proposed Highway 58 project.

9.2.4 Residual Effects

Unavoidable loss of vegetation will occur as a result of widening the existing road corridor and the new road corridor. Residual vegetation losses associated with the project are relatively small (<2% of the LSAs), and mostly include communities that are well represented in the area. Additional loss/alteration of communities as the result of altered drainage or infilling, as well as sedimentation is expected to be low. The residual impacts associated with vegetation loss and alteration are generally considered to be negative in direction, low in magnitude, local in extent, and permanent.

9.2.5 Significance Prediction (inside and outside WBNP)

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude that the proposed project is not likely to result in significant adverse environmental effects on habitat.

9.3 Change in Vegetation Quality

9.3.1 Effects Assessment (All Road Sections)

The effects assessment for this section will consider old growth forest, native vegetation, wetland communities, rare plants and merchantable timber. The incremental amount of highway contaminants deposited on road surfaces from vehicular traffic and maintenance operations as a result of the proposed Highway 58 project is expect to be relatively minor based on estimated traffic volumes (approximately 500 vehicles AADT). Relatively low traffic volumes are also expected along the new road section (Road Section C). The construction of a defined ditch may result in herbicides/pesticides being used along the road corridor during the reclamation and maintenance phases. Herbicides are typically used to control noxious weeds along roadways located adjacent to farm land as required by Alberta Agriculture. When herbicides are used they are applied in accordance with Alberta Agricultures policies which restrict certain products from being applied near water bodies. This project is not located near farm land therefore the use of herbicides is not anticipated. If herbicides are applied the application would be completed in accordance with Alberta Agriculture's policies. Pesticides will not be applied.

Air emissions from construction equipment and vehicular traffic may contain compounds that could potentially affect plant growth and health under certain conditions. However, since construction emissions will occur over a short period of time and rapidly dissipate, emissions are unlikely to have an adverse effect on adjacent vegetation communities. Emissions from vehicle traffic during the operation /

maintenance phases are also unlikely to affect native vegetation adjacent to the road corridor as well, since these emissions quickly dissipate and heavy traffic volumes are not anticipated.

Table 9.6. Environmental assessment of the potential effects of pollutants on vegetation VECs, Wood Buffalo National Park and the Province of Alberta

VEC	Potential Effects: Pollutants	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Native Vegetation	Reduction in Vegetation Health	Construction	Neutral - Negative	Low	Local	Short-term	Periodic - Accidental	High	Low	High
	Changes in Species Composition	Construction, Operation	Neutral - Negative	Low	Local	Short-term	Periodic - Accidental	High	Low	High
Rare Plants	Reduction in Vegetation Health	Construction	Neutral - Negative	Low– Moderate	Local	Short-term	Periodic - Accidental	High	Low	Medium
	Changes in Species Composition	Construction, Operation	Neutral - Negative	Low-Moderate	Local	Short term	Periodic - Accidental	High	Low	Medium
Old-Growth Forest	Reduction in Vegetation Health	Construction	Neutral - Negative	Low	Local	Short-term	Periodic - Accidental	High	Low	Medium
	Changes in Species Composition	Construction Operation	Neutral - Negative	Low	Local	Short-term	Periodic - Accidental	High	Low	High
Wetlands (Meadows Bogs/Fens) ~~Wet Shrub~~	Reduction in Vegetation Health	Construction	Neutral	Low-Moderate	Local	Short-term	Periodic - Accidental	High	Low	High
	Changes in Species Composition	Construction Operation	Negative	Low	Local	Short-term	Periodic - Accidental	High	Low	High
Merchantable Timber (Alberta Only)	Reduction in Vegetation Health	Construction	Negative	Low	Local	Short-term	Periodic - Accidental	High	Low	High
	Changes in Species Composition	Construction, Operation	Negative	Low	Local	Short-term	Periodic - Accidental	High	Low	High

9.3.2 Mitigation (All Road Sections)

Several mitigation measures will be implemented to avoid or minimize to impacts of pollutants resulting from the proposed Highway 58 project. These include the following:

- Proper maintenance of equipment and storage of fuels during construction will reduce the chance of accidental spills on site, and prompt clean-up will reduce adverse environmental effects to vegetation and wetlands. Fuel storage and equipment maintenance will not occur within 200 m of wetlands.

- The use of pesticides, including herbicides, will be restricted in the vicinity of creek crossings in the Province of Alberta sections, as will be the use of de-icing/anti-icing chemicals containing salt. Where possible, the use of de-icing salts on the road surface will be minimized. Wetting of salts during application would also reduce the potential for salt spray adversely affecting adjacent plant communities.
- The use of pesticides, including herbicides, will be restricted in the section of road within Wood Buffalo National Park. Cultural control (e.g., mowing, mulching) is recommended for reducing weed growth and spread in the park.
- The use of low sulfate diesel fuels, where available, would reduce the amount of harmful emissions during construction, which may directly or indirectly affect adjacent vegetation.

9.3.3 Residual Effects

Mitigation measures will reduce the probability of pollutants entering the environment during the construction phase. However, the potential for accidental release of deleterious substances into aquatic environments is still present and may have a significant temporary effect on wetland communities. The probability of this occurring, however, is considered to be low.

Overall, the impact of pollutants on terrestrial vegetation is considered to be negative in direction, low in magnitude, local in extent, short-term in duration, and highly reversible (Table 9.6).

9.3.4 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude that the proposed project is not likely to result in significant adverse environmental effects on vegetation quality.

9.4 Dust

9.4.1 Effects Assessment

Silty-sandy soils along the proposed road corridor can be suspended as dust. Therefore, dust created by equipment during road construction and by vehicle traffic during the summer period is likely. Dust may cover adjacent plants, potentially influencing photosynthesis and respiration. The amount of road dust created by construction activity is influenced by the extent of earthworks, equipment used, soil characteristics, and weather conditions. Factors such as road characteristics, traffic volumes, vehicle size and speed, and weather conditions are known to influence the amount of dust created by vehicles during the operation / maintenance phases. The zone of effect of road dust on vegetation may extend as far as 100-200 m. However, in the boreal forests of northeastern Alberta, road dust from traffic on unpaved roads was generally confined to the immediate area adjacent to the roadway (10-20 m). The effect of road dust on adjacent vegetation probably varies among species, with rare and sensitive species/communities (e.g. peatland, wetlands) more likely to be affected. Although a shift in species composition has been documented in some plant communities, there are no changes in structure or diversity of plant communities in the northeastern boreal forest as the result of dust from unpaved access roads. Rain was considered to have a cleansing effect by removing dust from the vegetation.

The existing road corridor already has been exposed to dust from summer traffic. In addition, the existing road surface generally has little ditch area associated with it. Only a minor increase in road surface width will occur as a result of the proposed project. The traffic volume within the existing road corridor is low and is not expected to increase significantly, therefore, little additional dust will be generated as a result of the proposed Highway 58 project. Effects of dust are expected to be greatest for the area immediately adjacent to the road surface, which will be ditch areas. Potential adverse effects on native vegetation adjacent to the road corridor are expected to be reduced by the cleansing affect of rainfall. The incremental effect of dust on native plant communities and wetlands is considered to be negative in direction, local in extent, low in magnitude, periodic in occurrence, and long-term in duration. The potential impact on rare plants adjacent to the proposed alignment is considered to be low to moderate in magnitude, and is similar to what would be occurring for much of the current alignment. Road Section C represents a new source of dust into the environment, however, this section of access road is short, and most of the dust–related effects will be largely confined to ditch vegetation. Overall, the impact of dust on vegetation communities and rare plant species is expected to be neutral to negative in direction, low in magnitude, local in extent, periodic in occurrence, and long-term in duration (Table 9.7).

Table 9.7. Environmental assessment of the potential effects of dust on vegetation VECs, Wood Buffalo National Park and the Province of Alberta

VEC	Potential Effects: Dust	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Native Vegetation	Reduction in Vegetation Health	Construction/ Operation	Neutral-Negative	Low	Local	Long-term	Periodic	High	Low	High
	Changes in Species Composition	Construction, Operation	Neutral-Negative	Low	Local	Long-term	Periodic	High	Low	High
Rare Plants	Reduction in Vegetation Health	Construction, Operation	Neutral - Negative	Low – Moderate	Local	Long-term	Periodic	Low-Medium	Low	Medium

VEC	Potential Effects: Dust	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
	Changes in Species Composition	Construction, Operation	Neutral - Negative	Low -	Local	Long-term	Periodic	Low-Medium	Low	Medium
Old-Growth Forest	Reduction in Vegetation Health	Construction, Operation	Neutral - Negative	Low	Local	Long-term	Periodic	High	Low	High
	Changes in Species Composition	Construction Operation	Neutral - Negative	Low	Local	Long-term	Periodic	High	Low	High
Wetlands (Meadows Bogs/Fens) Wet Shrub	Reduction in Vegetation	Construction, Operation	Neutral - Negative	Low	Local	Long-term	Periodic	High	Low	High
	Changes in Species Composition	Construction Operation	Neutral-Negative	Low	Local	Long-term	Periodic	High	Low	High
Merchantable Timber (Alberta Only)	Reduction in Vegetation Health	Construction, Operation	Neutral - Negative	Low	Local	Long-term	Periodic	High	Low	High
	Changes in Species Composition	Construction Operation	Neutral-Negative	Low	Local	Long-term	Periodic	High	Low	High

9.4.2 Mitigation (All Road Sections)

The RAs will ensure the following mitigation measures:

- Dust control measures (e.g., road watering) during construction and operation, where appropriate, will reduce the potential effects of dust on adjacent vegetation/wetlands.
- Low speed limits will be set and enforced in the project area to reduce impact from dust
- For long-term soil storage (more than one season), stockpiles will be seeded

9.4.3 Residual Effects

Overall the impact of dust on native vegetation, rare plant species, old growth forest, wetlands and merchantable timber is expected to be neutral to negative in direction, low in magnitude, local in extent, periodic in occurrence and long term in duration.

9.4.4 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude that the proposed project is not likely to result in significant adverse environmental effects of dust on vegetation.

9.5 Non-native Plants

9.5.1 Effects Assessment

Non-native and weedy native species identified along portions of a proposed winter road in Wood Buffalo National Park likely occur along much of the existing alignment, both inside and outside of the park. Road construction activities will result in considerable additional disturbance of soils along the road corridor that may provide habitat for non-native plant propagules present and those which may be transported into the area by human and animal vectors. The maintenance of ditches and embankments will also maintain favourable habitat for non-native plants along the road corridor. Despite the potential for some non-native plants to colonize exposed roadsides/ditches and other areas disturbed during the construction (e.g., burrow pits, staging areas), operation, and maintenance phases, their distribution will likely be largely confined to these areas and the immediate forest edge. Two non-native plants, yellow sweet-clover (dry shrub) and narrow-leaved hawksbeard (Pakwanutic Creek), were recorded in vegetation survey plots >50 m from the road, indicating some potential for invasion into adjacent native vegetation communities. Riparian areas, with their greater potential for dispersal of propagules along watercourses, represent other disperal routes for non-native plants. However, few new watercourse crossings will be constructed as part of the proposed Highway 58 project and the potential for increased presence of non-native plants along riparian corridors is therefore, considered to be relatively low.

Cutblocks and oil/gas seismic lines and well sites, and associated access roads, in and near Wood Buffalo National Park, also provide potential entry sites for introduction of non-native plants into the landscape because of disturbance factors associated with these areas. Once non-native plants become established on disturbed sites, propagules may be further dispersed by animal vectors such as bison,, wind, or water. However, the potential for non-native plants to become established in undisturbed plant communities is considered to be relatively low. Therefore significant effects of non-native plants on species composition and community function are not expected as part of the Highway 58 project.

The existing road corridor already provides some habitat for non-native plants in the landscape, and non-native plants are already widely distributed in disturbed areas in Wood Buffalo Provincial Park. The amount of additional native habitat likely to be affected by non-native plants as a result of the proposed Highway 58 project is likely to be relatively small. Upgrading the road into Garden Creek is unlikely to increase the number or range of non-native plants inside and outside of Wood Buffalo National Park, if at all, over the current situation. However, Road Section C will potentially represent a new entry point for non-native plants into the landscape, although some disturbance is already associated with portions of the alignment (e.g., existing winter road, cutline).

Table 9.8. Environmental assessment of the potential effects of exotic species on vegetation VECs, Wood Buffalo National Park and the Province of Alberta

VEC	Potential Effects: Exotic species	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Native Vegetation	Altered Community Structure	All	Neutral-Negative	Low	Local	Long-term	Constant	Medium	Low	High
	Altered Ecosystem Function	All	Neutral-Negative	Low	Local	Long-term	Constant	Medium	Low	High
Rare Plants	Altered Community Structure	All	Neutral - Negative	Low - Moderate	Local	Long-term	Constant	Medium	Low	Medium
	Altered Ecosystem Function	All	Neutral - Negative	Low - Moderate	Local	Long-term	Constant	Medium	Low	High
Old-Growth Forest	Altered Community Structure	All	Neutral - Negative	Low	Local	Long-term	Constant	Medium	Low	High
	Altered Ecosystem Function	All	Neutral - Negative	Low	Local	Long-term	Constant	Medium	Low	High
Wetlands (Meadows Bogs/Fens) Wet Shrub	Altered Community Structure	All	Neutral - Negative	Low	Local	Long-term	Constant	Medium	Low	High
	Altered Ecosystem Function	All	Neutral - Negative	Low	Local	Long-term	Constant	Medium	Low	High
Riparian	Altered Community Structure	All	Neutral - Negative	Low	Local	Long-term	Constant	Medium	Low	High
	Altered Ecosystem Function	All	Neutral - Negative	Low	Local	Long-term	Constant	Medium	Low	High
Merchantable Timber (Alberta	Altered Community Structure	All	Neutral-Negative	Low	Local	Long-term	Constant	Medium	Low	High

VEC	Potential Effects: Exotic species	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Only)	Altered Ecosystem Function	All	Neutral-Negative	Low	Local	Long-term	Constant	Low	Low	High

9.5.2 Mitigation (All Road Sections)

The RAs will ensure the following mitigation measures to avoid or minimize the impacts of non-native plants resulting from the proposed Highway 58 project. These include the following:

- Spraying weedy areas along the existing road corridor prior to construction. Alternative weed control techniques will be employed within 100 m of streams and will be used for the section of the highway located within Wood Buffalo National Park.
- Ensuring that construction equipment has been cleaned prior to use can reduce the potential for weed invasion on disturbed surfaces.
- Prompt reclamation of exposed soils along right-of-ways, borrow areas, and creek banks, as well as protection of topsoil stockpiles (e.g., seeding surface with annual grasses) will reduce the potential for weed invasion. Some rapidly establishing, relatively aggressive native species will be used to form an initial ground cover to reduce the potential for non-native plant establishment.
- Weed control methods will also be implemented during the construction, reclamation, and maintenance phases of the project in areas where weed problems are identified.
- mechanical clearing of roadway ditches to deter wildlife and maintain visibility
- Reclamation of abandoned roads may also reduce the existence or potential for non-native species in the landscape.

9.5.3 Residual Effects (All Road Sections)

The impact associated with potential establishment of non-native plants is expected to be negative in direction, low in magnitude, local to regional in extent, and long-term in duration (Table 9.8).

9.5.4 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude that the proposed project is not lkely to result in significant adverse environmental effects on native vegetation.

10.0 Aquatic resources

10.1 Introduction

In relation to aquatic resources, the Terms of Reference required an assessment of the following:

- An assessment of the aquatic community (fish and invertebrates) and habitat in the area of construction around any waterbodies that may be affected by the construction of the proposed access roads,
- Identification of the study area, assessment methods and any historical sources and/or previous aquatic assessments or studies used to describe the existing aquatic community,
- A description and map of the fish communities and habitat in all waterbodies affected by the project. Identify areas used for spawning, rearing, nursery, feeding, migration or over wintering. Include the common names, life stages utilizing these areas and habitat requirements for these species,
- Identification of construction, operation and reclamation activities and timing schedules and how these might affect fish and fish habitat, and
- The effects of stream alterations, placement of in-stream structures, changes to bank and bed substrate, riparian features and stream flow parameter changes such as velocities, discharge and gradients, and impacts on navigation.

Construction, operation and maintenance of the proposed all-weather access roads can affect water quality of the watercourses in the study area. Alberta Environment has developed surface water guidelines for the protection of aquatic life in Alberta. The guidelines are numerical concentrations or narrative statements recommended to support and maintain a designated water use. In the case of watercourses land crossed by the proposed extension of Highway 58 and the Fox lake access road, water quality issues are related to the protection of aquatic wildlife, including fish and invertebrates. For purposes of the impact assessment, the effect of the proposed all-weather access roads may affect five water quality parameters:

- Introduction of sediments;
- Introduction of deleterious substances;
- Changes in the dissolved oxygen levels;
- Changes in the pH balance in watercourses;
- Changes in the temperature regime of the watercourses.

Construction, operation and maintenance of the proposed road corridor can affect the abundance and distribution of fish populations in the Highway 58 study area. For purposes of the environmental assessment, these effects pathways are discussed under 6 general headings:

- Introduction of sediments;
- Introduction of deleterious substances;
- Disruption of fish passage;
- Changes in stream morphology;
- Alteration and loss of fish habitat; and
- Disturbance of the fish populations.

Most of these effects pathways can impact fish populations in several ways including through changes in water quality, cover availability, reproductive success, food availability and by increasing direct mortality.

10.2 Water Quality

10.2.1 Effects Assessment

Introduction of Sediments

In terms of water quality, the two main effects of sedimentation are the introduction of suspended solids and increase in turbidity.

Alberta Environment guidelines state that the suspended solids concentration should not be increased by more than 10 mg/l over the background value in both acute and chronic conditions. The Canadian Environmental Quality Guidelines (CEQG) (1999) allow for an increase of 25 mg/l over background levels for any short-term exposure (24 hr period) and a maximum increase of 5 mg/l from background levels for long-term exposure (between 24 hr and 30 d) for clear flow. For high flow periods, the maximum increase is 25 mg/l from background levels at any time when background levels are between 25 and 250 mg/l. In instances when the background level is more than 250 mg/l, the increase should not exceed 10%.

Turbidity guidelines have not been established by the Province of Alberta. CEQ guidelines allow for a maximum increase of 8 NTU (Nephelometric Turbidity Units) from background levels for short term exposure and 2 NTUs for long-term exposure for clear flow. For high flow periods, the maximum increase is 8 NTUs from background levels at any time when background levels are between 8 and 80 NTUs. In instances when the background level is more than 80 NTU, the increase should not exceed 10%.

Introduction of Deleterious Substances

The potential for accidental introduction of deleterious substances during the construction, operation and maintenance of the proposed access roads, as well as their impact on fish populations and habitat have been discussed in Section 14.0 .

Changes in Dissolved Oxygen Levels

Construction of the proposed all-weather access roads has the potential to induce local short-term changes in the oxygen levels in stagnant and slow flowing watercourses in the study area. The most likely mechanisms for these changes are the mobilization of organic sediments and the decline of photosynthetic activity caused by increased turbidity and consequently a reduction in available light.

Alberta Environment guidelines indicate a 5.0 mg/l 1-day minimum oxygen concentration (acute guideline) and 6.5 day mean oxygen concentration (chronic guideline). The chronic concentration should be increased to 8.3 mg/l from mid-May to the end of June to protect emergence of mayfly species into adults. The chronic guidelines should be increased to 9.5 mg/l for the areas and times where embryonic and larval stages of fish develop within gravel beds. For Arctic grayling within the study area, this period is expected to be between May and July. The only watercourse where Arctic grayling is expected to spawn within the LSA is the Wentzel River. The CEQG dissolved oxygen guidelines for warm water biota (which includes most of the fish species found in the LSA with the exception of Arctic grayling) are 6 mg/l for early life stages and 5.5 mg/l for other life stages. For cold water biota (e.g., Arctic grayling) the guidelines are 9.5 mg/l for early life stages and 6.5 mg/l for other life stages.

It should be reiterated, that at several sites, the baseline oxygen concentration have been below the guidelines. In such instances the Alberta Environmental Protection guidelines state that "Where natural conditions alone create dissolved oxygen concentrations less than 110% of the applicable criteria means or minimal or both, the minimum acceptable concentration is 90% of the natural concentrations."

Changes in the pH Balance in Watercourses

Construction, operation and maintenance of the proposed road corridor has the potential to change the pH balance in smaller watercourses in the Highway 58 study area. The main mechanisms are mobilization of sediments, contact with fresh concrete (e.g. bridge abutments, culvert end treatment), and road runoff. According to the Alberta Environmental Protection guidelines the pH should be between 6.5 and 8.5 but not altered by more than 0.5 pH units from background values. The CCME (CEQG) values are between 6.5 and 9.0 pH units.

Changes in the Temperature Regime of Watercourses

Construction of watercourse crossing structures for the proposed road corridor has the potential to create a local, short-term alteration of water temperature in the streams. Water temperatures could be increased in confined spaces created behind cofferdams, or during release of water from beaver ponds or work sites. Alberta Environmental Protection acute and chronic guidelines indicate that water temperature is not to be increased by more than 3^0C above the ambient water temperature. The CEQG temperature guideline state that thermal additions should not alter thermal stratification or turnover dates, exceed maximum weekly average temperatures, nor exceed maximum short term temperatures.

Water quality impacts at Sites 1 to 23 along the proposed road corridor are expected to be low in magnitude, short in duration, and local in extent if all established provincial and federal regulations, guidelines and policies are followed during road construction. At Site 24 (Peace River), the effects of in stream work (e.g. installation of piers) at the proposed open water season ferry and winter ice-bridge on water quality has not been subjected to a detailed evaluation because of the lack of project-specific data.

10.2.2 Mitigation

The potential effect of the proposed road corridor on the concentration of suspended solids and water turbidity, introduction of deleterious substances, dissolved oxygen, pH and temperature levels in watercourses should be mitigated by the use of the measures described in Section 10.3.1 and by the use of construction and maintenance best management practices.

10.2.3 Residual Effects

Residual effects will be considered in Section 10.3.2 under overall effects to aquatic resources

10.2.4 Significance Predictions

Significance predictions will be considered in Section 10.3.3 under overall significance to aquatic resources

10.3 Fish and Fish Habitat

Construction of watercourse crossings, including bridges and culverts has the potential to negatively impact fish and fish habitat through offstream and instream construction activities.

Introduction of Sediments

A major impact often associated with construction activities in the vicinity of stream crossings is the introduction of sediments. Construction activities cause short-term effects, however, subsequent erosion of roadside ditches and slopes, as well as erosion resulting from changes in the channel morphology, can have a long-lasting effect if not mitigated properly. The major sources of sediments in the vicinity of a watercourse include:

- Instream construction activities, including equipment crossing and movement, excavation, blasting, armoring, and the construction of temporary diversion structures;
- Erosion from exposed or improperly reclaimed areas;
- Headcutting upstream of an alteration;
- Mobilization of sediments when a cofferdam or beaverdam is removed;
- Increased erosion and bed scouring resulting from the sudden release of water when a beaverdam or cofferdam is removed;
- Introduction of suspended solids during the spring melt which may deposit contaminated road materials into a watercourse; and
- Increased erosion due to changes in downstream flow patterns

The negative effects of sedimentation on fish and other aquatic biota include, but are not limited to:

- Altered habitat (both water and substrate characteristic;
- Reduced plant and algae growth (primary production);
- Direct effects on aquatic invertebrates (habitat changes, smothering of benthic communities, abrasion of respiratory surfaces, interference with food intake etc.);
- Indirect impacts on fish (reduced food base, altered trophic interactions, altered ecosystem structure);

- Direct impact on fish (compromised egg and alevin survival due to reduced gas exchange and abrasion of the surface, reduced growth, reduced feeding, emigration of fish from areas with high suspended load, disruption of the social structure, increased stress, decrease in tolerance to toxicants, reduced resistance to parasites and diseases, alterations in blood chemistry, histological changes, and anoxia.

Eggs and alevins are particularly susceptible to the impact of suspended and bedload sediments. Studies have shown a 40% mortality rate of rainbow trout eggs exposed to 7 mg/l suspended fines. Numerical relationships between percentage of fines, their mean geometric diameter, and egg and fry survival have been established for salmonids.

The Province of Alberta has issued water quality guidelines for the protection of freshwater aquatic life (Alberta Environment 1999) in regards to suspended solids, while the Canadian Council of Ministers of the Environment has issued guidelines Canadian Environment Quality Guidelines for turbidity and suspended solids. These are discussed in Section 10.2.1 (Water Quality).

Introduction of Deleterious Substances
In addition to sediments, other deleterious substances may potentially be released into watercourses during the construction, operation and maintenance, of the proposed road crossings. These generally include:

- Hydrocarbons (e.g., Grease, oil, gas) and hydraulic fluid entering the stream as a result of accidental spills during refuelling and equipment maintenance;
- Toxic substances entering the stream as a result of dust, weed, and ice control;
- Chemicals and debris entering a watercourse during bridge or culvert maintenance, including bridge removal (paint, sandblasting residues, contaminated road surface material); and
- Various substances entering the watercourses during accidental spills throughout the life of a road.

These substances may result in direct fish mortality, cause health problems, affect the development of eggs and juveniles, or reduce food availability for fish populations.

Disruption of Fish Passage
Fish passage may be impeded due to instream construction activities or by the completed crossing structure. Depending on the watercourse, stream flow may have to be diverted, so that construction can be undertaken in dry conditions. The diversion may prevent fish migration. The sudden influx of water, created by the removal of cofferdams or beaver dams can also temporarily displace fish and impede passage.

Improperly installed culverts can impede fish passage by the following:

- Excessive water velocities at the inlet, outlet, and within the culvert;
- Inadequate water depth at the inlet, outlet or within the culvert during low flows;
- Excessive height of the culvert outlet above the stream (hanging culvert);
- Partial or full blockage of culverts by debris or beaver activity; and

- Lack of cover and resting areas upstream or downstream of the culvert.

Culverts require regular inspection and maintenance to ensure that barriers to fish passage do not develop.

Changes in Stream Morphology

The stream channel is created and maintained by the water flowing through it. Changes in water velocity, volume, or direction induce a compensative response by which the channel reaches a new equilibrium. The construction of bridges and culverts may result in changes to channel morphology which have the potential to affect fish habitat. There are several causes of negative effects on channel morphology including:

- Debris accumulation and blockage;
- Introduction of large quantities of sediment;
- Improper structure installation (culvert lifts, buckles, or scours);
- Confinement of flows;
- Upstream backwater effects altering channel morphology;
- Downstream scour and erosion altering channel morphology; and
- Changes in channel shape or cross-section.

Changes in water velocities, volumes, and direction can cause both local and large scale effects. Locally, bed materials can change, with finer particles deposited in areas with low velocity and removed from areas with higher velocities. Velocity increases can cause downstream scouring of the channel bottom and erosion of the banks, while channel constriction can cause headcutting. In some instances, increases in the channel cross sectional area and associated lower velocities can increase sediment deposition and channel aggradations. The magnitude of these effects is reflected in the degree of change in flow patterns and channel morphology. In extreme cases, the entire channel and the habitat it provides can be lost.

Alteration and Loss of Fish Habitat

The installation of culverts, construction of bridge abutments, erosion protection, beaverdam removal, and clearing associated with the proposed road corridor can result in the temporary or permanent alteration or loss of fish habitat.

Physical habitat losses are generally associated with positioning the crossing structure on the streambed (e.g., culverts) or banks (e.g., bridge abutments). Changes in channel morphology due to construction and maintenance of stream crossings can result in habitat changes (e.g. infilling of pools, cut-off of side channels, braiding of the channel) and different substrates, affecting cover, reproduction and food availability. In addition, removing riparian and streambank vegetation can affect fish populations by reducing cover, increasing exposure to solar radiation (i.e., increased water temperatures), reducing food availability, decreasing the efficiency of buffering runoff, and increasing bank instability.

Disturbance of the Fish Populations

Construction, operation and maintenance of the proposed road and associated stream crossings has the potential to disturbance fish populations. Some of the potential disturbance mechanisms include:

- Direct disturbance during the construction by the presence of humans and the operation of heavy machinery, creating noise, and disturbing the habitat. Larger fish are wary of large moving objects which are regarded as predators;
- Increased fishing pressure during the construction phase
- Increased fishing pressure due to improved access to remote areas; and
- Increased local fishing pressure caused by the use of the crossing as a point of access to the stream.

Some fish species, like Arctic grayling, walleye and northern pike are susceptible to increased fishing pressure. Disturbance during critical periods in the life cycle (e.g., spawning and pre- and post spawning) increases the stress on individual fish and may affect reproductive success.

As previously noted, the fisheries LSA consists of several discrete sites, corresponding to the stream crossings. For the purpose of the EIA, the indiv idual sites were assessed for potential impacts based on the existing environment and the crossing structure proposed for the site.

At each site, only 1 VEC was used to assess the potential effects of the proposed crossings, unless warranted by the specific requirements of other VECs. The VEC with the most stringent habitat and/or population requirements was selected

Single span bridge structure
Generally, the pre-mitigation effect of a single span crossing is negative, with the possibility of accidental introduction of silt and/or deleterious substances into the watercourse however, the magnitude of the impact is considered low.

Multiple span bridge
Overall, the direction of impact is negative for a multiple span crossing, however, the magnitude of the impact is considered low. Scientific confidence for the impact is considered high.

Culverts

Generally, the pre-mitigation impact of the proposed culvert crossings are negative, with a moderate probability of positive changes in channel morphology for the replacement of an undersized culvert -(the development of a visible channel with fluvial bed material), negative impact with a low probability of improved access at high flows, and accidental introduction of silt or deleterious substances downstream.

10.3.1 Mitigation and Compensation Measures

The Environmental Protection Measures described below will be included as a special provision in the tender package and within the contractor's Environmental Construction Operations (ECO) Plan to protect the terrestrial and aquatic environment. The measures contained within the plan are in addition to the requirements listed in Alberta Environment's Guide to the Code of Practice for Watercourse Crossings (2000) and the Fish Habitat Manual: Guidelines & Procedures for Watercourse Crossings in Alberta (2002).

The following environmental protection measures will be implemented to minimize the effects of construction and operations on the terrestrial and aquatic environment. The main objectives of the environmental protection measures are:

1. To reduce the risk of sedimentation from instream activities, clearing and excavation of stream banks and channel bed through erosion of exposed soils and destabilized banks.
2. To minimize sediment deposition and the release of deleterious substances that may result in impacts to the aquatic environment.
3. To minimize disturbance to soils, vegetation, fisheries and wildlife resources in the vicinity of the proposed works.

All activities will adhere to contract specifications and will be performed in accordance with established practices. All activities will be conducted in compliance with the appropriate approvals, permits, authorizations and/or dispositions and within the framework of the following recommendations.

Construction area boundaries and areas of concern related to watercourse crossings will be marked with conspicuous flagging tape to ensure that construction personnel know they are working in sensitive areas that cannot be disturbed. All individuals on-site will be orientated with respect to environmental protection measures. Every reasonable effort will be made to minimize the duration of construction, especially instream works. Clean-up of construction at the watercourse site will commence immediately following backfill and the placement of erosion control measures. Prior to undertaking any instream work, all required materials will be stockpiled on-site, and all surface water run-off and instream controls will be installed prior to construction and maintained throughout the installation period. All equipment will be assembled and checked for proper operation at least 100 m away from the watercourse. The fuelling, servicing, washing and staging of machines or equipment within the vicinity of watercourses will not be allowed. On-site servicing including fuelling and lubricating equipment will be conducted at least 100 m from the watercourse to prevent fluids from entering the watercourse. Prior to entering the water body, equipment will be cleaned of all external grease, oil, debris and other fluids and checked for leaks at least 100 m from the water body.

Construction staging areas should be developed in previously disturbed areas that are located at least 100 m from the watercourse. Fuel is to be stored within a containment berm that is to be located at least 100 m from any water body and is to have a capacity of 110% relative to the volume of fuel being stored.

All runoff from the washing/servicing station and containment area will be controlled such that it does not enter directly into the water body. A hydrocarbon spill containment will be retained on-site and be large enough to handle twice the maximum spill potential for substances such as diesel, gasoline and hydraulic fluids.

Waste management practices will be in compliance with all applicable regulations, including the Workplace Hazardous Materials Information System (WHMIS). Waste generated during construction and roll-back will be disposed of at local landfill sites in accordance with local guidelines. Weather-proof and wildlife-resistant containers will be provided for waste disposal. All waste and garbage will be collected and placed in designated storage areas. Attention will be given to the collection of spent welding rods, tape etc. All pressure test media and sewage will be handled and disposed of in an environmentally acceptable and approved manner. The construction specifications and inspection program will: ensure that the right-of-way and work spaces are clear of debris following cleanup; and, ensure that all wastes are disposed of in an approved manner.

All materials used for temporary or permanent installation in the river, including riprap material, and isolation berms, will meet the following conditions:

- Clean and free of fine materials;
- Non-toxic to fish; and
- Will not introduce silt and/or clay into the watercourses.

To protect fish and fish habitat during critical life periods, instream work windows are provided by the Alberta Code of Practice for Watercourse Crossings. According to this guideline, unless otherwise authorized under section 10 of the Code, the Restricted Activity Period for the watercourses affected by the project is April 16 to July 15.

It may be possible to stage construction in a manner that all construction activities would occur within the recommended instream work window of 16 July – April 15. Construction outside of this work window will require a permit from Alberta Environment and a *Fisheries Act* Authorization from Fisheries and Oceans Canada.

The clearing of vegetation will be kept to the minimum necessary to provide access to the work area. A vegetative buffer along each bank of the water body will be retained until just prior to the watercourse crossing works in order to filter potential upland runoff from entering the water body.

Soil conservation and the salvage of existing native plant materials and topsoil is a priority. The topsoil layer (leaf litter, topsoil) will be removed and stockpiled for site reclamation. Trench spoil will be stockpiled separately. All material will be placed/stockpiled at least 20 m away from the high water mark and in a manner that will prevent it from re-entering the water body.

Isolation Methods for Instream Works

Instream work will be carried out in a manner that isolates the instream construction site and eliminates the flow of surface water through the construction area. The details of isolation method will be determined close to the time of installation in conjunction with the contractor. In accordance with the Code of Practice, Section 8(4), where a water body is dry or frozen to the bottom at the time of carrying out the works, the requirement to isolate the location does not have to be met.

If isolation requires pumps (e.g. flows < 1 m^3/s), spare pumps and generators will be on hand. Pumps will be tested in advance to ensure that they are in good working order. At least 200 to 300 percent of planned pumping capacity will be available on site in case of equipment breakdown or increases in flows beyond magnitudes originally anticipated. All pumps used for bypass pumping will have capacity that exceeds expected flows. The bypass pump intake will be installed where it will not disturb sediments in the water body.

Any water entering an intake of a bypass pumping system must pass through a screen with openings that are no larger than 2.54 mm and at a velocity that does not result in the entrainment and entrapment of fish or fish fry.

Discharge water will be directed to prevent erosion of the area at and surrounding the outlet of the bypass pump by dissipating the energy to the released water using devices that include, but are not limited to tarps, flip buckets, or appropriately sized granular materials. Water will be pumped from the isolated construction site to a sediment trap or through a vegetated area to minimize the addition of sediment to the water body.

The water diverted around the crossing site will be returned to the water body downstream of the crossing site. Where ice is present on the water body, the diverted water will be returned to the water body downstream of the crossing site, under the ice.

Following the placement of isolation measures, fish salvage operations will be conducted within the isolated area using standard salvage techniques (i.e. electro-fishing, minnow traps, seine net, etc.). This activity will be conducted in accordance with a fish salvage permit, where required, to be obtained from ASRD, Fort Vermillion. Any fish found within the isolated portion of the construction site will be removed and released alive, without harm or destruction, to an area of the water body outside of the construction site.

An isolation method must not be used for longer than fourteen consecutive days, unless upstream and downstream fish migration is accommodated. Equipment will be available on-site to collect and move fish. As no more than 50% of the river's width is expected to be blocked off at any time, it is not anticipated that fish migration would be adversely affected.

The re-introduction of water into the construction area isolated by the dam will be carefully planned to minimize the introduction of sediment into the stream. Before removing the dams, the following will be completed:

- The isolated area will be thoroughly cleaned of any construction materials, aggregate stockpiles, or loose vegetation.
- The channel bed surfaces will be restored to natural contours with appropriate sized clean material.

The downstream dam will be removed first followed by the upstream dam. Care will be taken to do this with as little disruption to the channel bed and banks as possible. Some sediment will inevitably enter the stream as a result of these activities, but performing them quickly and carefully will reduce the quantity of sediment generation.

Control of Surface Water Run-off and Seepage

The release of sediment into the river will not be authorized by DFO, and its discharge could result in a contravention of the general prohibition under section 36 (3) of the *Fisheries Act*. All reasonable measures to prevent the deposit of deleterious substances will be exercised.

Best Management Practices (BMP) will be used for all construction and maintenance activities in and around the river to prevent HADD. Typical BMP's are outlined in Alberta Environment's Guide to the

Code of Practice for Watercourse Crossings (2000) and the Fish Habitat Manual: Guidelines & Procedures for Watercourse Crossings in Alberta (2002).

Sediment traps will be constructed in conjunction with the installation of the temporary sediment barriers when the potential surface runoff or pump bypass discharge and sediment load to the channel is greater then the capacity of the sediment barriers. These will be implemented as required prior to, during and following construction related activities.

Permanent Erosion Control

After the crossing construction is complete, topsoil and salvaged vegetation will be replaced. All slopes will be regraded to original grade to a maximum of 3:1. Disturbed areas will be revegetated using either bioengineering techniques (e.g. shrubs, cuttings, stakes, brush layering or wattles) or by seeding with a mixture of native plant species. Revegetation will be undertaken as soon as possible with the objective of permanently stabilizing disturbed areas within one growing season of the completion of construction.

All disturbed areas will be permanently stabilized by installing and placing long-term erosion control measures at the crossing site and the standard RoW width sloping to the water body, including, but not limited to, slope stabilization, revegetation, soil coverings, and riprap armouring.

Revegetation of disturbed roadways and other disturbed surfaces should include the recommended seed mixes for the Central Mixedwood Seed Mix Zone as outlined by the Alberta Infrastructure and Transportation Information Bulletin No. 25 (2005), as follows:

Slender wheat grass	Agropyron trachycaulum	*35%*
Rocky mountain fescue	Festuca saximontana	*20%*
Tickle grass	Agrostis scabra	*10%*
Fringed brome	Bromus ciliatus	*10%*
Canada wildrye	Elymus Canadensis	*10%*
Tufted hairgrass	Deschampsia cespitosa	*10%*
Fowl bluegrass	Poa palustris	*5%*

Where revegetation is required beyond grasse the Native Plant Revegetation Guideline for Alberta will be used.

Sandy soils along the road corridor may be more difficult to revegetate due to poor water retention and susceptibility to erosion following disturbance. Special reclamation measures, such as mulching, may be required to reduce erosion and improve revegetation on sandy soils.

The capture and containment of deleterious substances and debris must be completed during the decommissioning (demolition) of the existing bridge and during maintenance activities (i.e., repainting) of new watercourse crossings (including the Peace River bridge). Approaches that will be implemented, where applicable, include the following:

- Ground and water body covers: Sheets of plastic or cloth can be spread on the ground as well as suspended below bridges using safety nets as support to catch debris. Debris is collected manually from covers for periodic disposal.
- Vertical drapes hung from the bridge to divert debris down to barges/floating booms or horizontal nets suspended beneath the bridge.
- Vacuum shrouded hand tools can be used to collect debris as it is generated.

10.3.2 Residual Effects

The residual effects of elevated levels of suspended solids on fish populations and fish habitats are anticipated to be negative in direction, low in magnitude, local in extent, short-term in duration, isolated in frequency and high in reversibility.

Residual effects of the construction/operation on fish migration are anticipated to be negative in direction, low in magnitude, regional in extent, short-term in duration, isolated in frequency and high in reversibility.

Residual effects of changes in channel morphology on productive capacity, associated with the installation of a multiple span structure are anticipated to be negative in direction, moderate in magnitude, local in extent, short-term in duration, isolated in frequency and high in reversibility.

Residual effects of changes in channel morphology on productive capacity, associated with the installation of a culvert are anticipated to be negative in direction, moderate in magnitude, local in extent, long-term in duration, isolated in frequency and moderate in reversibility.

Residual effects from deleterious substances are expected to be negative in direction, low in magnitude, local in extent, long-term in duration, and high in reversibility.

A major environmental concern is the destruction of sensitive fish habitats such as overwintering refuges and fish spawning beds, either through direct impact resulting from installation of culverts and bridge footings and piers on these habitats or indirectly from sedimentation of bed materials scoured from the vicinity of these instream features. The alteration of the channel beds as a result of flow scour, infilling and downstream sedimentation within the zone of impact, are not anticipated to be of significant concern because 1) any scouring will occur during high flow events when levels of suspended sediment and sedimentation (sediment deposition) are naturally high; and 2) fish overwintering occurs in the winter during annual low flow stages and flow scour will be limited during this period. As a result, the alteration of spawning and deep water overwintering habitats resulting from sedimentation and sediment redistribution resulting from flow scour (during high flow stages) is anticipated to be negative in direction, low in magnitude, local in extent, short-term in duration, and high in reversibility.

A condition of the federal *Fisheries Act* Authorization is that measures be implemented to adequately compensate for the harmful alteration, disruption or destruction (HADD) of fish habitat, through replacement of the natural habitat or an increase in the productivity of natural habitat (no net loss). As a result, information will need to be prepared based on the final watercourse crossing designs and the ability to quantify and qualify the actual HADD resulting from the development of the crossings. The fish habitat compensation plan will include appropriate compensation strategies to ensure a "no net loss" of fish habitat pursuant to Section 35(2) of the federal *Fisheries Act*. The preliminary compensation strategies outlined by AMEC (2005), have been designed to achieve no net loss of fish habitat, by compensating for the residual negative effects on fish and fish habitat that were associated with the watercourse crossings.

10.3.3 Significance Predictions

Based on the information provided in this report and taking into account the proposed mitigation measures and the compensation plan, the RA's conclude that the proposed project is not likely to result in significant adverse environmental effects on aquatic resources.

11.0 Wildlife

11.1 Introduction

Construction, operation and maintenance of the proposed all-weather roads can affect the distribution and abundance of wildlife in the Highway 58 study area. Overall, roads can affect wildlife in 7 general ways:

- Increased mortality resulting from road construction;
- Increased mortality from vehicle collisions;
- Modification of animal behaviour (e.g., movement);
- Alteration of the physical environment (e.g., habitat fragmentation and loss);
- Alteration of the chemical environment (e.g., input of pollutants);
- Spread of exotic species that compete with native species; and
- Increased habitat use and habitat alteration by humans.

The effects pathways that describe the general linkages between the construction, operation and maintenance of the proposed access roads on wildlife distribution and abundance in the Highway 58 study area are described in the following Figure.

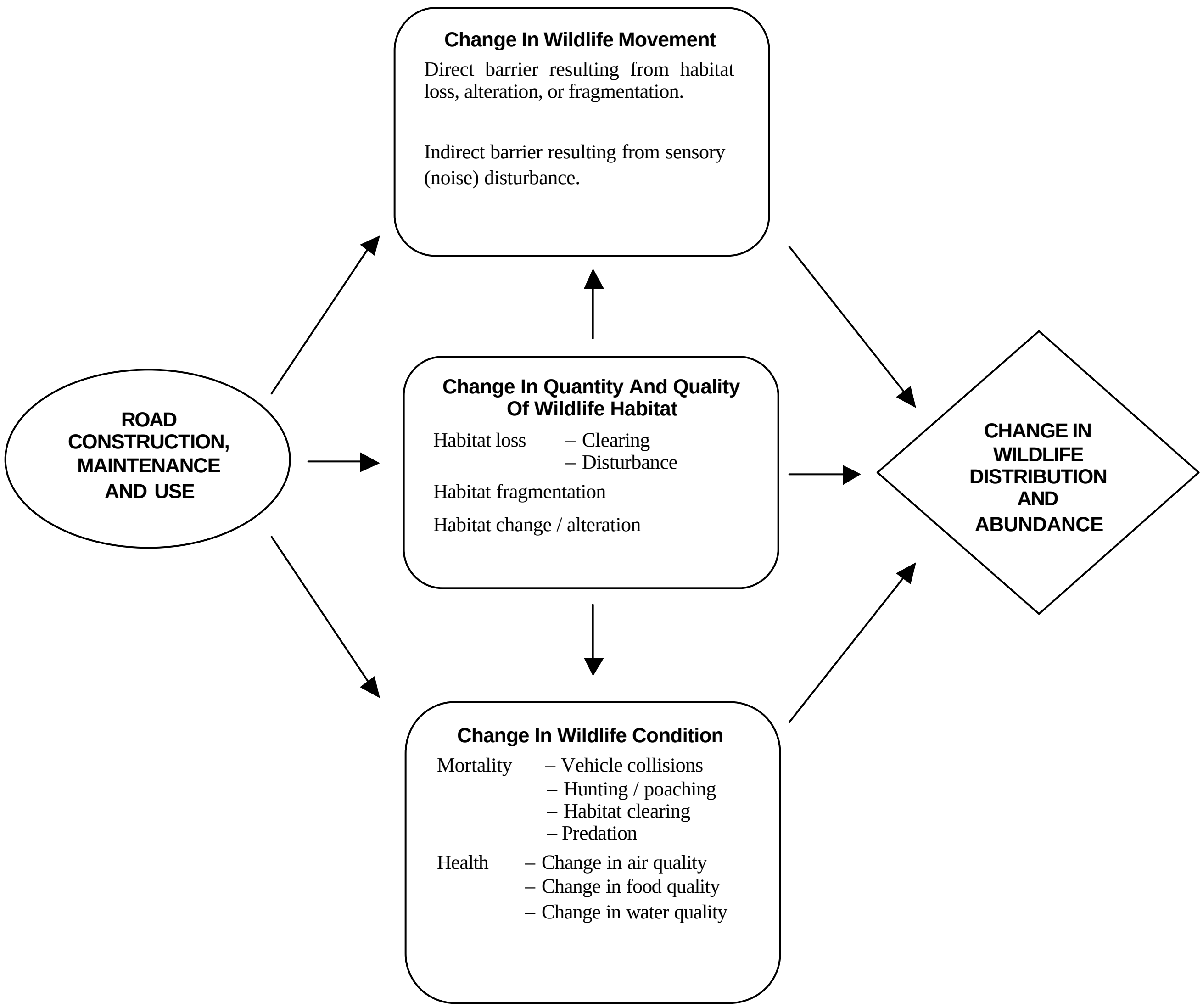


Figure 5. Effects pathways that describe the general linkages between the construction, operation and maintenance of the proposed access roads on wildlife distribution and abundance in the Highway 58 study area.

11.2 Wildlife Habitat

11.2.1 Effects Assessment (WBNP)

11.2.1.1 Habitat Loss, Fragmentation and Alteration

Expansion of the road corridor will result in the permanent loss of approximately 20 ha of habitat in the park, based on a 30 m wide right-of-way. The majority of habitat lost will be deciduous forest (7.3 ha), followed by mixedwood forest (6.4 ha), jack pine forest (5.9 ha) and finally wet shrub (0.5 ha) (Table 11.1). No treed bog habitat will be removed as a result of road construction. The percentage of each habitat removed from the LSA is generally low and ranges from 2.4% for mixedwood habitat to 0.3% for wet shrub habitat. Overall, 1.1% of vegetated areas in the LSA will be cleared for road construction.

The total amount of habitat lost from expansion of the road corridor in Wood Buffalo National Park represents a relatively small proportion (i.e., ~ 1%) of the LSA, and an extremely small proportion of the entire park (approximately 0.0001% of the total park area). This level of habitat loss will likely have little direct impact on the local and regional abundance of wildlife VECs, including those that require forested habitats. The amount of edge habitat and abundance of species that use edge should also not change (e.g., moose, lynx and grouse; assuming all other factors, such as hunting, trapping and predation, remain unchanged). Bison may actually benefit from road expansion because of increased availability of grasses along road shoulders. Bison are frequently observed along existing roadsides in Wood Buffalo National Park as well as in Elk Island National Park. However, this benefit may be reduced by poaching activity (see below).

Table 11.1. Habitat loss resulting from expansion of the road corridor (to 30 m), Wood Buffalo National Park.

Habitat Type	Habitat Lost (ha)[1]	% Total	% of Habitat in LSA [2]	% of LSA [3]
Deciduous	4.9	36.3	0.9	0.40
Jack Pine	3.5	29.4	1.2	0.32
Mixedwood	4.3	31.8	2.4	0.35
Treed Bog	0	0	0	0
Wet Shrub	0.3	2.5	0.3	0.03
Total	**20.1**	**100%**	**-**	**1.1%**

[1] This value does not include habitat loss resulting from the existing 10 m wide right-of-way (i.e., baseline conditions).
[2] For each habitat, calculated as: (habitat lost / total area habitat type in LSA) x 100
[3] Calculated as: (habitat lost / total vegetated area LSA) x 100

The effects of habitat fragmentation on wildlife VECs are more difficult to ascertain than the effects of habitat loss. Habitats in the study area have undergone a degree of fragmentation as a result of initial corridor construction in the early 1970s. Whether widening of the existing road corridor will contribute to additional fragmentation impacts is not entirely clear; however, additional impacts, if any, are expected to be small in magnitude.

The negative impacts of habitat fragmentation include increased isolation of forest patches and increased edge-to-interior ratios (Alberta Environmental Protection 1998a). The amount of edge habitat in the park should not change following widening of the road corridor (assuming the existing corridor is followed), resulting in little additional impact over baseline conditions for all wildlife VECs. However, some patches of forested habitat may be reduced in size, which may affect habitat use by forest interior specialists (e.g., ovenbird, Cape May warbler). Because of the small amount of habitat lost, this effect is not considered significant.

Creation of the road corridor during the early 1970s resulted in the spatial separation of habitats north and south of the road corridor. This may have created a barrier for species that have low mobility or are highly sensitive to forest openings (changes in movement patterns are discussed in more detail below). Island biogeography theory predicts that increased isolation of habitat patches leads to decreased rates of immigration, which, for small isolated habitat patches, increases the risk of local species extinctions. Widening of the existing road corridor will likely increase the degree of isolation between forested areas north and south of the road corridor for some wildlife VECs. However, because habitats adjacent to the road will remain connected to a surrounding forest matrix, increased corridor width is not likely cause a significant additional fragmentation/isolation effect (i.e., decline in immigration rates to forested habitats adjacent to the road).

11.2.1.2 Disturbance

Construction of the proposed all-weather access roads will result in an increase in traffic volume, particularly during the spring and summer periods when access has traditionally been most difficult. According to the socio-economic analysis of the proposed Highway 58 project (Applications Management consulting Ltd. 2003), improved access will likely result in an increase in both commercial and private traffic along the proposed roads. Estimates of increased road use indicate that traffic volumes may triple from current volumes (175 AADT).

Increased road use will likely result in increased disturbance to wildlife species. However, the level of disturbance will depend on traffic volumes and speed. Currently, the road experiences frequent use during the winter and during dry weather conditions (Alberta Transportation 2001; R. Wiacek, personal observation). Following construction of the proposed Highway 58 project, traffic will likely increase at these times, although a significant increase in traffic volume is not expected (road conditions are generally good during winter and during extended periods of dry weather, allowing access for all vehicle types). In contrast, improvements to the road will likely result in a significant increase in traffic volume during the spring and summer when traditional access has been difficult. This will likely result in an increase in disturbance to wildlife species in the study area at these times.

Although an increase in road disturbance is expected, impacts associated with this increase are expected not to be significant primarily because of existing levels of disturbance in the study area. For example, moose are hunted in the park by registered permit holders and thus may occur less frequently near the road, as is believed to occur outside the park, based on traditional ecological knowledge (T. Schramm, University of Alberta, personal communication). As a result, an increase in traffic volume may result in little additional disturbance for this species. Bison frequently make use of roads elsewhere in the park (Westworth Associates Environmental Ltd. 2000a) as well as in Elk Island National Park (R. Wiacek, personal observation), and thus may readily habituate to additional road disturbance (in the absence of poaching and harassment). Lynx and marten have also been observed in the vicinity of busy highways and dirt roads (Koehler and Aubry 1994, Jalkotzy et al. 1997, R. Wiacek personal observation) and thus may be tolerant of low to moderate levels of vehicle traffic. Finally, birds may not be sensitive to the relatively low traffic levels expected along the road, although high levels of traffic can have impacts on bird distribution and abundance (Jalkotzy et al. 1997).

In contrast to highway operation and maintenance, higher levels of disturbance during highway construction (i.e., equipment noise, worker presence) may cause some species to temporarily avoid habitats adjacent to the road corridor (e.g., moose, bison, marten, lynx and some birds). However, these impacts should subside once the project is completed. In addition, impacts resulting from construction activities will be highly localized, further reducing the impacts to wildlife VECs.

11.2.1.3 Residual Effects

The potential effects of habitat change on wildlife VECs resulting from road construction, operation and maintenance in Wood Buffalo National Park are outlined in Table 11.2. Scientific confidence in the potential impacts of habitat fragmentation is considered medium. Very little waterfowl and amphibian habitat occurs along the road corridor in Wood Buffalo National Park (mostly at the Garden Creek crossing). Consequently, impacts are considered low for these VECs in the park.

Table 11.2. Environmental assessment of the potential effects of habitat changes on wildlife VECs, Wood Buffalo National Park

Species	Change in Habitat: Potential Effects	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Moose	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High

Species	Change in Habitat: Potential Effects	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
		Operation	Negative	Moderate	Local	Long-term	Constant	Low	High	High
Bison	Habitat Loss, Fragmentation	All	Neutral/ Positive	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Neutral/ Negative	Low	Local	Long-term	Constant	Low	High	High
Marten	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Low	Local	Long-term	Constant	Low	High	Medium
Lynx	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Low	Local	Long-term	Constant	Low	High	Medium
Ovenbird	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Low	Local	Short-term	Isolated	High	High	High
		Operation	Neutral	Low	Local	Long-term	Constant	Low	High	Medium
Cape May Warbler	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat	Construction	Negative	Low	Local	Short-term	Isolated	High	High	High
	Disturbance/ Habitat Avoidance	Construction	Negative	Low	Local	Short-term	Isolated	High	High	High
		Operation	Neutral	Low	Local	Long-term	Constant	Low	High	Medium
Grouse	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Neutral	Low	Local	Long-term	Constant	Low	High	High
Waterfowl	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	High
	Disturbance/ Habitat Avoidance	Construction	Neutral	Low	Local	Short-term	Isolated	High	High	High
		Operation	Neutral	Low	Local	Long-term	Constant	Low	High	High
Wood Frog	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	High
	Disturbance/ Habitat Avoidance	Construction	Neutral	Low	Local	Short-term	Isolated	High	High	High
		Operation	Neutral	Low	Local	Long-term	Constant	Low	High	High

11.2.2 Effects Assessment Province of Alberta

11.2.2.1 Habitat Loss, Fragmentation and Alteration

The proposed Highway 58 project will result in the permanent loss of approximately 121 ha of habitat along Road Section A, and 42 ha of habitat along Road Section C, based on a 40 m wide road corridor. Most of the habitat lost along Road Section A will be deciduous forest (77.3 ha), followed by white spruce forest (13.0 ha), pine forest (12.5 ha), treed bog (8.0 ha) and wet shrub (5.9 ha) habitats (Table 8.15). Relatively low amounts of mixedwood (2.9 ha) and wetland (1.3 ha) habitats will be lost. Along Road Section C, the majority of habitat lost will also be deciduous forest (28.4 ha), followed by treed bog (5.6 ha) and white spruce (4.5 ha) habitats (Table 76). Relatively low amounts of wet shrub (1.8 ha) and mixedwood (1.6 ha) habitats will be lost. The percentage of each habitat type removed from the LSA (Road Sections A and C combined) varies from 2.1% for deciduous habitat to 1.0% for wet shrub habitat. Overall, 1.55% of the vegetated areas in the LSA will be cleared for road construction along both Road Sections A and C.

Table 11.3. Habitat losses associated with the proposed Highway 58 project, Province of Alberta.

Habitat Type	Road Section A				Road Section C			
	Habitat Lost (ha) [1]	% Total	% of Habitat in LSA[2]	% of LSA [3]	Habitat Lost (ha) [1]	% Total	% of Habitat in LSA[2]	% of LSA [3]
Deciduous	77.3	63.9	1.5	0.73	28.4	67.8	0.6	0.27
Jack Pine	12.5	10.3	1.9	0.12	-	-	-	-
White Spruce	13.0	10.8	1.3	0.12	4.5	10.7	0.4	0.04
Mixedwood	2.9	2.4	0.8	0.03	1.6	3.8	1.0	0.02
Treed Bog	8.0	6.6	0.6	0.08	5.6	13.4	1.0	0.05
Wet Shrub	5.9	4.9	0.6	0.06	1.8	4.3	0.4	0.02
Wetland	1.3	1.1	1.6	0.01	-	-	-	-
Total	**120.9**	**100%**	**-**	**1.15**	**41.9**	**100%**	**-**	**0.40**

[1] This value does not include habitat loss resulting from the existing 10 m wide right-of-way (i.e., baseline conditions).
[2] Calculated as: (habitat lost / total area habitat type in LSA) x 100
[3] Calculated as: (habitat lost / total vegetated area LSA) x 100

The total amount of habitat losses associated with the proposed Highway 58 project outside of Wood Buffalo National Park represents a relatively small proportion (1.55%) of the LSA and thus will likely have little direct impact on the bcal and regional abundance of wildlife VECs. The majority of habitat loss will occur along Road Section A (120.9 ha); however, this loss occurs over a distance of 45.4 km. In contrast, only 41.9 ha of habitat will be removed along Road Section C, but this occurs over a distance of 12.5 km. Construction along approximately two-thirds of Road Section C will involve clearing a new road corridor, unlike on sections A and B which follow an existing road corridor.

The effects of habitat fragmentation along Road Section A are considered identical to those described for Road Section B within Wood Buffalo National Park. Because of the existing road corridor, fragmentation impacts have likely occurred, and additional corridor clearing should not result in increased habitat isolation. However, some forest patches may be reduced in size, potentially affecting forest interior specialists such as the ovenbird and Cape May warbler. Because of the relatively small amount of habitat lost, this affect is not considered significant.

In contrast to Road Section A, right-of-way clearing has not occurred along much of Road Section C. As a result, clearing will result in habitat fragmentation along this road corridor, which may impede the movements of some VEC species (see review below). However, because extensive habitat still occurs on either side of the road, habitat isolation is not expected to cause significant declines in species abundance.

11.2.2.2 Disturbance

The available evidence suggests that existing disturbances along Road Section A (e.g., traffic, hunting and poaching) have had an impact on wildlife, particularly ungulates. For example, according to traditional knowledge experts, the Wentzel bison range once encompassed part of the road corridor outside of the park. However, because of hunting pressure along the road, bison are currently restricted to the slopes of the Caribou Mountains and seldom occur within 7 km of the road (T. Schramm, University of Alberta, personal communication). Similarly, encounters with moose along the road corridor have declined, suggesting that moose abundance may also have declined in this area, possibly as a result of hunting pressure (T. Schramm, University of Alberta, personal communication). Because of existing disturbances along Road Section A, increased traffic frequency and volume may not result in significant additional impacts to wildlife VECs. In contrast, disturbance caused by highway construction (e.g., noise, human presence) may cause some species to temporarily avoid habitats adjacent to the road corridor (e.g., moose, marten, lynx and some birds). However, these impacts should subside once the project construction phase is completed.

In contrast to Road Section A, little vehicle disturbance currently occurs along Road Section C. As a result, construction of the new road corridor in this area is expected to result in moderate impacts to wildlife VECs, particularly moose. Riparian areas along the Wentzel River provide important moose range, and abundant sign and tracks were observed in this area during the snow tracking surveys. Consequently, vehicle traffic and associated disturbances will likely result in a decline in the density of moose, and possibly other species, in this area.

11.2.2.3 Residual Effects

Because of the existing road corridor, the impact ratings for Road Section A were considered similar to those for Road Section B within Wood Buffalo National Park, with the exception of bison, waterfowl and wood frogs. Wood bison do not typically occur near the road corridor outside of the park; therefore, impacts to this species were not rated along Road Section A. Several small patches of wetlands and bogs will be cleared during construction activities along Road Section A, resulting in small impacts to waterfowl and frogs. Overall impacts on wildlife VECs resulting from changes in wildlife habitat along Road Section A are outlined in Table 11.4.

Table 11.4. Environmental assessment of the potential effects of habitat changes on wildlife VECs along Road Section A, Province of Alberta

Species	Change in Habitat: Potential Effects	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Moose	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Moderate	Local	Long-term	Constant	Low	High	High
Marten	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Low	Local	Long-term	Constant	Low	High	Medium
Lynx	Habitat Loss,	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Low	Local	Long-term	Constant	Low	High	Medium
Ovenbird	Habitat Loss,	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Low	Local	Short-term	Isolated	High	High	High
		Operation	Neutral	Low	Local	Long-term	Constant	Low	High	Medium
Cape May Warbler	Habitat Loss,	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Low	Local	Short-term	Isolated	High	High	High
		Operation	Neutral	Low	Local	Long-term	Constant	Low	High	Medium
Grouse	Habitat Loss,	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Neutral	Low	Local	Long-term	Constant	Low	High	High

Species	Change in Habitat: Potential Effects	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Waterfowl	Habitat Loss,	All	Negative	Low	Local	Long-term	Constant	Low	High	High
	Disturbance/ Habitat Avoidance	Construction	Negative	Low	Local	Short-term	Isolated	High	High	High
		Operation	Neutral	Low	Local	Long-term	Constant	Low	High	High
Wood Frog	Habitat Loss,	All	Negative	Low	Local	Long-term	Constant	Low	High	High
	Disturbance/ Habitat Avoidance	Construction	Negative	Low	Local	Short-term	Isolated	High	High	High
		Operation	Neutral	Low	Local	Long-term	Constant	Low	High	High

Road Section C was assessed separately from section A because of the absence of an existing right-of-way along much of its length. As a result, project impacts were generally higher than those identified along Road Section A, as outlined in Table 11.5. The magnitude of impacts resulting from disturbance was considered moderate for many VECs because construction of Road Section C represent a new road corridor. In addition, impacts resulting from habitat fragmentation for area sensitive forest birds (ovenbird and Cape May warbler) were considered moderate in magnitude.

Table 11.5. Environmental assessment of the potential effects of habitat changes on wildlife VECs along Road Section C, Province of Alberta

Species	Change in Habitat: Potential Effects	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Moose	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Moderate	Local	Long-term	Constant	Low	High	High
Marten	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Moderate	Local	Long-term	Constant	Low	High	Medium
Lynx	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Moderate	Local	Long-term	Constant	Low	High	Medium

Species	Change in Habitat: Potential Effects	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Ovenbird	Habitat Loss, Fragmentation	All	Negative	Moderate	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Low	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Low	Local	Long-term	Constant	Low	High	Medium
Cape May Warbler	Habitat Loss, Fragmentation	All	Negative	Moderate	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Low	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Low	Local	Long-term	Constant	Low	High	Medium
Grouse	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Low	Local	Long-term	Constant	Low	High	High
Waterfowl	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	High
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Low	Local	Long-term	Constant	Low	High	High
Wood Frog	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	High
Wood Frog	Habitat Loss, Fragmentation	All	Negative	Low	Local	Long-term	Constant	Low	High	High
	Disturbance/ Habitat Avoidance	Construction	Negative	Moderate	Local	Short-term	Isolated	High	High	High
		Operation	Negative	Low	Local	Long-term	Constant	Low	High	High

11.2.3 Mitigation (All Road Sections)

Several mitigation options are available to reduce the impacts of habitat changes resulting from highway construction, operation and maintenance of the proposed Highway 58 project on wildlife VECs. These include the following:

- Use existing rights-of-way as much as possible. This will minimize the amount of habitat loss, fragmentation and quantity of edge habitats.
- Minimize the width of the road corridor to 30 m where possible in the Province of Alberta road sections. The maximum width of the road corridor will be 30 m within the Wood Buffalo National Park sections. Reducing right-of-way width would result in less habitat loss, as summarized in Table 8.18 Habitat loss in Wood Buffalo National Park would be reduced to 13.0 ha (a net gain of 7.1 ha), 81.9 ha along Road Section A (net gain of 39.0 ha) and 31.0 ha along Road Section C (net gain of 10.9 ha) if a 30 m right-of-way was used over the entire length of the road.
- Vegetation clearing will be scheduled to avoid nesting periods.

- Clearing of the right-of-way will be limited.
- Use existing right-of-way as much as possible.
- Abandoned roadway will be revegetated with native vegetation.
- Low speed limits and warning signs will be posted on road in the vicinity of areas with higher wildlife movement.

Table 11.6 Comparison of habitat loss for 30 m and 40 m wide rights-of-way along the Highway 58 project corridor.

Habitat Type	Road Section A			Road Section B (WBNP)			Road Section C		
	Habitat Lost (ha)		Net Habitat Gain [1]	Habitat Lost (ha)		Net Habitat Gain [1]	Habitat Lost (ha)		Net Habitat Gain [1]
	40 m ROW	30 m ROW		40 m ROW	30 m ROW		40 m ROW	30 m ROW	
Deciduous	77.3	51.6	25.7	7.3	4.9	2.4	28.4	21.1	7.3
Jack Pine	12.5	9.3	3.2	5.9	3.5	2.4	-	-	-
White Spruce	13.0	8.7	4.3	-	-	-	4.5	3.4	1.1
Mixedwood	2.9	1.9	1.0	6.4	4.3	2.1	1.6	1.2	0.4
Treed Bog	8.0	5.3	2.7	0	0	0	5.6	4.1	1.5
Wet Shrub	5.9	4.2	1.7	0.5	0.3	0.2	1.8	1.2	0.6
Wetland	1.3	0.9	0.4	-	-	-	-	-	-
Total	**120.9**	**81.9**	**39.0**	**20.1**	**13.0**	**7.1**	**41.9**	**31.0**	**10.9**

[1] Net gain in habitat for a 30 m wide right-of-way in contrast to a 40 m wide right-of-way.

11.2.4 Residual Effects (All Road Sections)

Overall, the direction of impacts from habitat loss, fragmentation and alteration, as well as disturbance are negative; however, the magnitude of most impacts is considered low or moderate because of the presence of the existing road corridor (i.e., few additional impacts are expected to occur). Moderate impacts were assigned to some VECs because of disturbance that can result from construction activities; however, these impacts will be temporary in nature.

Reducing the width of the road corridor will result in less habitat loss along the road corridor. However, because some habitat loss will still occur, the direction of this impact will remain negative and the magnitude low for all Road Sections (i.e., no change from initial impact assessment). Similarly, because a new right-of-way will be constructed along parts of Road Section C, fragmentation impacts will still likely occur for area sensitive species (ovenbird and Cape May warbler), resulting in no change in initial ratings.

11.2.5 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude that the proposed project is not likely to result in significant adverse environmental effects on wildlife habitat.

11.3 Wildlife Movements

11.3.1 Effects Assessment

Impacts to wildlife movements resulting from road construction, operation and maintenance likely do not differ between Road Sections. Consequently, Road Sections A, B and C are considered collectively in this assessment component.

Data collected during field surveys indicated that wildlife movements may not be impeded by the existing 10 m wide corridor. In addition, the available scientific evidence suggests that increasing the width of the road corridor to 40 m should not significantly affect movement patterns of most wildlife VECs. Moose, deer, bison, lynx, marten, fisher, wolverine, wolf, fox, coyote, and grouse tracks were all observed crossing the road, with multiple track sightings recorded for most species.

The potential use of the road as a travel corridor by predators such as wolves and coyotes, as well as bison, is considered low. Few bison occur near the road corridor in Wood Buffalo National Park; therefore, potential movement along the road corridor is limited. In addition, bison that occur in the vicinity of the road outside the park are subjected to heavy hunting pressure. As a result, any long-distance movement along the road corridor out of the park is considered unlikely. The majority of bison movements in the region have been observed along the lower slopes of the Caribou Mountains, and south of the Peace River in the vicinity of Fox Lake. Consequently, expansion of the road corridor should not affect the risk of disease transmission to cattle and bison ranches outside of the park.

Although predators were observed crossing the road corridor, only one wolf was observed following the road, and this occurred only for a short distance. It is likely that current levels of traffic are high enough to discourage predators from traveling along the road. Consequently, improvement of the existing road corridor may further reduce these movements.

The direction of impacts associated with expansion of the road corridor on wildlife movements is expected to be either neutral or negative, and the magnitude of impacts low (Table 11.7). The available evidence indicates species sensitive to crossing open areas (e.g., marten and lynx) should not be significantly impeded by a 40 m wide corridor. Ungulates and birds should also not be impeded by this crossing distance. It is not known whether frogs will cross a 40 m wide road corridor; however, bridges and culverts at creek crossings will provide some movement opportunities for amphibians and other species.

Although the road should not act as a physical barrier to movement, sensory disturbance during road construction and use, as well as other road-associated disturbances (e.g., hunting, poaching and trapping pressure) may result in avoidance of the road corridor. In addition, although wildlife VECs will likely cross a 40 m wide corridor, mortality associated with road collisions may affect the abundance of some species. This impact is discussed in detail below.

11.3.2 Mitigation

The RAs will ensure the following mitigation measures:

- Road right-of-way access will be limited to 30 m (WBNP) for Garden River Access Road.
- During operations, maintenance requirements will be scheduled (clearing of re-growth, rut repair) to avoid the breeding/nesting period for birds (April 15 to July 31).
- Wildlife passage will be accommodated on the east side of the Peace River.
- Low speed limits and animal warning signs will be posted.
- Collision frequency will be monitored.
- Construction and road maintenance will be avoided during breeding/nesting times for migratory birds.
- During operations, maintenance requirements will be scheduled (clearing of re-growth, rut repair) to avoid the breeding/nesting period for birds (April 15 to July 31).
- Less palatable plants will be established on right-of-way to dissuade wildlife grazing, and
- Wildlife will be deterred from approaching roadway. For example:
    - Wildlife reflecting devices
    - Habitat alteration, consisting of removing vegetation along roadways and planting less palatable species

11.3.3 Residual Effects

The residual effects are identified in Table 11.7 below.

Table 11.7. Environmental assessment of the potential effects of road construction, use and maintenance on wildlife movements along the Highway 58 corridor

Species	Change in Movement: Potential Effects	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Moose	Barrier To Movement	All	Neutral	Low	Local	Long-term	Constant	Low	High	High
Bison [1]	Barrier To Movement	All	Neutral	Low	Local	Long-term	Constant	Low	High	High
Marten	Barrier To Movement	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
Lynx	Barrier To Movement	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium
Ovenbird	Barrier To Movement	All	Neutral	Low	Local	Long-term	Constant	Low	High	High

Species	Change in Movement: Potential Effects	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Cape May Warbler	Barrier To Movement	All	Neutral	Low	Local	Long-term	Constant	Low	High	High
Grouse	Barrier To Movement	All	Neutral	Low	Local	Long-term	Constant	Low	High	High
Waterfowl	Barrier To Movement	All	Neutral	Low	Local	Long-term	Constant	Low	High	High
Wood Frog	Barrier To Movement	All	Negative	Low	Local	Long-term	Constant	Low	High	Medium

[1] Likely only occur along the road corridor within Wood Buffalo National Park.

Overall the effects on wildlife movement are neutral to negative in direction, low in magnitude, local in extent and long term in duration.

11.3.4 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude that the proposed project is not likely to result in significant adverse environmental effects on wildlife movement.

11.4 Change in Wildlife Condition

11.4.1 Effects Assessment

11.4.1.1 Mortality

Small numbers of bison are killed in vehicle collisions in Wood Buffalo National Park on a yearly basis. In contrast, no moose collisions have recently been reported in the park.. Up to five bison have been killed by vehicle collisions in one year (Table 11.8). Information on bison mortalities in Wood Buffalo National Park has been summarized in Bison Mortality Surveys, which provide a breakdown of the probable causes of known bison deaths in the park (i.e., highway/vehicle, predation, poached, drowning, disease, hunting outside of park, and unknown). These estimates are not based on standardized surveys but are obtained from general observations by park wardens and visitors, and thus should not be used as an indication of overall park bison mortality.

Table 11.8 Total known and vehicle-induced bison mortality in Wood Buffalo National Park.

Bison Mortality	1988	1992	1993	1994	1995	1996	1997	1998	2000	2001
Known Yearly Mortality [1]	93	47	29	17	35	9	19	18	102	96
Yearly Vehicle Mortality	1	2	1	0	5	2	4	0	1	2

% Total	**1%**	**4%**	**3%**	**0%**	**14%**	**22%**	**21%**	**0%**	**1%**	**2%**

[1] Because it is difficult to monitor bison in the park, this value likely underestimates actual yearly mortality of park bison.

The population density found (0.12 moose/km^2) is within the normal range of moose densities found within the North West Territories. and northern Alberta. It is nearer the high end of the range, and so confirms the finding from the 1999 reconnaissance survey that the Garden River area is one of the better areas for moose in WBNP.

During field surveys, clumps of grouse feathers (primarily spruce grouse) were periodically observed on the road, possibly resulting from vehicle collisions. Higher traffic volumes and faster travelling vehicles may result in additional grouse mortality; however, this should not have an impact on local and regional populations. Mortality rates for other wildlife VECs along the road corridor are not known, but are not expected to be high based on probable traffic volumes.

Mortality resulting from direct clearing of the road will likely be low for most wildlife VECs in Wood Buffalo National Park. Some nesting bird species may be impacted, depending on the timing of site clearing. However, because of the small amount of habitat clearing, this impact is considered low. Similarly, because little amphibian habitat will be affected, impacts to frogs will also be low.

Impacts associated with increased mortality along edge habitats are also considered negligible. Because a road corridor already exists, predation and nest parasitism may already occur along the edge-forest interface (parasitism rates are likely low as only 1 brown-headed cowbird was observed during the bird surveys). Consequently, additional clearing is not expected to increase edge-related impacts. Increased movement of predators along the road corridor is also not expected to occur following construction of the Highway 58 project because of predicted traffic volume and associated disturbances.

Improved road access may result in increased mortality of wildlife resulting from increased hunting and poaching. However, the road is used frequently during certain times of the year, suggesting that periodic hunting and poaching opportunities currently exist. Furthermore, many hunters and poachers use 4x4 vehicles (including quads and snowmobiles), and may not be deterred by poor road conditions. As a result, improved road access may not significantly increase hunting and poaching pressure. In addition, moose and bison are widely distributed throughout Wood Buffalo National Park; therefore, a slight increase in hunting and poaching pressure along the road corridor should not impact populations of these species. Overall, improved road access may in fact allow better monitoring of the road corridor by park staff, and higher levels of traffic volume may deter some poaching activities.

The potential effects of road construction, maintenance and use on wildlife mortality along the Highway 58 corridor are summarized in Table 11.9. Overall, the direction of impacts resulting from vehicle collisions, predation/parasitism and hunting/poaching are negative; however, the magnitudes of most impacts are considered low.

11.4.1.2 Health

Although air pollutants can adversely affect air quality, vegetation quality and water quality, construction and operation of Highway 58 should not result in a significant increase in LSA and RSA air pollution. Traffic volumes along Highway 58 will be low relative to most highways in Alberta, resulting in low overall vehicle emissions. Consequently, no impacts to wildlife health are expected as a result of the release of airborne pollutants within Wood Buffalo National Park. Increased levels of dust are likely to occur following construction of the gravel road; however, impacts on air and vegetation quality are expected to the highly localized and thus should not have a significant impact on wildlife health in the local and Regional Study Areas. Proper fuel handling procedures will be followed during construction and maintenance operations to avoid any spills into terrestrial and aquatic environments.

Table 11.9 Environmental assessment of the potential effects of road construction, use and maintenance on wildlife mortality along the Highway 58 corridor

Species	Change in Condition: Potential Effects	Project Period	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Probability of Occurrence	Scientific Confidence
Moose	Mortality from collisions, etc.	All	Negative	Low/ Mode rate	Local	Long-term	Constant	Low	High	High
Bison [1]	Mortality from collisions, etc.	All	Negative	Low	Local	Long-term	Constant	Low	High	High
Marten	Mortality from collisions, etc.	All	Negative	Low	Local	Long-term	Constant	Low	High	High
Lynx	Mortality from	All	Negative	Low	Local	Long-term	Constant	Low	High	High
Ovenbird	Mortality from	All	Negative	Low	Local	Long-term	Constant	Low	High	High
Cape May Warbler	Mortality from	All	Negative	Low	Local	Long-term	Constant	Low	High	High
Grouse	Mortality from	All	Negative	Low	Local	Long-term	Constant	Low	High	High
Waterfowl	Mortality from	All	Negative	Low	Local	Long-term	Constant	Low	High	High
Wood Frog	Mortality from	All	Negative	Low	Local	Long-term	Constant	Low	High	Mediu m

[1] Ratings only apply within Wood Buffalo National Park.

11.4.2 Effects Assessment Province of Alberta

11.4.2.1 Mortality

No wildlife traffic mortality data is available for Road Sections A and C. However, data is available immediately west of the study area along Highway 58 between Highway 88 and the Wentzel River. For the five year period between 1996 – 2000, only 11 wildlife-vehicle collisions were reported along this Road Section, all involving deer (reportable collisions are those that cause more than $1,000 in damage). On average, 2 collisions were reported per year (range of 1 – 4). This represents a relatively low number of collisions. For example, along a 67 km section of Highway 43 between Wembley and the British Columbia border, 127 animal vehicle collisions were reported between 1995 and 1999. The small number of wildlife-vehicle collisions along Highway 58 is likely a function of low traffic volume, low densities of wildlife, and/or low habitat quality in the vicinity of the highway corridor.

Although several moose and deer tracks were observed crossing the road corridor, collision rates along the road corridor are expected to be low. According to traditional knowledge experts, encounters with moose along the road corridor have been declining, possibly as a result of increased hunting pressure in the study area.

During field surveys, clumps of grouse feathers (primarily spruce grouse) were periodically observed on the road, possibly resulting from vehicle collisions. Higher traffic volumes and faster travelling vehicles may result in additional grouse mortality; however, this should not have an impact on local and regional populations. Mortality rates for other wildlife VECs along the road corridor are not known, but are not expected to be high based on predicted traffic volumes.

Mortality resulting from direct clearing of the road will likely be low for most wildlife VECs along Road Sections A and C. Some nesting bird species may be impacted, depending on the timing of site clearing. However, because of the relatively low amount of habitat clearing, this impact is considered low. Similarly, impacts to local and regional populations of wood frogs will also be low.

Impacts associated with increased mortality along edge habitats are also considered negligible. Because of the presence of an existing road corridor along Road Section A and parts of Section C, predation and nest parasitism may already occur along the edge-forest interface (parasitism rates are likely low as only 1 brown-headed cowbird was observed during the bird surveys). Consequently, additional clearing should not increase edge-related impacts. Increased movement of predators along the road corridor is also not expected to occur following construction of the Highway 58 project because of predicted traffic volume and associated disturbances.

Enhanced road access may result in increased mortality of wildlife resulting from hunting and poaching. The study area is used by both native and non-native hunters and evidence of recent moose hunting was observed during the field surveys. Road Section A is used frequently during certain times of the year, suggesting that periodic hunting and poaching already occurs. Furthermore, many hunters and poachers use 4x4 vehicles (including quads and snowmobiles), and may not be deterred by poor road conditions. As a result, improved access along this Road Section may not significantly increase hunting and poaching pressure. In addition, moose are widely distributed throughout study area; therefore, a slight increase in hunting and poaching pressure along Road Section A is not expected to significantly affect populations of this species. In contrast to Road Section A, access will greatly increase along parts of Road Section C because of development of the new road corridor. This will likely increase hunting and poaching pressure along this Road Section.

The potential effects of road construction, operation and maintenance on wildlife mortality along Road Section A are considered similar to those within Wood Buffalo National Park. Overall, the direction of impacts resulting from vehicle collisions, predation/parasitism and hunting/poaching along this road section are negative; however, the magnitudes of most impacts are considered low.

In contrast, the potential effects of the proposed Highway 58 project on wildlife mortality along Road Section C are considered higher (especially for moose) because access has been limited in this area. The direction of impacts resulting from vehicle collisions and hunting/poaching along Road Section C on moose are considered negative and the magnitude of impacts moderate. For all other VECs, the direction and magnitude of impacts along Road Section C are considered similar to that along Road Sections A and B (see Table 11.9).

11.4.2.2 Health

Although air pollutants can adversely affect air quality, vegetation quality and water quality, construction and operation of the highway should not result in a significant increase in local and regional air pollution outside of Wood Buffalo National Park. Traffic volumes along Highway 58 will be low relative to most highways in Alberta, resulting in low overall vehicle emissions. Consequently, no impacts to wildlife health are expected as a result of the release of airborne pollutants. Increased levels of dust are likely to occur following construction of the gravel road; however, impacts on air and vegetation quality are expected to the highly localized and thus should not have a significant impact on wildlife health in the LSA and RSA.

11.4.3 Mitigation

A number of the effects discussed above will be mitigated through already existing processes and legislation. If required, hunting pressure can be regulated, in part, by government licenses and regulations. Discussions between the LRRCN and licensed outfitters will occur as necessary to manage bison populations outside of Wood Buffalo National Park. If poaching becomes a problem, a public education program and enforcement program can be initiated to address poacher behaviour. In addition, limiting access to problem areas can be considered (e.g., gating seismic lines and forestry roads), although this will require consultation with all stakeholders. All of these mitigations are part of the ongoing responsibilities of provincial and/or federal governments.

The RAs will ensure the following mitigation measures to ensure that any potential effects are minimized:

- Posting low speed limits and warning signs, particularly in the vicinity of higher wildlife movement areas such as watercourses and wetlands. Collision frequency should be assessed on a periodic basis to determine potential problem areas and to apply appropriate mitigation measures (e.g., roadside reflectors);
- Construction, particularly vegetation clearing, will be scheduled to avoid the breeding/nesting period for migratory birds. The recommended timing constraints for migratory birds in this region are April 15 to July 31. This timing constraint should also be applied to subsequent road maintenance (e.g., clearing of re-growth, rut repair, etc.) during the operation phase of the road corridor.
- If required, hunting pressure can be regulated, in part, by government licenses and regulations. Discussions between the LRRCN and licensed outfitters are critical for developing a management plan for bison populations outside of Wood Buffalo National Park. If poaching becomes a problem, a public education program can be initiated to address poacher behaviour. In addition, limiting access to problem areas can be considered (e.g., gating seismic lines and forestry roads), although this will require consultation with all stakeholders.
- Proper fuel handling procedures will be followed during construction and maintenance operations to avoid any spills into terrestrial and aquatic environments.
- Wildlife will be deterred from approaching roadway. For example, less palatable plants will be established on the right-of-way to dissuade wildlife grazing.

11.4.4 Residual Effects

Overall the residual effects of the project on wildlife mortality is negative in direction low in magnitude, local in extent and of long term duration.

11.4.5 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude that the proposed project is not likely to result in significant adverse environmental effects on wildlife condition.

12.0 Socio and Economic and Cultural Component

12.1 Introduction

The assessment of socio-economic effects under CEAA is outlined in the term "environmental effect", the definition of which is summarized as follows:

"Any change that the project may cause in the environment; any effect of any change to environment caused by the project on health and socio-economic conditions, including physical and cultural heritage; the current use of lands and resources for traditional purposes by aboriginal persons; or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance; or any change to the project that may be caused by the environment."

This means that RAs can only reach a conclusion on the significance of socio-economic effects caused by a change in the environment due to the project. They are not able to reach conclusions on socio-economic effects caused by the project not related to a change in the environment. However, given the significant economic benefits associated from the project to the local communities, it was decided that this information should be collected and presented in this report but will not be used by the RAs in their conclusions on significance under the CEAA.

In the event that the Minister of Environment determines under section 23 of the CEAA, that the project is likely to cause significant adverse environmental effects, she will be required to determine whether or not such effects are justifiable in the circumstances. The information contained within this section will be relevant to the question of justification should such a question arise.

12.2 Socio-Economic Component

12.2.1 Physical Description

The Little Red River Cree Nation is comprised of three separate communities located in the far north of central Alberta between the 58th and 59th north latitudes. The First Nation's administrative centre is in John D'or Prairie (Reserve #215), located north of the Peace River and about 120 km. east of the town of High Level. To the east, and on the south shore of the Peace River, is Fox Lake (Reserve #162), the largest of the three communities and the most isolated. Further east, and downstream from Fox Lake, on the north shore of the Peace River, lies the settlement of Garden River, a community about 7 km. inside the western boundary of Wood Buffalo National Park.

The communities of Fox Lake and Garden River have been hindered in their economic and social development by the lack of all-weather roads to the communities in the region. The communities must rely on air services to provide emergency access to outside communities during the winter, and for almost all access post spring break-up. Air links are subject to interruption during the spring melt and bad weather. The loss of both air and road links presents conditions of high risk to the health and security of the communities.

The Little Red River Cree Nation (LRRCN) operates their own air charter service, Little Red Air, to the two communities linking them with John D'or Prairie, Fort Vermillion, High Level and Edmonton, and providing for medical evacuations, freight delivery and passenger services.

Garden River

When dryer conditions prevail, some vehicles are able to travel the 52.4 km east of Highway 58 to Garden River. The road conditions are very poor requiring the crossing of several streams and creeks, muskeg, and old, narrow bridges. The condition of some of the bridges is deteriorating leaving their structural integrity questionable.

Fox Lake

Fox Lake has three winter roads. One links the community via a route south of the Peace River to Fort Vermillion. This road is about 100 km long and is the longest route. It is also in the worst condition, having two rivers, the Wabasca and Mikkwa (Little Red River), to cross. In winter an ice bridge allows vehicles and trucks, including logging trucks, to cross the river. The two other winter roads cross the Peace River and connect Fox Lake to Garden River and John D'or Prairie. The ice bridge comes into safe operation approximately the middle of December and can be used until approximately the middle of March when poor road conditions and muddy approaches to the bridge prevent its continued use.

After the spring break-up, when the ice bridge connection is lost, Fox Lake becomes completely isolated for a period of several months. There is the possibility of crossing the river using a small, privately operated, single-vehicle barge. It can only be operated when the water is deep enough to allow the barge to make the crossing. The Peace River is quite wide and shallow at this point. The barge cannot operate during spring melt when the water is fast flowing and full of logs and heavy debris, when heavy rainfall causes the river to swell, or in the autumn when water levels are far too low.

12.2.2 Profile of the Communities

12.2.2.1 Population and Demographic Characteristics

The population of Fox Lake is 1,665 (compared to 942 in 1991), while Garden River's population has attained 462 (compared to 261 in 1991). The age profile of the population in each of the communities is shown in Table 9.1. In both Fox Lake and Garden River, the population is concentrated primarily in the younger age groups.

Over 60% of the population in Fox Lake is under 20 years of age, while only 2% of the population is 65 years and older. Similarly, 59% of Garden River's population is less than 20 years, and 2% over age 65. Large young families are predominant in both communities.

Over the period 1986 to 2001, the average annual population growth in Fox Lake was 4.9%. If this rapid population growth rate continues in the future, the community's population could more than double in the next 15 years, reaching 3,422 by 2016. The historical and projected population of Fox Lake is indicated in Table 12.2

Table 12.1 Population for Fox Lake and Garden River communities (January 2002 Census)

Age group	Fox Lake	Garden Lake
0	61	12
1 – 4	251	71
5 – 9	314	71
10 – 14	216	62
15 – 19	159	56
20 – 24	155	38
25 – 29	121	29
30 – 34	106	28
35 – 39	77	27
40 – 44	50	20
45 – 49	39	14
50 – 54	22	10
55 – 59	26	9
60 – 64	18	6
65 – 69	19	3
70 – 74	9	3
75 – 79	7	1
80 +	5	2
Total	1665	462

Source: Little Red River Cree Nation

12.2.2.2 Education

The remoteness of Fox Lake and Garden River is a factor that likely contributes to the lower level of education achieved by residents in the communities. Statistics Canada data show a wide gulf in the level of education attained between Fox Lake and John D'or Prairie, which has an all weather road access to outside communities. Education statistics from the 1996 census show that while 42% of the residents of John D'or Prairie aged 25 years and over had less than a grade nine education, this figure jumps to 62% in the case of Fox Lake residents. Figures for the achievement of a high school certificate or higher in the population that is 25 years and over show a similar pattern: almost 40% in John D'or Prairie and only 15% in Fox Lake. In comparison, the figures for the province of Alberta are reversed. Only about 9% of Albertans over the age of 25 have less than a grade nine education and almost 70% have achieved their high school certificate or higher. No education census data is available for Garden River.

The school in Fox Lake has a total enrollment of 541 students in 2001/02 from kindergarten to Grade 12, with 77% of the enrollment in the primary grades. This reflects the young population profile of the community as well as the relatively low level of educational attainment of the population. Only a small group of students graduate each year from Grade 12 and in 2000 only three students graduated. The detailed breakdown of student enrollment by Grade level in 2001/02 is indicated in 9.3

The situation in Garden River is similar. Of their total enrollment of 166 students in 2001/02, 73% are in the Elementary grades. In 2000, the first year that Grade 12 courses were offered, two students completed their diploma requirements. The detailed breakdown of student enrollment by Grade level in 2001/02 is indicated in Table 9.3.

Table 12.2 Fox Lake population projection

		Change from previous year	
Year	Total	Aggregate	Percent
1986	811		
1987	837	26	3.2
1988	863	26	3.1
1989	890	26	3.0
1990	916	26	2.9
1991	942	26	2.9
1992	1,012	70	7.4
1993	1,081	70	6.9
1994	1,151	70	6.4
1995	1,220	70	6.0
1996	1,290	70	5.7
1997	1,365	75	5.8
1988	1,440	75	5.5
1999	1,515	75	5.2
2000	1,590	75	5.0
2001	1,665	75	4.7
2002	1,747	82	4.9
2003	1,833	86	4.9
2004	1,923	90	4.9
2005	2,018	95	4.9

2006	2,117	99	4.9
2007	2,221	104	4.9
2008	2,330	109	4.9
2009	2,445	115	4.9
2010	2,565	120	4.9
2011	2,692	126	4.9
2012	2,824	132	4.9
2013	2,963	139	4.9
2014	3,109	146	4.9
2015	3,262	153	4.9
2016	3,422	160	4.9
Average	Historical	57	4.9
	Projection	117	4.9

Sources: Statistics Canada, 1986, 1991, 1996 Census;
LRRCN Census for 2001 population estimate;
other historical data are estimates

Table 12.3 School Enrollments 2001 / 2002

Grade	Fox Lake	Garden River
Kindergarten	30	29
Pre-Readiness[1]	30	-
Grade 1	75	21
Grade 2	82	18
Grade 3	79	20
Grade 4	36	11
Grade 5	38	11
Grade 6	46	11
Grade 7	23	6
Grade 8	24	8
Grade 9	9	4
Junior High Split[2]	48	-
Grade 10	8	12
Grade 11	10	11
Grade 12	3	4
Total Enrollments	**541**	**166**

[1] Children aged 6 to 8 years, who haven't attended school, preparing to enter Grade 1
[2] Children aged 14 to 18 years, who have missed some schooling, preparing to enter Grade 10

The Kayas Cultural College, which has its main office and classrooms in Fox Lake, and satellite facilities in John D'or Prairie and Garden River, provides adult and post secondary education and training. It offers programs in adult upgrading (literacy, basic education, and university and college entrance preparation), apprenticeship in carpentry, plumbing and warehousing, safety training, office computing, heavy equipment, and emergency medical responder/nursing assistant. The college uses interactive videoconferencing as part of its teaching method. About 60 people are enrolled in the college.

12.2.2.3 Employment

The isolation of Fox Lake and Garden River and poor transportation links with outside communities may circumscribe their ability to participate in the labour market and to create employment within their own communities. Statistics show that there is a very real difference in the employment rates of Fox Lake and John D'or Prairie, both communities being part of the same First Nation and under the same administration.

According to 1996 census data the labour force participation rate in Fox Lake was half that of John D'or Prairie. Only 23.3% of Fox Lake residents participated in the labour market compared to 47.2% of John D'or Prairie residents. By comparison almost three quarters of Alberta residents were labour force participants.

In most instances there is an inverse relationship between the participation rate and the unemployment rate. That is, the higher the participation rate, the lower the unemployment rate, and vice versa. However, in the case of Fox Lake, despite a participation rate that is half that of John D'or Prairie, the unemployment rate is again half that of John D'or Prairie. This suggests that while residents of John D'or Prairie are still looking for work, the residents of Fox Lake have resigned themselves to the lack of opportunities in and out of their communities and are not looking for work.

	Fox Lake	John D'or Prairie	Alberta
Participation rate	23.3 %	47.2 %	72.4 %
Unemployment rate	13.3 %	24.2 %	7.2 %
Average total income	$ 10,073	$ 11,997	$ 26,138

Source: Statistics Canada, 1996 Census, labour force characteristics of the population age 15 and over
No labour census data is available for Garden River

Within the communities of Fox Lake and Garden River, employment opportunities are limited to service occupations at the school, nursing station and store. Seasonal work is available on capital projects to expand or improve community infrastructure. Only a small percentage of residents are involved in traditional pursuits such as trapping and hunting. Outside the communities, seasonal job opportunities are available in Little Red River Forestry Ltd.'s logging operations within the Caribou-Lower Peace Special Management Area. In 2002, Little Red River Forestry will require 40 workers for tree planting over a 3 month period; 14 workers for brushing and weeding for 2 months; 6 part-time seasonal cone pickers; 8

forestry field workers; 20 full-time seasonal workers for logging over 4 months; and 8 full-time employees in the areas of planning, preparation for logging and silviculture. Trained members of the Little Red River Cree Nation will have access to these jobs.

12.2.2.4 Community Facilities

The facilities in Fox Lake, apart from the housing, include a fair weather airstrip, a school that caters to all the grades, a brand new nursing station, a Northern store, an RCMP and Tribal Police station (a trailer office), the Community Development and Child and Family Services office housed in the old nursing station, and a natural outdoor ice arena. Garden River also has a fair weather airstrip, a school, a nursing station, a Fifth Meridian store, an outdoor hockey rink and a church.

12.2.2.5 Housing

The housing stock in Fox Lake and Garden River is not sufficient given the rapid growth of the community. The waiting list for new housing is particularly long in Fox Lake. This year alone there are 80 applicants on the waiting list for the 10 units that will be built this year. This implies that the waiting period for housing is up to 8 years at present, and will increase as demand pressures expand with population growth. In Garden River the pressure is less given that there are 20 applicants for the 5 units to be built. Many of the housing units require major renovations to bring them up to minimum National Building Code standards. In Fox Lake almost one-third of the housing in 1999 required major renovations (or replacement) to bring them up to minimum National Building Code standard. In Garden River 45% of the housing units required renovations of a similar nature in 1999.

	Fox Lake	%	Garden River	%
Total number of housing units (1998 / 1999)	241		66	
Requiring major renovations or replacement	77	32	30	45
Units with piped water and sewage*	98	41	57	86
Units without piped waste and sewage*	97	40	9	14
Number of units to be built in 2002	10		5	
Number of applicants on the waiting list	80		20	

Source: Housing & Infrastructure Assets 1999, Indian & Northern Affairs and LRRCN
* Does not add up to 100% in Fox Lake. There are 48 units that have water trucked to a cistern and their sewage is disposed of by septic truck of some other method

12.2.2.6 Heating and Electricity

Heating in the communities of Fox Lake and Garden River is provided mainly by propane and there are supply issues related to the lack of year round road access. Prior to the spring break-up propane must be shipped into Fox Lake and stored for the entire eight month period during which time propane cannot be transported to the communities. There are times when, in the latter part of the year, prior to the construction of the ice bridge in mid-December, propane levels are so low in Fox Lake that they start running out and residents have to go to the school to get propane to heat their homes. In 2001 even the school's propane supply almost ran out. This can cause considerable hardship and a sense of insecurity, especially for the elders. The schools and the nursing stations must ensure adequate supplies of propane to allow them to function and to supplement the residents' requirements later in the year. The necessity of stocking large amounts of propane puts a financial burden on residents of the two communities and particularly on the budgets of service providers.

ATCO Electric uses diesel generators to supply electricity to the communities. There are higher costs associated with diesel-generated electricity compared to supplying electricity via landlines. As with the propane and gasoline supplies, most of the diesel fuel required to run the generators must be shipped in prior to spring break-up and stored in large holding tanks. This contributes to higher costs. Extra equipment is kept on hand in the communities that, in normal circumstances, could be brought in by road when the need arises.

It is worth noting that the electricity bills for residents in Fox Lake and Garden River remain higher than those of residents in John D'Or and other more accessible communities in the vicinity. This is due to the spillover effects of the isolation of the two communities. Residents of Fox Lake and Garden River generally use more electricity. The inability to receive propane supplies between spring break-up and December, when shipments can be resumed, has resulted in the substitution of electricity for propane as an energy source for heating. Electric heaters, which consume a lot more energy, are much more prevalent in these communities, and some households have converted their water heaters from propane to electricity.

The diesel generator in Fox Lake is nearing the end of its life cycle and will need to be either overhauled or replaced. With the rapidly growing population and the anticipated increase in demand for electricity, ATCO Electric is considering laying landlines to supply electricity to Fox Lake. The diesel generator in Garden River is relatively new by comparison, and has sufficient capacity for the foreseeable future.

12.2.3 Socio-economic Impacts of the Proposed Access Road

12.2.3.1 Economic Development Opportunities

The proposed access roads to Garden River and Fox Lake would support First Nations' economic development and capacity building. The project is synergistic with forestry development, with complementary seasonal use of labour and equipment for road construction work during the summer months, and for on-going regional forestry activity during the winter months. Road maintenance activity would occur on a year round basis.

The construction and on-going maintenance of the proposed access roads to Garden River and Fox Lake will generate economic activity both locally and in the Province of Alberta. Based on the capital and maintenance cost information provided by EXH Engineering Services Ltd., order-of-magnitude estimates of the project's impacts on the provincial economy and the local economy are provided below for the construction and operational phases.

12.2.3.2 Provincial Impacts: Construction Phase

The impacts of the road project on the Alberta economy are calculated on the basis of the total capital costs for the overall project. Provincial multipliers for non-residential construction15 have been applied to the capital cost estimates to provide a measure of the direct and indirect effects on the provincial economy arising from the capital expenditures. The direct effects relate to the impacts of the expenditures on businesses that provide their services to satisfy the demand created by the project, while the indirect effects relate to the spin-off activity attributed to suppliers and producers of inputs, which are utilized, by businesses directly engaged in the project.

Direct and indirect project impacts are measured in terms of provincial Gross Output,17 Gross Domestic Product (GDP) at factor cost 18, labour income and employment (person-years). The table below provides the results of the multiplier analysis for each of the four years of the construction phase. Note: although the dates of the project have change, the information remains applicable.

Provincial Impact – Construction Phase

Output category	2002 / 03	2003 / 04	2004 / 05	2005 / 06	Total
Gross output	817,759	1,226,640	14,651,527	14,651,527	31,347,453
GDP at factor cost	306,959	460,440	5,499,693	5,499,693	11,766,786
Labour income	236,934	355,402	4,245,076	4,245,076	9,082,488
Employment (PY's)	5	7	84	84	180

Based upon this analysis, the total direct and indirect impacts associated with the construction of the proposed access roads on the provincial economy are significant. In terms of Gross Output, the impact on the provincial economy will exceed $31 million over the 4-year period. GDP at factor cost will increase by nearly $12 million and labour income by over $9 million. A total of 180 person years of employment will be generated by the construction of the proposed roadway.

12.2.3.3 Local Impacts of the Construction Phase

The impacts of the project on the local economy have been estimated for only direct labour income and direct employment (person-years) and are summarized in the table below. These estimates do not include any indirect multiplier impacts that may result from the project.

Local Impact – Construction cost

Output	2002 / 03	2003 / 04	2004 / 05	2005 / 06	Total
Labour income	7,848	11,773	1,448,684	1,448,684	2,916,989
Employment	0	0	39	39	78

The construction phase of the proposed roadway project is estimated to result in an increase in local labour income of nearly $3 million over the 4-year period. This is associated with an incremental 78 person years of employment. It is estimated that 75% of the labour value will be comprised of aboriginal contractors.

12.2.3.4 Provincial Impacts: Operational Phase

The operational phase of the roadway project involves annual maintenance. The annual cost of maintenance is estimated to be approximately $320,000.

The annual direct and indirect impact of the operational phase on the provincial economy in terms of gross output is estimated to total approximately $545,000. In terms of GDP at factor cost, the provincial impact is just over $200,000 per year. Labour income associated with the operational phase is projected at approximately $158,000. Maintenance of the access roads will require 3 person years of employment per year.

11.2.3.5 Local Impacts of the Operational Phase

Most of the maintenance activity benefits are expected to be retained within the local economy. LRRCN members would capture employment opportunities related to the operation and maintenance of the ferry.

12.2.3.6 Forestry Development

The construction of the proposed access roads will provide 3 seasons of summer work for First Nations members, who will then be employed in the forestry industry during the winter months. Based on a KPMG study, it is anticipated that 6 new business units (enterprises), each employing up to 18 people, will be created for loading and hauling of timber (103 jobs) and for site preparation (5 jobs) in the forestry sector. Training will be provided for these forecast jobs, to enable the participation of First Nations members in the potential employment opportunities.

With the completion of the access roads, the amount of equipment and the number of trucks required by forestry companies will be reduced from current levels since cutting and hauling will occur over a longer period, lowering costs. It is anticipated by Little Red River Forestry Ltd. that the hauling and cutting season will be extended from 3 months to 8 months of the year. During the remainder of the year, First Nations workers will have access to road maintenance work in the region. Attachment to the labour force will be enhanced through the availability of full-time work through most of the year on a long-term basis.

12.2.3.7 Oil and Gas Exploration

The completion of the access roads to Fox Lake and Garden River could renew interest in oil and gas exploration. The oil industry will be able to haul heavy equipment into areas of the region that are currently inaccessible. It is anticipated that the costs of exploration will decline because of the improved road access.

12.2.3.8 Tourism and Recreation

Recognizing that Wood Buffalo National Park is the second largest national park in Canada and has been designated by the United Nations as a World Heritage Site, there are potential tourism and recreation opportunities associated with the availability of all-weather access to Garden River. In consultation with Parks Canada, the development of an interpretive trail near Garden River, for example, could be explored. However, any increase in tourism and recreation activity, or transfer of this activity to Fox Lake and Garden River, will depend on the ability of the communities to deliver hospitality services and guiding / outfitting services.

Parks Canada does not anticipate charging entry fees to Wood Buffalo National Park visitors in the future. The access road is not expected to have an impact on Parks Canada costs since most traffic to the Park is expected to be limited to Garden River residents and their relatives. However, a large increase in the number of visitors and "events" (such as speeding, forest fires, poaching in the vicinity of Park boundaries and car accidents) may require the deployment of more resources.

The access road is not expected to have a significant impact on the foreign adventure tourism market. About 100 visitors, primarily from Germany, currently fly into the area in small groups during the summer months (usually to Fort Vermilion), canoe down the Peace River, and fly out of Fort Chipewyan.

All-weather road access to Fox Lake and Garden River could, however, increase the attractiveness of guided and unguided canoeing down the Peace River to Alberta residents from both within and outside the region.

More non-aboriginal hunting activity can be expected in the vicinity of the communities, outside Wood Buffalo National Park boundaries, as a result of the access roads. Garden River residents have expressed concern about poaching outside the Park, and this illegal activity could increase because of improved access to the area.

12.2.3.9 Opportunities for Regional Employment

Residents of Fox Lake and Garden River will be able to compete for jobs in the region with less concern for the isolation from their families. The enhanced integration of these communities within the region will improve the skill sets and capacity available to the communities as well as the region.

12.2.3.10 Mobility and Efficiency Benefits to Residents

Benefit-cost analysis of transportation projects has traditionally emphasized quantifiable monetary benefits associated with time savings, vehicle operating costs, safety impacts and economic revitalization (job creation and business growth). Although these are important benefits that can flow from road projects, there are other benefits that can be identified.

What has possibly kept these other benefits, or "externalities", from the forefront of project appraisal is the difficulty of attributing quantifiable monetary values to them. In recent years however, transportation economists and policy analysts are starting to recognize and consider the importance of social benefits in road construction projects.

Included in the highway funding benefit criteria are accessibility, integration, and efficiencies, which are defined as follows:

- Accessibility—increased accessibility and mobility options available to people and to
- freight.
- Integration—enhance the integration and connectivity of the transportation system, across and between modes, for people and freight.
- Efficiencies—promote efficient system management and operation (including efficient user movement and costs).

The construction of the access roads will enable these communities' integration with the transportation system that exists outside the community. This transportation system is comprised of the roads and air-links that emanate from High Level, Fort Vermilion, La Crete and John D'or Prairie. The result is that people of Fox Lake and Garden River (and freight movement) can take advantage of the benefits that already exist with these transport modes.

The mobility benefits of the access roads translate into a more efficient use of community resources, improved service delivery, and increased individual consumer surplus from both a financial and personal preference standpoint.

12.2.3.10 Service Delivery

More residents of Fox Lake and Garden River would likely shop outside their communities if the access roads were built, because of lower prices and a wider selection available in the other urban centres in the region. Local stores could, however, become more price competitive with other stores in the region as a result of the reduction in the freight component of their costs and the elimination of inventories and the associated interest costs. The selection of foods, particularly perishable items, would likely expand in Garden River. Shifts in preferences to fresh fruits, vegetables, meats, fish and poultry would improve the nutrition of individuals in this community. Diets would also improve among Fox Lake residents since nutritious foods would be available at a lower cost for most of the year.

With the elimination of the need for warehousing and storage as a result of all-weather road access, more frequent shipments by truck to the stores in the communities would be required. The Northern Store in Fox Lake would require a semi-trailer truck twice a week, as well as a refrigerated truck to bring in perishables. There is potential for the establishment of a local trucking business by the LRRCN to truck in food, perishable items and other goods from La Crete, where deliveries are made from Edmonton, to the communities of Fox Lake and Garden River. As well, the community of Fox Lake could possibly support a gas station, with a mechanic to service vehicles, since more residents would likely own vehicles.

12.2.3.11 Education and Training

The construction of access roads to Fox Lake and Garden River would immediately result in cost savings to the school budgets and allow for improved services. The requirement for storing huge quantities of propane and stocking school and janitorial supplies would be reduced or eliminated. Cost savings for maintenance and hot lunch programs would also allow the schools to better utilize their resources.

The access roads would allow residents and therefore the school-going population to adjust to the outside world. This in turn could encourage more students to stay in school and thereby increase the education level of the communities and in the long run improve labour force participation rates.

The access roads would also allow the LRRCN to consider consolidating the high school students from all three communities. They could upgrade or construct a full-fledged high school. This would allow high school graduates to be fully prepared to enter postsecondary education.

There would also be more likelihood of staff retention and the schools would be better able to recruit new teachers when required. School activities and sporting events could be expanded. Sporting events could take place in a more normal manner and not have to be specially arranged to have to overcome the difficulties associated with road conditions. Thus teams could visit each other throughout the year without having to make arrangements for accommodations. They could even participate in regional sporting events, with students from Fort Vermillion, High Level and La Crete.

An access road would allow students from these isolated communities to commute to nearby colleges. For many students the prospect of residing in an outside community, away from family, friends and the familiarity of their own culture and language, acts as a barrier to continuing their studies. Knowing that they can return home will allow them to take the first step towards obtaining further education and gaining confidence in their interaction with other students.

12.2.3.12 Police Protection

The RCMP and North Peace Tribal Police detachment in Fort Vermilion could improve its level of service to Garden River with year-round access to the community by road. The detachment would be able to respond to calls more promptly. It is likely that a greater number of problems in the community would be reported to the police. The number of vehicle accidents is expected to increase in the area because of increased traffic levels between the three communities of the LRRCN. However this potential increase in accidents could be offset by the improved road standard, which would make road travel safer.

Estimated cost savings associated with the shift from air to road travel, and the reduction in the cost of living in Fox Lake (i.e. because of the expectation that fuel prices, groceries and the cost of propane for heating will decline with year round road access), are estimated at $50,000 per year.

The improved road standard would reduce vehicle maintenance costs for the RCMP and Tribal Police (these costs exceeded $25,000 in the 2000/01 fiscal year) and lengthen the time between vehicle replacements. By way of comparison, RCMP vehicles are replaced every 200,000 kilometres in the Edmonton region, and every 180,000 kilometres in the Fort Vermilion area because of road conditions. Suburban vehicles are replaced every 180,000 kilometres in the Edmonton region compared to 160,000 kilometres in the Fort Vermilion area.

It is anticipated that consumption of homemade brew may decline in Garden River and Fox Lake since liquor stores in urban centres in the region will be accessible for most of the year. Drug and alcohol use could increase in Garden River and Fox Lake because of increased exposure and easier access.

12.2.3.13 Child and Family Services and Social Development

The all-weather access road would enhance the coordination of service delivery to the three LRRCN communities. There would be fewer impediments to the development and coordination of education and prevention programs (e.g. for spousal and child abuse and alcohol abuse). Training workshops could be held more frequently and scheduled throughout the year instead of the December to March period. The costs of delivering services would decline as a result of the shift from air travel to road travel. Improved mobility in the region would help the communities in attracting and retaining qualified staff. It is anticipated that the main office for Child and Family Services, Health, and Social Development would relocate from John D'Or to Fox Lake once the access road is built.

The access roads would facilitate the social interactions between the three communities of the LRRCN. There would be more opportunities for events uniting LRRCN members (e.g. cultural celebrations and sports tournaments). The all-weather access roads could, however, create difficulties for elders who are more closely bound to traditional ways of life and who are less adaptable to change. The Cree language and culture have flourished particularly in Fox Lake because of the community's isolation from regional social and economic influences. Although the access road will remove barriers that have prevented residents from participating in regional activity, the communities will need to take steps to ensure that the Cree language and culture are preserved.

12.2.3.14 Health Care

An all-weather access road to Fox Lake and Garden River will reduce the cost of shipping medical supplies and facility equipment to the health stations. Medical emergencies will continue to be evacuated from Fox Lake and Garden River by air. However, residents of these communities who require non-emergency medical services will be able to travel by car or taxi to urban centres in the region that provide these services, at a considerably reduced cost.

By reducing the isolation of Fox Lake and Garden River, the access road would enhance staff retention. The stress on nurses would be reduced in emergency situations occurring during extreme weather conditions since they would have the option of transporting out critically ill patients immediately by road rather than waiting for better weather to evacuate by air.

12.2.3.15 Capital Projects

The construction of the proposed access roads would change the classification of the LRRCN from "special access" to "remote access", and would allow Indian and Northern Affairs Canada to realize significant cost savings. Less INAC funding would be required for the transportation component of capital projects. The cost of service calls would decline with the access roads as a result of the reduction in transportation costs, the greater flexibility in scheduling maintenance and repairs, and the elimination of the need to house workers.

12.2.3.16 Electricity

ATCO Electric is considering laying landlines to supply electricity to Fox Lake because of the community's rapidly growing population and the anticipated increase in demand for electricity. The company has indicated that an access road to Fox Lake could considerably lower the cost of laying landlines to the community. The "ideal" situation would be to lay their landlines about 10 metres off road (depending on the alignment and the terrain). The savings would accrue from improved access for their construction crew and equipment, as well as a reduction in the amount of clearing they would have to undertake. The road would also provide optimal access to the lines for repair and maintenance. Environmental impacts could be reduced if both the road and the landlines followed the same route.

At present, however, ATCO Electric is not considering laying landlines alongside the proposed access road alignment to Fox Lake since the ferry crossing will not suit their purpose. Without a bridge the cost of getting the electric cables across the Peace River would be too high. To lay cables under the river would require dredging the riverbed to a considerable depth and the use of specialized cables. In addition, the dredging might cause significant environmental damage. Alternatively, to run the cables over the river the company would have to erect 400 ft high towers due to the width of the river. The expense of erecting these towers would be prohibitive, and the maintenance or repair costs, were any problems to develop, would be quite high. In addition, the proximity of high towers to the Fox Lake landing strip could pose a safety hazard. A bridge across the Peace River, they suggest, would allow them to benefit from the savings that would be realized by following the proposed access road alignment and would provide them with a means of getting their cables across the river. Without the possibility of a bridge, ATCO Electric is considering extending landlines south of the Peace River from Fort Vermillion to Fox Lake. This route will require ATCO to lay cables over twice the distance as compared to the proposed access road alignment.

12.2.3.17 Little Red Air

The access roads will have a negative impact on the activity of Little Red Air, the LRRCN's air charter service. Air passenger travel and freight shipments will decline dramatically because of shifts to road transportation. However, Little Red Air will continue to provide air service for emergency medical evacuations and for passengers who prefer to travel to Fox Lake and Garden River by air charter to save time (e.g. physicians, dentists, government officials).

12.3 Cultural Resources

12.3.1 Introduction

The Terms of Reference required an analysis of effects on Cultural Resources including:

- the likelihood of cultural resources being located along the right-of-way
- a description of the unique sites and special features
- an assessment of areas that are proposed in the project description for gravel extraction, excavation, soil disturbance and other ancillary project activities
- an evaluation of the impacts that the road would have on traditional users relative to hunting and trapping in the proposed road areas
- a consultation with all First Nations groups that have an interest in the proposed road corridor to determine any impacts and conflicts that road developments might pose to their cultural activities; and
- an evaluation of how the road will impact the current aesthetic features

Vegetation Clearing
Any surface or near-surface sites will be susceptible to disturbance. Materials will be scattered and fragile artifacts will be destroyed. If the material is cleared by pushing with a bulldozer, then effects will

be more severe. Uprooted trees and tractor treads will pull up subsurface deposits. Surface and near-surface sites will be scattered and artifacts crushed under the weight of the heavy equipment.

Burning

Burning of stumps and brush within the road corridor has the potential to affect the integrity of archaeological sites. The introduction of modern charcoal to older deposits may affect any occupation dates obtained through radiocarbon dating, and the burning of the protective vegetation layer may accelerate erosion and expose previously concealed sites.

As the road comes into use, road traffic may further affect the corridor. People using the road to access hunting and fishing locations may set up camps along the road corridor. This has already occurred at several locations along the existing road corridor. This may further disturb historical and archaeological sites along the road corridor, depending on the location of these sites.

Accelerated erosion of soils on eskers, dunes and other areas of light soil susceptible to movement by wind and water may increase the potential for disturbance of nearby archaeological sites. Additional impacts on archaeological resources could occur through the proposed restoration of areas previously disturbed by initial construction, operation and maintenance of the road corridor.

12.3.2 Effects Assessment - WBNP

Archaeological assessment along Road Section B produced no indication of cultural remains. It is recommended that no further archaeological work be undertaken prior to full construction of the proposed road expansion, since most of the area has already been disturbed. Based on the available information including field surveys, no further impacts are likely along this road section.

12.3.3 Effects Assessment - Province of Alberta

A number of stream terrace locations are crossed by the existing corridor of Road Section A, and these were shovel tested. Nearly all yielded no cultural remains, although the crossing of the Pakwanutik River (where other historical remains have been recorded in the past) yielded one apparently significant archaeological site (IePm-1) that may require additional assessment if the expanded road corridor will affect its remaining integrity in any way. Unfortunately, without an actual staked corridor boundary, the effect of proposed expansion on the site cannot be evaluated at this time. The same can be said for sites IdPq-2 and 3, located in a gravel quarry locality. These sites are located outside of the proposed development route. Nevertheless, it is expected that gravel from this locality will be used to construct the western reaches of the new road, and archaeological assessment of the quarry locality will be required if this is the case.

If Road Section A does not deviate from the existing road corridor other than a simple widening of the existing corridor (notwithstanding the planned shortening of one route location that is not considered archaeologically significant), it is recommended that construction of Road Section A can proceed without any further concerns for the provisions of the Alberta Historical Resources Act. However, there are two exceptions:

- The proposed expansion of the road corridor in the vicinity of the east side of the Pakwanutik River crossing, south side of the road, be configured so as to avoid any impact on the existing undisturbed terrace in that location. If road expansion can not avoid disturbance to this location, additional archaeological assessment and mitigation may be required, as determined by the provincial historical resources regulator, Alberta Community Development.
- Any use of the gravel pits located on the east side of the Wentzel River will require archaeological assessment, since 2 archaeological sites have been found within the boundaries of the existing quarry area, and other cultural resources are expected to be present in the locality

Much of Road Section C appeared to exhibit low habitation potential because it was dominated by muskeg. Limited in-field visual assessment appeared to verify this evaluation. However, several significant localities were identified for more detailed archaeological assessment, particularly the south side of the Wentzel River crossing, the Dummy Creek crossing and the locality where the ferry crossing will be established across from Fox Lake. These locations could not be tested archaeologically during this particular survey because of limited access, and the fact that specific locations were not marked in the somewhat undifferentiated forest environment around the key assessment areas. This is particularly the case for the proposed ferry landing, which may be located very close the currently unrelocated Colvile House, an early historic fur trade post believed to be present in the area.

Because in-field evaluation of most of the proposed route indicates that it is dominated by muskeg and thus has low human habitation potential, it is recommended that the proposed development proceed without further archaeological assessment. However, because of the lack of specific survey locations during the assessment, several exceptions are noted:

- The south side of the Wentzel River crossing, when staked for development, will require archaeological assessment. The area south of the crossing appears to be of low habitation potential and will not require assessment.
- Both sides of the proposed Dummy Creek crossing, when fully staked, will require archaeological assessment. The wet areas north and south of the creek appear to be of low habitation potential and will not require assessment.
- The proposed development areas in the vicinity of the ferry crossing on the Peace River across from Fox Lake (and on the other side of the Peace River in the Fox Lake community) will require assessment once their locations are marked on the ground. Locations north of the river towards Dummy Creek will not require assessment.

12.3.4 Mitigation

Once the cleared areas are flagged, a more detailed assessment of impacts at the sites identified above can be made. If the gravel pit east of Wentzel River is to be expanded as part of road construction, shovel testing is recommended for the associated historical sites (IdPq-2 and IdPq-3). Further assessment for Site IePm-1 should involve a more formal excavation since it is possible that there is not much left of the buried deposits. However, further archaeological assessments along the remainder of Road Sections A and C are not required prior to road construction.

12.3.5 Residual Effects

Overall residual effects of the project on cultural resources are negative in direction, low to moderate in magnitude, local in extent and short-term in duration.

12.3.6 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude that the proposed project is not likely to result in significant adverse environmental effects on cultural resources.

12.4 Aboriginal Component and the Current Use of Lands for Traditional Purposes

12.4.1 Introduction

Little Red River Cree traditional knowledge experts observed that the building of the road to John D'Or Prairie and the Garden Creek had negative impacts on local wood bison and woodland caribou populations and likely also affected moose. Both caribou and bison, which at one time frequented the prairies near John D'Or Prairie and the Wentzel River, have retreated into the Caribou Mountains away from the road, mainly in response to increased human hunting pressure and noise disturbance. The proposed Highway 58 project will likely increase both noise and human hunting pressure. Vehicle traffic is expected to be more frequent and to occur at higher speeds, thereby increasing noise. The presence of an all-weather road will likely attract more outside trophy hunters, which may expose the Wentzel Lake bison herd and black bears to increased trophy hunting pressure. The practice of bear baiting at the camp along the road near the Wentzel River may also increase the chance of vehicle collisions with bears. Although bison have stopped visiting mineral licks near the existing road to Garden Creek (along and east of the Wentzel River), it is recommended that the licks be preserved in case the Wentzel Lake bison expand to their former range in the future.

12.4.2 Effects Assessment

Construction of Road Section C to Fox Lake will likely increase chance encounter subsistence hunting of moose along the Wentzel River, since wetlands in the area provide good moose habitat. For the local subsistence economy, this presents an advantage.

The proposed Highway 58 project will likely impact some local berry and herb gathering activities. Some easily accessible berry bushes may disappear because of road expansion although local herb experts usually never harvest herbs in the immediate vicinity of roads. Many herb experts leave a 3 - 5 m buffer away from the road before they harvest an herb. The expansion of the road could spoil the usability of a local herb if it is suddenly situated in the new buffer zone.

Trappers who hold traplines along the proposed all-weather roads may experience a decrease in wildlife in the vicinity of the roads because of increases in human activity and noise. Trappers along the Road Section C to Fox Lake will be particularly affected since the travel frequency on their trapline will change from occasional quad and skidoo traffic on a seismic line to daily vehicle traffic on a road. Consequently, active trappers in the area are likely to encounter a decrease in income.

Many traditional ecological knowledge study participants were very concerned about industrial pollution. The maintenance of the brush-free corridor along all-weather roads through the use of herbicides is likely to cause concern because moose are feared to feed on contaminated freshly sprayed leaves or twigs. Since local people consider wildlife a healthy and natural source of food, any contamination of wild foods is seen as threat to human and animal welfare.

12.4.3 Mitigation

The influx of outside trophy hunters and their impact on local bison and bear populations appears to be one of the biggest local concerns. Preventative measures are difficult to take as long as provincial regulations allow for bison trophy hunting of animals that local residents want to see protected, and practices such as bear baiting and abandonment of bear carcasses are legal. Access into the Caribou Mountains through existing seismic lines could be limited through the installation of gates with the consent of local trapline holders. This would give local residents more control over who accesses their traplines and could limit outside trophy hunting of bison and bears. The installation of gates, however, might also be perceived locally as a restriction of subsistence activities. Community consultation and consent is necessary.

Consultation on the conservation of herb gathering areas is a difficult process. Senior trapline holders along the road should be individually consulted on the issue. Other local herb specialists should also be consulted individually with the help of a community liaison. The knowledge of herbs is a very private issue, to a point where an herb expert may object to a consultation and documentation process. The planning of an herb conservation consultation component requires great sensitivity and detailed knowledge of local culture and protocol.

It is recommended that future management plans for the Highway 58 project avoid the use of herbicides in order to prevent local wildlife and herbs from being affected. Alternatively, the maintenance of the brush-free corridor along all-weather roads could be achieved through mowing and brush cutting, which could provide for occasional local employment.

Consideration should be given to compensating trappers who hold traplines along the proposed all-weather roads for lost income (in particular those trappers who are affected by new Road Section C). It is difficult to measure the loss of income since the current prices of pelt (e.g., $80.00 for a lynx) do not reflect the potential income possible, if the fur market should recover (e.g., $ 600.00 for a lynx before the crash of the fur market). Currently, the forestry company ALPAC is developing compensation models for trappers in their forest management agreement area near Lac LaBiche. The development of these compensation models involves ALPAC biologists and aboriginal liaisons, as well as local trappers. Compensation through employment of trappers as monitors in bio-scientific research is one of the approaches taken by the company. In the Highway 58 study area, a fair negotiation process would involve the affected trappers, and chief and council of the Little Red River Cree Nation.

Environmental assessment of the potential effects on Cultural Resources

Potential Effects: Exotic species	**Project Period**	**Direction**	**Magnitude**	**Geographical Extent**	**Duration**	**Frequency**	**Reversibility**	**Probability of Occurrence**
Disturbance of Herb gathering and trapping	All	Negative	Moderate	Local	Long-term	Constant	Low	Medium
Disturbance to River Traffic	All	Negative	Low	Local	Long-term	Constant	Low	Low
Historic/Pre-historic resources may be lost	All	Negative	Low	Local	Short-term	Isolated	Low	Medium

12.4.4 Residual Effects

Overall the effects of the project on the current use of land for traditional purposes are negative in direction, moderate in magnitude, local in extent and long term in duration.

12.4.5 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude that the proposed project is not likely to result in significant adverse environmental effects on current use of land for traditional purposes.

13.0 Navigation

13.1 Introduction

There are three navigable watercourses within the LSA including Peace River, Wentzel River and Garden Creek. A major bridge with 10 instream piers spaced approximately 90 m apart will be constructed over the Peace River with a 17 to 18 m streambed height. Standard span bridges will be constructed over the Wentzel River and Garden Creek.

13.2 Effects Assessment

The placement of berms could pose a hazard to river traffic on Peace River. However, at no time will there be an impassable barrier to traffic. River traffic will not be impeded at Wentzel River or Garden Creek as the construction of a span bridge does not require use of isolation techniques. Once the bridges are operational the instream piers may pose a hazard to boaters, but traffic will not be impeded on Peace River. Again, there will not be any instream structures in Wentzel River or Garden Creek; therefore, there will be no hazards or traffic impediments during operations.

13.3 Mitigation

The RAs will ensure that the proponent develop and implement a boating and public safety plan.

13.4 Residual Effect

The effects of construction and operation of bridges over the Peace River, Wentzel River and Garden Creek on navigation are anticipated to be negative in direction, low in magnitude, local in extent, long-term in duration and constant in frequency, and low in reversibility (Peace River crossing only).

13.5 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude that the proposed project is not likely to result in significant adverse environmental effects on navigation.

14.0 Accidents and Malfunctions

14.1 Introduction

During any phases of a construction project such as this, there is the potential for malfunctions and accidental events to occur. Such events may include fires and uncontrolled releases of materials such as petroleum, oils and lubricants, garbage or maintenance materials (e.g. paint) can have significant consequences. Forest fires can be started from sparks from equipment or from careless disposal of cigarettes. Forest fires can create unsafe working and driving conditions. Depending on the location of the forest fires, they could threaten infrastructure and property. Uncontrolled release of such materials may affect the health and safety of individuals, air quality, water quality, including surface or ground water and terrestrial or aquatic habitat. Any accidental spills are predicted to be mainly contained within the right-of-way.

14.2 Effects Assessment

The effects of accidents and malfunctions include:

- accidental forest fires
- accidental spills,
- traffic-related contaminants,
- herbicides/pesticides,
- and de-icing salts

These effects will be largely contained in the right-of-way during the construction/operation/maintenance phases of the project.

Input of deleterious substances into wetlands could have a significant adverse effect on the aquatic vegetation. Contaminants entering creek systems may be transported further, increasing the zone of effect, although dilution is likely to occur and the magnitude of the response will decrease with distance. The greatest concern during construction is the potential damage to the aquatic environment that could result from a major spill of fuel or other hazardous substances, and possible human health concerns related to consumption of contaminated water or fish.

14.3 Mitigation Measures

The RAs will ensure the proponent implements the following prevention/protection measures :

- Development of an ECO Plan to be reviewed and approved by the RAs, FAs and INFTRA. This ECO Plan will identify how fuels, oils and lubricants will be stored by the contractors and how emergency response actions to spills and or other events will be handled. The ECO plan will contain emergency procedures as well as specify how the contractor(s) conduct training for their project employees. In the event that there are uncontrolled releases with the potential for adverse effects, they will be reported to the appropriate provincial/federal authorities as required by the legislation.
- Develop some 'non-draining' borrow excavations at strategic locations along the road in case of vehicle fire.
- Construction and use of the road should be suspended during periods of poor air quality/visibility or when the fire is near or within the active working or driving area.
- Post kilometre marker signs along road indicating location so that people are able to communicate their location in case they spot fire.
- Contingency planning can substantially reduce these risks, but a major spill at the Peace River can have a significant impact in the immediate spill area as well as downstream receiving waters.
- Any forest fires incidents will be responded to as directed by the Alberta Forest and Prairie Protection Act and associated regulations and policies and/or the Canada National Parks Act and associated policies and management plans.

14.4 Residual Effects

The likelihood of accidental spills occurring, or contaminants entering the wetlands in amounts substantial enough to cause significant long-term adverse effects on aquatic vegetation is considered to be relatively low. The likelihood of forest fires occurring is considered to be very low.

The impact from accidents and malfunction is considered to be negative in direction, low to high in magnitude, local to regional in extent, short-term in duration, and highly reversible. The probability of pollutants significantly impacting on native vegetation and wetlands communities is considered to be low.

14.5 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude that the proposed project is not likely to result in significant adverse environmental effects from accidents and malfunctions.

15.0 Effects of the Environment on the Project

15.1 Introduction

The definition of an environmental effect under Section 2(1) of the *CEAA* includes any change to the project that may be caused by the environment. Infrastructure projects (i.e., roads) are subject to the environment in which they are located. The Project may be affected by the following:

- Wind and surface water (includes erosion events);
- Flooding;
- Precipitation;
- Landslides;
- Forest Fires
- Ice Jams
- Washouts

15.2 Effects Assessment

A trend has developed between each environmental component and its impacts on the project. Generally, erosion of the roadway, sedimentation of ditches, road subsidence, slumping and poor working and driving conditions result from each environmental impact.

15.2.1 Effects Assessment during Construction and Operation

Environmental Component	Effect During Construction	Effects During Operations
Flooding caused by high precipitation events or beaver dam back up.	• Erosion; • Unsafe working conditions; • Unsafe driving conditions, including road washouts; and • Sedimentation of drainage channels. • loss of road building and reclamation materials required for construction of the project.	• Erosion; • Unsafe working conditions; • Unsafe driving conditions, including road washouts; and • Sedimentation of drainage channels.
Wind and water	• Erosion; • Sedimentation of drainage channels; • Unsafe working conditions; • Unsafe driving conditions, including road washouts; and • Rill and gully erosion within the road surface. • loss of valuable road building and reclamation material	• Erosion during operations can lead to rill and gully erosion of the road and road washouts, which can create unsafe driving conditions. • Siltation may block crossing structures and create floods

Landslides	• Erosion; • Subsidence; and • Loss of road and bridge use.	• Erosion; • Subsidence; and • Loss of road and bridge use.
Forest fires	• Unsafe working conditions; and • Unsafe driving conditions.	• Unsafe working conditions; and Unsafe driving conditions.
Ice jams	Not Applicable	• result from the accumulation of ice fragments that build up to restrict the flow of water and then act as a temporary obstruction can lead to erosion of materials along the bed and banks of the river • displacement of riprap on the headslopes of the bridge

15.3 Mitigation

The RAs propose the following mitigation measures:

- Geo-textile materials, mulches, water bars and check dams will be used on slopes until vegetation is re-established;
- Construction practices that reduce impact such as proper sequencing, proper surface treatment, limiting construction phase lengths and planning for corrective and preventive practices at the beginning of the project will be implemented;
- In areas of lighter soils, soil stockpile areas will be temporarily seeded to lower wind erosion effects;
- Disturbed areas will be reclaimed;
- Erosion potential will be identified during the planning and engineering of the road and mitigated. Proper design will divert water to ditches where it can properly drained;
- Regular road and bridge monitoring and maintenance will be conducted to ensure revegetation and erosion control structures are effective and to identify problem areas;
- Standard bridge designs and construction will be used to ensure that the banks of the Peace River are well armored and protected against erosion;
- The proponent will develop the erosion control ECO Plan, which will address effects of the environment on erosion and sedimentation;
- Snow will be graded into the ditch to reduce erosion during snowmelt runoff; and
- Regular road maintenance such as snow ploughing, grading and gravelling the road will be conducted to maintain safe driving conditions.
- Riprap on the headslopes of the bridge will be sized to generally resist the effects of moving ice, although some displacement of riprap could be expected to occur and maintenance would be required periodically.

- Regular monitoring of culverts for blockage will be conducted and cleaned when necessary. Crossing structures will be chosen or designed to accommodate any reasonable increases in water levels such as peak discharge events.
- In extreme weather conditions, construction will be postponed and operations, driving, will be suspended until conditions improve.
- To mitigate the impacts of a forest fire, construction and use of the road should be suspended during periods of poor air quality/visibility or when the fire is near or within the active working or driving area.

15.4 Residual Effect

Following the implementation of mitigation strategies and design components outlined above the effects of the environment on the Project are negative in direction, low in magnitude, short-term, low in reversibility and local in extent.

15.5 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude the effects of the environment proposed are not likely to cause significant adverse effects.

16.0 Effects of the Project on Capacity of Renewable Resources

Section 16(2) of *Canadian Environmental Assessment Act* and section 1.2 of the *Terms of Reference* requires that the scope of the assessment include a discussion of, "the capacity of renewable resources that is likely to be significantly affected by the project to meet the needs of the present and those of the future." As the Project includes upgrading an existing roadway to provincial standards, the discussion of the capacity of renewable resources that is likely to be significantly affected by the projects is primarily applicable to the Peace River Bridge crossing and the 7 km of new roadway as the existing road corridor is cleared.

Several of the VECs identified may be considered to be renewable resources (i.e., resource will return to a natural state over time) these would include:

- Fish species;
- Vegetation (native vegetation, forestry areas, wetlands); and
- Wildlife.

Presently, the VECs identified above are managed by the Province of Alberta (excluding those VECs within WBNP), and the Province allows sustainable harvesting/usage of VECs such as hunting, fishing, and forestry.

No residual effects have been identified that would cause a detectable change outside of the range of ecological sustainability in valued resource components. In other words, there are no residual effects that have been identified that would have a measurable effect on the population as a whole, diminish the quality of the renewable resource, critically reduce the availability of the renewable resource, or compromise the ability of other species or future generations to meet their needs.

A significant effect was considered to occur if there was a detectable change in valued resource components beyond the range of ecological sustainability in a local/regional context over a period of time. As no significant residual effects were identified, the capacity of the renewable resources (in a regional context) would not be affected by the proposed Project.

It should be recognized that the capacity of the renewable resources to meets the needs of the present (i.e., the ones that would be affected by the Project) is considered during the determination of significance. The criteria of magnitude and direction both involve assessment of net loss/benefit to the resource as well as the magnitude of detectable change in the resource.

17.0 Peace River Bridge Crossing at Fox Lake

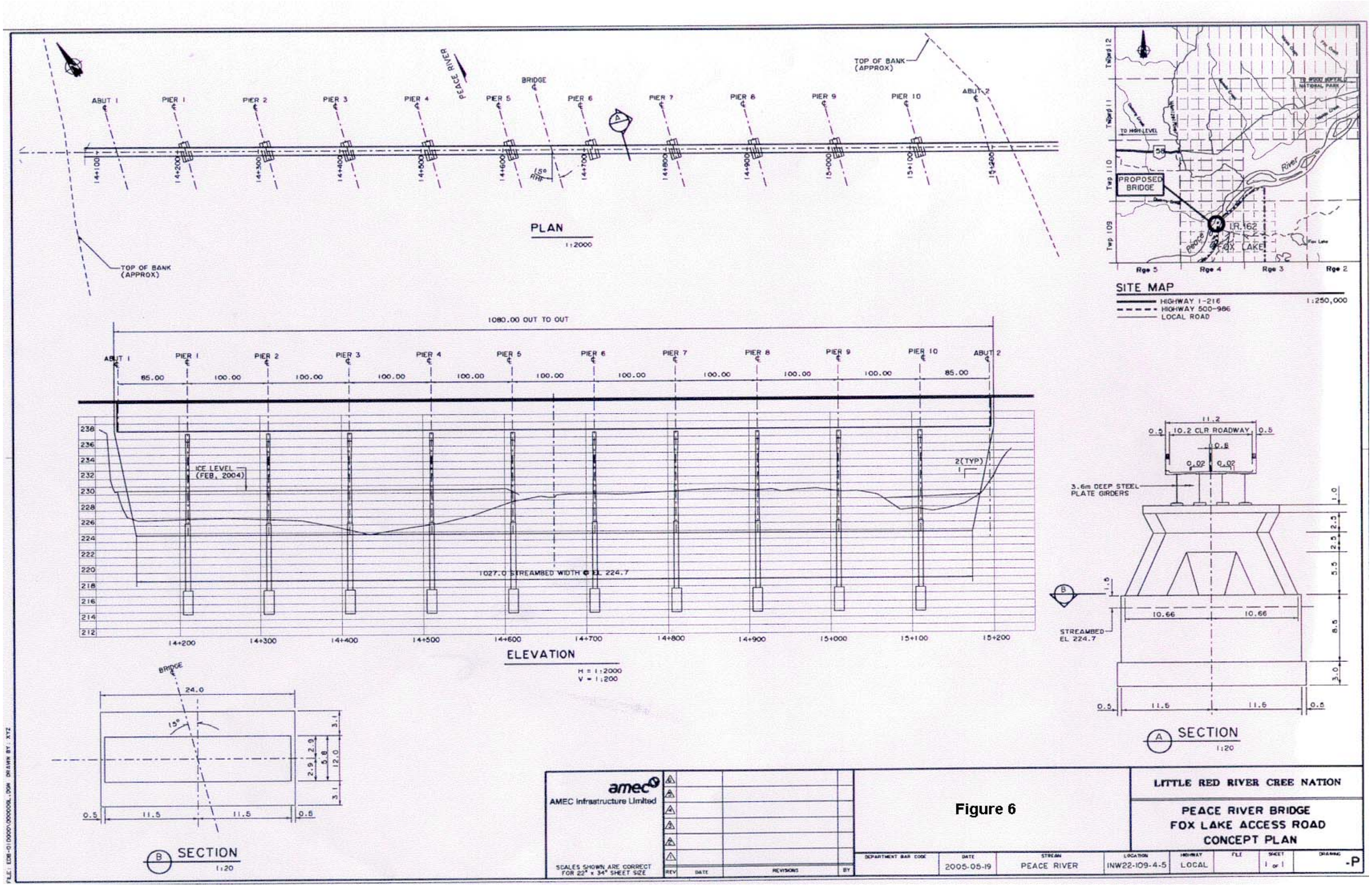
17.1 Bridge Location

The location of the Peace Bridge will be at the existing winter ice bridge-crossing site at Fox Lake as shown in Figure 15.1 This crossing site presently supports existing infrastructure and roadway access from the east bank of the Peace River to the community of Fox Lake. Currently, the west bank contains a cleared staging area and a landing cut through the riverbank, which is used for the ice bridge crossing.

The proposed bridge crossing will be located from km 13.950 to km 15.065 of the Fox Lake Access Road at the existing winter bridge. The channel width is approximately 1030 m. The channel pattern within the reach is weakly sinuous with split channels and extensive bar complexes. As such, the Peace River is predominantly shallow and wide at the crossing, with the channel thalweg flowing along the west bank. The east bank is armoured / depositional and is composed primarily of sand overlying cobbles. The west bank is steep and erosional with bank height ranging from 3.0 to 5.5 m.

17.2 Bridge Concept

A bridge configuration as shown in Figure 6 is being considered in the conceptual scenario for the proposed Peace River crossing. This design has the largest footprint on the aquatic and terrestrial environment in terms of potential alternative bridge structures.


PLAN
1:2000
ELEVATION
H = 1:2000
V = 1:200
1080.00 OUT TO OUT
SITE MAP
1:250,000
SECTION A
1:20
SECTION B
1:20
AMEC Infrastructure Limited
Figure 6
LITTLE RED RIVER CREE NATION
PEACE RIVER BRIDGE
FOX LAKE ACCESS ROAD
CONCEPT PLAN
2005-05-19
PEACE RIVER
INW22-109-4-5
LOCAL

A 1070 m long bridge would be required for that crossing based on a 2:1 headslopes and 1027 m bed width. This bridge option would consist of 9 – 100 m spans and 2 – 85 m approach spans. Deck to streambed height will be 17-18 m. The superstructure would consist of four girder lines of the 3600 mm deep steel plate girder with a 225 mm Class SF precast concrete deck with 10.2 m clear roadway width. The substructure design is based on the accommodation of six girder lines for future widening of the superstructure. It is assumed that the piers will be supported on spread footing (to be confirmed by a geotechnical investigation).

The principal activities associated with the construction of the bridge include:

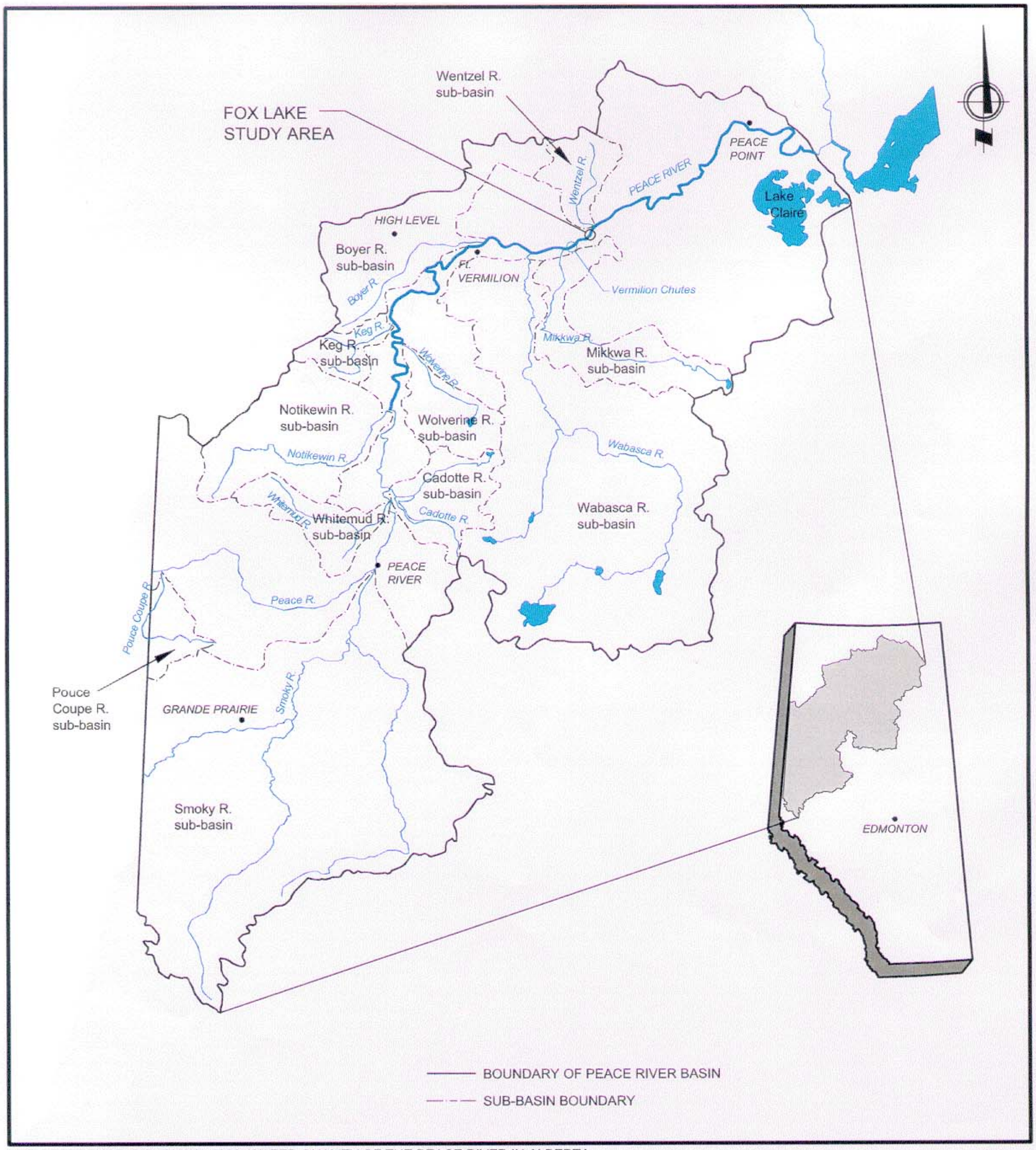
- Clearing and grading of the approaches to the bridge site;
- Construction of approach fills to the bridge;
- Installation of 10 piers in the bed of the river for support of the bridge;
- Construction of 9 spans;
- Reclamation and revegetation of project area disturbances.

17.3 Baseline Conditions

17.3.1 Introduction

The Peace River originates within the Rocky Mountains in northeastern British Columbia. Flow from the upper headwaters feed into the downstream Willinton Reservoir formed by the W.A.C. Bennett Dam. The River flows northeasterly across northern Alberta and drains into the Slave River, 50 km north of Fort Chipewyan. The Peace River drains much of northeartern BC and northern Alberta and together with the tributary Smoky / Wabasca system, coveys the largest volume of water of any river in Alberta, with a mean annual flow almost four-times that of the Athabasca River. See Figure 7.

Flow regulation commenced on the Peace River mainstream in January 1968. The main influence of the W.A.C. Bennett Dam on the natural monthly flows of the Peace River has been the redistribution of discharge throughout the year. Flow regulation has resulted in lower mean monthly flows during the summer and higher mean monthly flows during the winter. In addition, maximum daily flood peaks have been substantially reduced while the minimum daily flows have increased. Peak discharge is experienced from May to late August, and base flows occur from September through April. Flood peaks in the Peace and Smoky rivers generally occur in late May and early June, coincident with the snowmelt runoff in the headwaters of these rivers. During the summer of most years, summer rainstorm events produce additional flood peaks.



MAP REFERENCE: R.D. SHAW, 1990. WATER QUALITY OF THE PEACE RIVER IN ALBERTA. ALBERTA ENVIRONMENT, EDMONTON.

LITTLE RED RIVER CREE NATION AND INDIAN AND NORTHERN AFFAIRS CANADA		DWN BY: SW CHK'D BY: RW	LOCATION MAP OF THE PEACE RIVER BASIN AND SUB-BASINS	AMEC PROJECT NO: EA15444 REV. NO.: -
AMEC Earth & Environmental	amec	SCALE 1 : 4,000,000 DATE: NOV, 2004		Figure 7

S:\Cadd\Mat\EA15400\EA15444\Task 500\EA15444-500-003.dwg – Fig 1 – Nov. 08, 2004 8:44am – scott.wilcox

17.3.2 Geologic Characteristics

The Peace River basin occupies portions of two major physiographic regions: the Cordillera and Interior Plains. The Cordillera covers much of the southwestern portion of the Basin, including the Rocky Mountains, and is composed of sedimentary rocks with deep valleys and high plateaus covered by glacial tills. The majority of the Peace River Basin is within the Interior Plains and is underlain by recent metamorphic and sedimentary bedrock of Devonian and cretaceous ages (Green 1972).

The elevation of the Peace River in Alberta is 375 m (a.m.s.l.) at the British Columbia – Alberta border, and 207 m (a.m.s.l.) at the confluence with the Slave River. The river drops 168 m in Alberta for an average gradient of 0.16 m / km. A major feature of the gradient profile is a drop of 9.5 m at the Vermillion Chutes.

As the Peace River flows through two physiographic regions, various sections of the river system display different morphologic characteristics. Changes in the underlying geologic structure, basin relief and surficial deposits coupled with the influence of runoff from upstream and tributaries determine the overall river morphology. In general. The river can be divided into the Upper Peace River, Middle Peace River, Lower Peace River, and the Peace – Athabasca Delta.

17.3.3 Soils and Vegetation

The upland areas of concern consist mainly of the bridge approaches on the east and the west banks of the Peace River, where the approaches to the winter road ice bridge crossing currently exists. The area nearest the Peace River is within the Athabasca Delta Ecodistrict and Peace River Lowland ecoregion. The surficial materials are predominantly fluvial, occurring on level terraces of the Peace River.

On the east bank, the surrounding vegetation indicated various degrees of anthropogenic disturbances, including clearing, soil compaction, ATV use and introduction of non-native vegetation. The vegetation communities transitioning from the waters edge to the upland forest community are typical of the depositional / armoured bank type and representative soil moisture regime.

On the west bank, steep erosional banks composed mainly of slit and sand that have been eroding and slumping were the dominant feature. Because of the nature of the steep erosional bank, the vegetation community along the river is consistent with the upland vegetation community type, with little vegetation zonation observed.

17.3.4 Wildlife

The reach of the Peace River is largely undeveloped and is composed of one long continuous unit of forested valley habitat. The relatively undisturbed river valley and associated habitat diversity or river floodplain is thought to support the highest wildlife species richness in the study area. Alberta Sustainable Resources development has delineated a key ungulate management zone along the Peace River that defines important moose wintering habitat. In addition, the Peace River lowlands have been designated a nationally important environmentally significant area.

In addition to providing resident wildlife winter and summer habitat, the river valley is considered to be an important corridor for wildlife movement.

17.3.5 Hydrologic and Geomorphic Features

Based on the information reviewed, the following conclusion was reached regarding the stability of the Peace River at the proposed bridge location:

- Sand banks appear to be a normal feature in this reach of the Peace River. Thus, they would be expected to occur over the anticipated lifetime of the proposed bridge
- Sand banks in this reach are transient features, accreting and eroding in response to annual flood discharges
- The large islands upstream, which influence the flow distribution at the proposed bridge, have been relatively stable over the past five decades, with three of the four islands examined still remaining. The large island, "1", has existed for over 90 years as evidenced by its presence on the Township Plan in 1913, labelled "Island No. 3". It is likely that a trend towards greater stability had evolved due to upstream regulation of flows by the W.A.C.Bennett Dam.
- The river thalweg has been and is expected to remain situated to the west of Island 1 and within the western portion of the channel at the proposed bridge location
- Islands 1 and 2 would affect patterns for moderate and high river stages. Sand bars would have a greater effect on flow at low river stages.

Determination of the zone of impact

For sediment discharge over the sand bar, the maximum downstream distance for the sediment plume to return to 10% of its initial concentration is 1520 m along the centreline of the sand bar. For sediment discharge in the main (west) channel near the channel thalweg, the maximum downstream distance for the sediment plume to return to 10% of its initial concentration is 1650 m.

17.3.5.1 Bottom sediment sampling

Flow conditions in the Peace River at the time of the survey were relatively high for the fall season, so sand bar bottom sediments were sampled in water depths ranging from 1.0 to 1.4m East side channel sediments were taken from a depth of approximately 2.0 m. The sample details are summarized in Table 17.1

Table 17.1 Summary of Bottom sediment samples

Sample No	Location description	Material description

PSA 001	Top of Shoal	36% sand, 59% silt, 5 % clay
PSA 002	Top of Sand bar	100% sand
PSA 003	Top of Sand bar	100% sand
PSA 004	Top of Shoal	100% sand
PSA 005	Top of Shoal (upstream end)	100% sand
PSA 006	Bottom of East side bar	100% sand
PSA 007	Top of Sand bar	100% sand

Six of the seven samples taken are composed of 100% uniformly graded sand. Representative grain sizes are D_{90} = 0.300 to 0.400 mm; D_{50} = 0.200 to 0.300 mm, and D_{10} = 0.120 to 0.180 mm. Based on the Unified Soils Classification system, the sampled material falls into the category of fine sand. The D_{50} for bed material for the Peace Point gauge is 0.220 mm (fine sand), which correlates well with the sampled gradation at Fox Lake. Channel bed gradation results for sample locations 20 km upstream and 70 km downstream from Fox Lake have particle size gradation of 97.9% and 99.9% sand respectively.

17.3.5.2 Water level measurement

Estimated river discharges based on recorded mean daily flows from the WSC gauging station at Peace Point are included in Table 17.2. The flows were corrected for an estimated two-day lad between the field survey location on the Peace River near Fox Lake and the gauge at Peace Point, approximately 200 km downstream of the survey station.

Table 17.2 Summary of water surface levels

Date	Water surface elevation (m)	Estimated river discharge (m^3/s) [1]
2004 – 09 – 27	231.42	3428
2004 – 09 – 28	231.45	3351
2004 – 09 – 29	231.33	3210
2004 – 09 – 30	231.14	2958

Note: [1] River discharges estimated from records at Peace Point with a 2-day lag

The estimated stage-discharge relationship at Fox Lake is parallel to that for Peace Point, which indicates a similar rating relationship. Three water surface indicate a much steeper stage-discharge relationship. However, the range of discharges recorded is only 200 m^3/s, which is small in comparison to the range of discharges measured in 2004, which is over 1500 m^3/s. The benchmark that the water levels were tied to was removed prior to 2004, there fore it was impossible to verify its elevation in the field. Therefore, the surveyed water levels were not incorporated in the development of the revised stage-discharge rating curve.

17.3.5.3 Sediment plume modeling

The sediment transport model required selection of a characteristic grain size and calculation of the particle fall velocity for the channel bed material. For the purposes of investigating sediment plume dispersion, the lower limit of the grain size gradation is of the most interest, as the finest particle sizes would travel the greatest distance. From the channel bottom sediment particle size curves, a lower limit D_{10} value of 0.120 mm was selected from the six fine sand curves for input into the model. The single silt sample, was not selected for modelling as any pockets of fine sediment that might be discharged during the excavation would enter the wash load of the river.

Two aspects of sediment discharge were assessed, assuming no use of instream sediment control measures such as cofferdam or berm. First, sediment from the channel bed will be suspended by the digging or excavation action. Second, the discharge of sediment into the channel (for in-water disposal) will create a sediment plume.

Two sediment concentrations of 500 mg/L and 1000 mg/L were selected for modelling to represent the maximum expected range of TSS at the sediment discharge locations over the mid-channel bar and channel thalweg. Simulating the sediment plume as a steady state process was a required simplification, however, in practice the sediment plume concentration would be highly variable. The result of the eight model runs undertaken to model the sediment plume over an average distance to 10% concentration from 500 and 1000 mg/L initial plume concentration runs are summarized in Table 17.3.]

Table 17.3 Summary of sediment plume modelling results

Instream activity	Plume location	River discharge (m^3/s)	Average distance to 10% concentration (m)
Excavation or discharge	Sand bar	2960 (late July)	1360
		3515 (June)	1520
Discharge	Thalweg	2960 (late July)	1260
		3515 (June)	1650

The study reach or "zone of impact" is defined as the area of bed and banks of the Peace River that will be altered as a result of bridge construction and operation. For the purposes of this assessment, the study reach extends from 400 m upstream of the proposed bridge location to approximately 1.5 km downstream. For the purposes of fish habitat mapping, this was extended to 900 m upstream of the bridge location to 2.4 km downstream.

Bank types

The east bank is armoured / depositional and consists primarily of silt overlying sand and small cobble. The west bank of the main channel and banks of the islands are predominantly eroding and slumping with heights ranging to 3.0 to 5.5 m. Bank composition is summarized in Table 17.4

Table 17.4 Bank type composition in the study reach during high flow stages

Bank type composition						
	East and west banks					
	A1	D1	E1	E2	E4	E5
Length (m)	915	2625	855 Bank type	570	1890	-
% Linear length[2] for east and west	13	38	13	8	28	-
	Island banks					
Length (m)	-	990	-	-	945	1695
% Linear length[1] for east and west	-	27	-	-	26	47
Total % linear length[2]	8.7	34.5	8.2	5.4	27.0	16.2

[1] Bank lengths: Total = 10,485 m, East bank = 3540 m, West bank = 3315 m, Island bank = 3630 m

E4 banks are defined as steep, eroding or slumping highwall banks consisting primarily of fines. E4 banks constitute 27% of the total banks type in the study reach. Instream cover is generally limited to bank irregularities, and overhead cover is provided by depth and turbidity.

E1 and E2 bank types are present along the west river bank, accounting for 13.6% of the total study reach bank type. They are frequently slumping and eroding, with sand / silt substrates.

E 5 banks constitute 16.2% of the total study reach bank type and are associated with the islands.

The east bank is characterized by D1 and A1 bank types. These banks account for 42.7% of the total bank types available in the study reach. D1 bank types (34.5%) are low relief, gently sloping banks, with shallow water depths offshore.

Instream habitat units

Deep runs (R1) are shallower areas (bars and shoals) are predominant. Run habitat constitutes approximately 40% of the study area, and shallow areas approximately 48% (40% bars and 7% shoals). Deep pools (P1) were also observed throughout the study reach, and occur over approximately 12% of the study reach. Habitat unit composition is summarized in Table 17.5.

Table 17.5 Habitat type composition in the Fox Lake – Peace River study reach

Habitat type composition					Cover type composition						
	R1	P1	SH	BA		SWD	LWD	U	DP	OV	IV
Area (ha)	134.5	40.3	23.5	137.8	Area (ha)	<1.4	<1.4	0	40.3	<1	<1
% Wetted area	40	12	7	41	% Total area	<1	<1	0	12	<1	<1
Number of units	2	6	3	2							

Run habitat, generally 3.5 m to 5.5 m deep at bankfull stage, is most prevalent through the western portion of the channel and is indicative of the main thalweg through the study area. A narrow run occurs along the east side of the river, at and upstream of the crossing. This run transitions into a bar approximately 100 m downstream from the crossing, and then transitions back into a run approximately 350 m further downstream. This narrow run connects with the main west side run approximately 1600 m downstream, just upstream of a large vegetated island.

Shallow depositional bar and shoal areas occur primarily in near shore banks, providing potential fish rearing habitat, especially where gravels and cobbles provided an additional velocity break along depositional banks. A large shoal and bar complex is situated at and upstream of the existing crossing, which extends approximately 2 km further downstream from the crossing, closer to the middle of the river, and averages 160 m in width.

Pools typically range in depth from 5.5 m to 8.5 m. The three larger pools occur within the thalweg of the river, which is in the middle to west portion of the river. Three smaller pools occur within the narrower run close to the east bank. These pools are capable of providing overwhelming habitat for most fish species.

The proposed bridge alignment bisects run, deeper pool, and shallower shoal and bar habitats. The percentage of each habitat at the crossing is approximately 12% deep pool, 31% run, and 52% bar or shoal (water depth between approximately 0.5 m and 3.5 m).

Cover features appear to be limiting in this reach. The availability of instream cover ranges from 12 – 13% of the total wetted channel area (Table 15.5). The dominant cover type is provided by depth of water and turbidity. Other cover types are present but in trace amounts. Infrequent areas of large woody debris and overstream vegetation are present primarily along erosional banks, and provide only minor contributions. Small amounts of instream vegetation were observed near shore along the depositional east bank, with gravel and cobble bed substrates.

17.3.6 Sediment quality

Bed materials across the channel in the study reach consist of sand with local gravel over easily erodible shale, except for the uppermost section within the influence of Vermillion Chutes where the bed consist of coarse substrate and occasional bedrock. Bathymetric data and historical aerial photograph interpretation indicated significant seasonal and year-to-year variability in bed morphology, with deposition and scour capable of occurring simultaneously over adjacent bed areas, as well as subsequently in the same area. The results of channel bed texture surveys within the potential zone of impact during 2004 fall surveys are provided in Table 17.6.

Bed material could not be detected at a depth greater than about 4.5 m. In this case, the field crew travelled upstream of the site until substrate type could be determined with sampling equipment. Based on the erodible and slumping bank material along the west bank and vegetated islands, it is likely bed materials in this vicinity would be largely influenced by sand materials contributed from these banks.

Table 17.6 Bed material sampling results

Transect	Landing	Location relative to landing	Distance from shore	Substrates	
				Bank (upstream) materials	Bed materials
H	West bank	400 m upstream	10	Sand	Sand
H	West bank	400 m upstream	100	Sand	Sand
H	West bank	400 m upstream	400	(Sand)	Sand
H	East bank	400 m upstream	0 – 10	Fines	Sand
H	East bank	400 m upstream	100	Sand	Sand
H	East bank	400 m upstream	400	(Sand)	Sand
G	West bank	West banding	10	Sand	Sand
G	West bank	Bridge alignment	100	Sand	Sand
G	West bank	Bridge alignment	300	(Sand)	4.5 m depth
G	East bank	Bridge alignment	0 – 3	Fines / Cobble	Gravel
G	East bank	Bridge alignment	100	Sand	Sand
G	East bank	Bridge alignment	400	(Sand)	Sand
G	East bank	Bridge alignment	600	(Sand)	Sand
F	West bank	400 m downstream	5	Sand	Sand
F	West bank	400 m downstream	400	(Sand)	> 4.5 m depth
F	East bank	400 m downstream	0 – 23	Fines / Cobble	Cobble / gravel
F	East bank	400 m downstream	400	(Sand)	Sand
E	West bank	800 m downstream	100	Sand	Sand
E	West bank	800 m downstream	400	(Sand)	> 4.5 m depth
E	East bank	800 m downstream	0 – 2	Fines / Cobble	Cobble / gravel
E	East bank	800 m downstream	300	(Sand)	Sand
D	West bank	1200 m downstream	100	Sand	Sand
D	West bank	1200 m downstream	400	(Sand)	> 4.5 m depth
D	East bank	1200 m downstream	0 – 6	Fines / Cobble	Cobble / gravel
D	East bank	1200 m downstream	100	(Sand)	> 4.5 m depth
D	East bank	1200 m downstream	400	(Sand)	Sand
C	West bank	1600 m downstream	100	Sand	Sand
C	West bank	1600 m downstream	400	Sand (island bank)	> 4.5 m depth
C	East bank	1600 m downstream	0 – 6	Fines / Cobble	Cobble / gravel
C	East bank	1600 m downstream	200	(Sand)	Sand
C	East bank	1600 m downstream	400	Sand	Sand
B	West bank	2000 m downstream	50	Sand	Sand
B	West bank	2000 m downstream	300	Sand (island bank)	> 4.5 m depth
B	East bank	2000 m downstream	0 – 6	Fines / Cobble	Cobble / gravel
B	East bank	2000 m downstream	200	(Sand)	Sand
B	East bank	2000 m downstream	500	(Sand)	Sand
A	West bank	2400 m downstream	50	Sand	Sand
A	West bank	2400 m downstream	300	Sand (island bank)	> 4.5 m depth
A	East bank	2400 m downstream	0 – 6	Fines	Sand
A	East bank	2400 m downstream	400	(Sand)	Sand
A	East bank	2400 m downstream	700	(Sand)	Sand

17.3.6.1 Sediment contaminant analysis

The initial screening for contamination was designed to determine if the sediments contain contaminants in forms and concentrations that are likely to cause unacceptable impacts to the environment, primary during the construction stage when excavation for bridge pier replacement would occur. During the screening procedure, specific contaminants of concern were identified based on available information, so that subsequent evaluation was focused on the most pertinent contaminants. Contaminants associated with bleached pulp mill effluents were determined to be of most concern in the Peace River. The principal contaminants in bleached pulp mill effluents include:

- Organochlorine compounds such as chlorinated dimethylsulphones, chlorinated aromatics including dioxins and furans, chlorophenolics, chlorinated terpenes and in some cases, poly chlorinated byphenols (PCBs),
- Natural plant extracts such as terpenes, resin and fatty acids, phenolics and substituted benzene compounds,
- Poly aromatic hydrocarbons (PAHs), and
- Certain trace metals, such as zinc, aluminium and manganese.

Sediment toxicity studies found that most of the physiological responses observed in fish downstream from pulp mills in 1992 were not evident by the end of the study in 1995. This was attributed to the apparent improvements in process modifications that occurred at the mills during the study. It is assumed that baseline concentrations of these compounds have not significantly changed over the last 10 years. In fact concentrations have likely decreased from those found in the early 1990's.

Polychlorinated dibenzodioxins (PCDD) and dibenzofurans (PCDF)

These organo-chlorine compounds are found at parts per trillion concentrations within the air, soil, sediment and biota in almost all geographic locations.

Analysis of the dioxin, furans and chlorophenolics was not included in the present analytical program. Of the 25-dioxin and furan congeners tested for in the Peace River sediment below the Vermillion Chutes (MCL 1991), only hexachloro and octachloro dibenzo-p-dioxin were detected at 0.4 and 1.5 pg/g, respectively. The study also found PCDD/F compounds in the suspended sediment at concentrations ranging from 0.2 – 12 pg/g. In 1994 the sediments of Peace River downstream from Fort Vermillion, were tested for various PCDD/F congeners. Sediment concentrations of various congeners ranged from <0.3 to 6.4 pg/g, which equated to a 2,3,7,8 – TCDD toxic equivalent of 0.23 pg/g. The CCME (2001) have adopted an interim sediment quality guideline (SQG) for the 2,3,7,8 – TCDD toxic equivalent of 0.85 pg/g-dry weight.

Chlorinated phenolics

The baseline study reported on the concentration of chlorinated phenolics in the bed and suspended sediments within the Peace River. At the station downstream of Vermillion Chutes, trichlorophenol was found at 0.3 ng/g, pentachlorophenol at 2 ng/g, and trichloroguaiacol at 0.6 ng/g. At the confluence of the Wabasca River, the suspended sediments contained tricholorophenol, tetrachloroguaicol and trichloroguaiacol ranging between 2 and 12 ng/g. Bed sediment concentrations of the chlorinated phenolics downstream of Fort Vermillion have been found between 0.6 and 11 ng/g.

PCDD/Fs were excluded from this analytical program because there are no guidelines or benchmarks on which to base an assessment.

Laboratory analytical analysis
A total of six sediment samples was collected along the proposed bridge location. Other that Site 01, all samples were considered to be well-sorted sands. Site 01 contained finer clay fractions.

There were no extractable organic chlorine of detectable PCBs in any of the sediments samples analyzed. Only a single sediment sample (Site 01) contained any detectable concentration of select PAHs. Methylated naphthalene and phenanthrene were present at approximately 20 ppb. Three heavier molecular weight PAHs were detected at trace (7 ppb) concentrations. None of these concentrations pf PAHs in Site 01 sediment exceeded the CCME freshwater sediment quality guidelines. The trace metal concentrations within these sediments appear unaffected by anthropogenic sources. The fine sediment sample (Site 01) contains marginally higher concentrations of most elements and an arsenic concentration, which matched the CCME ISQG criterion. Nevertheless, this concentration falls within the range of the other samples and does not imply anthropogenic impacts. Traces of myristic, palmitic and stearic acids are present in all sediment samples. In addition to the three fatty acids listed above, the fines sediments (Site 01) also contains traces of three other fatty acids and a single resin acid. Detectable concentrations range from 5.3 ppm to 0.07 ppm.

17.3.7 Water quality

Peatlands cover large portions of the northern part of the Peace River basin, in particular the Buffalo Head Hills, Birch Mountains and Caribou Mountains. Drainage from peatlands may affect the water quality of many northern tributaries, in particular the Mikkwa and Wentzel rivers.

Water quality parameters were sampled in the study reach during the September – October field survey. At the time of the survey, flows were at an 80% high flow and were considered representative of water quality characteristics during the high flow stages. Water temperatures ranged from 7.6 to 8.4 ^{o}C . Water clarity was very low with a mean Secchi disk depth of 0.12 m. Conductivity of the study reach ranged from 227 to 232 µomhs/cm. Dissolved oxygen levels ranged from 10.85 to 11.18 mg/L.

Water temperature in the Peace River ranged from 12 to 19 ^{o}C in the August 1988 survey, from 1 to 12 ^{o}C in October 1988, and from 16 to 19 ^{o}C in June 1989. Shaw et.al (1990) reported that the warmest water temperatures in the Peace River upstream of Wood Buffalo National Park occurred in August, where the temperature was 18.3°C. Water temperatures in the Mikkwa River in August reached up to 18.5°C and in the Wentzel River in July up to 17.4 °C. The Pouce Coupe River was considerably warmer in July reaching 23.5°C.

During the spring and fall of 1988, water temperatures in the Peace River near Peace Point were lower than near the BC – Alberta border. However, in the summer months the pattern was reversed as temperatures at Peace Point were as much as 5 °C warmer than at the border, as a result of:

- outflow of cool, hypolimnetic water from Williston Reservoir,
- warming of the mainstrem river water as it flowed across Alberta, and
- mixing of relatively warm tributary water with the mainstem.

17.3.7.1 Suspended solids and turbidity

Turbidity is positively correlated to discharge. Both the actual and flow adjusted values were highest in summer and lowest in winter, following the same pattern as for suspended solid concentrations. In 1988 – 1989, average turbidity values increased substantially along the length of the river from about 55 NTU near the B.C. – Alberta border to 300 NTU near Peace Point.

As in most rivers, suspended solids concentrations in the Peace River mainstem increased significantly with discharge. The Peace River has a large watershed area, and high annual discharge, and it carries vast amounts of sediments. Both the actual and flow adjusted suspended solid concentrations in the Peace River follow a strong seasonal pattern. In 1988 – 1989 average concentration of suspended solids in the mainstem increased gradually from 41 mg/L at the B.C. – Alberta border to 408 mg/L at peace Point. The increase in suspended solids concentrations along the mainstream was largely a result of a change in the channel geomorphology. In the upper reaches of the river, the channel bed is predominantly sand and gravel and the channel bank is primarily gravel, whereas in the lower reaches of the river the channel bed is predominantly sand and bank consists of silt, sand and gravel. The finer-grained sand and silt particles are more easily eroded and transported in the river than gravel. Subsequently, suspended solids concentrations increase along the mainstem.

Nine TSS samples were collected in September 2004 from the proposed bridge location. Water quality parameters for turbidity and total suspended solids were analyzed by AMEC's laboratory and the results are presented in Table 17.7

Table 17.7 Water quality – Turbidity and total suspended solids (TSS)

Date of collection	Analytical parameter	Units	Reference method[1]	Site 1 – 1000 m Upstream			Site 2 – At bridge			Site 3 – 1500 m downstream		
				LDB	MDL	RDB	LDB	MDL	RDB	LDB	MDL	RDB

2004-09-30	Turbidity	NTU	2130-b	540	640	640	600	557	630	660	650	650
2004-09-30	TSS	Mg/L	2540-d	545	792	728	653	640	367	643	582	745

where LDB = approximately 250 m from left downstream bank (west bank); MDL = approximately centre of channel; and RDB = approximately 250 m from right downstream bank (east bank)
[1] APHA Standard Method for the Examination of water and Wastewater1998

17.3.7.2 Dissolved oxygen and biological oxygen demand

Long-term (1977 – 1988) trends in dissolved oxygen (DO) concentrations for the Peace River at Dunvegan have been . DO has increased slightly (from 11.9 to 12.2 mg/L; by approximately 0.07 mg/L/y) since 1977 and this trend has been attributed to changes in water quality of the Williston Reservoir in B.C.. As part of a 1988 to 1990 study of water quality of the Peace River within Alberta, DO, BOD5 and sicharge were measured at ten sites along the mainstem in February and March 1989. DO concentrations in the Peace River were found to decrease from 13.7 mg/L at the B.C. – Alberta border to 12.5 mg/L at Peace Point.

Dissolved oxygen levels in the Peace River mainstream were independent of the discharge and were highest in winter and lowest in summer, reflecting a greater solubility of oxygen with lower water temperatures. In the Peace River, DO concentrations remain at or near saturation levels throughout the year. Dissolved oxygen deletion during the winter is minimal because:

- BOD concentrations are low
- the water column is saturated with oxygen as it enters Alberta
- re-aeration likely occurs at the Vermillion Chutes, and
- the reach from the B.C. border to the town of Peace River remains ice-free for much of the year.

17.4 Aquatic Resources

17.4.1 Benthic invertebrates

Invertebrates populations densities in the Peace River were found to be low (400 specimens per sample in the upper Peace River to less than 50 specimen per sample at Wood Buffalo National Park) compared to those reported in more productive rivers in southern Alberta (usually greater than 1000 specimens per sample in the North Saskatchewan River.

17.4.2 Fish species and general status

The Peace River Basin supports 29 fish species including 12 commercial / sport species. The upper Peace River (from Alberta border to Smoky River confluence) contained the greatest diversity of fish species and represented a transitional zone between cold and coolwater habitats. The middle (from Smoky River confluence to Vermillion Chutes) and lower section (from Vermillion Rapids to Peace Point, and Peace Point to Peace – Athabasca Delta) supported the greatest species richness.

17.4.3 Relationship between physical habitat and aquatic resources

Fish abundance is greatest along the riverbanks and fish distribution is based on bankside habitat, with a general lack of mainstem mid-channel use by fish in the Peace River. In general, fish concentrated in similar habitat in the summer and fall, similar to those in the spring depending upon individual life-history requirements.

17.4.4 Fish habitat evaluation

The behaviour of the fine sand as it enters the water column is of interest in determining the relative location and distance to which the sediment travel. Therefore the sediment transport modelling was designed to determine the settling character of fine sand at two discharge points in the river. The modelling determined that the fine sand would settle out within 1700 m of the location where the material is released into the water column.

17.4.4.1 Spawning

In the lower reaches of the river, from Carcajou to Peace Point, the channel bed is predominantly sand with gravel over easily erodible shales and the channel banks consist of silt, sand and localized gravel. In the study reach, sand bars are a normal feature that are transient, accreting and eroding in response to annual flood discharges. Fine texture sediments are dominant bed material in the study reach. Gravels and cobbles were recorded in the nerarshore zone along the east bank, however, siltation levels were high.

17.4.4.2 Rearing

The definition of rearing habitat as used in most studies of the Peace River, is habitat utilized by young-of-the-year (y-o-y) and juveniles. Sandy channel bed materials and extensive sand bars with low gradient slopes (1 – 6%) provide little structure and instream cover for fish in the study reach. The amount of instream cover was very low, with few pools and sparsely distributed large woody debris providing instream velocity breaks along the west river bank. Overhead cover is predominantly provided by turbidity and depth of water. As a result, rearing habitat would be largely associated with bankside habitat, with a general lack of mainstem mid-channel use by fish.

17.4.4.3 Over wintering

Critical overwintering areas in the Peace River are deep water pools having a depth greater than 7 m. mainstream areas greater than 5 m may provide suitable overwintering habitats. Deep water sites greater than 5.0 m depth are relatively numerous in the Peace River and are distributed throughout the system, which suggests deepwater overwintering refuges are not severely limiting.

In the Peace River mainstream, available evidence indicated that the middle reaches were used for overwintering. Overwintering populations of sportfish have been reported upstream of Vermillion Chutes and downstream of Peace Point. The Peace – Athabasca delta in the lower Peace River has been described as an important overwintering area for sportfish.

17.5 Effects Assessment

The following section addresses the potential environmental effects of the development of the Peace River bridge crossing based on the conceptual bridge design. This design includes the construction of 10 instream piers at 100 m spacing. This conceptual bridge design presents a conservative project footprint and options to remove piers should be pursued as design alternatives during detailed design.

17.5.1 Soils

Construction activities will involve surface removal of soil from the bridge approaches, salvage of topsoil for use in ditches and borrow areas, stockpiling of topsoil, and removal of topsoil material. Soil quality may be impacted through degradation of the soil physical and chemical properties as a consequence of disturbance, handling and storage. Specific impacts of development on soil quality, quantity, and associated landscape capability may include:

- Admixing which may result in loss of soil profile, integrity, dilution of organic matter, and reduction of nutrient status, as well as in possibly increasing water holding capacity and improving soil texture (sandy soils),
- Compaction, which degrades soil structure and increases bulk density, and thereby reduces permeability, aeration, and water holding capacity
- Erosion (wind and water), which results in loss of soil volume and reduction in nutrient status, and
- Contamination by spills and leaks

17.5.1.1 Construction Stage Effects

Both the east and west bridge approaches will be situated within the previously cleared R-O-W and staging area which are characterized by existing soil and vegetation degradation due to human activities. Additional clearing and grading for the development of bridge approaches is anticipated to be minimal. Exposed soils resulting from clearing and grading will potentially be subject to surface erosion or insufficient drainage, particularly in areas that are steeply sloping or where seepage water may be concentrated. The implementation of standard and project specific erosion and sediment control measures, and reclamation of these disturbed areas, will be required.

The greatest concern during construction is the potential damage to the aquatic environment that could result from a major spill of fuel or other hazardous substances, and possible human health concerns related to consumption of contaminated water or fish. Contingency planning can substantially reduce these risks, but a major spill at the Peace River can have a significant impact in the immediate spill area as well as downstream receiving waters.

17.5.1.2 Operation Stage Effects

The key operational issue for the bridge approaches is erosion of exposed soils, and their deposition onto undisturbed soils and vegetation. Use of appropriate erosion and sediment control structures will reduce the impact of eroded soils on adjacent undisturbed areas. Reclamation and monitoring will be required to identify areas where additional remedial measures may be required. Operational impacts can be minimized with the implementation of appropriate reclamation of disturbed areas and maintenance of permanent erosion and sediment control measures.

17.5.1.3 Mitigation

The RAs propose the following mitigation measures:

- Erosion of soils during approach construction and operation must be prevented in order to limit the amount of soil lost during construction and transported to the river. Both temporary (i.e., during construction and vegetation establishment) and permanent erosion and sediment control measures, following Alberta Transportation (2003) guidelines, will be utilized to reduce soil loss.
- Construction activities will be scheduled to avoid periods of rapidly changing weather, including heavy rains or rapid snowmelt, which could lead to surface runoff and soil erosion.
- Temporary and permanent erosion control measures such as construction phasing (e.g., clearing and grading small sections at once), surface roughening (e.g., leaving soil in rough-grading state as long as possible) and soil stabilization (e.g., sprinkling of water in dry conditions, permanent erosion control blankets, vegetation establishment) will reduce the amount of eroded soil.
- If topsoil stockpiles are to be in place for a long period, stabilization with vegetation cover, and management of surface run-off (snow melt, rainfall) will reduce the potential risk of water erosion. Erosion control materials (mats, netting, mulches, straw) can be used to reduce soil surface exposure, in addition to re-vegetation of stockpile surfaces. The incorporation of organic material (forest duff or peat) into coarse-textured (sandy) soils or those deficient in organic matter at the time of salvage, can assist in preventing wind erosion, and will improve water holding capacity.
- Compaction will be carried out at the bridge approaches to minimize erosion. Development and implementation of an erosion and sedimentation control plan is recommended.
- A spill prevention and response plan must be designed and implemented to prevent contamination of any soil system, including soil stored for later use, and in the event of accidental contamination, to immediately respond and mitigate the contamination.

17.5.1.4 Residual Effects

Residual effects due to construction on native soils in terms of loss of soil cover are anticipated to be negative in direction, low in magnitude, local in extent, long-term in duration and low in reversibility.

The residual effects during operation are considered to be negative in direction, low in magnitude, local in extent, short-term in duration, and high in reversibility.

17.5.1.5 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude the effects of the bridge on soils during construction and operation are not likely to cause significant adverse effects.

17.5.2 Vegetation

Bridge construction has the potential to affect vegetation in the local study area in a number of ways, including the loss of species or communities, change in vegetation quality due to pollutants and increased ecotone or "edge" habitat, and invasion of non-native plants.

Permanent facilities of the bridge structure will replace native habitats, resulting in the loss of native vegetation species and communities. There is also the potential for the bridge to alter natural drainage patterns, thereby affecting species distribution and community composition in adjacent areas.

Construction activities will result in the clearing of vegetation, affecting the distribution and abundance of vegetation species and communities, and causing habitat alteration. Vegetation clearing will create an edge effect, which is a relative increase in mean light levels, air and soil temperatures, vapor pressure deficits, wind speeds and lower relative humidity and soil moisture.

Vegetation communities surrounding the proposed bridge will most likely be exposed to dust, exhaust emissions, and potentially be affected by accidental spills and contaminated runoff from construction equipment. Other deleterious substances such as road salts, herbicides and pesticides used during maintenance may also come into contact with vegetation in the vicinity. These pollutants may adversely affect the vegetation by reducing plant growth and vigor, particularly for sensitive plant species.

17.5.2.1 Construction Stage Impacts

Both the east and west bridge approaches will be situated within previously cleared R-O-W and additional vegetation loss is anticipated to be minimal. Widening of the current approaches will affect native habitats to some extent, resulting in the loss of native vegetation species and communities. There is also the potential for the R-O-W to alter natural drainage patterns, thereby affecting species distribution and community composition in adjacent areas. Corresponding soil erosion and sedimentation in aquatic ecosystems due to bridge construction and operation may have an adverse effect on water quality.

No species at risk have been identified. As a result, potential adverse effects on provincially listed species and federally listed species protected under the *Species at Risk Act* (SARA), or their critical habitats is not anticipated to be an issue.

Edge habitat that is created during construction creates habitat for the colonization of non-native plants whose seeds have been transported by wind, water, wildlife or human-related activity. These non-native plants may then be able to move into adjacent areas, potentially disrupting the functioning of the native ecosystem.

17.5.2.2 Operation Stage Effects

Pollutants from vehicle and maintenance equipment emissions on and near the bridge approaches are expected to have a small effect on vegetation, as they will dissipate quickly. The likelihood of a substantial spill large enough to cause a substantial effect is considered low.

There is a relatively high potential for introducing invasive weeds and non-native vegetation during operation and maintenance, thereby disturbing native vegetation communities.

17.5.2.3 Mitigation

The RA's propose the following mitigation measures:

- The removal of native vegetation should be minimized where possible by limiting the clearing to the required approach widths. Soil conservation and the salvage of existing native plant materials and topsoil is a priority. The topsoil layer (leaf litter, topsoil and upper subsoil) will be removed and stockpiled for site reclamation (side slopes, ditch bottoms, back slopes, construction staging areas, and any other disturbed areas).
- Vegetation salvage will be conducted prior to clearing, and where possible, native forbs, shrubs and trees will be salvaged and transferred to a temporary nursery. This stock material will be used later to reclaim native vegetation and wildlife habitat.
- Reclamation of disturbed areas should be incorporated into the project development. The reclamation will include regrading, placement of native topsoil salvaged, and plantings of native grass seed, shrubs and trees.
- All construction and maintenance equipment will be cleaned prior to moving from one working area to another to ensure it is free of weeds and other foreign material.
- All construction traffic will be confined to the bridge RoW, existing access roads and approved staging areas.
- All seed used during reclamation will consist of native plant species. All equipment used for seeding will be cleaned prior to use to ensure it is free of weeds.

- Weed control methods should also be implemented during the construction, reclamation and maintenance phases of the project in areas where weed problems are identified. The use of herbicides should not be employed within 100 m of the river.

17.5.2.4 Residual Effects

Residual impacts due to construction to native vegetation resulting from the construction of bridge approaches is anticipated to be negative in direction, low in magnitude, local in extent, short-term in duration and low in reversibility.

The residual effects due to operations are considered to be negative in direction, low in magnitude, local in extent, long-term in duration, and moderate in reversibility.

The effect of pollutants on vegetation during bridge approach operation is considered negative in direction, low in magnitude, local in extent, long-term in duration, low in probability, and high in reversibility.

17.5.2.5 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude the effects of the bridge on vegetation during construction and operation are not likely to cause significant adverse effects.

17.5.3 Wildlife

17.5.3.1 Construction Stage Effects

Clearing of forest and shrub vegetation during the bird-breeding season may directly and indirectly affect the success of breeding birds. Vegetation removal may destroy nests and construction noise can disturb breeding birds and nesting activities.

A change in wildlife movement patterns may occur due to construction related disturbance. Noise associated with the operation of equipment is anticipated to cause short-term disturbance to wildlife.

The bridge development will result in direct habitat losses, which will change the availability and quality of wildlife habitat in the vicinity of the project. Impacts will vary depending on species, mobility, home range size, and sensitivity to edge habitats. Habitat alterations can also occur as a result of changes in soil water content, soil temperature, soil density, surface drainage patterns, light levels, and contaminant levels (e.g. dust and air emissions) along the forest-edge interface. These changes, in turn, may affect the composition, growth and vegetative species adjacent to the bridge corridor.

Habitat fragmentation occurs as a direct result of forest clearing and, similar to habitat loss, is considered a serious threat to biological diversity. Fragmentation can potentially alter the diversity of species in a landscape, and ultimately (depending on the extent of fragmentation) result in the population decline of sensitive wildlife species.

Disturbance from construction, operation and other human activities can result in habitat avoidance and a decline in wildlife abundance near the bridge, and disruption to wildlife movement along the river corridor.

17.5.3.2 Operation Stage Effects

Road avoidance may reduce the availability of habitat for some distance from the road, potentially affecting wildlife habitat suitability. Ensuing traffic flow disturbs the area adjacent to the road, causing quantitative and qualitative changes to the area that influences a variety of population variables (i.e., noise, edge effect). Road density is one key predictive variable that can be used to estimate the effects of disturbance and fragmentation, as road density increases, road avoidance by wildlife results in less habitat being suitable. In the case of the current project, closing and/or removal of the existing winter roads (i.e., Wentzel River from Hwy 58, and along the west bank of the Peace River from Jon D'or Prairie) will result through the development of the Fox Lake Access road and permanent river crossing. This inadvertent benefit of the of the project is the most effective solution in mitigating factors associated with dissection of forested habitats by a road network and degraded wildlife habitat. Nevertheless, the residual impact on wildlife is predicted to be negative in direction, moderate in magnitude, regional in extent, long-term in duration, and low in reversibility.

When roads or other infrastructure cross a wildlife corridor, such as the riparian corridor along the Peace River, it is essential to maintain the effectiveness of the corridor. The low relief terrain along the west side of the Peace River lacks significant topographical variability, and wildlife movement would occur within the continuous upland interior habitat which provides numerous alternate routes for wildlife. As such, there is a high potential for success in movement through the area. Movement along the east side of the river is generally limited to the riparian corridor "bottleneck" along the river. Accommodating wildlife passage under the bridge structure along the east bank of the Peace River is recommended. By incorporating wildlife passage under the proposed bridge structure along the east bank of the river channel, residual impacts to wildlife movement across adjacent habitats is anticipated to be negative in direction, moderate in magnitude, regional in extent, long-term in duration, and low in reversibility.

Incidences of mortality due to collisions with vehicles and increased hunting/poaching can occur throughout the R-O-W. Although moose and deer are known to travel through the area, collision rates along the road corridor and at the bridge crossing are expected to be low. Implementing measures to deter wildlife from approaching the roadway can reduce the potential impacts.

Effects to wildlife movement may develop as a result of the structure creating a physical barrier along the river corridor.

17.5.3.3 Habitat Loss

For the current project, the reclamation of disturbed areas not occupied by permanent bridge facilities will promote natural regrowth, thereby limiting residual losses to wildlife habitat in the local study area.

17.5.3.4 Habitat Fragmentation

Fragmentation occurs when large contiguous blocks of habitat are dissected into smaller, more isolated patches of habitat. Smaller patches of habitat have larger edge-to-interior ratios and depending on patch size, are considered lower quality for forest interior specialists (e.g., warblers). Some wildlife species, (e.g., habitat generalists and edge species) can thrive in highly fragmented habitats.

17.5.3.5 Road Disturbance and Wildlife Movement

High traffic volume reduces the density of woodland songbirds near roads. Bird species such as waterfowl and shorebirds may also be affected by operational disturbances, particularly in sensitive areas such as the river that provide a high degree of ecotonal or edge habitat. Ensuing traffic lowers the suitability for wildlife in these habitats by causing quantitative and qualitative changes that influence a variety of population variables (e.g., noise, edge effect). Noise in particular degrades habitat, especially for avian communities.

The Peace River valley serves as a travel corridor for wildlife within the region; the project falls within an area of nearly continuous habitat, in which upland habitat also serves as a travel corridor.

17.5.3.6 Mitigation

- Construction timing and/or field verification of the presence/absence of nesting birds is the most appropriate measure to minimize potential adverse impacts to breeding birds. As such, site inspection by a qualified wildlife biologist will be undertaken from April 15 to July 31 prior to vegetation removal to determine the presence/absence of nesting birds and to identify mitigation measures, where appropriate.
- Planting of less palatable plant species should be implemented to dissuade wildlife grazing in close proximity to the roadway.
- Roadway salts may attract wildlife. This can be controlled by improving drainage and waterproofing roadway shoulders where salt is likely to accumulate in the soil. Establishment of artificial salt sources distal from the roadway as counter attractants may also be considered.
- Accommodating wildlife passage underneath the proposed bridge structure along the east bank to facilitate wildlife movement across the linear riparian corridor between the river channel and upland community of Fox Lake.

17.5.3.7 Residual Effects
Residual effects due to construction are expected to be negative to neutral in direction, low in magnitude, local in extent, short-term in duration, and high in reversibility.

Residual effects from operations is rated as negative in direction, low in magnitude, local to regional in extent, long-term in duration, and low to moderate in reversibility.

16.5.3.5 Significance Prediction
Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude the effects of the bridge on wildlife during construction and operation are not likely to cause significant adverse effects.

17.5.4 Water Quality

17.5.4.1 Construction Stage Effects
Excavation, transport and discharge of sediment of bed material are the primary sources of water quality impacts that may occur during construction. The environmental effects normally associated with the disturbance of bed sediments and discharge of sediments are increases in turbidity, re-suspension of contaminated sediments and dissolved oxygen decreases.

17.5.4.2 Turbidity and Suspended Sediment
The potential impacts during the construction phase are primarily associated with releases of deleterious substances (i.e., sediment, hydrocarbons), which can occur if appropriate construction and reclamation techniques are not implemented. The bridge construction will require extensive instream construction activities. Effluent from the dewatering of the proposed construction site (i.e., dewatering of isolation berms), and the introduction of suspended sediments to the river upon placement and removal of berm materials, are the main environmental issues.

Excavation and removal of bottom sediments during construction of bridge piers and abutments could result in the discharge of sediment and consequently an increase in suspended material and turbidity. When particles remain in the water column water transparency is reduced. There can be exceptions to the latter situation, especially in the Peace River, where the suspended sediment levels are naturally high during high flow stages. Any silt that enters the water column as a result of construction activity will become part of the wash load of the channel, and would be carried downstream in suspension. On the other hand, sand will be transported short distances and will settle out of the water column onto the channel bed.

17.5.4.3 Dissolved Oxygen
Dissolved oxygen (DO) reduction in the water column around an excavation and sediment discharge point is a direct consequence of the suspension of anoxic sediment material (i.e., silt, clays and organics).

Processes associated with DO reduction suggested that DO demand is a function of the amount of suspended sediment being placed in the water column, the oxygen demand of the sediment, and duration of resuspension. Particle size analysis of bed material in the present study indicated that sediments have a low composition of silt and organic materials.

Available information on DO depletion around instream excavation and sediment discharge operations suggests that, given low levels of suspended materials generated by operations, and considering factors such as flushing by local currents, DO depletion around these operations should be minimal.

Sensitivity of fish to low concentrations of dissolved oxygen differs between species, between life stages (eggs, larvae, adults), and between the different life processes (feeding, growth and reproduction), and may also depend on swimming ability and specialized behavior). CCME (1999) and ASWQO (AENV 2000) guidelines for surface water suggest that a minimum of 5 mg/L would be satisfactory for most of the processes required in a successful fish life cycle, though it may be unnecessarily high merely to ensure satisfactory survival of fish and growth of juveniles. Consequently, fluctuations about 5 mg/L or any reduction below 5 mg/L could have a greater effect on some processes than on others.

17.5.4.4 Contaminants

Disturbance to bed sediment and suspension of sediment can result in the injection of interstitial fluids into the water column and release of nutrients, metals, and oxygen consuming organic matter. The release of toxins into the water column from sediment disturbance is a particular concern as the sediments can be contaminated with metals (such as mercury, cadmium, arsenic, chromium, copper and lead), petroleum, hydrocarbons, pesticides, PCBs, and a variety of synthetic compounds associated with industrial activities. There is strong evidence that these contaminants can enter and modify the food chain.

17.5.4.5 Operation Stage Effects

Operational issues include the introduction of sediment associated with roadway storm water drainage from upland areas into the Peace River, and bridge drainage of untreated wastewater from the bridge deck. Implementation of appropriate storm water management facilities (i.e., drainage diversion to wide gully along west bank), and stabilization and re-vegetation of bridge approach slopes will reduce the potential for surface erosion and instream sedimentation.

17.5.4.6 Mitigation

Due to similarities in water quality and aquatic resources impacts, mitigation measures for minimizing adverse effects to water quality are presented in Section 9.3.2.

17.5.4.8 Residual Effects

With the implementation of Best management Practices in accordance with all established provincial and federal regulations, guidelines and policies, water quality residual effects due to construction and operation at the bridge crossing site are expected to be negative in direction, low in magnitude, local in extent, short-term in duration, and high in reversibility.

17.5.4.8 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude the effects of the bridge on wildlife during construction and operation are not likely to cause significant adverse effects.

17.5.5 Aquatic Resources

17.5.5.1 Construction and Operation Stage Effects

The potential effects of the construction and operation of the Peace River bridge crossing on the fish community and fish habitat in the Peace River will be primarily due to changes in:

- Sediment discharge and deposition;
- Water Quality (inadvertent release of deleterious substances);
- Migration blockage;
- Aquatic Habitat area and structure; and
- Channel morphology.

The magnitude of these changes and potential impacts will be largely dictated by the selection and implementation of the bridge design, construction staging and techniques, and environmental management practices employed during construction. The source of these impacts, their significance and mitigation opportunities are discussed in the following sections.

17.5.5.2 Sedimentation

In the Peace River, construction associated with the Peace River Bridge Crossing has the potential to elevate suspended sediment loads and increase sediment deposition in downstream areas. These downstream habitats include rearing habitats and possibly overwintering refuges identified within the zone of impact. Increased sediment loading could result from:

- Erosion and surface water runoff from removal of vegetative cover and regrading during site preparation and access road construction;
- Installation of berms and disturbance of river substrates;
- Removal of berms; and
- Bed erosion (scour) and sediment transport within the channel.

The magnitude of physiological responses is dependent on the background levels of suspended solids and water quality parameters, concentration of sediment release, duration of exposure and physical properties of the sediment particles. Low concentrations or short exposure periods generally result in minor physiological changes that revert to normal conditions once the sediment concentration returns to background levels. The impact of exposure to higher concentrations or longer exposure periods is a greater severity of change. In the extreme case this can lead to fish death.

Elevated suspended loads and increased sediment deposition in downstream areas could result of fish habitat, thus contravening the federal *Fisheries Act*, and exceeding federal and provincial water quality guidelines. The effects of introduced sediment on fish are many, ranging from direct mortality (in extreme cases) to various sub-lethal effects including: habitat avoidance, reduced feeding and growth, respiratory impairment, and reduced tolerance to disease. In the vicinity of the bridge crossing, natural turbidity levels are seasonally very high, and most species have a relatively high tolerance of elevated suspended sediment levels. However, overwintering fish may have a relatively low tolerance to suspended sediment.

In addition to sediments, other deleterious substances such as hydrocarbons used for equipment operation and maintenance, substances used for road maintenance (road salts, herbicides and pesticides), and chemicals and debris from construction or maintenance (paint, sandblasting residue) may cause direct egg or fish mortality, negatively affect fish health and development, or reduce food availability.

For the proposed project, the risk associated the inadvertent release of contaminants (e.g., hydrocarbons) is largely related to construction machinery operating in and adjacent to the river. Depending on the quantity and type of released substance, the effects may be deleterious to aquatic biota at the construction site and in downstream areas. Seepage waters, pumped from within the berm during construction activities, could be contaminated or high in suspended sediment concentrations. Post-construction spill potential and introduction via stormwater drainage from the roadway also exists.

17.5.5.3 Migration Blockage

Construction activities could temporarily interfere with fish migrations. Potential spawning habitats for spring spawning fish are present in the upper reaches of the mainstem and on larger tributaries. Available evidence indicates that the middle reaches of the Peace are used for overwintering (upstream of Vermillion Chutes and downstream of Peace Point), which suggests fall migrations may occur through the crossing location. Obstructions that prevent the normal migration of spring spawners such as goldeye, walleye, and northern pike during the months of April and May, and burbot from November to May, could have adverse impacts on their spawning success. Similarly, fish moving through the bridge site in late summer and fall periods (August to October) to overwintering refuges could be affected by changes in flow conditions.

When in position, the berms could constrict the channel width by up to 60 %, and hydraulic conditions (flow velocities and patterns) will change. An assessment of flow patterns and velocity fields must be conducted to evaluate mid-stream velocities at the crossing to determine if migratory fish could experience delays if attempting passage immediately along the face of the berm. The potential for blockage of fish movements is dependent upon the timing of operation of the berms. Not withstanding, migratory fish could experience delays if attempting passage immediately along the face of the berm. A large backwater will be formed below the berm and may tend to concentrate fish that are unable to move through the high velocities along the structure. Some weaker swimming fish species (i.e., burbot, northern pike) may have difficulty passing the berm during all but the lowest flow conditions. Most adult fish individuals (> 300 mm) which are encountered in the Peace River fish community are capable of maintaining speeds of 0.6 to 0.9 m/s for prolonged periods, except for northern pike and burbot, which exhibit critical velocities of less than 0.5 m/s regardless of fish length (Jones et al. 1974).

17.5.5.4 Aquatic Habitat Alterations

Fish habitat in the immediate construction zone will be lost or altered primarily as a result of:

1. Construction of berms or cofferdams.
2. Bridge footings and piers.
3. Bank protection structures.

The placement of instream piers will result in the permanent loss of habitat from the pier footprint areas and habitat alteration from changes in flow velocities around the piers. Stream channel, streambed, and stream bank disturbance as a result of berm and/or cofferdam construction associated with the installation of the bridge piers will result in localized instream and riparian habitat alterations and temporary loss of this habitat. No guidebanks or bank protection structures are proposed under the current conceptual design, therefore no permanent alteration of riparian habitat and near-shore instream habitat is anticipated at this time. The potential effects based on the conceptual bridge design are discussed below:

Bridge piers: the bridge design indicates the construction of 10 – 21.3 m x 5.8 m instream piers set on 24 m x 18.2 m buried footings. The total permanent loss due to the piers will be approximately 494 m^2 of deep run/pool habitat (4 piers in the channel thalweg along the west bank) and 740 m^2 of shallow run habitat.

Berms and cofferdams: Bridge pier construction will be done in the dry, inside a berm, and no instream activity (other than the presence of the berm) will occur during most of the construction period. Berm construction will temporarily affect predominantly shallow run habitat, although deeper run/pool habitat along the west bank will also be affected. Banks along the east bank are generally repose or low relief and gently sloping. The west bank consists of steep erosional banks ranging in height from 3.5 m to 5.5 m.

17.5.5.5 Changes in Channel Morphology

Changes in flow velocities and direction can cause both local and large scale effects. Locally, bed materials can change, with finer particles deposited in areas with low velocity and removed in areas with higher velocities. Velocity increases can cause downstream scouring of the channel bottom and erosion of the banks. The magnitude of these effects is reflected in the degree of change in flow patterns and channel morphology. Several effects on channel morphology resulting form the installation of the bridge include:

- Debris accumulation and blockage;
- Confinement of flows;
- Upstream backwater effects altering channel morphology;
- Downstream scour and erosion altering channel morphology; and
- Changes in channel shape and cross section.

17.5.5.6 Mitigation

Instream Timing Constraints protect fish and fish habitat during critical life periods, instream work windows are provided by the Alberta *Code of Practice for Watercourse Crossings*. According to this guideline, unless otherwise authorized under section 10 of the Code, the Restricted Activity Period for the Peace River is 16 April – 15 July. It may be possible to stage construction in a manner that all construction activities would occur within the recommended instream work window of 16 July – April 15. Construction outside of this work window will require a permit from Alberta Environment and a *Fisheries Act* Authorization from Fisheries and Oceans Canada.

17.5.5.7 Sediment Discharge and Deposition

The deposition of deleterious substances will not be authorized by DFO, and their deposit would be a contravention of the general prohibition under section 36 (3) of the Fisheries Act. As such, the project must demonstrate that all reasonable measures to prevent the deposit of deleterious substances have been exercised. The implementation of mitigation measures would be based on the Best Practicable Technology (BPT) and Best Management Practices (BMP), which would be expected to address exercising all due diligence to prevent the commission of the offence pursuant to Section 36 (3) of the Fisheries Act.

Best Management Practices (BMP) should be used for all construction and maintenance activities in and around the river to prevent HADD. Typical BMP's are outlined in Alberta Environment's *Guide to the Code of Practice for Watercourse Crossings* (AENV 2000a) and the *Fish Habitat Manual: Guidelines & Procedures for Watercourse Crossings in Alberta* (AT 2002).

A water quality monitoring program is recommended during placement and removal of berms in the river. TSS concentrations recorded immediately downstream of work site will be employed as the benchmark for identifying exceedence of the CCME (1999) guidelines. Should the TSS concentrations at this location exceed the CCME guidelines for short-term exposure (e.g. 24 hr) (25 mg/L TSS above background levels or 10% of background when background exceeds 250 mg/L; turbidity not to exceed

5NTU above background or 5% above background when background exceeds 80 NTU), remedial actions can be taken to control and reduce TSS levels are required.

If the guidelines continue to be exceeded, there is a potential for a HADD of fish habitat to occur if sediment concentrations increase significantly. Instream sediment concentrations will be used to determine if the HADD is significant to warrant compensation measures.

17.5.5.8 Deleterious Substances

Mitigation of potential water quality impacts involves prevention by ensuring that contractors on-site are properly trained in the use of and storage of hazardous materials. Strict adherence to established guidelines, systematic reporting, and use of a predetermined contingency response plan will need to be implemented to minimize the risk of toxic releases. Containment ponds, and during construction and post-construction stormwater drainage, must be designed to intercept any deleterious or toxic materials before reaching the river.

17.5.5.9 Fish Salvage

Following the placement of isolation measures, fish salvage operations will be conducted within the isolated area using standard salvage techniques (ie. electro-fishing, minnow traps, seine net, etc.). This activity will be conducted in accordance with a fish salvage permit to be obtained from ASRD, Fort Vermillion. Any fish found within the isolated portion of the construction site will be removed and released alive, without harm or destruction, to an area of the water body outside of the construction site.

17.5.5.10 Migration Blockage

The current criteria used by Alberta Environment if the water body is flowing, is the water body channel must not be constricted by more than two-thirds (2/3) of its width during the carrying out of the works. Under this condition, the permissible blockage due to flow velocities should not create a barrier to migrating fish for more than 3 consecutive days at a 1 in 10 year flood recurrence interval, unless upstream and downstream fish migration is accommodated.

Monitoring is recommended to focus on the identification of fish species/maturity/density downstream of the berm (impact zone) and in an area upstream of the berm (control area) during the spring spawning migratory period (April and May) and fall overwintering migrations (August to October). Daily discharges and velocities should be measured during these periods of monitoring, and discharge requirements for key fish species (e.g., goldeye, walleye, and pike in the spring, and burbot in the fall) should be determined from calculated velocities and swimming performance data.

The potential for blockage of fish movements is often dependent upon the timing of berm operations; in late fall and winter upstream migration of burbot can be blocked as this species is regarded a weak swimmer. The presence of the berm in spring may affect spawning migrations of weak swimming northern pike. In general, movement of all fish species will be affected by the constricted river channel to some degree. However, the potential for a significant delay or creation of a total barrier to upstream fish migration is unknown. Modeling of flow velocities and patterns in the vicinity of the berm is required to assess potential effects on fish movements. At this time, it is recommended that modeling be used to implement mitigation measures that will reduce or eliminate the impacts on fish migration by identifying where the potential blockages of fish movements may occur.

17.5.5.11 Channel Morphology

Several mitigative options could be considered in order to avoid or minimize the adverse effects on river morphology due to the installation of permanent facilities in the Peace River. Based on a review of the preliminary design, the recommended options may include, but are not limited to, the following:

- Relocation of the structure to minimize flow erosion and depth of scour; and
- Redesigning the structure and incorporation of features which can be used to eliminate or reduce the physical footprint of permanent facilities in the river.

The most effective and preferred mitigation procedure is to relocate and configure the structure in a manner that avoids impacts on fish habitat. For example, the instream pier within the river thalweg (deep pool) along the west bank can be relocated to avoid physical alterations of this fish habitat unit.

17.5.5.12 Fish Habitat Alteration – Mitigation and Compensation Options

The implementation of mitigation measures is often sufficient to avoid harmful alteration, disruption or destruction of fish habitat caused by construction and operation of watercourse crossings. Nevertheless, certain project actions during bridge construction will result in a HADD of fish habitat which cannot be mitigated, and would therefore require an *Authorization for Works or Undertakings Affecting Fish Habitat* issued by DFO under Section 35 (2) of the *Fisheries Act.*

Compensation involves the replacement of damaged or lost habitat with newly created habitat or enhancement of existing habitat. Several options are available for fish habitat compensation listed in order of preference):

- Replacement of habitat near the site;
- Replacement of habitat away from the site;
- Enhancement or improvement of habitat near the site; and
- Enhancement or improvement of habitat away from the site.

Adequate mitigation and compensation measures must be developed on a site-specific and design specific basis. This will be developed during the detailed design phase of the Peace River Bridge Crossing and should incorporate the recommendations of a qualified aquatic environmental specialist.

Streambed disturbance from construction and placement of berms will affect a large, but as yet unquantified, area for the period of construction. This change to the channel and flow velocities around the berms will impact downstream streambed conditions, and a loss of aquatic production (fish communities, and periphyton and benthic communities) may occur during this time. In the study reach, the homogeneous sandy bed substrate offers a less stable and less physically diverse habitat for fish communities and benthic invertebrates than would coarse substrate bed materials. As such, significant seasonal and year-to-year variability, especially in relation to waves and currents, and particularly high flow events, limits productive capacity within these unstable macrohabitats. This is primarily attributed to limited spatial refugia in the shifting sandy sediments, which provides little opportunity for detritus to accumulate or primary producers to become abundant. Further, fish communities and benthic invertebrates common in these macrohabitats would have life cycles that allow them to withstand stresses imposed by natural instability of the channel bed.

Due to the homogenous run-type habitat typical of the bridge crossing location, the berms will inadvertently create some temporary, useful habitat features for fish. A large low velocity eddy is typically formed immediately downstream of the berm, and a small water eddy is also typically formed upstream of the berm. These large pools and mid-stream berm will likely provide some instream refugia for adult fish.

The residual effects of elevated levels of suspended solids of fish populations and sedimentation of fish habitats is anticipated to be negative in direction, low in magnitude, local in extent, short-term in duration, isolated in frequency and high in reversibility.

The residual effects of the installation and removal of the berm is anticipated to be negative in direction, low in magnitude, local in extent, short-term in duration, isolated in frequency and high in reversibility.

Residual effects of the construction/operation on fish migration are anticipated to be negative in direction, low in magnitude, regional in extent, short-term in duration, isolated in frequency and high in reversibility.

Residual effects of changes in channel morphology on productive capacity are anticipated to be negative in direction, moderate in magnitude, local in extent, short-term in duration, isolated in frequency and high in reversibility.

Indirect residual effects associated with inadvertent development of habitat features are anticipated to be positive in direction, low in magnitude, local in extent, short-term in duration, and high in reversibility. Residual effects from deleterious substances are expected to be negative in direction, low in magnitude, local in extent, long-term in duration, and high in reversibility.

A major environmental concern is the destruction of sensitive fish habitats such as overwintering refuges and fish spawning beds, either through direct impact resulting from installation of footings and piers on these habitats or indirectly from sedimentation of bed materials scoured from the vicinity of these instream features. The alteration of the channel bed as a result of flow scour, and downstream sedimentation within the zone of impact, is not anticipated to be of significant concern because 1) scour will occur during high flow events when levels of suspended sediment and sedimentation (sediment deposition) are naturally high; 2) fish overwintering occurs in the winter during annual low flow stages and flow scour will be limited during this period; and 3) coarse substrates are not present naturally and infilling of interstitial spaces that are used for egg deposition will not occur. Where target sportfish species utilize sandy substrate for spawning (i.e., burbot), no alteration of available spawning areas is anticipated. As a result, the alteration of spawning and deep water overwintering habitats resulting from sedimentation and sediment redistribution resulting from flow scour (during high flow stages) is anticipated to be negative in direction, low in magnitude, local in extent, short-term in duration, and high in reversibility.

The development of deeper flow in the mid-channel sand bar resulting from bed scour in and around the bridge footings and piers are not anticipated to negatively affect fish and fish habitat. The installation of bridge piers may result in flow scour creating deep water pools. In the vicinity of the proposed bridge the study reach is composed of runs, with streambed substrate consisting of primarily sand, with isolated cobble along the east bank. As such, depth of water and some bank diversity (large woody debris) along the east and west bank provides the only instream cover for fish. Instream piers will create a low velocity eddy immediately downstream of each pier. These features provide velocity breaks and resting areas for other fish life stages. As a result, the creation of habitat is anticipated to be neutral in direction, low in magnitude, local in extent, long-term in duration, and low in reversibility.

Certain project actions resulting from the development of the Peace River bridge crossing may result in HADD of fish habitat that cannot be mitigated. Preliminary bridge design drawings indicate the total permanent loss of channel area due to the piers will be approximately 494 m^2 of deep run/pool habitat (4 piers in the channel thalweg along the west bank) and 740 m^2 of shallow run habitat. A condition of the federal *Fisheries Act* Authorization is that measures be implemented to adequately compensate for the HADD, through replacement of the natural habitat or an increase in the productivity of natural habitat (no net loss). As a result, information will need to be prepared based on the final design bridge structure and the ability to quantify and qualify the actual HADD resulting from the bridge development. The fish habitat compensation plan will include appropriate compensation strategies to ensure a "no net loss" of fish habitat pursuant to Section 35(2) of the federal *Fisheries Act*. Therefore, the implementation of an appropriate compensation plan, and subsequent effects on fish productive capacity, is anticipated to be positive in direction, moderate in magnitude, local in extent, long-term in duration, and low in reversibility.

The new road will increase access to the watercourses being crossed, and could raise the fishing pressure on local fish populations, particularly at the Peace River. Because of the low human population in the regional area, this residual impact is expected to be neutral in direction.

17.5.5.15 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RA's conclude the effects of the construction and operation of the bridge on aquatic resources are not likely to cause significant adverse effects.

17.5.6 Land Use

17.5.6.1 Construction and Operation Stage Effects

17.5.6.2 Navigation

Effects on navigation would occur during the bridge construction period, when flow isolation measures (i.e., berms) would be used during the construction of in stream piers and footings. The placement of berms could pose a hazard to normal river traffic; however, at no point during construction will there be an impassable barrier to riverboats, assuming water levels accommodates navigation.

During subsequent operation of the bridge, the bridge structure will have 10 in stream piers spaced approximately 90 m apart with deck to streambed height of 17-18 m. Overhead clearance during high flow stages is not anticipated to be a major issue. The Peace River is not used as a major transportation route but is utilized for recreational boating and fishing with the use of small personal watercraft. There are no commercial fisheries opportunities but subsistence and sport fisheries occur in the area. Construction activities and installation of permanent in stream piers could pose a hazard to local river traffic. The channel morphology consists of frequent sand bars, including the mid-channel bar at the crossing site, which requires a certain level of awareness during even regular boating activities on the river.

17.5.6.3 Waste Management

Operational waste from vehicles, if not properly managed, can end up in the river where the potential for contamination or pollution occurs. The following types of waste that can arise from the bridge operations and local boat traffic have been raised as potential issues:

- Oil;
- Garbage; and
- Paint scraps and maintenance wastes.

The above wastes can be broadly divided into three main sources: operational waste from commercial cargo activities, and wastes generated from maintenance activities and associated industry activities (logging trucks). The latter source is not unique to the bridge operations and its impact should be no more than that from similar activities on land provided it is disposed via normal routes (landfill, recycling or incineration). However, the other two sources of waste, if not properly managed, have the potential to cause impacts on wildlife and fisheries.

Improvements in waste management have been largely attributed to the measures required by environmental legislation and best management practices, which are discussed below. Operational strategies should also include the development and implementation of safety and project specific waste management plans. Increased awareness among river users of the problems associated with pollution is also important, and can be promoted by a number of environmental awareness education programs.

17.5.6.4 Mitigation

The RAs propose the following mitigation measures:

- the development of a boating and public safety plan (as indicated in Section 13.3).
- Continued education and motivation of local users and associated operators;
- Development of waste management plans and provision of adequate reception facilities; and
- Preparation and implementation of oil and chemical spill contingency plans.

Many of these management practices are regulated by federal and provincial regulatory requirements, including the federal *Fisheries Act* and *Navigable Water Protection Act*, and the Alberta *Environmental Protection and Enhancement Act*.

17.5.6.5 Residual Effect

With the implementation of appropriate waste management practices, the residual impacts associated with operational wastes are anticipated to be negative in direction, low in magnitude, local in extent, medium in probability of occurrence, and high in reversibility.

The residual impacts to navigation are anticipated to be negative in direction, low in magnitude, local in extent, long-term in duration, constant in frequency, and low in reversibility.

17.5.6.6 Significance Prediction

Based on the information provided in this report and taking into account the proposed mitigation measures, the RAs conclude the effects of the bridge on navigation during construction and operation are not likely to cause significant adverse effects.

17.5.6.7 Accidents and Malfunctions

Contamination of soils is possible in many aspects of bridge operation. Localized contamination could result from accidental spills and leaks. While these would likely be confined to ditches, possible impacts on adjacent undisturbed soils could include changes in pH, nutrient status, and water holding capacity. Prevention of contamination through provision of appropriate facilities, and immediate response to accidental contamination are of primary importance. Contamination response to chemical releases should be developed through a spill contingency and response plan, which may be part of an Environmental Management Plan. Because these events would be handled immediately, the residual effect is considered negative in direction, low in magnitude, local in extent, medium in the probability of occurrence, and high in reversibility.

18.0 CUMULATIVE EFFECTS ASSESSMENT

The *Canadian Environmental Assessment Act* requires that every comprehensive study of a project include a consideration of “any cumulative effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out”.

Although the Act does not define cumulative effects, a reference guide subsequently prepared by the Canadian Environmental Assessment Agency (1999) defines cumulative environmental effects as:

> *The effect on the environment, which results from effects of a project when combined with those of other past, existing and imminent projects and activities.*

To satisfy this requirement, an effort was made to evaluate the potential contribution of the proposed project to environmental stressors presently considered to be operating both within and outside of Wood Buffalo National Park.

18.1 Introduction

The level of effort required for a cumulative effects assessment depends on the nature of the project, its potential effects and the environmental setting. Taking these factors into account, the Terms of Reference outlines the following requirements for the Highway 58 cumulative effects assessment:

- Identify past and existing stressors (i.e., human land use, resource consumption, habitat fragmentation, pollutants, climate change, exotic species, roads, fire control, other park specific issues, timber berth revegetation, land excisions, etc.) on key components of Wood Buffalo National Park that impact on the heritage values of Wood Buffalo National Park (i.e., ecological integrity, biological diversity, ecosystem function, and presentation and protection of the park);
- Identify past and existing stressors on land outside of WBNP that impact the heritage values associated with these lands
- Discuss the impact of the potential construction of the winter road between Peace Point and Garden River
- Discuss and attempt to quantify the resulting contribution of the road (i.e., direct loss of habitat, habitat fragmentation, and its effects such as habitat avoidance, individual and social disruption of wildlife) to these existing stressors and the resulting cumulative impact to heritage values as described above;
- Discuss and quantify the capacity for renewable resources affected by the construction and operation of the project, to continue to meet the needs of the current and potential future land users
- Discuss the possibility of increased year-round human activity along the road and its effects to heritage values of the project area;
- Discuss environmental effects to lands surrounding the park as a result of increased access, including opportunities for resource extraction (i.e., heavy oil, gas and forestry, tourism, additional roads) and the possible "islandification" of Wood Buffalo National Park;
- Discuss the impact of the proposed road on treaty land entitlement negotiations;
- Identify mitigation measures for the cumulative effects;
- Determine whether the residual impacts of the cumulative effects will adversely impact on the heritage values of Wood Buffalo National Park (i.e., ecological integrity, presentation and protection of the site) and its carrying capacity;

- Identify uncertainties and feedback to evaluate the accuracy of the assessment of cumulative effects and any proposed mitigation.

A draft Ecological Integrity Statement recently completed for Wood Buffalo National Park indicates that ecosystem function within the park is already being affected by land use changes or resource development in other parts of the greater Wood Buffalo Ecosystem. As a result, it is important to consider how activities outside the park may affect ecological integrity within the park. Because the assessment approach outlined by Parks Canada includes a discussion of the environmental effects of lands surrounding Wood Buffalo National Park, a separate CEA for provincial land outside of the park was not provided. This information will be included in the assessment of cumulative impacts in Wood Buffalo National Park. This approach is considered valid because cumulative impacts need to be addressed at the regional, rather than local scale. Although the CEA will address cumulative impacts to both federal and provincial lands, emphasis will be placed on impacts within Wood Buffalo National Park because of the protected status of this area.

18.2 Other Activities within the Study Area

In addition to road development, there are other activities within the study area that may contribute to environmental or heritage value impacts. These activities include:

- Oil and gas exploration and extraction;
- Logging;
- Excisement of park lands; and
- Power plant and power lines.

A diesel-fired power plant was relocated adjacent to the WBNP boundary and a 9.2 km power line was constructed to the community of Garden River. A cumulative effects assessment was conducted prior to this development and it concluded that critical impacts on vegetation and wildlife are not anticipated. A second power line is scheduled for construction in January 2005 from west of the Wentzel River to approximately km 11.8 on the Garden River Access Road. ATCO will be required to complete an EFR and the power line through the Wentzel River crossing will be placed 0.6 m within the proposed right of way.

18.3 Study Area Boundaries

Spatial boundaries for the study area were delineated based on the location of potential regional developments that could be affected by road development. The dominant disturbance factor outside the western boundary of Wood Buffalo National Park is forest harvesting. Elsewhere in the boreal forest, oil and gas development is the primary disturbance factor; however, oil and gas activity in the study area is relatively low compared to other boreal regions. Presence of all-weather access roads could potentially affect forest harvesting (e.g., rate of cut, timing of cut) within provincial Forest Management Units. As a result, the boundaries of the cumulative effects assessment study area encompass provincial FMUs F4 and F6, as well as Timber Berth 408 within Wood Buffalo National Park. Temporal boundaries for the CEA have been defined as long-term because of the permanent nature of the road corridor.

18.4 Existing Ecosystem Stressors

The protection and management of ecological integrity within national parks is the fundamental mandate of Parks Canada. This mandate is derived from the *Canada National Parks Act*:

> *Maintenance or restoration of ecological integrity, through the protection of natural resources and natural processes, shall be the first priority of the Minister when considering all aspects of the management of parks. (Section 8(2))*

It follows that the primary focus of a cumulative effects assessment should be to consider the cumulative effects of the project on the ecological integrity of Wood Buffalo National Park. The *Canada National Parks Act* defines ecological integrity as "with respect to a park, a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes" The draft Ecological Integrity Statement that has been prepared for Wood Buffalo National Park outlines the key ecological issues and values relating specifically to the park. The Ecological Integrity Statement, which was developed on the basis of input from scientific, aboriginal and local community interests, provides an operational framework for addressing Parks Canada's mandate to protect and manage the park's ecological integrity. This document has been used as a framework for evaluating potential cumulative effects of the proposed Highway 58 project. Wood Buffalo National Park's draft Ecological Integrity Statement, identifies 5 major stressors that are believed to be affecting the ecological integrity of the park:

- Isolation of Wood Buffalo National Park as a natural area;
- Habitat fragmentation/loss within the park;
- Upstream effects on water quality and hydrology;
- Global warming; and
- Bovine diseases.

An initial scoping of the relationship between the proposed Highway 58 project and stressors affecting ecological integrity in the park indicated that a likely mechanism would not exist for the project to contribute to stresses associated with either hydrological change (except for water quality) or global warming. However, a potential does exist for environmental effects of the proposed Highway 58 project to contribute cumulatively to the remaining stressors.

Major developments or activities that are ongoing or proposed in the study region that can contribute to cumulative environmental impacts include timber harvesting, oil and gas exploration and extraction, and excisement of parklands. Although identified in the terms of reference as a potential project to be considered, the winter road proposal for Garden River to Peace Point Road in Wood Buffalo National Park was subject to court ruling and is no longer active. As a result, this road will not be further considered in this assessment. No other proposed surface allocations (e.g., mining, pipelines) were identified in the Highway 58 study area based on the most recent provincial reviews (June and August 2002) of planned, approved and ongoing developments in Alberta (Alberta Economic Development website, "Inventory of Major Alberta Projects" and "Inventory of Alberta Regional Projects"; www.albertacanada.com/statpub/conspro.cfm).

18.5 Potential Cumulative Effects

18.5.1 Isolation of Wood Buffalo National Park and Contribution to Regional Development

Parks Canada has expressed concern that the integrity of WBNP's ecosystems could be affected by land use changes occurring outside of the park. Activities associated with oil and gas development, oil sands development, logging, and mineral exploration etc., are altering the landscapes surrounding the Park. Resource development activities are most prominent along the south and west sides of the park, which results in a decrease of core habitat in the region surrounding the park. A large network of seismic lines, trails and clear cuts is evident in the area surrounding the Park, indicating that a high level of resource development activity has occurred under present road access conditions. This leads to concern of "islandification" of the park.

Development of the highway should not result in an increase of oil and gas activity. Most exploration occurs in the winter when ground conditions are frozen in order to access wet muskeg areas.

Logging activity (i.e. renewable resources) may be affected by the road upgrade. It will extend the logging season from 3 months per year to 8 months per year; however, the annual allowable cut volume will not change. Since the volume will remain the same, the upgrade of the highway will not contribute to further "islandification" of WBNP or affect the amount of renewable resources removed from the area. The extension of the logging season may encourage logging during the spring and early summer, which may impact natural resources such as breeding birds.

The development may also accelerate the negotiation process for land excisement. Improvement of the road may result in increased economic development in Garden Creek, which could lead to increased demand by community residents for self-management. Treaty land entitlement negotiations are ongoing but sufficient information is not publicly available to conduct an assessment of cumulative effects.

18.5.2 Wildlife Habitat

Habitat loss and fragmentation resulting from anthropogenic activity is a major stressor within WBNP. It has occurred as a result of logging, road construction and community development (Table 18.1). The total area affected by these activities amounts to 833 km^2. If edge effects are considered, the affected area would increase to 1,375 km^2, assuming a 100 m edge effect.

Table 18.1 Summary of Habitat Loss within WBNP.

Disturbance Type	Area of Disturbance		
	Total (ha)	**Km**	**% of Park**
Travel Corridors Constructed			
Winter Road, Cart Track	1856	928.0	0.04
Highway 5	639	127.8	0.01
Trail, Cut Line, Portage	547	1094.0	0.01
Pine Lake to Peace Point	206	68.7	0.00
Road: Loose Surface	204	68.0	0.00
Pine Lake to Ft. Smith	142	28.4	0.00
Fitzgerald to Hay Camp	114	28.5	0.00
Peace Point to Carlson Landing	80	26.7	0.00
Proposed Garden River-Peace Point Winter Road	118	118.0	0.00
Subtotal Travel Corridor	**3806**	**2488.1**	**0.08**
Development			
Settlement	739		0.02
Cleared Area	488		0.01
Cabin	335		0.01
Gravel Pits	314		0.01
Picnic Site	87		0.00
Fire Tower	52		0.00
Fire Guard	11		0.00
Subtotal Development	**2,026**		**0.05**
Forestry			
Timber Harvesting	77,500		1.73
Total	**83,314**	**2,370.1**	**1.86**

The upgrade of the road will result in a loss of an additional 20 ha of forested habitat within WBNP, which increases the amount of area lost to transportation by 0.004%. In addition, since the road corridor already exists, additional fragmentation will be minimal. The type of habitat lost is also important to consider in addition to the quantity of habitat lost. WBNP contains a number of rare or unique habitats, including sand dunes, sinkhole lakes, spring and seeps and disjunct grasslands. Loss of these specialized habitats can contribute to a loss of natural biodiversity. None of these habitat features occur along or near the proposed road alignment, thus limiting the cumulative impact of the road upgrade in WBNP.

Considerable habitat loss and fragmentation have occurred outside of WBNP in the remaining study area from oil and gas activity, logging and transportation corridors. However, since the road will be developed utilizing an existing road corridor, it will not contribute to a considerable increase in habitat loss or fragmentation. Therefore, the cumulative effect of the proposed Highway 58 project on habitat loss and fragmentation is not considered significant.

18.5.3 Effects on Water Quality and Aquatic Resources

Existing stressors on the Peace River include hydroelectric dams, pulp mills, saw mills, oil and gas plants and municipal sewage plants.

Construction of the road will require installation of new watercourse crossing structures. Of the 20 locations of structure instalment, 19 locations are currently crossed using substandard structures. Thus, the installation of the new structures should improve current water hydrology. The hydrology of the Peace River may be slightly impacted by rip rap and piers associated with the bridge.

The current water quality of all the watercourses aside from Peace River is relatively unaffected by other activities in the area. Those potential activities, which may contribute to impact of this quality, include sedimentation from logging or spillage of fuel or other substances when using the existing road corridor. The water quality of the Peace River is most likely impacted by hydroelectric dams, pulp mills; saw mills, oil and gas plants and municipal sewage plants upstream of Fox Creek.

The upgrading and construction of the road have the potential to impact the water quality and aquatics of the watercourses during crossing installation and road operation. Siltation and contamination are potential sources of water quality and aquatic impact arising from road and bridge construction. However, considering mitigation and the low possibility of occurrence, the cumulative impact of the road and crossing structures construction/installation is anticipated to be insignificant.

The improved access may increase fishing pressure on fish populations. However, the current pressure on fish population from other sources is light. Therefore, the cumulative effect on fish population is anticipated to be insignificant.

18.5.4 Bison

The wood bison has been affected by disease, predation, habitat alteration and flooding. There are few activities, which impact Bison living within WBNP. Those animals living outside of the Park are subjected to high hunting pressure, especially in the vicinity of the existing road corridor. They are also more likely to be involved in vehicle – wildlife collisions.

There is concern that the upgrade could contribute to the spread of bovine brucellosis and tuberculosis; this is uncertain. The road will only be 7 km within WBNP and given a corridor currently exists; the bison already have a path leaving the park from which they can spread disease. Therefore, the cumulative effect of the road upgrade on bison disease spread is considered to be insignificant.

18.6 Traditional Ecological Knowledge

The cumulative effects of the proposed road, logging and mineral exploration and activity will likely increase pressure on local wildlife in terms of noise disturbance, hunting pressure, and loss of food and shelter habitat. Traditional ecological experts indicate that logging activity particularly affects caribou through the loss of critical spring habitat. Access roads constructed for logging and mineral exploration in the Caribou Mountains will create travel corridors for trophy and subsistence hunters, which may further endanger the Wentzel Lake bison herd. The potential for pollution associated with industrial activities (e.g. oil spill) is also a major concern to local traditional ecological knowledge experts.

18.7 Mitigation

The residual cumulative effects resulting from the expansion of the road are not expected to be significant, considering the occurrence of the existing road corridor. Therefore, few mitigative measures, which include the following, are required to reduce the cumulative effects of the road expansion on terrestrial resources.

- Reduce the width of the road right of way wherever possible (e.g. WBNP).
- Reclaim previously disturbed areas that are no longer used to minimize the effects of habitat loss and fragmentation.

Several measures will be implemented to mitigate both the effects and cumulative effects of the road expansion construction and installation of crossing structures on watercourse hydrology, water quality and aquatic life. These measures are discussed in Section 17.

18.8 Residual Cumulative Effects

Following mitigation, there is little potential for residual cumulative effects to arise and therefore; the cumulative impact on the environment and heritage values is insignificant.
A summary of cumulative effects is included in Table 18.2

Table 18.2 Summary of the Cumulative Effects

Stressor	Effect
Contribution to Regional Developments and Isolation of WBNP	~~2~~ Extending an all-season road to WBNP is not anticipated to have any effect on oil and gas development in the region. The all-season access road however, will extend the logging season from 3 months/year to 8 months/year.
Habitat Loss and Fragmentation	• Additional clearing will be required for the 7 km of roadway within WBNP. This is not expected to have any cumulative impact on the habitat loss and fragmentation as an existing road corridor is being used. • Due to the presence of an existing road corridor, the cumulative impact of the proposed project on habitat loss and fragmentation outside of WBNP is not considered significant.
Effects on Water Quality & Aquatic Resources	• Fuel spills at watercourse crossings – possibility of occurrence is considered to be low, the remoteness of the area, the potentially-long response times and difficult operating conditions may reduce the likelihood that spills could be contained and cleaned up without damage to the environment. • Increase of fishing pressure in Mikkwa River, Margaret Lake and Wentzel Lake
Bovine Diseases	• The project's contribution to the cumulative effects of disease transmission within the WBNP is expected to be relatively low. • There is the potential for upgrade to access roads (outside of the WBNP) to increase the hunting pressure, but it is not anticipated to increase the risk in disease transmission to cattle and bison herds. • Improved access and year round human activity will likely result in higher hunting pressure in road corridor

The development of the road will most likely increase the year round activity along the road, since it will be available in all weather conditions. However, the residual cumulative effects resulting from the expansion of the road are not expected to be significant, considering the occurrence of the existing road corridor. Logging and oil and gas activities disturb a much greater amount of habitat than the road expansion will require. The impact to renewable resources should be minimal as the allowable annual cut will not change. The cumulative effects impact on Wood Buffalo National Park are not expected to negatively affect ecological integrity because there will be no adverse effects to ecosystem-wide composition, structure or function. The growth and development of the communities of Garden River and Fox Lake will improve significantly from the all-weather access.

18.10 Significance Prediction

Confidence in the prediction of the cumulative effects assessment is high. Given a road corridor currently exists at the location of the expansion, the widening of the road will not significantly change the current situation in terms of impact on terrestrial and heritage value resources. The effect of the bridge installation was well studied by the proponent using widely accepted methodology and mitigation measures are well known and based on provincial guidelines.

19.0 Environmental Management and Monitoring

19.1 Introduction

Environmental management and monitoring is important in all phases of the proposed project. Effective management and implementation of monitoring will ensure that the recommended mitigation measures outlined in this report are effective.

19.2 Construction

Environmental management of the project will be facilitated through an Environmental Construction Operations Plan (ECO Plan). The development, implementation and maintenance of the ECO Plan will be the responsibility of the proponent. The ECO Plan will be developed consistent with and in conformance with the commitments contained in the comprehensive study report, including the recommended monitoring and management programs identified in Table 19.1. A third party ECO Plan audit is also a requirement of the ECO Plan process. The purpose of the audit is to ensure ECO Plan implementation and conformance to stated requirements.

A framework guide for the preparation of ECO Plans is available from http://www.trans.gov.ab.ca.

An ECO Plan documents the proponent's (or the contractor for the proponent) plan for satisfying the environmental requirements specific to the construction and rehabilitation of a project. The plan will:

- Provide a statement of the proponent's commitment for protection of the environment, compliance with environmental legislation and permits, and satisfying contractual and policy requirements,
- Identify and address construction and rehabilitation procedures, the environmental requirements and potential impacts associated with various construction and rehabilitation activities,
- Provide emergency response procedures to minimize potential impacts of emergency situations on the environment,
- Describe how monitoring and reporting will be conducted to satisfy contractual and regulatory requirements, and
- Describe how the ECO Plan will be implemented by establishing a plan for training, communication, documentation, auditing, management review and ECO Plan adjustments.

The ECO Plan framework provides a management framework for planning, site activities, implementation and checking/monitoring. The ECO Plan will include the following information:

- Planning – Environmental Policy Statement
- Identification of Environmental Aspects of Site Activities
    - Vegetation Clearing and Timber Salvage
    - Weed Control Planning
    - Wildlife Management
    - Aquatic Resources Protection
    - Sediment and Erosion Control Planning
    - Cultural/ Historical Resources Protection
    - Soil Salvage and Reclamation Planning
    - Construction Site Management
    - Hazardous Materials Storage, Handling and Disposal
    - Spill Prevention Planning
    - Waste Management Planning
    - Emergency Response Procedures
    - Boating and Public Safety Plan
    - Monitoring and Reporting
- Implementation of ECO Plan and Activity Management
    - Training and awareness
    - Documentation
    - Communication
- Monitoring and Measurement
    - Inspection
    - Auditing
    - Monitoring Programs

Table 19.1: Recommended Management and Monitoring Programs during Construction, Post Construction and Operation/Maintenance

Environmental Component	Construction	Post-Construction
Vegetation	Monitor to ensure clearing is within Right-of-way. Monitor construction equipment to ensure free of weeds or non-native species. Monitor and control site for restricted and noxious weeds as per *Public Lands Operational Handbook* (Alberta Sustainable Resources Development 2003).	Monitor establishment of vegetation along roadway and in borrow excavations according to the Revegetation *Using Native Plant Materials Guidelines for Industrial Development Sites* (Alberta Environment 2003). Conduct detailed assessment at three key times to ensure plant growth is sustainable: - 3-6 weeks following seeding, - end of first growing season, - end of establishment period. For communities that take a longer time to develop (forests) assessment is required until the plant community is considered sustainable.
Wildlife	Biologist to monitor if any clearing activities are scheduled between April 15 and July 31 to determine presence of nesting birds including raptors.	Monitor collision data, and hunting pressure to identify any additional or increased impact.
Aquatic Resources	Implement aquatic monitoring program as per requirements in DFO and/or Alberta Environment authorizations. Program should evaluate erosion and sediment control, stream morphology and hydrology, fish passage and fish habitat usage. Qualified aquatic environmental specialist to inspect all stream crossings during construction period.	Implement a regular program of monitoring and maintenance to ensure facilities continue to meet requirements and have minimal effect on the environment. The maintenance should include bridges and culverts according to information provided in the *Public Lands Operational Handbook* (Alberta Sustainable Resources Development 2003). Implement aquatic monitoring program as per requirements in DFO and/or Alberta Environment authorizations. Program should evaluate erosion and sediment control, stream morphology and hydrology, fish passage and fish habitat usage.

Environmental Component	Construction	Post-Construction
Soils and Landforms	Implement temporary sediment and erosion control measures for protection during construction. The temporary works will be removed and if necessary replaced with post construction measures.	Implement sediment and erosion control plans for permanent protection as per Alberta Transportation Construction Bulletin #12 (2003). To maintain erosion control devices: - the consultant indicates maintenance procedures, - the consultant provides information in the form of a written report including inspection and maintenance forms, - the consultant shall inspect sites to ensure written document detailing location and maintenance requirements for devices.
	Document actual topsoil depths on the right-of-way and document anticipated volumes. Ensure that soil is salvaged according to *Disposal of Excess Soil Material from Roadways* (Alberta Environment 2000). Have a qualified soils specialist monitor and plan for on site salvage and implementation of requirements identified in pre borrow assessment.	Any excess soil or topsoil should be used for reclamation if possible or transferred to landowner according to the *Disposal of Excess Soil Material from Roadways* (Alberta Environment 2000).
Cultural Resources	Archaeologist to monitor construction at locations where resources were identified and that may be impacted by access road development. i.e. Pakwanutik River.	Not applicable.
Abandoned roadway reclamation	Monitor activities to ensure a record of conservation, degradation, mitigation and reclamation events. Site assessments following reclamation should include evaluation of soil, landscape and vegetation conditions *Conservation and Reclamation Guidelines for Alberta* (Alberta Environment 1997).	Implement post construction monitoring program to review success of revegetation and influx of non-native species.
Contamination	Implement spill contingency planning and response procedures. Monitor accidental spills as well as their follow up.	Implement spill contingency planning and response procedures. Monitor accidental spills as well as their follow up.

19.3 Operation and Maintenance

Ongoing monitoring programs for the operations and maintenance phase of the project that were recommended in the environmental assessment studies are summarized in Table 18.2. These programs are directed at ensuring that habitat function is maintained.

Table 19.2: Recommended Management and Monitoring Programs during Operation / Maintenance

Environmental Component	Operation & Maintenance
Vegetation	Mechanical clearing of roadway ditches to deter wildlife and maintain visibility. Monitor and control weeds to minimize impacts from non-native plants and noxious weeds.
Wildlife	Regulate hunting and/or implement education program to address poaching Biologist to monitor if any clearing/grubbing activities are scheduled between April 15 and July 31 to determine presence of nesting birds including raptors.
Aquatic Resources	Implement a regular program of monitoring and maintenance to ensure facilities continue to meet requirements and have minimal effect on the environment. The maintenance should include bridges and culverts according to information provided in the *Public Lands Operational Handbook* (Alberta Sustainable Resources Development 2003).
Soils and Landforms	Maintain permanent erosion and sediment control measures as directed in the Road Use Maintenance Agreement between the maintenance contractor and Alberta Infrastructure and Transportation and the agreement between Parks Canada and LRRC.
Contamination	Manage contamination as directed in Road Use Maintenance Agreement between maintenance contractor and Alberta Infrastructure and Transportation and the agreement between Parks Canada and LRRC. Maintenance contractor will contain the release and repair the effects of a release in compliance with laws and regulations, and report to the correct authority. The maintenance contractor will also ensure that waste is not placed or left on the road.
Navigation	Develop a boating and public safety plan for navigation around bridge in Peace River.

19.4 Follow Up

One of the requirements under section 16(2) of CEAA is for the RAs to determine the need for, and the requirements of, any follow-up program in respect of the project. The purpose of a follow-up program is to verify the accuracy of the environmental assessment and, determine the effectiveness of any mitigation measures taken to mitigate the adverse environmental effects of the project. Typically, a follow-up program is required where a project has the potential to cause significant adverse environmental effects unless mitigation is applied and where mitigate measures proposed are new and unproven. This does not apply to this project as the environmental effects are known and can be mitigated through standard, industry best management practices. Therefore, the RAs conclude that a follow up program under CEAA is not required taking into account the implementation of the proposed mitigation measures. However, monitoring may be deemed necessary under other legislation (e.g. Fisheries Act).

20.0 RA's Conclusions

Based on the information contained within this comprehensive study report, the RAs have concluded that there are no likely significant adverse environmental effects resulting from the project after the implementation of mitigation measures. In addition, there are no significant adverse cumulative effects predicted.

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