KEEYASK TRANSMISSION PROJECT MAMMALS TECHNICAL REPORT

Prepared for
Manitoba Hydro
and
Stantec Inc.

by
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PREFACE

The following is one of several technical reports for Manitoba Hydro's application for environmental licensing of the Keeyask Transmission Project. This technical report has been prepared by an independent technical discipline specialist who is a member of the Environmental Assessment Study Team retained to assist in the environmental assessment of the Project. This report provides detailed information and analyses on the related area of study. The key findings outlined in this technical report are integrated into the Keeyask Transmission Environmental Assessment Report.

Each technical report focuses on a particular biophysical or socio-economic subject area and does not attempt to incorporate information or perspectives from other subject areas with the exception of Aboriginal Traditional Knowledge (ATK). Applicable ATK is incorporated where available at time of submission. Most potentially significant issues identified in the various technical reports are generally avoided through the Site Selection and Environmental Assessment (SSEA) process. Any potentially significant effects not avoided in this process are identified in the Environmental Assessment Report along with various mitigation options that would address those potential effects.

While the format of the technical reports varies between each discipline, the reports generally contain the following:

- Methods and procedures.
- Study Area characterization.
- Description and evaluation of alternative routes and infrastructure sites.
- Review of potential effects associated with the preferred transmission routes and station sites.

Following receipt of the required environmental approvals, an Environmental Protection Plan (EnvPP) will be completed and will outline specific mitigation measures to be applied during construction, operation, and maintenance of the proposed Keeyask Transmission Project. An EnvPP is typically developed from a balance of each specialist's recommendations and external input.

Each of the technical reports is based on fieldwork and analysis undertaken throughout the various stages of the SSEA process for the Project. The technical reports are as follows:

- Technical Report 1: Aquatics Environment
- Technical Report 2: Terrestrial Habitat, Ecosystems and Plants
- Technical Report 3: Amphibians
- Technical Report 4: Avian

- Technical Report 5: Mammals
- Technical Report 6: Forestry
- Technical Report 7: Socio-economic Environment
- Technical Report 8: Heritage Resources
- Technical Report 9: Tataskweyak Cree Nation Report on Keeyask Transmission Project

The technical reports contain more detail on individual subject areas than is provided in the Environmental Assessment Report. The technical reports have been reviewed by Manitoba Hydro, but the content reflects the opinions of the author. They have not been edited for consistency in format, style, and wording with either the Environmental Assessment Report or other technical reports.

ACKNOWLEDGEMENTS

Chief(s) and Council(s) of the Tataskweyak Cree First Nation (TCN), Fox Lake Cree Nation (FLCN), War Lake First Nation (WLFN) and York Factory First Nation (YFFN) are gratefully acknowledged for their support of this program. We would also like to thank Victor Spence and Douglas Kitchekeesik of TCN, Ray Mayham of FLCN, Phillip Morris of WLFN and Evelyn Beardy of YFFN for arranging logistic support for field studies associated with the project.

We would like to thank Mr. James Matthewson, Ms. Fiona Scurrah, and Mr. David Block (Manitoba Hydro) for providing their guidance and for the opportunity and resources to conduct this assessment. Also thanked are Mr. George Rempel and Mr. Blair McMahon (Stantec Inc.) who provided technical support and direction during the course of this study and North/South Consultants Inc., who provided logistical support that made this study feasible. Special thanks are also extended to Dr. James Ehnes (ECOSTEM Ltd.) and staff, who are gratefully acknowledged for providing technical support throughout the study.

STUDY TEAM

The study team consisted of personnel from Wildlife Resource Consulting Services MB Inc (WRCS) as well as field assistants from the Tataskweyak Cree First Nation (TCN), Fox Lake Cree Nation (FLCN), War Lake First Nation (WLCN), and York Factory First Nation (YFCN). WRCS personnel who have worked on this field project include Brian Kiss, Jonathan Hopkins, Justin Paillé, Peter Hettinga, Scott Johnstone, and Timothy Kroeker. Technical and research support staff included Jason Kelly and Andrea Ambrose, who are gratefully acknowledged for their support.

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EXECUTIVE SUMMARY

Manitoba Hydro is proposing to develop the Keeyask Transmission Project, hereafter known as 'the Project'. The Project would consist of a new 138 kV Construction Power transmission line and Keeyask Construction Power Station for construction of the Keeyask Generating Station and Generation Outlet Transmission lines and the Keeyask Switching Station, including a 138 kV Unit Transmission line from Radisson Converter Station to the construction power transformer station to be used as a back-up power during construction. Once the Keeyask Generating Station is complete, the Generation Outlet Transmission lines will be partially salvaged and used to tie the Keeyask Generating Station into the Manitoba Hydro Northern Collector System via the proposed Keeyask Switching Station and Radisson Converter Station.

The proposed Project will be located in the Split Lake Resource Management Area, about 300 kilometres northeast of Thompson, in northern Manitoba. The Keeyask Transmission Project Study Area, known as the Project Study Area, extends from the Radisson Converter Station (about six kilometres northeast of the town of Gillam), along the south shore of Stephens Lake to the proposed Keeyask Generating Station, and includes the town of Gillam.

Manitoba Hydro’s Site Selection and Environmental Assessment process was used to evaluate the suitability of locations for Project routes and infrastructure. Potential constraints and opportunities for the proposed Construction Power transmission line and Generation Outlet Transmission lines route alternative options were identified by using scientific literature, existing data, and professional judgement. Other Project infrastructure that was evaluated included the Keeyask Construction Power Station, Keeyask Switching Station, and Unit Transmission lines. An initial review of available data including hunting and trapping data, local knowledge, and Aboriginal traditional knowledge was conducted to develop a base of knowledge for mammals in the region, and field studies were conducted to collect additional mammal data.

Wildlife use of existing habitats and specific habitat features was measured using techniques conforming to accepted professional standards and practices. A variety of methods, including summer and winter ground tracking surveys, trail camera surveys of potential caribou and moose calving habitat, and aerial surveys for beaver and muskrat were used to improve the characterization of mammal populations and habitat in the Project Study Area. Data and results from other Manitoba Hydro projects including the proposed Keeyask Generation Project and Bipole III Project and literature were used to support the analyses.

Up to 38 mammal species could currently range into the Project Study Area, 15 of which were recorded during field studies. In order to evaluate effects of the Project on mammals, valued environmental components (VECs) were selected from the mammal species in the Project Study Area. Two species, caribou and moose, were selected as mammal VECs. All other mammal species were grouped according to general characteristics. Mammal groups included

small mammals, aquatic furbearers, terrestrial furbearers, large carnivores, and ungulates. Species listed by the federal *Species at Risk Act*, *The Endangered Species Act* of Manitoba, or the Committee on the Status of Endangered Wildlife in Canada included little brown myotis (small mammals) and wolverine (terrestrial furbearers).

Two alternative routes for the proposed Construction Power transmission line and four route alternative options for the proposed Generation Outlet Transmission lines were assessed to determine which of the options would have the fewest potential effects on and the greatest benefit to mammals and habitats in the Project Study Area. The sites of the Unit Transmission lines, Keeyask Construction Power Station, Keeyask Switching Station, and the Radisson Converter Station upgrades were also screened for potential sensitivities. Potential caribou calving and rearing habitat and streams were identified as habitat criteria to be avoided where possible. Differences in habitat loss or alteration as measured by line length, potential caribou migration corridors and proximity to existing and potential future Project linear features were also considered.

The preferred routes for the Construction Power transmission line and the Generation Outlet Transmission lines were determined based on field studies, mapping, literature, and professional judgement. From a mammal's perspective, CP Route 1 is the recommended route for the Construction Power transmission line and GOT Route Alternative Option B or C is the preferred route for the Generation Outlet Transmission lines. After considering the preferred route recommendations from all of the biophysical, social, and technical perspectives, Manitoba Hydro selected an overall preferred routes for the Construction Power and Generation Outlet transmission lines. CP Route 1 was selected for the Keeyask Transmission Project. The preferred route for the Generation Outlet Transmission line followed GOT Route Alternative Option B for most of the approximately 14 km of line extending eastward from the Keeyask Switching Station; the remainder of the line extending to the Radisson Converter Station followed GOT Route Alternative Option C.

Effects of clearing, construction, operation, and maintenance of the Construction Power transmission line, Keeyask Construction Power Station, Unit Transmission lines, Keeyask Switching Station, Generation Outlet Transmission lines, and Radisson Converter Station upgrades on mammals could include habitat loss, alteration, and fragmentation; sensory disturbances; and mortality. Habitat alteration and loss is expected to be small compared to the local and regional availability of mammal habitat. Fragmentation effects are expected to be manageable with other developments proposed in the region. Based on the selected locations for the transmission line rights-of-way and the station sites, the Project is not expected to substantially affect mammals or mammal habitat. Adverse effects will be minimized with mitigation measures, and no significant residual effects are anticipated. In order to assess long-term effects of the Project on caribou and moose, and the effectiveness of mitigation measures, some monitoring will be required.

1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

The primary function of the Keeyask Transmission Project (the Project) is to provide construction power and generation outlet transmission capacity for the Keeyask Generating Station. The Project will consist of a Construction Power transmission line, Keeyask Construction Power Station, and four Unit Transmission lines originating at the Keeyask Generating Station and terminating at the Keeyask Switching Station. Three Generation Outlet Transmission lines will link the Keeyask Switching Station to the northern collector system, terminating at the Radisson Converter Station. Project components are described below.

1.1.1 Construction Power Transmission Line and Station

A new Construction Power transmission line (138 kilovolts (kV) and approximately 22 kilometres (km) long) from the existing 138 kV KN 36 transmission line to a new 138 kV to 12.47 kV construction power station to be located north of the proposed Keeyask Generating Station will be needed for construction power. The new wood-pole/steel transformer station will be built on a 2.25 hectare (ha) site that will be developed to accommodate three transformer banks T1-3 and will supply the necessary power (22 megavolt amperes (MVA)) for the construction of the generating station.

The purpose of the Construction Power transmission line and Keeyask Construction Power Station is to provide power for the construction activities of the generating station. After operation, the Construction Power transmission line will be left in place, as will a portion of the construction power station, to provide a contingency function for a “black start” emergency backup to diesel generation units at the generating station. Two alternative Construction Power transmission line routes (CP Route 1 and CP Route 2) were assessed, which begin on the north side of the Nelson River at Gull Rapids (at the Keeyask Generating Station site) and run south to an existing Manitoba Hydro transmission line (KN 36), situated between the Butnau and Kettle rivers.

1.1.2 Unit Transmission Lines

Four 138 kV alternating current (ac) Unit Transmission lines (KE1 to 4) will transmit power from the seven generators located at the Keeyask Generating Station to the new Keeyask Switching Station. Three lines will be double circuit and one line single circuit to accept power from the seven generating station turbines. The four lines, each approximately 4 km long, will be located in a single corridor.

1.1.3 Keeyask Switching Station

A new Keeyask Switching Station will accept power from the generating station via four Unit Transmission lines from the generating station transformers and switch that power to three Generation Outlet Transmission lines. The switching station will be located on the south side of the Nelson River. The purpose of the switching station is to provide the terminal facilities for the electrical connection to the generating station, and to provide flexibility for accommodating power transmission from the generating station to the Radisson Converter Station. The proposed Keeyask Switching Station will require 13 ha of land for Project development and another 22 ha will be acquired for possible future expansion for a total site area of 35 ha.

Six alternative sites were identified for the switching station (SS Sites 1, 3, 4, 5, 6, and 7), however all sites on the north side of the river were ruled out due to the increased transmission line distance, one site was within the flood area of the Keeyask Generating Station, and one site was within a rock quarry. Due to these considerations Site 3 is the preferred switching station site and was the site assessed within this report.

1.1.4 Generation Outlet Transmission Lines

Three 138 kV AC Generation Outlet Transmission lines will transmit power from the Keeyask Switching Station to the existing Radisson Converter Station 138 kV AC switchyard. The three lines, each approximately 38 km long, will be located in a single 200 m-wide corridor. Manitoba Hydro plans to build one of these Generation Outlet Transmission lines to serve as a backup construction power line during construction and will be partially salvaged back to the Keeyask Switching Station and utilized as a generation outlet transmission line.

Four GOT Route Alternative Options (A, B, C, and D) were assessed, which begin on the north side of the Nelson River at Gull Rapids and run parallel to the south shore of Stephens Lake to the Radisson Converter Station (about 6 km northeast of the town of Gillam).

1.1.5 Radisson Converter Station Upgrades

The existing Radisson Converter Station will be upgraded in two stages, as follows:

- Stage I: Radisson Converter Station will require the addition of a 138 kV breaker to accommodate the initial new 138 kV transmission line KR1 from Keeyask Switching Station.
- Stage II: Station equipment will include the addition of a 138 kV bay (Bay 1) complete with four 138 kV breakers and associated equipment for the termination of two additional lines (KR2 and KR3) from Keeyask Switching Station. KR2 and KR3 will enter the west side of the station utilizing dead-ended steel structure with line switches. KR2 and KR3 lines will proceed to underground around the station and finally terminate to Bay 1. This is done to

avoid complex line crossings into the station. Thirty-one 138 kV AC breakers will also need to be replaced due to fault levels exceeding existing breaker ratings.

1.2 PROJECT STUDY AREA

The Keeyask Transmission Project Study Area, referred to as the Project Study Area, is approximately 600 square kilometres (km^2) in size, and is located in northern Manitoba. It falls entirely within the Split Lake Resource Management Area and includes the town of Gillam (Map 1-1). Project footprints that are in the Project Study Area are described in Section 1.1. For the alternative route selection process (see Section 4.0), a 1,150 m buffer of the rights-of-way (ROWs) was selected for all six proposed alternative routes (see Terrestrial Habitat Ecosystem and Plants Technical Report). For the effects assessment (see Section 5.0) of the Construction Power and Generation Outlet transmission line ROWs a buffer of 400 m was used to determine the direct and indirect effects on mammals. For the caribou habitat fragmentation analysis, a buffer of 500 m was selected. The nested design of these features allowed for the assessment of the direct and indirect Project effects on mammal populations and their **habitats**, and as may be compared to a larger regional study area.

Five Regional Study Areas were selected for mammals from the Keeyask Generation Project Environmental Impact Assessment (Keeyask Hydropower Limited Partnership 2012) (Table 1-1 and Map 1-2). The need for multiple zones that describe the size of a study area is based, in part, on the relative size required to maintain a minimum resident mammal species population in the order of 100 to 500 individuals or more. Home ranges large enough to maintain mammal populations in a community were considered in the development and selection of study areas. When the general area of the Keeyask Generation Project is referred to rather than a specific study area or zone, the term “Keeyask region” is used.

Table 1-1: Regional Study Areas from the Keeyask Generation Project Environmental Impact Statement

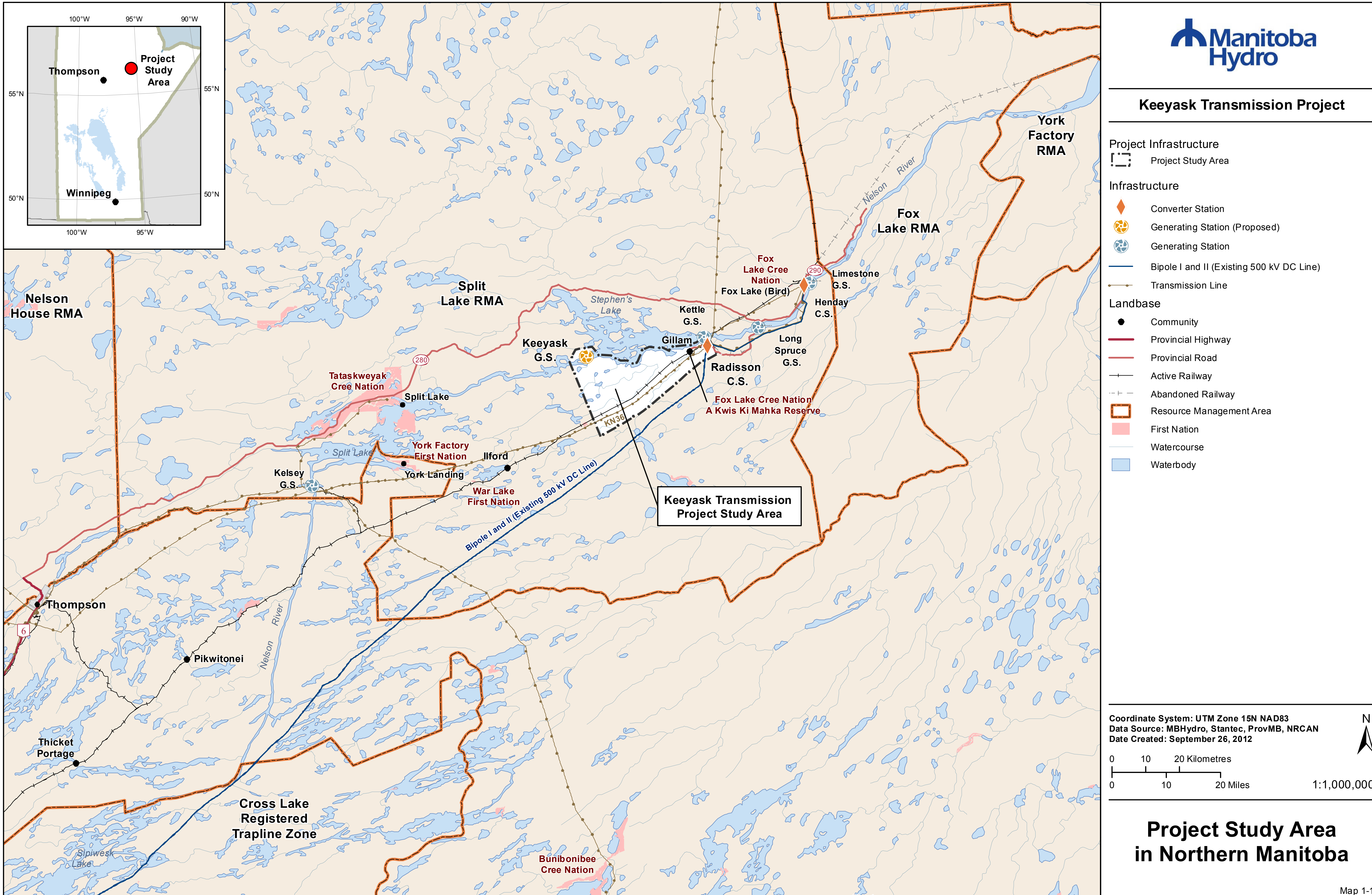
Mammal Group or VEC	Regional Study Area Zone
Small mammals	3
Furbearers (aquatic and terrestrial)	4
Large carnivores	6
Caribou	5 or 6[1]
Moose	5

1. Summer resident caribou habitat and fragmentation effects are considered in Zone 5; effects on all caribou, including barren-ground and coastal caribou, are considered in Zone 6.

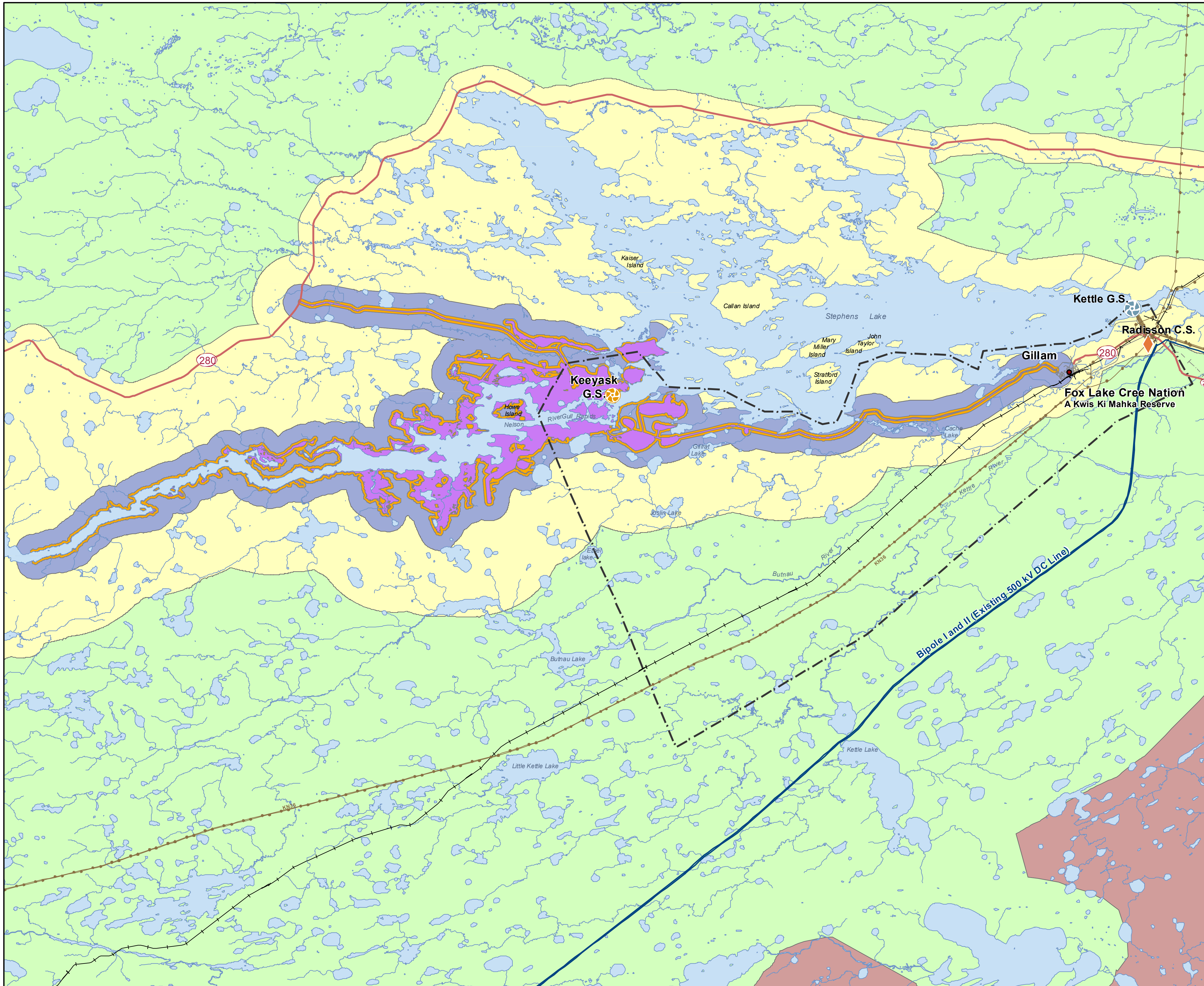
The Regional Study Area is in the Boreal Shield Ecozone, which stretches across most of north-central and eastern Manitoba, and is dominated by the metamorphic gneiss bedrock of the Canadian Shield, broad expanses of coniferous dominated **boreal forest**, and numerous lakes. The Project Study Area is located in the Hayes River Upland Ecoregion of the Boreal Shield Ecozone. Surficial materials in the Gillam area consist of organic deposits and lacustrine mineral deposits. Peatlands dominate the area, and veneer bogs and blanket bogs are the most common peatland types. Surface permafrost is widespread and discontinuous. Climate parameters vary, with mean annual temperatures ranging from about -2.4 to -4.9 degrees Celsius, with growing seasons ranging from 124 days to 149 days. Total annual precipitation averages about 499.4 millimetres. Refer to Terrestrial Habitat Ecosystem and Plants Technical Report for additional detail concerning the Project Study Area.

Land cover is dominated by sparsely to densely treed needleleaf vegetation on thin or shallow peatlands. Black spruce (*Picea mariana*) on thin peatlands and black spruce on shallow peatlands are the two most abundant coarse habitat types. The other needleleaf coarse habitat types are jack pine (*Pinus banksiana*) and tamarack (*Larix laricina*) types. Less common broadleaf treed and mixedwood coarse habitat types include trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), and white birch (*Betula papyrifera*). Large fires occur frequently in the Keeyask region, and approximately one-quarter of inland **terrestrial** habitat is less than 50 years old. Shoreline wetland coarse habitat types comprise only a small fraction of land area. Refer to the Terrestrial Habitat Ecosystem and Plants Technical Report for additional detail concerning the Project Study Area.

Common mammals expected in the Hayes River Upland Ecoregion include moose (*Alces alces*), black bear (*Ursus americanus*), caribou (*Rangifer tarandus*), lynx (*Lynx lynx*), gray wolf (*Canis lupus*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), and snowshoe hare (*Lepus americanus*) (Smith *et al.* 1998; Environment Canada 2000).



Manitoba Hydro
Keeyask Transmission Project
Project Infrastructure
Project Study Area
Infrastructure
Converter Station
Generating Station (Proposed)
Generating Station
Bipole I and II (Existing 500 kV DC Line)
Transmission Line
Landbase
Community
Provincial Highway
Provincial Road
Active Railway
Abandoned Railway
Resource Management Area
First Nation
Watercourse
Waterbody
Coordinate System: UTM Zone 15N NAD83
Data Source: MBHydro, Stantec, ProvMB, NRCAN
Date Created: September 26, 2012
N
0 10 20 Kilometres
0 10 20 Miles
1:1,000,000
Project Study Area in Northern Manitoba
Map 1-1
100°W 95°W 90°W
Project Study Area
Thompson
Winnipeg
55°N
50°N
Nelson House RMA
Split Lake RMA
York Factory RMA
Fox Lake RMA
Stephen's Lake
Keeyask G.S.
Kettle G.S.
Gillam
Fox Lake Cree Nation
Fox Lake (Bird)
Limestone G.S.
Henday C.S.
Long Spruce G.S.
Radisson C.S.
Fox Lake Cree Nation A Kwis Ki Mahka Reserve
Nelson River
Tataskweyak Cree Nation
Split Lake
York Factory First Nation
York Landing
Ilford
Kelsey G.S.
War Lake First Nation
KN36
Bipole I and II (Existing 500 kV DC Line)
Keeyask Transmission Project Study Area
Thompson
Pikwitonei
Thicket Portage
Cross Lake Registered Trapline Zone
Sipiwesk Lake
Bunibonibee Cree Nation
Manto
280
290
6



Manitoba Hydro

Keeyask Transmission Project

Project Infrastructure

- Project Study Area

Infrastructure

- Converter Station
- Generating Station (Proposed)
- Generating Station
- Bipole I and II (Existing 500 kV DC Line)
- Transmission Line

Geographic Zones

- Study Zone 1 (Project Footprint Both Phases)
- Study Zone 2
- Study Zone 3
- Study Zone 4
- Study Zone 5
- Study Zone 6

Landbase

- Provincial Road
- Municipal Road
- Active Railway
- Abandoned Railway
- Watercourse
- Waterbody

Coordinate System: UTM Zone 15N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: September 10, 2012

N

0 2 4 Kilometres

0 2 4 Miles

1:250,000

Keeyask Generation Project Study Areas

Map 1-2

2.0 METHODS AND PROCEDURES

The Project Study Area is sufficiently large to allow for the identification of several alternative routes and sites (see Map 1-1). This study area allows for an appropriate range of planning choices for consideration based on the collection of environmental information about its physical and biological characteristics (including wildlife and aquatic resources), as well as socio-economic and land use characteristics (including locations of communities, conservation areas, economic land uses [*e.g.*, trapping], and archaeological and heritage resources). Study area characterization, although broadly focused on all aspects of the **environment**, was guided by prior SSEA project experience through which Manitoba Hydro has established an understanding of the environmental issues and concerns associated with the development of transmission facilities.

From 2009 through 2011, SSEA studies were conducted to gather information on a variety of wildlife groups, including mammals, using the habitats within areas where the proposed transmission line routes are located. Information gained through these mammal studies, together with other environmental study results, will be used to assist in the route selection process for the Construction Power and Generation Outlet transmission lines. This information will be used in the development of the Keeyask Transmission Project Environmental Assessment Report that will be submitted to Manitoba Conservation and Water Stewardship for licensing approval.

This report also provides information gathered from 2001 to 2011 on mammal communities in various habitats located throughout areas proposed for transmission line development and from the Keeyask area (Manitoba Hydro 2011a, 2011b; Keeyask Hydropower Limited Partnership 2012). Mammal abundance and diversity were described and compared for the habitats potentially affected by the Project. The routing analysis and effects assessment is based on data using those methods described below.

2.1.1 Overview of Information Sources and Data

Assessment of mammal community composition and of the abundance and distribution of individual species within the Project Study Area was conducted using a variety of methods. Mammal studies began with desktop exercises, including a review of peer-reviewed literature, other reports, and field surveys. Important data sources included existing mammal data collected from field studies completed for the Keeyask Generation Project on Gull Lake and Stephens Lake between 2001 and 2011. Data included ground tracking surveys for mammals, aquatic furbearer aerial surveys, caribou and moose aerial surveys, and small mammal surveys. Data from Aboriginal traditional knowledge documents provided by the Keeyask Cree Nations (KCNs) involved with the Keeyask Generation Project were also used. Data and results were also reviewed from Bipole III field studies. Studies conducted in 2009 were designed fill in the gaps in order to characterize wildlife and wildlife habitat types in the Project Study Area, and especially near the preliminary proposed Construction Power transmission line and Generation Outlet Transmission lines alternate routes. Resource use and commercial trapping is evaluated in the Keeyask Transmission Project Socio-economic Technical Report.

Data collections for wildlife species and habitats focused on mammal species of regulatory concern, conservation concern, and on potentially regionally rare (*i.e*., comprising about 1% or less) or uncommon habitat types found in the Project Study Area. Wildlife use of existing habitats and specific habitat features were measured from aerial surveys for beaver and muskrat, caribou calving island surveys, and mammal tracking surveys to describe relative abundance and distribution, relative habitat use, and seasonality (Schemnitz 1980; Elzinga *et al.* 2001).

In order to evaluate effects of the Project on mammals, Valued Environmental Components (VECs) were selected from the mammal species in the Keeyask region. Two species, caribou and moose, were selected as mammal VECs. A limited assessment was also conducted for all mammal species that were not selected as VECs where certain effects could not be described by only caribou and moose. These mammals were grouped according to general characteristics, and included:

- Small mammals;
- Aquatic furbearers;
- Terrestrial furbearers;
- Large carnivores; and
- Ungulates.

Two ungulate species can be found in the Keeyask region. Caribou and moose are both VECs and are described as such. Groups were based on general characteristics such as body size and broad habitat requirements, and not on biological **taxonomy**. As such, mammal groupings are not meant to imply similarity in specific characteristics such as diet (*e.g*., herbivore or carnivore), or particular habitat preferences (*e.g*., mature forest or recent burns).

Mammal groups also included species listed by the federal *Species at Risk Act* (SARA) or *The Endangered Species Act* of Manitoba (MESA), or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Wolverine is listed as a species of special concern by COSEWIC. Its range includes the Project Study Area, but it is not found in large numbers in Manitoba. Little brown myotis (*Myotis lucifugus*) is not currently listed by SARA or MESA, but it is listed as endangered by COSEWIC, which has recommended that it be listed under Schedule 1 of SARA (COSEWIC 2012).

2.1.1.1 Aboriginal Traditional Knowledge and Local Knowledge

Aboriginal traditional knowledge (ATK) materials, including published information, were obtained from the following communities and reviewed: Tataskweyak Cree Nation (TCN), Fox Lake Cree Nation (FLCN), War Lake First Nation (WLFN), and York Factory First Nation (YFFN) (Keeyask Hydropower Limited Partnership 2012). Sensitive information that was known but not published was considered in alternative routing and the effects assessment.

Once collected, the ATK survey data were reviewed for species location information, species composition, and other relevant features such as hunting grounds. The locations of important sites and mammal habitats were also noted, especially in relation to the alternative routes and the preferred route.

Local knowledge was recorded during field studies when offered. The mammal study team included TCN, FLCN, WLFN, and YFFN. Members were responsible for identifying and recording **mammal signs** by species and by attributes such as sex, age, and activity.

2.1.1.2 Mammal Surveys

Summer Ground Tracking Survey

Ground tracking surveys were used to collect information on mammal species occurrences. Using the same methods as described in the Keeyask Generation Project Environmental Impact Statement (EIS) (Keeyask Hydropower Limited Partnership 2012), the presence or absence of species along surveyed transect routes was assessed in summer and winter. Summer ground tracking transects were distributed near the proposed Construction Power transmission line and Generation Outlet Transmission lines alternative routes (Map 2-1). Transects were located in a variety of habitats including **riparian** areas, wetlands, and coniferous and deciduous forested areas.

A total of 169 transects were established on the proposed Construction Power transmission line and Generation Outlet Transmission lines alternative routes and were distributed about in proportion to habitat availability. The Construction Power transmission line alternative routes overlapped 11 habitats and the GOT Route Alternative Options A, B and C overlapped 8 habitats. Summer ground tracking surveys were not established for GOT Route Alternative Option D option, which was identified by FLCN after the field studies were concluded. Ninety transects were distributed on the Construction Power transmission line alternative routes and 79 transects were surveyed on the GOT Route Alternative Options. Transects were 500 metre (m) long thread lines placed approximately 60 centimetres off the ground with sections marked every 50 m. Transects were visited on three occasions in summer. Data collected and recorded along each transect on the first visit included: UTM location, mammal signs (track and scat data), and sex and age of the animal where possible. Signs of all mammals were recorded during the first visit. During the second and third visits, data were only collected at thread breaks along each transect. Due to the height of the thread, the presence of larger mammals such as black bear, gray wolf, caribou, and moose was detected.

Three surveys took place on the Construction Power transmission line alternative routes between June 15 and June 20, July 3 and July 8, and July 23 and July 29, 2009. Three surveys were completed on the GOT Route Alternative Options between July 7 and July 16, July 27 and August 14, and August 24 and August 27, 2009.

Winter Ground Tracking Survey

Using the same methods as described in the Keeyask Generation Project EIS (Keeyask Hydropower Limited Partnership 2012), a winter ground tracking survey of the Construction Power transmission line and Generation Outlet Transmission lines alternative routes (Map 2-2) took place from March 4 to March 10, 2010. Snow-track count surveys have been used extensively in studies of many forest-dwelling mammals (Livaitis *et al*. 1985; Thompson *et al*. 1989; Bayne *et al*. 2005). Snow tracking methods were used to detect signs of medium-sized mammals (*e.g.*, American marten) and large mammals (*e.g.*, moose). One site visit was conducted for this survey. Data collected and recorded along each transect included: UTM location, mammal signs, and sex and age of the animal where possible. A total of 103 transects were established on the proposed Construction Power transmission line and Generation Outlet Transmission lines alternative routes and were distributed about in proportion to habitat availability.

Moose Browse Survey

Moose browse surveys were conducted concurrently with summer ground tracking surveys on 169 transects surveyed July 7 and July 20 2009. A linear intercept survey technique based on Canfield (1941) and Hoskins and Dalke (1955) was used to assess the quantity of moose browse on ground tracking transects: uniformly distributed samples at 100 m intervals and browse encounter samples at the first five times evidence of browse was observed.

Trail Camera Survey

Trail camera surveys for large mammals were conducted in 2010 and 2011 to monitor caribou and moose activity in potential calving areas in the Keeyask region. These studies were not specifically conducted for the Project; however, trail camera survey data for the Project Study Area were available from Manitoba Hydro (Keeyask Hydropower Limited Partnership 2012). Trail cameras were set up in potential caribou calving islands. Caribou calving and rearing islands consisted of either clusters of islands in Stephens Lake or terrestrial islands of black spruce surrounded by expansive wetlands or treeless areas (*i.e.*, peatland complexes). Data recorded from the cameras included species, number of individuals, activity, and where possible sex and individual animal identification. These data allowed for the validation of the habitats animals either revisited or in which they spend considerable periods of time, and for determining how individuals move between areas. Ground tracking transects were also established on calving islands in the same fashion as the summer and winter ground tracking surveys in the Project Study Area. Table 2-1 outlines the number of calving islands surveyed in relation to various Project components.

Table 2-1: Number of Calving and Rearing Islands Surveyed Along Infrastructure Planned For the Project Infrastructure

Transmission Line	Option/ Structure	Calving and Rearing Islands Intersected	Calving and Rearing Islands within 1 km	Calving and Rearing Islands within 1 to 2 km	Calving and Rearing Islands within 2 km
Construction Power	CP Route 1	0	5	12	17
	CP Route 2	2	6	2	8
	Keeyask Construction Power Station	0	0	3	3
	Unit Transmission Lines	0	2	4	6
Generation Outlet	GOT Route Alternative Option A	0	3	9	12
	GOT Route Alternative Option B	0	5	6	11
	GOT Route Alternative Option C	0	3	11	14
Generation Outlet	GOT Route Alternative Option D	0	3	12	15
	Switching Station	0	1	3	4
	Radisson Converter Station	0	0	0	0

Caribou Radio-Collaring

Radio-collaring of caribou was not specifically conducted for the Project; however, radio-collaring reports from the Bipole III Transmission Line Project were available from Manitoba

Hydro (2012c). **Monitoring** of 22 collared caribou in the Pen Islands coastal caribou range occurred between January 2010 and January 2012. A subset of 8 of the 22 collared animals was found to inhabit the Gillam area for all or part of the year. Ten caribou from the Cape Churchill herd were also collared in 2010, and none were found to frequent the Project Study Area. Detailed methods are described in Manitoba Hydro 2011b and Manitoba Hydro 2012.

Aerial Survey for Ungulates

Aerial surveys for large mammals were not specifically conducted for the Project; however, aerial survey data for the Caribou Regional Study Area were available from Manitoba Hydro (Keeyask Hydropower Limited Partnership 2012) and Knudsen *et al.* (2010). Detailed methods are described in these reports.

Aerial Survey for Beaver and Muskrat

Using the same methods as described in Keeyask Hydropower Limited Partnership (2012), an aerial survey for beaver took place on October 1, 2009 and for muskrat on March 30, 2010 in the Project Study Area. A predetermined flight path was followed in fall and spring. Sample sites included creeks, streams, rivers, ponds, and small lakes in the Project Study Area. A helicopter with two observers was used to record all sign of beaver including lodge, lodge status (active or inactive), food cache presence, and other beaver activity in fall (Map 2-3). Flights were conducted at approximately 100 kilometres per hour at an altitude ranging from 60 to 80 m above ground level. A GPS was used for the duration of the flight to record the flight path and signs. Larger lakes on the survey route were circled to ensure that all signs were sampled. Muskrat **push-ups**, which indicate muskrat activity, were only recorded in spring, when they are more visible on frozen waterbodies without snow cover. Other wildlife sightings were recorded incidentally.

2.1.1.3 Mammal Habitat Models

Habitat models for the Project were adopted from the expert knowledge and professional judgement models developed as part of the Keeyask Generation Project EIS. Models were used to:

- Improve the understanding of patterns, processes and functions that were relevant to the assessment;
- Predict potential changes caused by the Project; and
- Evaluate uncertainty in the assessment.

The caribou and moose habitat models used in this assessment are described in detail in Section 7.3.6.1 of the Keeyask Generation Project EIS (Keeyask Hydropower Limited Partnership 2012). Caribou winter habitat, primary and secondary caribou calving and rearing islands, and intact caribou habitat are used to describe caribou habitat quality and quantity in both summer and winter. Moose primary and secondary habitat used to describe moose habitat quality and quantity is a non-seasonal model.

2.2 VALUED ENVIRONMENTAL COMPONENT SELECTION

Valued Environmental Components (VECs) are components of the biological or socio-economic environment that may be affected by the Project. VECs are species and/or environmental components that are used to highlight or focus an environmental assessment. They are defined as elements of the environment having scientific, social, cultural, economic, historical, archaeological, or aesthetic importance and are proposed and identified and described under each environmental component. VECs are typically selected on the basis of their importance or relevance to stakeholders (*e.g.*, species such as moose that are hunted) and/or as indicators of environmental effects to a broader range of animals. They are typically determined with input from regulators and stakeholders, Aboriginal people, and discipline experts, as well as literature reviews and experience with other projects. Environmental indicators and measurable parameters or variables were identified and described for each VEC. The same indicators and parameters/variables were used to describe environmental effects and residual environmental effects, and to monitor changes or trends over time during the Project construction and operation/maintenance phases.

VECs were selected to evaluate potential environmental impacts on species and/or environmental components with an identified ecological or societal importance. Mammal VECs for were selected from a review of the Project Description, consideration of the VECs selected for the Keeyask Generation Project EIS, and a review of the Bipole III Transmission Project EIS. All mammal species in the Project Study Area were considered to determine which should be identified as VECs.

The selection of mammal VECs took a variety of selection criteria into consideration (Appendix A). One selection criterion used was the importance of each species to people, including First Nations. Protection under the federal *Species at Risk Act* or *The Endangered Species Act* of Manitoba was also used as a selection criterion. Federal regulatory requirements applied to species currently listed as ‘species of special concern,’ ‘threatened’, or ‘endangered’ by COSEWIC. Provincial regulatory requirements such as those applied to those mammal species that are intensively managed and are particularly vulnerable to harvesting such as big game species, were also criteria considered.

Ecological concepts including **umbrella species**, **keystone species,** and **indicator species** were used as selection criteria to rank species. Other selection criteria included whether species’ presence was confirmed in the area through field studies for the Keeyask Transmission

Project or for the Keeyask Generation Project. Consideration was given to the expected positive or negative environmental impacts of the Project on mammal species through a net gain or loss of habitat, the expectation of population pressures caused by **density dependence,** and the potential for increased harvesting of species. Habitat use by mammal species was categorized based largely on Kuhnke and Watkins' (1999) work and was instructive in applying habitat selection criteria by mammals residing in the Boreal Shield Ecoregion (Appendix A).

As moose and caribou were ranked the highest, they were selected as VECs. Other important topics considered when evaluating and assessing potential Project effects on mammals were mortality, habitat alteration, disruption of movements, and sensory disturbance. Refer to the Terrestrial Habitat Ecosystem and Plants Technical Report, the Bird Technical Report, the Amphibian Technical Report and the Keeyask Transmission Project Socio-economic Technical Report for other VEC topics considered in the environmental assessment.

2.3 EVALUATION OF ALTERNATIVE ROUTES AND INFRASTRUCTURE

Careful routing of transmission facilities is important to avoid and minimize potential adverse effects associated with their development. As such, the process of identification, comparison, and evaluation of alternative routes is based on criteria related to environmental issues and concerns, Project-specific criteria identified during the course of Project Study Area delineation and characterization (including initial consultation), and on the technical and economic feasibility requirements of the transmission facilities. As part of this process, potential constraints and opportunities were assessed for mammals and mammal habitat near the alternative routes and the location of Project infrastructure. Potential constraints and opportunities for the Construction Power transmission line and Generation Outlet Transmission lines alternative routes were identified by using scientific literature, existing data, and professional judgement. The criteria used to assess the constraints and opportunities that consider routing alternatives for mammals included:

Constraints	**Opportunities**
Caribou calving and rearing habitat	Proximity to other linear features
Riparian habitat (*i.e.*, stream crossings)	Common mammal habitat
Movement corridors	
Habitat fragmentation (including line of sight)	

Calving and rearing islands are considered sensitive sites because they are usually uncommon and caribou are particularly susceptible to disturbances. These habitats are particularly important because they decrease the risk of predation, and in the case of rearing, these areas provide more forage while providing a safe haven from predators (Hirai 1998; Dyke 2008). These habitats are best avoided where possible. The spatial relationship of calving and rearing islands was assessed in relation to the proposed alternative routes and Project infrastructure using a Geographic Information System (GIS).

Riparian areas are considered sensitive sites and these are best avoided where possible. Mammal species generally have higher densities in wetland, creek, and riparian habitats, often due to higher-quality food and foraging opportunities (Shultz and Leininger 1991; Naiman *et al.* 1993). Biodiversity tends to be higher near waterbodies and watercourses (Naiman *et al*. 1993). The spatial relationship of creeks in the Project Study Area was assessed in relation to the proposed alternative routes and Project infrastructure using GIS.

Movement corridors are best avoided where possible. Traditional migration routes for more sensitive species such as caribou could be affected by linear features if these become barriers to movements (James and Stuart-Smith 2000; Wolfe *et al.* 2000; Hundertmark 2007), and distribution patterns on the landscape could be influenced. The spatial relationship of known caribou movement corridors were assessed in relation to the proposed alternative routes and Project infrastructure using GIS. Movement corridors are often associated with watercourses (Naiman *et al*. 2000), and these were considered below.

The Project could increase fragmentation of mammal habitat by adding linear features to the landscape and reducing core areas. The transmission lines and associated access trails and roads will likely increase linear feature density. The evaluation that compares route lengths and core area reductions for each of the alternatives is described in the Terrestrial Habitat Ecosystem and Plants Technical Report. Opportunities exist for the selection of a route that would be near existing transmission lines, a railway, or future linear features, including the proposed Keeyask Generating Station south access road (Keeyask Hydropower Limited Partnership 2012). The placement of linear features together would be preferred, as it would minimize potential fragmentation effects. Finally, line of sight, defined as the straight line between a hunter or predator and its prey, is also associated with access and habitat fragmentation. The wider and/or longer a linear feature without visual obstructions, the greater the potential effect for prey. Although in many cases this can be mitigated by allowing vegetation to regenerate in a transmission line ROW, a very wide ROW is generally less preferable than a narrow ROW.

The Project Study Area is comprised of common and widespread habitat mosaics mostly made up of tall shrub or low shrub on peatland, needleleaf treed on peatland, and needleleaf treed on mineral soil (ECOSTEM 2009). Because common and widespread habitats are much less likely to be affected by a Project as compared to rare or uncommon habitats, numerous opportunities exist to select a preferred route through these common mammal habitats.

2.4 PREFERRED ROUTE ASSESSMENT

The selection of preferred transmission line routing options was done to reduce the potential environmental effects from proposed Project components on mammal species in the Project Study Area. The selection of the final preferred route options was done based on a weighing of varying environmental factors as they applied to selected VECs, which in the case of mammals was limited primarily to moose and caribou; however, the routing process took other mammal grouping into consideration as well.

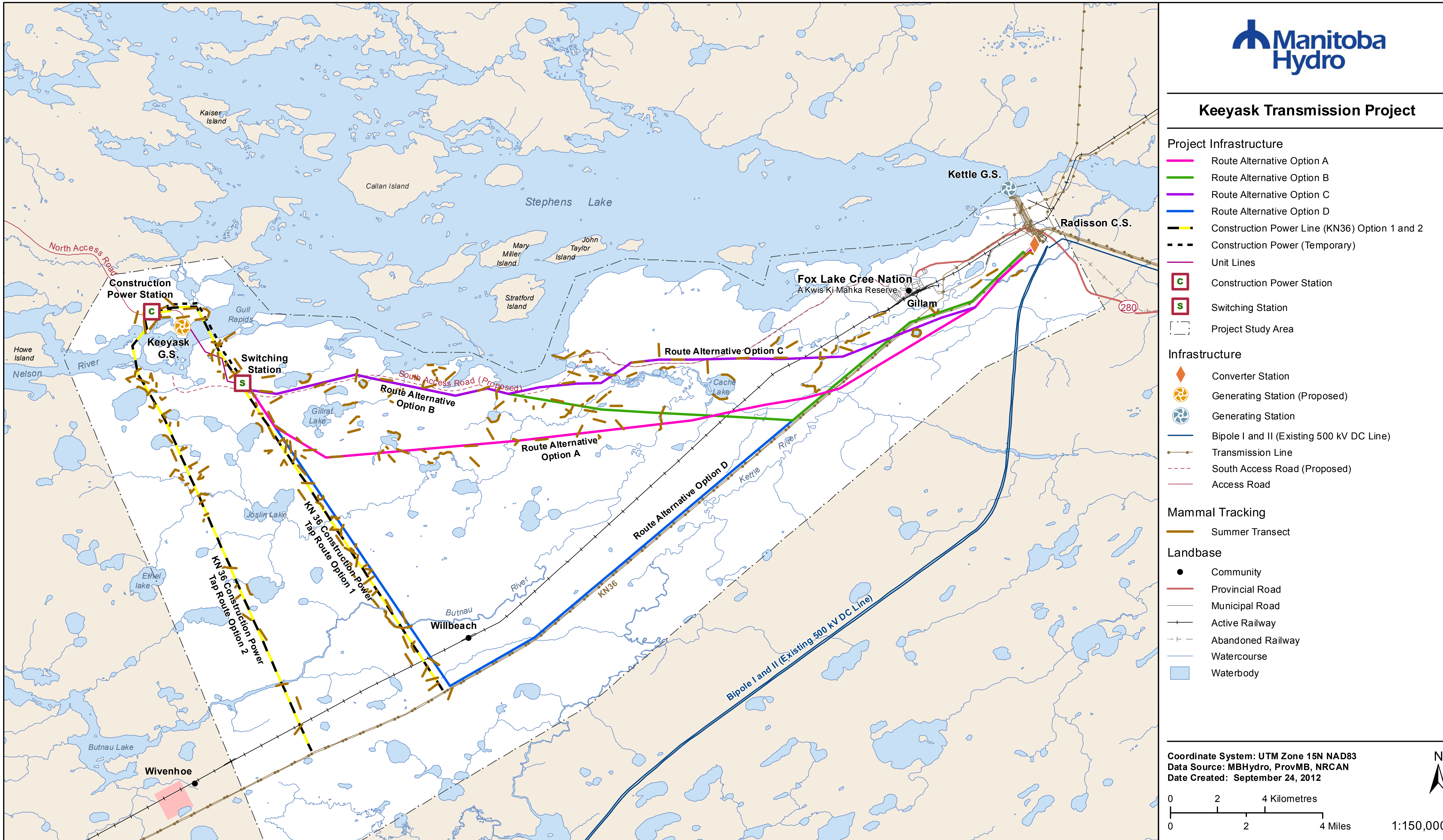
2.5 EFFECTS ASSESSMENT

Residual effects are the actual or anticipated Project effects that remain after considering mitigation and the combined effects of other past and existing developments and activities. The significance of the residual environmental effects was evaluated using factors adapted from the Canadian Environmental Assessment Agency (see Chapter 3 of the Keeyask Transmission Project Environmental Assessment Report). Significance was evaluated based on the criteria and ratings described below. Each potential effect on a VEC is initially evaluated using the following criteria:

- Direction or nature (*i.e.*, positive, neutral, or adverse) of the effect;
- Magnitude (*i.e.*, severity) of the effect;
- Duration (temporal boundaries); and
- Geographic extent (spatial boundaries).

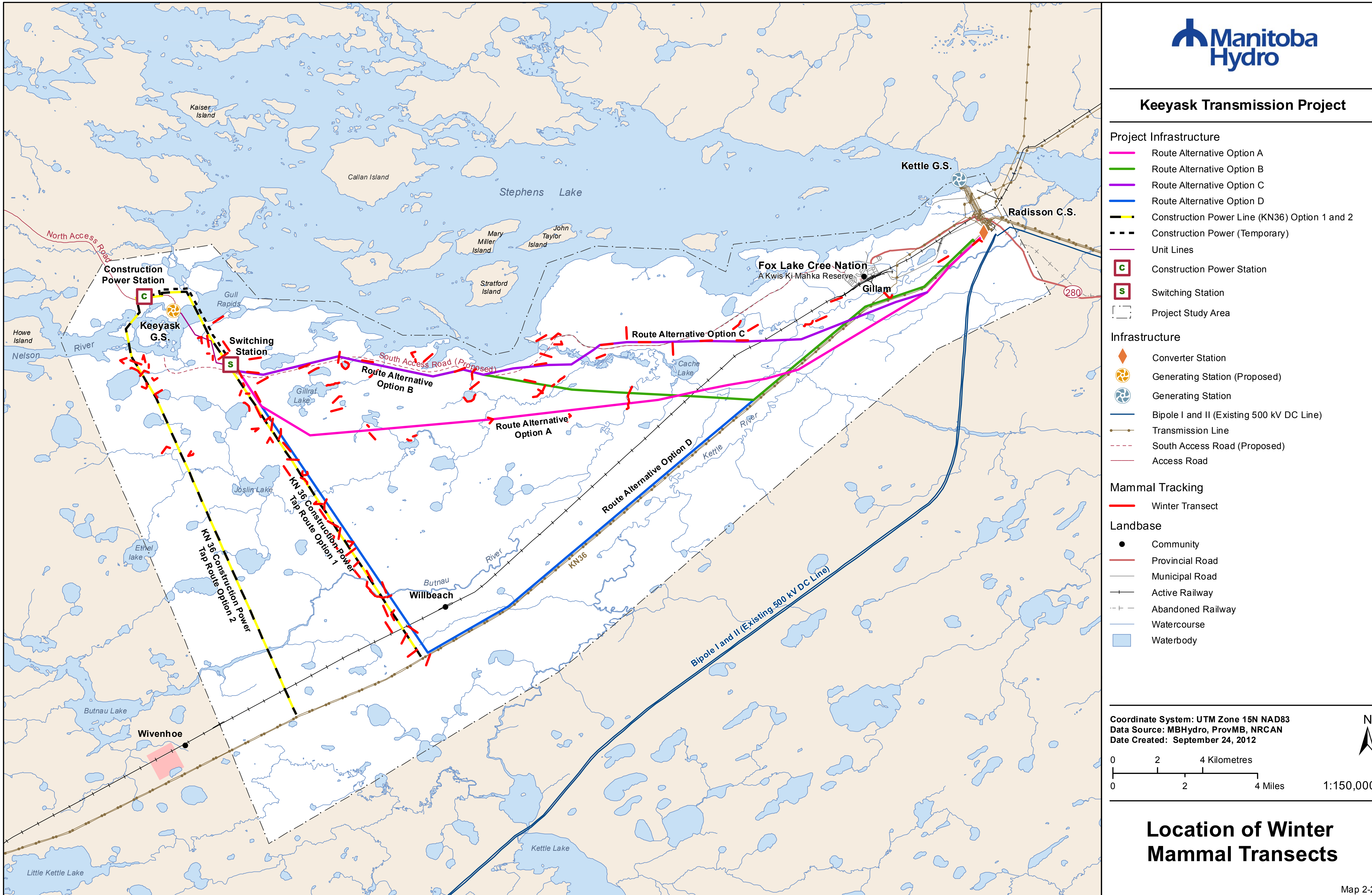
For those VECs requiring further evaluation the frequency, reversibility, and ecological context of the potential residual environmental effects were considered using additional criteria, as follows:

- Frequency;
- Reversibility; and
- Ecological context.



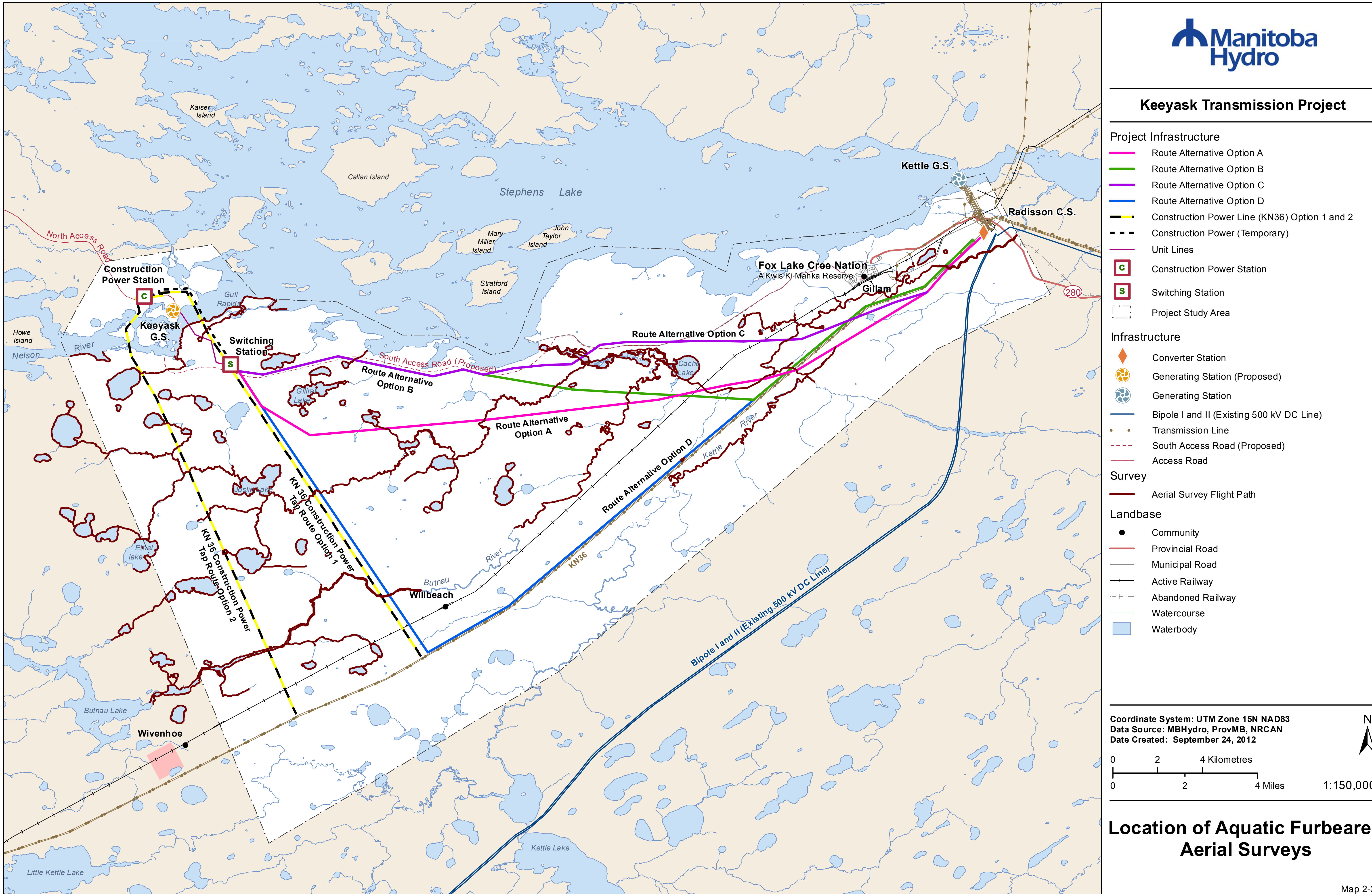
Location of Summer Mammal Transects

Map 2-1



Location of Winter Mammal Transects

Map 2-2



Location of Aquatic Furbearer Aerial Surveys

3.0 STUDY AREA CHARACTERIZATION

3.1 STUDY AREA OVERVIEW

Up to 38 mammal species (Table 3-1) could currently range into the Project Study Area. Some species, such as snowshoe hare and moose, are common and widely distributed in the region, while others are at the edge of their ranges: porcupine (*Erithizon dorsatum*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and white-tailed deer (*Odocoileus virginianus*). Common mammals found in the Keeyask region include red-backed vole (*Clethrionomys gapperi*), beaver, muskrat, snowshoe hare, American marten (*Martes americana*), gray wolf, black bear, moose, and caribou (Appendix B). Detailed results of mammal studies in the Project Study Area are outlined in Appendix C. Several species or their sign were observed incidentally and outside of formal studies in the Keeyask region, including woodchuck (*Marmota monax*), northern flying squirrel (*Glaucomys sabrinus*), ermine (*Mustela erminea*), and arctic fox (*Alopex lagopus*). Signs of fifteen mammal species or groups were recorded during field studies in the Project Study Area.

Table 3-1: Mammal Species in the Project Study Area

Common Name	Taxonomic Name	Summer Ground Tracking Survey[1]	Winter Ground Tracking Survey	Aerial Survey for Ungulates	Aerial Surveys for Beaver and Muskrat	Presence in Region Confirmed by KGS Field Studies
Masked shrew	*Sorex cinereus*	-	-	-	-	✓
American water shrew	*Sorex palustris*	-	-	-	-	✓
Arctic shrew	*Sorex arcticus*	-	-	-	-	✓
Pygmy shrew	*Sorex hoyi*	-	-	-	-	✓
Little brown myotis	*Myotis lucifugus*	-	-	-	-	Bat species unconfirmed
Hoary bat	*Lasiurus cinereus*	-	-	-	-	Bat species unconfirmed
Snowshoe hare	*Lepus americanus*	i	✓	-	-	✓
Least chipmunk	*Tamius minimus*	-	-	-	-	✓
Woodchuck	*Marmota monax*	-	-	-	-	

Table 3-1: Mammal Species in the Project Study Area

Common Name	Taxonomic Name	Summer Ground Tracking Survey[1]	Winter Ground Tracking Survey	Aerial Survey for Ungulates	Aerial Surveys for Beaver and Muskrat	Presence in Region Confirmed by KGS Field Studies
Red squirrel	*Tamiasciurus hudsonicus*	i	-	-	-	✓
Northern flying squirrel	*Glaucomys sabrinus*	-	-	-	-	
Beaver	*Castor canadensis*	-	-	-	✓	✓
Deer mouse	*Peromyscus maniculatus*	-	-	-	-	✓
Gapper's red-backed vole	*Clethrionomys gapperi*	-	-	-	-	✓
Northern bog lemming	*Synaptomys borealis*	-	-	-	-	✓
Heather vole	*Phenacomys intermedius*	-	-	-	-	✓
Muskrat	*Ondatra zibethicus*	i	-	-	✓	✓
Meadow vole	*Microtus pennsylvanicus*	-	-	-	-	✓
Meadow jumping mouse	*Zapus hudsonius*	-	-	-	-	✓
Porcupine	*Erethizon dorsatum*	-	-	-	-	
Coyote	*Canis latrans*	-	-	-	-	✓
Gray wolf	*Canis lupus*	✓	✓	-	-	✓
Arctic fox	*Alopex lagopus*	-	-	-	-	
Red fox	*Vulpes vulpes*	i	i	-	-	✓
Raccoon	*Procyon lotor*	-	-	-	-	✓
American marten	*Martes americana*	i	✓	-	-	✓
Fisher	*Martes pennanti*	i	-	-	-	✓
Ermine	*Mustela erminea*	i	✓	-	-	✓
Least weasel	*Mustela nivalis*					
Mink	*Mustela vison*	i	✓	-	-	✓
Wolverine	*Gulo gulo*	-	-	-	-	✓
Striped skunk	*Mephitis mephitis*	-	-	-	-	
River otter	*Lontra canadensis*	i	✓	-	-	✓

Table 3-1: Mammal Species in the Project Study Area

Common Name	Taxonomic Name	Summer Ground Tracking Survey[1]	Winter Ground Tracking Survey	Aerial Survey for Ungulates	Aerial Surveys for Beaver and Muskrat	Presence in Region Confirmed by KGS Field Studies
Lynx	*Lynx canadensis*	-	✓	-	-	✓
Black bear	*Ursus americanus*	✓	-	-	-	✓
Caribou	*Rangifer tarandus*	✓	X	✓	-	✓
White-tailed deer	*Odocoileus virginianus*	-	-	-	-	
Moose	*Alces alces*	✓	✓	✓	-	✓

1. A dash indicates that the study was not intended to detect the presence of the species and no incidental observations of its presence were observed; ✓ indicates that sign of the species was observed; X indicates that the species was not observed; i indicates that the species was not expected to be detected consistently due to study design, species activity pattern, or species rarity, but was observed incidentally

Species that are likely rare in the Project Study Area but are common elsewhere in Manitoba include American water shrew, little brown myotis, porcupine, striped skunk, and coyote (Keeyask Hydropower Limited Partnership 2012). No species listed by SARA or MESA are found. The range of boreal woodland caribou, which are listed as threatened by SARA and MESA, does not overlap the Project Study Area (Manitoba Conservation 2005; Environment Canada 2011; Map 3-1); however, the presence of caribou calving and rearing habitat was considered (see Section 0). The current ranges of little brown myotis and wolverine, which are not listed by SARA or MESA but are listed under COSEWIC (2003, 2012b), overlap the Project Study Area.

Mammal communities within the Project Study Area consist predominantly of resident species, although a few species such as caribou migrate into the Keeyask region from Ontario and Nunavut. Resident species rely on a wide variety of boreal forest habitats to support their life functions for breeding, food, and shelter. Mammal community dynamics in the Project Study Area are influenced by many factors including fire, weather, disease, insect populations, human development, hunting, and climate change (Fisher and Wilkinson 2005; Murray *et al*. 2006).

3.2 ENVIRONMENTAL SETTING

3.2.1 Small Mammals

Small mammals are the foundation of the carnivore and omnivore food webs. Small mammals include mice, voles, shrews, squirrels, chipmunks, and bats. They occupy a diverse range of habitats, including exposures of bedrock along river and stream channels and in areas of stunted tamarack and swamp birch.

There is little historical information describing small mammal populations and habitats in the Keeyask region. Many species were reported as far north as the Churchill area in the early 1900s (Preble 1902). Currently, small mammals are abundant and widespread in Manitoba (Banfield 1987) including the Keeyask region (Keeyask Hydropower Limited Partnership 2012), while their populations cycle with relative regularity (Boonstra *et al.* 1998). While no studies were conducted to detect the presence of small mammals, their sign was observed incidentally on ground tracking transects.

Common small mammals reported in the Project Study Area during field studies for the Keeyask Generation Project EIS include red-backed vole, heather vole, and masked shrew. Uncommon small mammals include pygmy shrew and American water shrew. Of the ten small mammal species reported, some species such as meadow vole were captured more frequently in riparian habitats; however, many small mammal species occupied most broad habitat types (Keeyask Hydropower Limited Partnership 2012).

The little brown myotis, a species of bat, is a habitat generalist, occupying a range of habitats (Wund 2006). While they inhabit parts of Alaska and northern Canada, their wings and ears are poorly suited to the cold, and they hibernate in caves or other shelters for the winter (Banfield 1987). They occur throughout much of Manitoba, including the Keeyask region (Humphrey 1982). While breeding occurrences in Manitoba are rare, the Manitoba Conservation Data Centre lists the non-breeding status of the little brown myotis as widespread, abundant, and secure in the province or throughout its range. This species is not yet listed by SARA, but an emergency order to place this and other bat species on Schedule 1 of the *Species at Risk Act* has been requested (COSEWIC 2012b) and it is listed as endangered under COSEWIC. The primary threat to little brown myotis is the spread of white-nose syndrome, caused by a fungus, which is predicted to result in the extirpation of little brown myotis within 16 years (Frick *et al.* 2010; Forbes 2012). While white-nose syndrome has not been identified west of Ontario, it is expected to spread to hibernacula across North America within 11 to 22 years (Frick *et al.* 2010; Forbes 2012).

Little brown myotis appear to be sparse in the Keeyask region (Keeyask Hydropower Limited Partnership 2012). No little brown bats were positively identified in the Project Study Area during field surveys; however, a bat was detected in late summer 2001 feeding at Gull Lake camp (Keeyask Hydropower Limited Partnership 2012). Anecdotal reports of bat (likely little brown myotis) observations near cabins in Stephens Lake have been made, but not confirmed. Bats have also been observed in and near Gillam, Manitoba, but the species is not reported (FLCN 2010 Draft).

3.2.2 Furbearers

Furbearers are generally medium-sized mammals that inhabit aquatic or terrestrial habitat. Furbearers such as snowshoe hare are recognized as important species by local resource users (Manitoba Hydro and Fox Lake Cree Nation Elder and Resource User Group Keeyask Transmission Project Workshop June 13, 2012). Due to their size, they were not expected to break the thread during summer ground tracking surveys, and signs of their presence were only recorded during the first visit. Winter ground tracking surveys are better suited to assess furbearer abundance than summer surveys, as signs such as tracks and scat are more easily detected in snow. As such, summer data should be interpreted with caution (Keeyask Hydropower Limited Partnership 2012b).

3.2.2.1 Aquatic Furbearers

Aquatic furbearers rely on water for a large portion of their food or habitat. Aquatic furbearers in the Project Study Area are beaver, muskrat, mink, and river otter. They are currently widespread and secure throughout their ranges in Manitoba (NatureServe 2012), which includes the Project Study Area and the Furbearers Regional Study Area (Zone 4).

Beavers inhabit waterbodies in forested areas (Banfield 1987). They alter aquatic **ecosystems** by building dams and through their feeding activities, and increase the diversity of species and habitat on a landscape (Naiman *et al.* 1986; Wright *et al.* 2002; Rosell *et al.* 2005). As such, the beaver is an important keystone species in the Project Study Area.

Beavers are abundant and common in the Project Study Area, but their distribution is highly variable (Appendix C). A total of 167 beaver lodges were observed during the fall 2009 aerial survey (Map 3–2). Of these, 59 were active. Beavers were most active in streams and ponds in the Project Study Area, and their presence was seldom detected in upland habitats. The current beaver population in the Beaver Regional Study Area (Zone 4) is estimated at approximately 250 active colonies (Keeyask Hydropower Limited Partnership 2012; Appendix C). Trapping is an important cultural activity (Tataskweyak Cree Nation 2011). Beavers were one of the three most commonly reported trapped furbearers on traplines 7, 8, 9, 15, 17, and 65 from 2001 to 2011, portions of which overlap the Project Study Area (Keeyask Transmission Project Socio-Economic Technical Report).

Muskrats require a source of permanent water such as marshes, ponds, lakes, streams, and rivers for habitat (Boutin and Birkenholz 1998). They generally inhabit the edges of emergent vegetation zones and are absent from large bodies of open water (Errington 1963; Banfield 1987), where wave action is greater. A total of 272 muskrat push-ups were observed during the spring 2010 aerial survey. Muskrat activity was most common on ponds, but activity was also detected on other riparian shorelines such as streams and lake perimeters (Map 3–2). Muskrat activity was greatest in streams and ponds in the Furbearers Regional Study Area over three years of aerial surveys. Although muskrat was not one of the most commonly trapped species on the six traplines overlapping the Project Study Area from 2001 to 2011 (Keeyask Transmission Project Socio-Economic Technical Report) or in the Keeyask region from 1996 to 2008, this species accounted for 32% of the furbearer harvest in the Split Lake Resource Management Area from 1960 to 1996 (Keeyask Hydropower Limited Partnership 2012).

Mink and river otter occupy similar habitats in the Project and Furbearers Regional Study Areas. Mink habitat is associated with water, including stream banks, lakeshores, forest edges, and swamps (Banfield 1987). Signs of mink activity were observed on ground tracking transects in summer and winter, but were generally scarce. All but one of the eight mink signs found in the Project Study Area were observed in summer. River otters inhabit aquatic environments including lakes, streams, and other wetlands (Melquist and Dronkert 1998). Of the 69 river otter signs observed during ground tracking surveys, 32 were found in summer and 37 were found in winter. Mink was one of the three most commonly reported trapped furbearer species on the six traplines that overlap the Project Study Area from 2001 to 2011 (Keeyask Transmission Project Socio-Economic Technical Report), while river otter was less commonly trapped. Mink and otter accounted for 5% and 2% of the furbearer harvest in the Keeyask region from 1996 to 2008, respectively (Keeyask Hydropower Limited Partnership 2012).

3.2.2.2 Terrestrial Furbearers

Terrestrial furbearers spend the majority of their time in and acquire most or all of their food from upland habitats. Snowshoe hare, woodchuck, red fox, arctic fox, American marten, fisher, weasels, and lynx can be found in the both the Project Study Area and Furbearers Regional Study Area. While woodchucks' range includes the Project Study Area, they were not detected during formal surveys. An individual was observed incidentally along Provincial Road (PR) 280 during studies for the Keeyask Generation Project and reported in the Keeyask Generation Project EIS (Keeyask Hydropower Limited Partnership 2012).

Snowshoe hares are found in deciduous, coniferous, and mixedwood forests, with an apparent preference for conifer-dominated habitats (Litvaitis *et al.* 1985; Hoover *et al.* 1999). In winter, snowshoe hares use dense understory vegetation for thermal cover and protection from predators (Litvaitis *et al.* 1985). Habitat structure, not species composition, is the primary factor for selection by snowshoe hares (Ferron and Ouellet 1992). Snowshoe hares may shelter under branches or in short tunnels dug under the snow (Banfield 1987). Signs were relatively abundant on ground tracking transects in summer and winter. As snowshoe hare scat, the sign most commonly observed in summer, tends to be scattered along a transect and it cannot be determined how many individuals it came from, abundance is likely overestimated and summer data should be interpreted with caution. Observations of signs were most frequent in winter. Signs of snowshoe hare activity were relatively widely distributed, found on 44% of transects in the Project Study Area.

The red fox prefers diverse habitats including farmland, pasture, hardwood stands, and open areas with edges suitable for hunting. They are rarely found in the core area of boreal forests (Eadie 1943; Cook and Hamilton 1944; Ables 1974; Banfield 1987). Diverse edge habitat is particularly desirable (Ables 1974). The red fox is a generalist predator capable of increasing predation pressure in boreal areas exhibiting human fragmentation (Kurki *et al*. 1998). Although **anthropogenic** fragmentation can increase populations, studies indicate that red foxes avoid areas with high human densities (Randa and Yunger 2006). A limited number of red fox signs were observed in the Project Study Area (Appendix C).

The arctic fox is not a resident of the Project Study Area; it is a migrant seen only in winter (see Appendix B). No arctic fox signs were recorded during winter tracking surveys.

American martens are predators whose diet varies somewhat with the season (Takats *et al.* 1999). While voles are the preferred prey (Banfield 1987; Strickland *et al.* 1998), the American marten diet extends to berries, mice, shrews, snowshoe hares, squirrels, birds, amphibians, insects, and fish, when available (Banfield 1987; Ben-David *et al.* 1997; Takats *et al.* 1999). American martens have also been known to scavenge winterkilled ungulates and other carrion (Strickland *et al.* 1998; Ben-David *et al.* 1997; Takats *et al.* 1999). While American martens spend much of their time in trees, they also move and hunt on the ground (Banfield 1987). Contiguous, mature, or old forest is preferred by this species (Chapin *et al.* 1998). Most of the American marten signs observed in the Project Study Area were encountered in winter, on 33% of the transects surveyed. Signs were relatively scarce in summer. American marten has always been an important furbearing species for First Nations Members (Split Lake Cree 1996), and local trappers have commented that its numbers have been increasing over the past two decades (Keeyask Hydropower Limited Partnership 2012). American marten was one of the three most commonly reported trapped furbearer species on the six traplines that overlap the Project Study Area from 2001 to 2011 (Keeyask Transmission Project Socio-Economic Technical Report) and accounted for 68% of the furbearer harvest in the Keeyask region from 1996 to 2008 (Keeyask Hydropower Limited Partnership 2012).

The fisher is a common inhabitant of mature boreal forest (Banfield 1987). Mammals such as squirrels, voles, shrews, and particularly snowshoe hares constitute the majority of the fisher diet (Banfield 1987). Fishers are also capable predators of porcupines (Powell 1994). Local trappers have commented that fisher numbers have been in decline over the past two decades. It has been suggested that the increase in American marten in the area may have resulted in fisher being out-competed for food resources, and subsequently, a population decline in fisher may have occurred. A resource user from FLCN noted that there were no fishers around his trapline (FLCN 2010 Draft). A contributing factor that may help explain the lower abundance of fishers is the scarcity of porcupine, a potential food source, in northeastern Manitoba. A single fisher sign was observed during summer and winter ground tracking surveys.

Ermine (*Mustela erminea*) and least weasel (*Mustela nivalis*) are the two species of weasel (collectively referred to as weasels) found in the Project Study Area. Ermine are the larger of the two species and least weasels are the smallest carnivores in North America (Banfield 1987; Fagerstone 1987). Weasels have been described as both nocturnal (Banfield 1987) and active during the day (Fagerstone 1987), with peak activity varying with the season (Svendsen 1982). Weasels are active all year and do not hibernate (Svendsen 1982). These species occupy similar, wide-ranging habitats (Fagerstone 1987) such as boreal coniferous or mixedwood forests, tundra, meadows, lakeshores, and riverbanks (Banfield 1987). Most of the weasel signs observed on ground tracking transects were found in winter. Three signs were observed in summer. Due to an overlap in track size between ermine and least weasel, signs could not be identified to species.

The lynx is a common inhabitant of mature boreal forest, and prefers dense understory (Banfield 1987). Snowshoe hare is an important prey species for lynx, and has been linked to cyclical population peaks and lows (Brand and Fischer 1976; Banfield 1987; Poole 1994; O'Donoghue *et al.* 1997; Krebs *et al.* 2001). Relatively few signs of lynx activity were observed in the Project Study Area. None were observed in summer. Eight signs were observed on 5% of the transects surveyed in winter.

Historically, the trapping of terrestrial furbearers has been a common practice in the Keeyask region and has been a valuable cultural and economic practice (Keeyask Hydropower Limited Partnership 2012). Some of the terrestrial furbearers trapped in the Keeyask region include American marten, mink, lynx, fisher, and ermine. American marten (14%) and mink (12%) made up most of the terrestrial harvest from 1960 to the mid-1990's (Keeyask Hydropower Limited Partnership 2012). More recently, American marten has made up 68% of the harvest and mink has made up 5% of the harvest (Keeyask Hydropower Limited Partnership 2012).

Wolverines were widely distributed in the area between Lake Winnipeg and Hudson Bay in the early 1900s, but were particularly rare in the southern region (Preble 1902). They were somewhat more abundant in the north (Preble 1902). Because declines have been reported in parts of the wolverine range and little data exists related to wolverine population trends, wolverines were listed as special concern by COSEWIC (2003). The western population of wolverine is not listed under SARA. The Manitoba wolverine population has been estimated to be between 1,200 and 1,600 animals, and it is estimated that the provincial population is either increasing or stable (COSEWIC 2003).

Wolverines are sparse in the Project Study Area and surrounding region, and no signs were recorded during summer or winter ground tracking surveys. Wolverine signs were rarely observed in the Terrestrial Furbearers Study Area during Keeyask Generation Project field studies (Keeyask Hydropower Limited Partnership 2012). Local resource users report that the number of wolverines observed in the lower Nelson River area has recently increased (Mammals Working Group December 9, 2010). More wolverines were observed in the Keeyask region in 2009 than in previous years (FLCN 2010 Draft). No wolverine den sites were identified during field studies in the Project Study Area, but it cannot be stated with certainty that none exist in the region.

3.2.3 Large Carnivores

Large carnivores are larger-sized mammals that contribute to ecosystem function by preying on other animals. Gray wolf and black bear are the two species found in the Project Study Area and Large Carnivores Regional Study Area (Zone 6).

Gray wolves are not restricted to a single habitat type, as they will typically follow their primary prey (Banfield 1987; Carbyn 1998). They are more likely to occupy mixed conifer-hardwood forests and forested wetlands than other habitat types (Mladenoff *et al.* 1995), and prefer to inhabit areas with low densities of roads and human activity (Houts 2001; Larsen and Ripple 2004). In the mid-1900s, gray wolf numbers decreased from rabies outbreaks and wolf control programs in western Canada (Paradiso and Nowak 1982). The gray wolf population is now stable in Manitoba (Manitoba Conservation and Water Stewardship 2012a). At least one wolf pack has been reported in the Project Study Area (WRCS unpubl. data). Gray wolf signs were relatively sparse in the Project Study Area. Most of the signs observed in summer were during the first visit. Fewer signs were encountered in winter (n = 8) than in summer (n = 21), which may be accounted for by the greater survey effort in summer. Signs were localized, observed on 7% of the transects surveyed in summer and 4% of the transects surveyed in winter.

Black bears are common inhabitants of coniferous and deciduous forests, swamps, and berry patches (Banfield 1987). Black bears are distributed throughout North America and now occupy approximately 85% of their historic range in Canada (Kolenosky and Strathearn 1998). The Manitoba black bear population is sustainable (Manitoba Conservation and Water Stewardship 2012b) and the species is common in the Project Study Area (Appendix C). Black bear signs were observed on 20% of the transects surveyed in the Project Study Area. No sign of black bear activity was observed in winter, likely because bears are hibernating and inactive at that time of year. No black bear dens were found during the winter surveys.

3.2.4 Ungulates

Ungulates are hoofed mammals that contribute to ecosystem function by consuming plants and providing prey for large carnivores. Ungulates that occur in the Project Study Area are moose and caribou. Caribou and moose are widespread throughout the Project Study Area as well as their respective regional study areas. Traditional resource use activities in the Keeyask region include moose and caribou hunting by TCN, WLCN, YFFN, and FLCN Members (Keeyask Hydropower Limited Partnership 2012). FLCN Members hunt for moose in the areas around Stephens Lake (Keeyask Hydropower Limited Partnership 2012). FLCN has also identified Cache Lake, the Butnau, Moswakot and Kettle rivers as important traditional resource use areas (Keeyask Transmission Project Socio-Economic Technical Report). TCN reports that Members travel in the Project Study Area and use rights-of-ways such as the CN Rail line between Wivenhoe and Gillam existing transmission lines. TCN documents a variety of traditional land uses that include hunting areas (Tataskweyak Cree Nation 2011). Moose and caribou are VECs and are discussed in Section 3.2.5.

It is unlikely that white-tailed deer occur in the Project Study Area. White-tailed deer range does not include the Keeyask region (Banfield 1987). White-tailed deer are absent to scarce in the Keeyask region and no signs were observed during field studies. Limited habitat supply and severe winters likely restrict white-tailed deer from becoming established residents of the Keeyask region.

3.2.5 Valued Environmental Components

3.2.5.1 Moose

Moose inhabit the boreal forest and their distribution follows those of preferred trees and shrubs. In winter, moose ranges are smaller than in summer (Phillips *et al.* 1973). Food availability, thermal cover, and predator avoidance influence habitat selection in winter (Dussault *et al.* 2005). Moose occupy habitat in a wide range of seral stages, riparian and forested areas, and the periphery of burns (Irwin 1975; Coady 1982). Upland and lowland habitats are used throughout the winter and lowland riparian areas are used when snow is deep (Coady 1982).

In summer, moose home ranges expand (Stevens 1970; Philips.*et al*. 1973; Crête and Courtois 1997). Lowland and upland mature stands, shrubby areas, and aquatic areas are commonly inhabited (Irwin 1975; Coady 1982). Burned areas are also used in summer; deciduous stands are preferred but conifer stands may also be used (Irwin 1975). Coniferous trees near shrub stands often create edge effects that allow moose to browse on new growth while utilizing protective cover from the nearby canopy.

Moose may have migratory routes in addition to seasonal ranges (Goddard 1970; LaResche *et al*. 1974). Moose migrate as a survival tactic for locating optimal forage throughout the year, as they generally consume aquatic vegetation in summer and browse on shrubs in winter (Drucker *et al.* 2010). Change in habitats may involve movements that vary in length and elevation. Snow conditions are the prime factor in initiating winter moose migration, but in other seasons, changes in forage quality or quantity may be responsible for moose movement (LaResche *et al.*1974).

Historically, moose were a main staple for First Nations Members in the Keeyask region (Keeyask Hydropower Limited Partnership 2012). Hunters typically harvest moose near waterways, as moose are attracted to riparian habitats and are easier to transport after harvest (Keeyask Hydropower Limited Partnership 2012). As moose numbers fluctuate, hunters must travel further from their home communities when populations are low (Keeyask Hydropower Limited Partnership 2012). Moose are often observed on the shores of Stephens Lake, and the islands in the lake are used by cows for calving (FLCN 2010 Draft).

Signs of moose activity were common on ground tracking transects in the Project Study Area in summer and winter. Moose signs were widely distributed in summer, observed on 98% of the transects surveyed over three visits. Signs were observed in all habitats surveyed. In winter, signs were observed on 25% of the transects surveyed. Moose browse was generally observed in shrubby habitats. It was recorded at the greatest proportion of sites in tall shrub on riparian peatland (50%) and tamarack-black spruce mixture on wet peatland (45%; Appendix C). Browse was observed at a third of the sites in black spruce mixedwood on mineral or thin peatland, broadleaf treed on all ecosites, low vegetation on mineral and thin peatland, tall shrub on mineral or thin peatland, and tall shrub on wet peatland habitat. No browse was observed in off-system marsh, shallow water, tall shrub on shallow peatland, or tamarack-black spruce mixture on wet peatland habitat. A single site was surveyed in tall shrub on shallow peatland habitat, which probably reduced the likelihood of detecting browse in this habitat type.

The moose population in the Split Lake Resource Management Area and the Moose Regional Study Area (Zone 5) was estimated at 2,600 and 950 individuals, respectively, based on aerial surveys conducted in 2009 and 2010 (Keeyask Hydropower Limited Partnership 2012). Moose density varied throughout the Moose Regional Study Area and ranged from extra low to high (Map 3–3). Habitat quality, predation, and hunting play important roles in moose density and distribution.

Trail cameras and ground tracking transects in potential moose calving habitat in the Project Study Area indicated potential evidence of calving on ten of the 33 islands (33%) surveyed in (Table 3-2). Adult moose activity was documented on 21, or 64%, of the islands surveyed.

Table 3-2: Moose Activity on Calving and Rearing Islands in the Project Study Area, 2010 and 2011

Age of Moose	Number of Islands	Proportion of Islands
Adult	21	0.64
Calf	10	0.30
Total surveyed	33	1.00

3.2.5.2 Caribou

Three types of caribou have been identified in the Keeyask region (see Map 3-1): barren-ground caribou (*Rangifer tarandus groenlandicus)*; coastal caribou (*R. t. caribou*), also known as the forest-tundra migratory woodland caribou ecotype; and boreal woodland caribou (*R. t. caribou*), also known as the forest-dwelling sedentary woodland caribou ecotype. Barren-ground caribou from the Qamanirjuaq herd migrate from Nunavut in autumn to overwinter in Manitoba's forests (Keeyask Hydropower Limited Partnership 2012). Barren-ground caribou are an occasional winter resident, temporarily migrating into the Caribou Regional Study Area (Zone 6). However, they are generally found north of the Nelson River, and while river crossings have been reported (FLCN 2010 Draft; Keeyask Hydropower Limited Partnership 2012) they are not likely to inhabit the Project Study Area. Coastal caribou occupy the Caribou Regional Study Area mainly in winter, and originate from the Pen Islands and the Cape Churchill areas, for which their herds are named. The current range of the Wapisu boreal woodland caribou (*R. t. caribou*) herd (Manitoba Conservation 2005; Environment Canada 2011) near Harding Lake overlaps a small fraction of the southwestern portion of the Caribou Regional Study Area (Manitoba Hydro 2012). Additionally, a group of caribou inhabits the Stephens Lake area in summer, which has been identified as Pen Islands coastal caribou (Manitoba Hydro 2012). As barren-ground caribou and coastal caribou inhabit the area in winter and are thought to depart in spring for their calving grounds, the identity of this group, called summer resident caribou, is uncertain.

Prior to contact with Europeans, residents of the Keeyask region subsisted, in part, on caribou. Families would travel between the region and the arctic coast, following migrating caribou (Keeyask Hydropower Limited Partnership 2012). Today, caribou still play an important role as a food source for First Nations Members, but caribou are harvested to a lesser extent than moose (Keeyask Hydropower Limited Partnership 2012).

Surveys conducted during the 1980s estimated the Qamanirjuaq barren-ground caribou population between 125,000 and 190,000 animals (Beverly and Qamanirjuaq Caribou

Management Board 2002). The 1994 estimate for the Qamanirjuaq herd was about 496,000 animals (Campbell *et al*. 2010). The population was estimated at 348,000 individuals in 2008 (Campbell *et al*. 2010). Few were observed in Manitoba in 2011, and the Qamanirjuaq herd may be in decline (Beverly and Qamanirjuaq Management Board 2011). Barren-ground caribou spend much of the summer in the tundra, beyond the tree line, and overwinter in the boreal forest (Kelsall 1968). They form large herds during the calving season and tend to calve *en masse* and form nursery groups (Kelsall 1968). Previous studies indicate that barren-ground caribou from the Qamanirjuaq herd range as far south as Split Lake and as far east as the Hudson Bay railway track running between Ilford and Churchill (Miller and Robertson 1967; Engin 1996). In the 1990s, there was a limited return of caribou (Engin 1996) while recently, in the winter of 2004–2005, a large number of barren-ground caribou returned to the Caribou Regional Study Area. Current range data for the herd supports this, where the southeastern limit is now near Stephens Lake (WRCS unpubl. data).

Coastal caribou behaviour is similar to that of barren-ground caribou, particularly during calving (Abraham and Thompson 1998). Animals from the Pen Islands herd were only reported in the Caribou Regional Study Area in the 1990s (Thompson and Abraham 1994; Abraham and Thompson 1998). The herd was estimated at 10,000 individuals in 1997 (Keeyask Hydropower Limited Partnership 2012). Aerial surveys of known Pen Islands caribou calving grounds in Manitoba indicate that summer residency has declined in the province and that the majority of observed animals now calve near Cape Henrietta Maria, Ontario, east of their traditional calving grounds near Fort Severn, Ontario (Abraham *et al*. 2012a). Post-calving surveys indicated that the majority of caribou were around Cape Henrietta Maria, but groups of caribou were observed inland in Ontario (Abraham *et al*. 2012a). Eight of the 22 Pen Islands caribou collared between 2010 and 2012 were active in the Project Study Area, with the largest concentrations of GPS locations occurring in the western portion of the Project Study Area around Joslin Lake, south of Gull Rapids (Manitoba Hydro 2012). Data for the rest of the Project Study Area indicated that collared animals made periodic movements through the Gillam area (Manitoba Hydro 2012), and occasionally staged near Gillam and Stephens Lake, south of the Nelson River (Manitoba Hydro 2011b).

The Cape Churchill coastal caribou herd was estimated at approximately 3,000 individuals in 2007 (Abraham *et al*. 2012b) and is currently estimated at 3,500 to 5,000 individuals (Manitoba Hydro 2012). A large migration into the Bipole III Study Area, which is located north of the Project Study Area and the Nelson River, was observed in December 2010 (Manitoba Hydro 2012). This herd generally remains north of the Nelson River, where winter use of the Caribou Regional Study Area has been documented (Manitoba Hydro 2011b). Cape Churchill caribou are unlikely to occur in the Project Study Area

Boreal woodland caribou, which are listed as threatened under SARA and MESA, occurred historically in the Keeyask region, but their current range does not include the Project Study Area (Manitoba Conservation 2005; Environment Canada 2011). They do not tend to form large herds when calving, calve on islands when possible (Thomas and Gray 2002), and can exhibit seasonal movements within a range (Darby and Duquette 1986; Brown *et al*. 2000; Brown *et al.* 2003; Ferguson and Elkie 2004). Manitoba Conservation and Water Stewardship range maps show the Nelson-Hayes boreal woodland caribou herd once occurred within the Project Study Area. It appears the Nelson-Hayes herd blended with the coastal Pen Islands herd and no longer exists as a discrete population (Manitoba Conservation 2005).

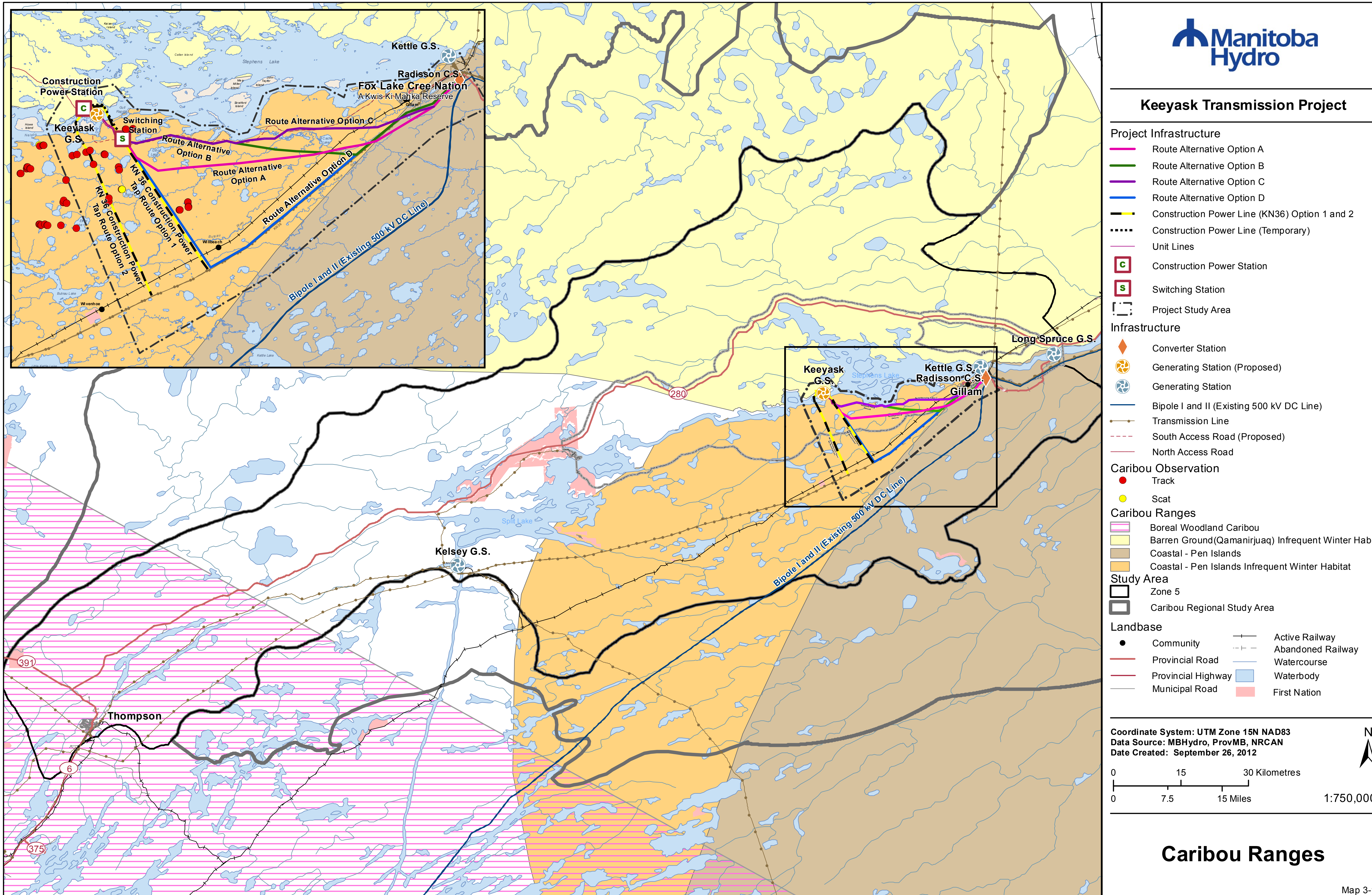
A group of summer resident caribou in the Keeyask region has been observed to calve in isolation or make use of island habitat (Map 3–4), as is characteristic of boreal woodland caribou in Manitoba and elsewhere (Shoesmith and Storey 1977; Hirai 1998; Rettie and Messier 2000). This group of caribou has recently been described as migratory woodland caribou (Keeyask Hydropower Limited Partnership 2012). Summer resident caribou are conservatively estimated to number 20 to 50 individuals in an area slightly broader than the Project Study Area. Based on telemetry data, it has been suggested that these summer residents are Pen Islands caribou, some of which calved in the Caribou Regional Study Area, spent the summer near Gillam, and moved toward Hudson Bay or Ontario for the winter (Manitoba Hydro 2012). During the winter, these animals most likely interact with long-distance migratory caribou, making it difficult to differentiate among caribou populations. The annual home range of collared summer residents was significantly larger than those of individual collared boreal woodland caribou (Manitoba Hydro 2012), and substantially larger than other boreal woodland caribou ranges (*e.g.*, Stuart-Smith *et al*. 1997; Brown *et al*. 2000; Rettie and Messier 2001; Brown *et al.* 2003; Schindler 2005), but the total range was smaller than the entire Pen Islands range that extends to Cape Henrietta Maria in Ontario. It is unclear whether summer residents are boreal woodland caribou or are coastal caribou that do not return north to calve. Regardless of specific type, the occurrence of limited calving and rearing habitat in the Project Study Area is important, and is considered in the habitat assessment.

Signs of caribou activity were relatively abundant on ground tracking transects surveyed in the Project Study Area in summer. Caribou signs were observed in 13 of the 19 habitats surveyed. No signs were observed in aspen mixture, black spruce mixedwood, jack pine pure, tamarack pure, tall shrub, or young regeneration habitat. No signs of caribou activity were observed during the 2010 winter ground tracking surveys (Appendix C). Although winter habitat is limited in the Project Study Area, it appears to be extensive in the Caribou Regional Study Area. Large variations in the number of migratory caribou occupying the Caribou Regional Study Area have been reported historically during winter (Keeyask Hydropower Limited Partnership 2012; Manitoba 2012).

Trail cameras and ground tracking transects in potential caribou calving and rearing habitat in the Project Study Area indicated use by cows with calves on six of the 33 islands (18%) surveyed (Table 3-3). Adult caribou activity was documented on 16, or 48%, of the islands surveyed. Calves or their signs were observed on six, or 18%, of islands surveyed.

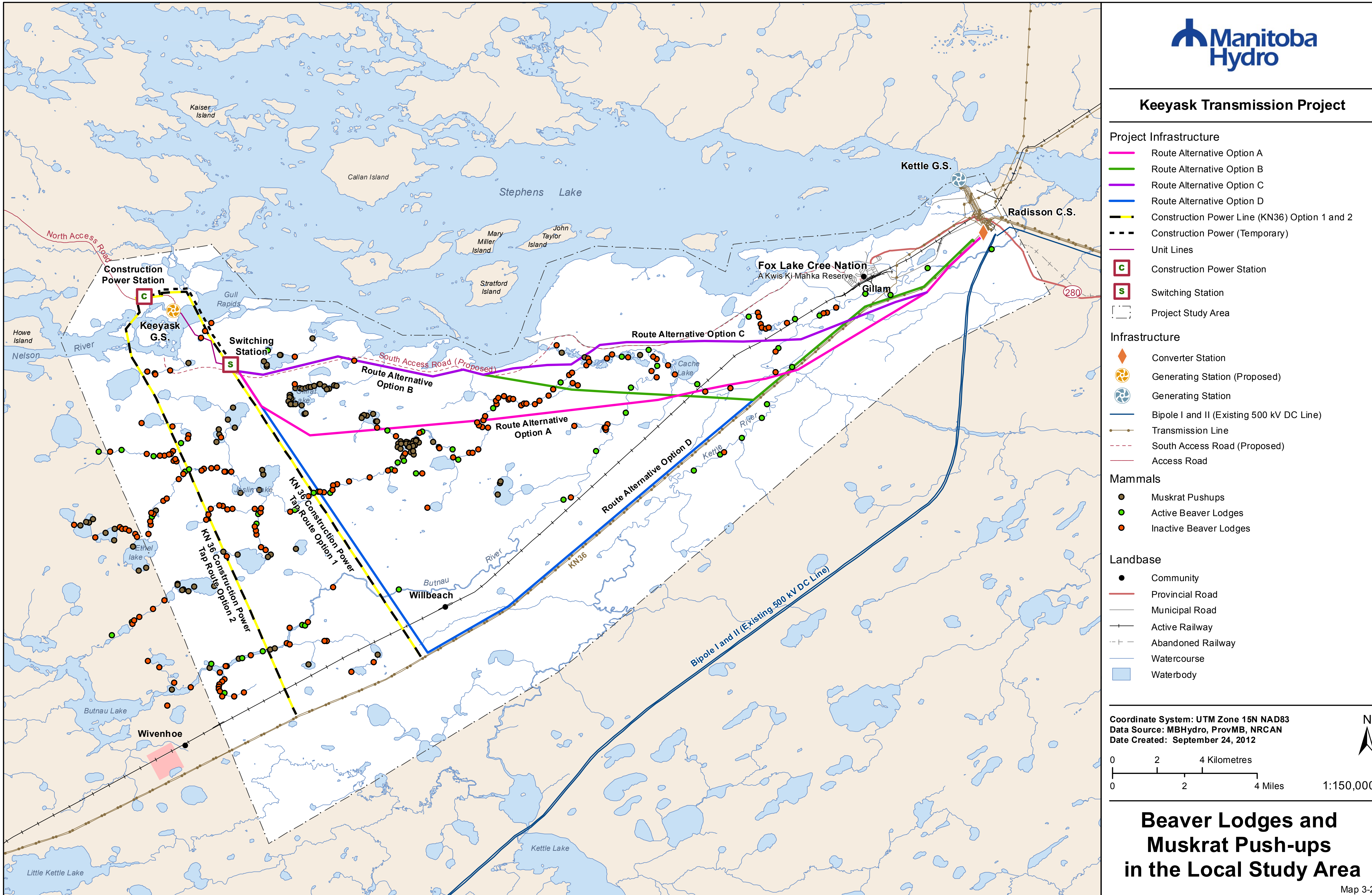
Table 3-3: Caribou Activity on Calving and Rearing Islands in the Project Study Area, 2010 and 2011

Age of Caribou	Number of Islands	Proportion of Islands
Adult	16	0.48
Calf	6	0.18
Total surveyed	33	1.00



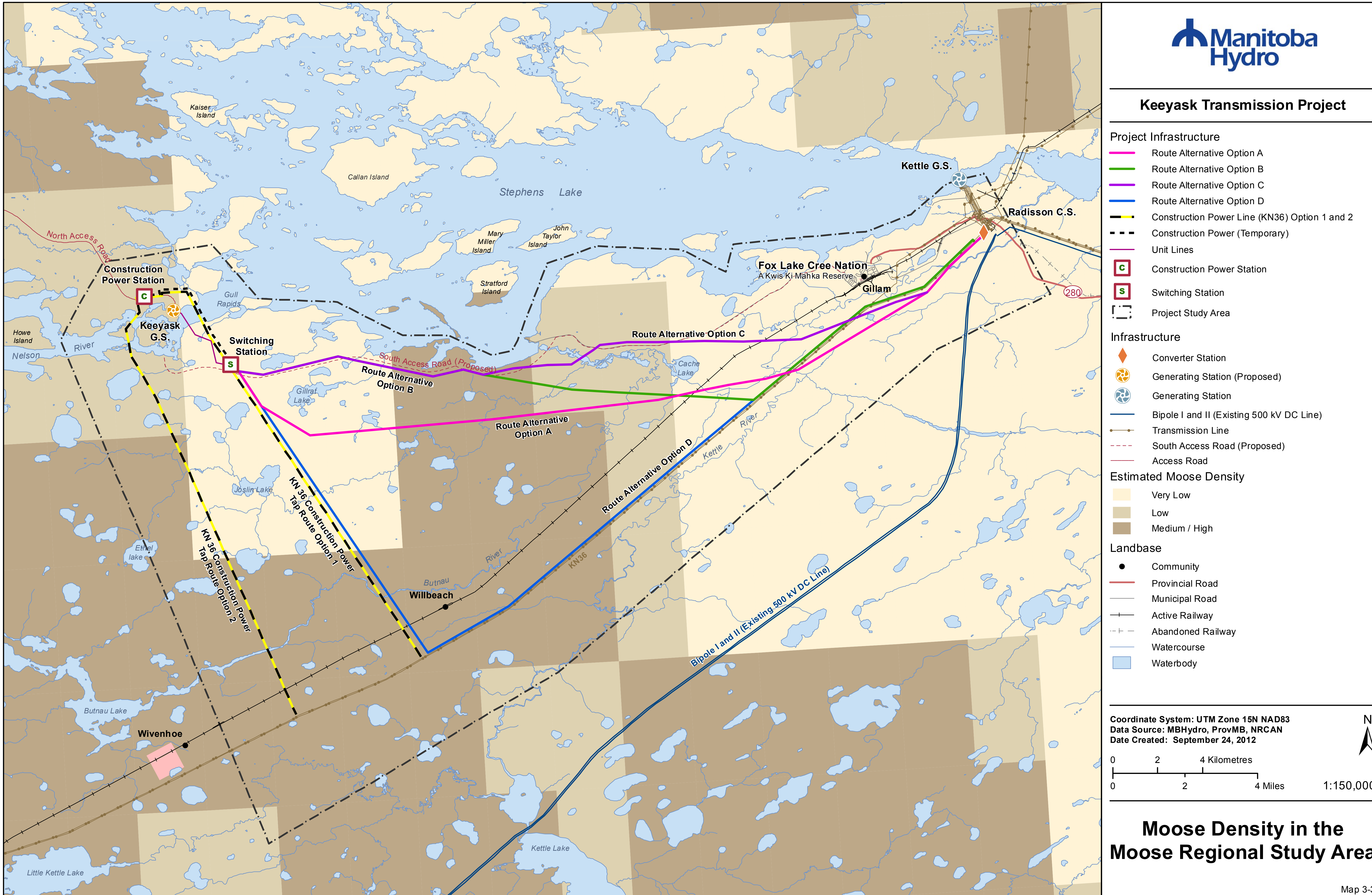
Caribou Ranges

Map 3-1



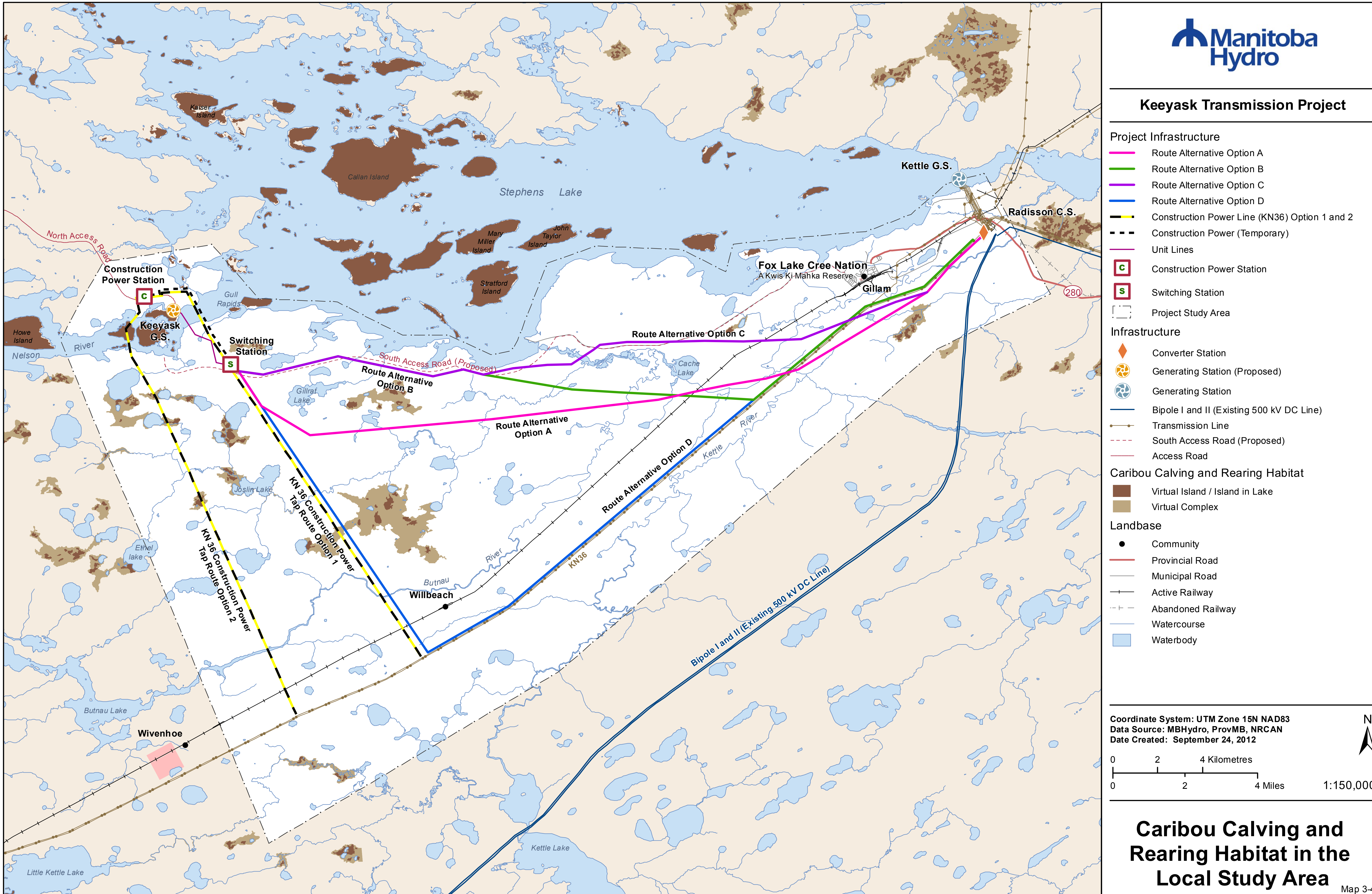
Beaver Lodges and Muskrat Push-ups in the Local Study Area

Map 3-2



Moose Density in the Moose Regional Study Area

Map 3-3



Caribou Calving and Rearing Habitat in the Local Study Area

Map 3-4

4.0 EVALUATION OF ALTERNATIVE ROUTES AND OTHER INFRASTRUCTURE

4.1 ALTERNATIVE ROUTE EVALUATION

An evaluation of two options for Construction Power transmission line (CP) alternative routes (with the Keeyask Construction Power Station and Unit Transmission lines) and four options for Generation Outlet Transmission lines (GOT) route alternative options (with the Keeyask Switching Station and Radisson Converter Station upgrade) was completed by comparing route options and Project infrastructure locations with potentially sensitive mammal habitats. Table 4-1 compares the most sensitive site measures, which are calving islands and stream crossings associated with each of the proposed alternative routes and infrastructure. The potential to affect movements is also characterized.

Table 4-1: Matrix Table of Sensitive Sites and Other Factors Associated With Infrastructure Planned For the Construction Power and Transmission Lines and Associated Structures

Transmission Line	Option/ Structure	Stream Crossings	Calving and Rearing Islands Intersected	Calving and Rearing Islands within 1 km	Calving and Rearing Islands within 1 to 2 km	Calving and Rearing Islands within 2 km	Potential to Affect Movements
Construction Power	CP Route 1	5	0	9	17	26	Low
	CP Route 2	10	5	11	10	21	Low
	Keeyask Construction Power Station	NA	0	1	12	13	Negligible
	Unit Transmission Lines	2	0	6	16	22	Low
Generation Outlet	GOT Route Alternative Option A	10	0	13	12	25	Low
	GOT Route Alternative Option B	14	0	15	11	26	Low

Table 4-1: Matrix Table of Sensitive Sites and Other Factors Associated With Infrastructure Planned For the Construction Power and Transmission Lines and Associated Structures

Transmission Line	Option/ Structure	Stream Crossings	Calving and Rearing Islands Intersected	Calving and Rearing Islands within 1 km	Calving and Rearing Islands within 1 to 2 km	Calving and Rearing Islands within 2 km	Potential to Affect Movements
Generation Outlet	GOT Route Alternative Option C	7	0	13	12	25	Low
	GOT Route Alternative Option D	8	0	3	21	34	Low
	Switching Station	NA	0	1	2	3	Negligible
	Radisson Converter Station	NA	0	0	0	0	None

4.1.1 Construction Power Transmission Line

The Construction Power transmission line would be built to tap the existing 138 kV line (KN 36) to feed the proposed Keeyask Construction Power Station. The approximately 21 km-long line (see Map 1-1) would cross several streams and either black spruce treed on shallow peatland, black spruce treed on thin peatland, and low vegetation on mineral or thin peatland (Terrestrial Habitat, Ecosystems and Plants Technical Report), three common habitats in the Project Study Area. When comparing alternative routes, CP Route 1 would be approximately 20.5 km in length and would cross 5 streams or riparian areas while CP Route 2 would span approximately 21.5 km and would cross 10 streams or riparian areas.

4.1.1.1 Small Mammals

Riparian areas are typically more productive for small mammals and CP Route 2, which has more stream crossings, is expected to have a greater diversity of small mammal species. To minimize potential effects on small mammals, CP Route 1 is preferred. No little brown myotis hibernacula or roosting areas were observed along either route.

4.1.1.2 Aquatic Furbearers

More beaver lodges and muskrat push-ups were observed on CP Route 2 than CP Route 1 during aerial surveys for aquatic furbearers, indicating that the habitat along CP Route 2 could support a greater number of aquatic furbearers due to the greater number of stream crossings along CP Route 2 than along CP Route 1. To minimize potential effects on aquatic furbearers, CP Route 1 is preferred.

4.1.1.3 Terrestrial Furbearers

While no specific studies were done to assess the presence and abundance of terrestrial furbearer species in the Project Study Area, a number of species were detected during winter tracking studies. Signs of American marten, lynx, red squirrel, snowshoe hare, weasel, and fox (species unknown) activity were observed near both Construction Power transmission line alternative routes; neither route is preferred. Additionally, both routes would likely fall within the home range of a single wolverine. Due to the larger number of stream crossings on CP Route 2, CP Route 1 is slightly preferred to reduce potential Project-related effects on terrestrial furbearers.

4.1.1.4 Large Carnivores

Signs of gray wolf and black bear activity were found along both Construction Power transmission line routes; however, more gray wolf signs were found along CP Route 1. Given the large home ranges of both gray wolves and black bears, it is likely that the same individuals would be affected by either route, and therefore, neither route is preferred over the other.

4.1.1.5 Ungulates

Both ungulate species in the Project Study Area are VECs and are considered in Section 4.1.1.6 below.

4.1.1.6 Valued Environmental Components

Moose

In addition to lake and river shorelines, moose use islands in lakes and occasionally in peatland complexes in the Project Study Area for calving and rearing. Adults may also use these habitats for predator protection or summer thermal cover. Some of the potential calving and rearing islands within 2 km of CP Routes 1 and 2 were surveyed for moose presence (see Table 2-1). Not all of the potential habitat was occupied. Adult moose were found on two of the five potential calving and rearing islands bisected by CP Route 2 during field studies in the area. No islands are bisected by CP Route 1, and no moose activity was recorded in the calving and rearing complex traversed by this route. Nine islands are within 1 km of CP Route 1, two of which were occupied by adult moose. Seventeen more islands are within 1 to 2 km of CP Route 1, one of which was occupied by adult moose. Ten islands are within 1 to 2 km of CP Route 2; moose adults and calves were observed on one.

Abundant signs of moose activity were found along CP Route 1 and CP Route 2. Either route is likely to enhance hunter and predator access to moose habitat and improve the line of sight when it is cleared. Because CP Route 1 will cross the fewest streams and calving and rearing islands, it is preferred to minimize potential effects on moose.

Caribou

Summer resident caribou use islands in lakes and in peatland complexes for calving and rearing. No islands are bisected by CP Route 1. Some of the calving and rearing islands within 2 km of CP Routes 1 and 2 were surveyed for caribou presence (see Table 2-1). Not all of the potential habitat was occupied. Nine islands are within 1 km of CP Route 1; caribou adults and calves were documented on one of these islands and adults were documented on another during field studies in the area. Two of the islands within 1 to 2 km of CP Route 1 were occupied by adult caribou. Signs of caribou adults and calves were observed on two of the islands bisected by CP Route 2, and an adult was photographed on another. Additionally, an adult caribou occupied one of the islands within 1 km of CP Route 2.

Signs of caribou activity were found along both routes during field studies. Caribou movements would likely be equally affected by either route based on their proximity to each other and their north-south orientation. Either route is likely to enhance hunter and predator access to caribou habitat and improve the line of sight when it is cleared. Caribou are widespread and few animals are expected to occur along either route. As such, neither is more likely than the other to affect caribou movements and mortality. Because CP Route 1 will cross the fewest calving and rearing islands, it is likely a better option to minimize potential effects on caribou.

4.1.1.7 Construction Power Transmission Line Preference for Mammals

Based on field studies, mapping, literature, and professional judgment, CP Route 1 is preferred from a mammal's perspective. CP Route 1 is marginally preferred for moose because potential moose habitat loss would be lower and there would be less fragmentation along the slightly shorter route. CP Route 1 is highly preferred from a caribou perspective because it would not cross any potential calving and islands compared with five islands on CP Route 2. Neither alternative is preferred for listed species; no site-specific habitat differences were observed for little brown myotis or wolverine. Wolverine tend to occupy large home ranges, and because the separation distance between the proposed alternatives is so small geographically, the alternate placement of CP Route 1 or 2 would make little difference concerning habitat or fragmentation effects. CP Route 1 is also the slightly preferred option for other mammals because it has fewer potential fragmentation effects as it is the shorter route, and because potential habitat loss and access effects would be slightly less on CP Route 1 than on CP Route 2 because the diversity of mammals is somewhat lower and less riparian habitat would be crossed on CP Route 1 than on CP Route 2.

4.1.2 Keeyask Construction Power Station

The proposed new 138 to 12.47 kV permanent wood-pole/steel transformer station will be located on the north side of the Nelson River (see Map 1–1) in a mostly burned area containing 1 to 2 m-high regenerated conifers. The transformer station will be built on a 2 ha site that will accommodate three transformer banks to supply the necessary power for construction of the Keeyask Generating Station.

The site of the Keeyask Construction Power Station is in a common habitat type and does not affect uncommon habitats, minimizing potential effects on small mammals, furbearers, large carnivores, moose, and caribou. No calving and rearing islands are in the immediate area. As the proposed power station site is limited in scope and scale and does not intersect any streams, it will not likely affect caribou movements. Because the site will likely have a small effect on mammals and their habitat, no alternative locations were assessed.

4.1.3 Unit Transmission Lines

Four 138 kV AC Unit Transmission lines will transmit power from the seven generators at the Keeyask Generating Station to the Keeyask Switching Station. The four lines, each approximately 4 km long, will be within a single corridor (see Map 1–1) and will form a 260 m-wide ROW. No alternative routes were identified for the Unit Transmission lines. Most of the affected habitat is black spruce treed on shallow peatland and black spruce treed on thin peatland, which are common in the Project Study Area (Terrestrial Habitat, Ecosystems and Plants Technical Report). It is anticipated that because the Unit Transmission lines will occur in the immediate area of the Keeyask Generating Station, effects on mammal species will be negligible compared to those of the nearby generating station. Traffic on the south access road, which will connect the generating station with the community of Gillam, will also affect mammals in the footprint of the Unit Transmission lines.

4.1.4 Keeyask Switching Station

A switching station is proposed south of the Nelson River to accommodate the new transmission lines (see Map 1–1). Power from the proposed Keeyask Generating Station will be delivered to the Keeyask Switching Station by four 138 kV Generation Outlet Transmission lines with steel-lattice towers (Keeyask Transmission Project Environmental Assessment Report Section 2). Habitat at the site is predominantly needleleaf treed on peatland, which is common in the Project Study Area (Terrestrial Habitat, Ecosystems and Plants Technical Report) and areas near the site have been described as good moose habitat (Manitoba Hydro and Fox Lake

Cree Nation Core Elder and Resource User Group Keeyask Transmission Project Workshop June 13, 2012). No streams run through the site. There is one calving and rearing complex approximately 1 km northeast of the site, and a second calving area within 2 km. Because the site is about 1 km away from the nearest potential calving and rearing complex, its use by moose or caribou will not likely be affected. Because the switching station site itself is limited in scope and scale, it is highly unlikely to affect caribou movements in the area. As the site does not overlap uncommon habitat or calving and rearing habitat, potential effects on mammals will be minimal. As such, there is no need to assess an alternative switching station site.

4.1.5 Generation Outlet Transmission Lines

Manitoba Hydro is proposing to construct Generation Outlet Transmission lines from the Radisson Converter Station to the Keeyask Construction Power Station, as a source of backup power during construction of the Keeyask Generating Station (see Map 1–1). Once the generating station is complete, a portion of the KR1 from near the proposed Keeyask Switching Station to the Keeyask Construction Power Station will be salvaged, and KR1 will terminate at the Keeyask Switching Station. Two additional 138 kV transmission lines (KR2 and KR3) will be built from Radisson Converter Station to the new Keeyask Switching Station (Keeyask Transmission Project Environmental Assessment Report Section 2).

Habitat in the areas of the four GOT Route Alternative Options (A, B, C, and D) consists primarily of black spruce treed on thin peatland, black spruce treed on shallow peatland, and black spruce treed on mineral soil, which are all common in the Project Study Area (Terrestrial Habitat, Ecosystems and Plants Technical Report). Uncommon habitats include broadleaf treed on mineral soil, broadleaf treed on peatland, and tall shrub or low vegetation on mineral soil. GOT Route Alternative Option A crosses the most (n = 14) streams and GOT Route Alternative Option C crosses the fewest (n = 7; see Table 4-1). GOT Route Alternative Options B and C are the shortest of the four routes. No clear determination of a preferred route could be made based on results of field studies. Identification of the preferred Generation Outlet Transmission lines route was based on habitat characteristics in the Project Study Area and their importance to mammal communities.

4.1.5.1 Small Mammals

While no studies were conducted for small mammals along the proposed routes, incidental observations of small mammal signs were recorded opportunistically with winter mammal tracking surveys. No little brown myotis hibernacula or roosting areas were observed along either route. Riparian areas are typically more productive for small mammals and the route with more stream crossings may support larger small mammal communities. Based on the number of stream crossings, GOT Route Alternative Option C or D is marginally preferred for small mammals.

4.1.5.2 Aquatic Furbearers

Aerial surveys for aquatic furbearers indicated that beavers were most numerous along GOT Route Alternative Options A, B, and C, in descending order. In spring, the most muskrat push-ups were counted on GOT Route Alternative Option C and the fewest on GOT Route Alternative Option A. Signs of river otter activity were observed on GOT Route Alternative Options A, B, and C during ground tracking surveys. GOT Route Alternative C or D, with the fewest stream crossings, would likely have the smallest effect on river otter habitat. Because GOT Route Alternative Options C and D cross the fewest streams, they are slightly preferred for aquatic furbearers.

4.1.5.3 Terrestrial Furbearers

During ground tracking surveys, a greater diversity of terrestrial mammal species was observed on GOT Route Alternative Option C than on GOT Route Alternative Options A and B. As the shortest routes, GOT Route Alternative Options B and C would likely affect less terrestrial furbearer habitat than GOT Route Alternative Options A and D. The entire Project Study Area would likely fall within the home range of one or a few wolverine. GOT Route Alternative Options B and C are slightly preferred for wolverine, largely because the routes are shorter and follow existing human features. Based on species diversity and the length of the route, GOT Route Alternative Option B would be preferred from a terrestrial furbearer perspective.

4.1.5.4 Large Carnivores

Gray wolf and black bear activity was recorded on GOT Route Alternative Options A, B, and C during ground tracking surveys. The level of large carnivore activity was generally similar on each route, with one exception. More gray wolf signs were observed on GOT Route Alternative Option A than on GOT Route Alternative Options B and C in summer. Because large carnivores are wide-ranging and do not appear to favour particular habitat types, none of the routes are preferred.

4.1.5.5 Valued Environmental Components

Moose

Ground tracking surveys indicated varying levels of moose activity on the three alternative routes surveyed. The most moose signs were recorded on GOT Route Alternative Option C and the fewest on GOT Route Alternative Option A during summer ground tracking surveys. In winter, the reverse was true.

In addition to lake and river shorelines, moose use islands in lakes and occasionally, peatland complexes in the Project Study Area for calving and rearing. Adults may also use these habitats for predator protection or summer thermal cover. None of the four alternative routes intersects potential calving and rearing islands. Some of the calving and rearing islands within 2 km of GOT Route Alternatives A through D were surveyed for moose presence (see Table 2-1). Adult moose were found on 1 of the calving and rearing islands within 1 km of GOT Route Alternative A during field studies in the area. Adult moose were observed on one of the islands within 1 km of GOT Route Alternative Option B and on one of the islands within 1 km of GOT Route Alternative Option C. Of the islands within 1 km of GOT Route Alternative D, adult moose were observed on two. Adult moose were observed on one of the islands within 1 to 2 km of GOT Route Alternative Option A, on one of the islands within 1 to 2 km of GOT Route Alternative Option B, on one of the islands within 1 to 2 km of GOT Route Option C, and in the peatland complex of 21 islands within 1 to 2 km of GOT Route Alternative Option D.

Recorded signs of moose activity appeared to be distributed evenly among the routes sampled. It is expected therefore, that all proposed routes will increase hunter and predator access to moose in the Project Study Area to some degree along the cleared ROW. However, GOT Route Alternative Option D follows pre-existing linear features including KN36, so new access would be minimized. GOT Route Alternative Options B and C will closely parallel the south access road and will therefore not create new access. GOT Route Alternative Option A is the only route that would create new access in a previously remote area. GOT Route Alternative Option D intersects one calving and rearing complex, in which moose have been observed. GOT Alternative Route D is slightly less preferred over Routes B and C because of the marginally wider sight-line created by this route that is expected to increase hunting opportunities. While none of the options would likely lead to large alterations in the distribution and abundance of local moose populations, GOT Route Alternative Options B and C are shortest, and are the preferred routes.

Caribou

Ground tracking surveys indicated varying levels of caribou activity on the three alternative routes surveyed. The most caribou signs were recorded on GOT Route Alternative Option C and the fewest on GOT Route Alternative Option A.

Summer resident caribou use islands in lakes and in peatland complexes for calving and rearing. None of the four routes intersects potential calving and rearing islands. Some of the calving and rearing islands within 2 km of GOT Route Alternatives A through D were surveyed for caribou presence (see Table 2-1) Adult caribou were found on two of the islands within 1 km of GOT Route Alternative A during field studies in the area. Adult caribou were observed on one of the islands within 1 km of GOT Route Alternative Option B and on one of the islands within 1 km of GOT Route Alternative Option C. Of the islands within 1 km of GOT Route Alternative D, adult caribou were observed on two. Adult moose were observed on one of the islands within 1 to 2 km of GOT Route Alternative Option A, on one of the 11 islands within 1 to 2 km of GOT Route Alternative Option B, on one of the 12 islands within 1 to 2 km of GOT Route Option C, and none were observed on the 21 islands within 1 to 2 km of GOT Route Alternative Option D.

Potential caribou migration corridors are generally widespread in the Keeyask region. However, GOT Route Alternative Option D, which is farthest south, would likely intersect the greatest number of migrating Pen Islands caribou most frequently. Although caribou would be distributed relatively equally by all of the routes, GOT Route Alternative Option D is the slightly less preferred option for this reason. All of the routes will increase hunter and predator access into the Project Study Area through the creation of cleared linear corridors. However, GOT Route Alternative Option D would marginally increase access along pre-existing linear features, GOT Route Alternative Options B or C would marginally increase access along the south access road, and GOT Route Alternative Option A would create new access in an area that does not have pre-existing linear features. The construction of an additional ROW adjacent to KN36 may increase available hunter sightlines such that the placement of this route could lead to proportionally higher numbers of migrating caribou being successfully hunted. GOT Route Alternative Options B and C will closely parallel the south access road and will therefore not create a new corridor for hunter and predator access. Hunting restrictions would apply adjacent to the road. For all of the above listed reasons, GOT Route Alternative Options B and C are the preferred routing options for caribou.

4.1.5.6 Generation Outlet Transmission Lines Preference for Mammals

Based on field studies, mapping, literature, and professional judgement, GOT Route Alternative Option B or C is moderately preferred over GOT Route Alternative Options A and D from a mammal's perspective because GOT Route Alternative Option B or C would have the fewest adverse Project effects on caribou and moose. GOT Route Alternative Options C and D, with the fewest stream crossings, are slightly preferred from an aquatic furbearer perspective. GOT Route Alternative Options B and C are moderately preferred from a caribou perspective because these shorter routes would disturb fewer caribou calving islands and result in the lowest habitat loss. GOT Route Alternative Options B and C are slightly preferred from a moose perspective because potential habitat loss and fragmentation effects would be lower on these shorter routes. Route Alternative Options B and C are slightly preferred for wolverine, largely because the routes are shorter and follow existing human features. No substantial little brown myotis habitat differences are apparent on any of the routes. GOT Route Alternative Options B and C are also the slightly preferred options for other mammals because they are the shorter routes, and potential habitat loss and access effects would be slightly less than on the other routes.

4.1.6 Radisson Converter Station Upgrades

The selected site for the Radisson Converter Station upgrades is currently located next to the Radisson Converter Station. Alternative sites were not provided for assessment. The Radisson Converter Station expansion is relatively small and appears to be contained within a previously fenced-in and disturbed area. As such, only small and incremental mammal habitat effects are anticipated at this location.

4.1.7 Summary of Inputs

The construction of project components associated with the Keeyask Transmission Project is anticipated to only have minor potential impacts on local mammal populations, regardless of the location selected. However, where alternative routing options were available for specific project components, it was determined that CP Route 1 was preferred as it is most likely to minimize potential projects effects for moose and caribou. Similarly for the GOT Route Alternative Options, GOT Route Alternative Options B and C are considered as equally viable for mammal species including moose and caribou, when considering the alternate General Outlet Transmission Line routing options.

No options were considered for the Keeyask Switching Station, Keeyask Construction Power Station, Unit Transmission lines, and the Radisson Converter Station upgrades. These project components are relatively small compared to routing options considered for Construction Power and General Outlet transmission lines and are anticipated to have only minor effects on mammal species in the Project Study Area.

5.0 EFFECTS AND MITIGATION

5.1 OVERVIEW

This section considers potential effects of the Project based on the final preferred sites for each Project component. The selection process that resulted in the final preferred sites is described in Chapter 6 of the Keeyask Transmission Project Environmental Assessment Report. CP Route 1 was selected for the Construction Power transmission line. The preferred route for the Generation Outlet Transmission line followed GOT Route Alternative Option B for most of the approximately 14 km of line extending eastward from the Keeyask Switching Station; the remainder of the line extending to the Radisson Converter Station followed GOT Route Alternative Option C.

A range of effects on mammal species can be associated with the development of infrastructure related to the Project. Changes in species diversity and abundance occur through the anthropogenic development of habitat areas such that these areas are no longer able to sustain some species. Changes in habitat composition can also lead to increases in the abundance of other species, such as increases in white-tailed deer populations in southern Manitoba, which can lead to increased competition for resources between wildlife species where none existed before. Construction of Project components can lead to sensory disturbance and discourage species' use of habitats. Operation of Project components can lead to increased opportunities for harvesting species by hunting, trapping, and poaching. While these activities can occur in a sustainable manner with regulation or enforcement, if done in excess they can lead to local and potentially regional declines in some mammal populations.

In this assessment, particular attention was given to the potential effects of the Project on VECs. However, effects are also anticipated for non-VEC species. Species of cultural and economic importance, including beaver and muskrat, could be affected by the construction and operation of Project components if riparian habitat is affected or if considerably improved access leads to an increase in trapping. Potential effects on these species were mitigated by selecting transmission line routes to minimize the number of stream crossings and to avoid areas that have not yet been altered through large-scale anthropogenic development. Reducing access to previously undisturbed areas and minimizing effects on sensitive habitat areas will also likely reduce potential Project effects on mammal species, including VECs considered in more detail below.

Clearing, construction, operation, and maintenance of the Construction Power transmission line, Generation Outlet Transmission lines, Unit Transmission lines, Keeyask Construction Power Station, Keeyask Switching Station, and the Radisson Converter Station upgrades could affect moose and caribou directly and indirectly in three primary ways:

- Habitat loss and alteration;
- Sensory disturbance, disruption of movement, and habitat fragmentation; and
- Mortality.

Mammals are expected to experience a loss of habitat and change in habitat structure and composition through the clearing and construction of transmission lines and associated Project infrastructure. The effects of habitat alteration could have more pronounced effects on some species, such as caribou, than others, such as large carnivores.

Sensory disturbance and habitat fragmentation will likely affect mammals in the Project Study Area, and could result in disruption of movements. Sensory disturbance will likely be due to construction activities and traffic. Such disturbances could decrease the amount of effective habitat available for various species, as individuals disturbed by construction activities will avoid active construction zones. Avoidance of the area by wildlife is a concern for FLCN Members (Manitoba Hydro and Fox Lake Cree Nation Core Elder and Resource User Group Keeyask Transmission Project Workshop September 6, 2012). Sensory disturbance could also be due to transmission line maintenance during operation. Transmission line rights-of-way and access trails contribute to habitat fragmentation, which reduces core area size for mammals requiring large, undisturbed blocks of habitat. Fragmentation also influences ecosystem processes and species. Fragmentation effects are discussed in detail in the Terrestrial Habitat Ecosystem and Plants Technical Report. Sensory disturbance and habitat fragmentation could result in avoidance of the Project Study Area by mammals, disrupting their movements. Such disruptions could occur temporarily during construction or over a longer term due to the presence of transmission line rights-of-way and Project infrastructure.

Mammal mortality could occur as a result of improved access to the Project Study Area by hunters, trappers, and predators, and via accidents such as collisions with vehicles. Linear features including roads and transmission lines act as movement corridors for predators such as red fox and gray wolf, and improve access to formerly remote areas by resource users. Increased mortality of prey species and harvested animals could result from increased access to the Project Study Area. Improved hunting efficiency could benefit some predator species.

A literature review for potential effects related to general transmission line construction, operation, and maintenance activities was conducted, and where information was limited, information from similar projects and activities has been provided. Benchmarks and thresholds that were used to evaluate residual environmental effects were the same as for the Keeyask Generation Project EIS (Keeyask Hydropower Limited Partnership 2012).

Because the SSEA process was used to determine the ideal locations for Project infrastructure, it is expected that many potential negative effects will have been mitigated entirely or minimized for mammals including small mammals, aquatic furbearers, terrestrial furbearers, large carnivores, and ungulates. In addition, clearing and construction activities will be limited to the winter months, reducing some environmental effects but potentially increasing others. Generally, construction-related effects should be minimal, as Manitoba Hydro's current fire protection practices, oil containment, and materials handling/spill response practices will be applied throughout the construction and operation phases (Environmental Protection Plan). Mitigation for accidents and malfunctions includes planned measures such as training in fire response protocols, and the presence of fire suppression equipment on site will reduce the extent of fire damage. Spill response programs and equipment will be in place for spillage or leaks of any oils or contaminants. All material will be stored and handled in accordance with established policies and regulations. Legislation and regulations will be followed for the transportation of dangerous goods, and on-site emergency response teams will receive training with respect to fuel spill containment, cleanup, and other emergency measures.

5.2 VALUED ENVIRONMENTAL COMPONENTS

5.2.1 Moose

5.2.1.1 Construction

Habitat loss and alteration is expected along the ROWs from the clearing of vegetation and construction of the Generation Outlet Transmission lines, Construction Power transmission l*ine, an*d Unit Transmission lines. Moose will likely take advantage of the new forage regenerating on the ROW (Peek *et al.* 1976; Banfield 1987; Rempel *et al.* 1997; Coady 1982; Pattie and Hoffman 1990; Peek 2007), but winter and summer **thermal and snow interception cover** may be reduced in areas where trees are removed (Coady 1974; Peek *et al.* 1976; Demarchi and Bunnell 1993; Osko and Hilz 2004). Habitat loss is expected within the Keeyask Construction Power Station and Keeyask Switching Station footprints because moose will be excluded from the infrastructure.

Based on the results of a desktop habitat modelling exercise, the Construction Power transmission line footprint consists of 4.1% primary moose habitat and 83.2% secondary moose habitat (Table 5-1, Map 5–1). Because the footprint only encompasses an area of 755 ha, the amount of moose habitat lost is expected to be small.

Table 5-1: Moose Habitat (ha) Overlapped by Components of the Keeyask Transmission Project

	Coarse Habitat	CP Route 1	Unit Transmission Lines	GOT Route Alternative Option B	Keeyask Switching Station	Total
Primary Moose Habitat	Broadleaf mixedwood on all ecosites	0	0	4	0	4
	Broadleaf treed on all ecosites	0	0	11	0	11
	Jack pine mixedwood on mineral or thin peatland	0	0	8	0	8
	Jack pine treed on mineral or thin peatland	6	0	41	0	47
	Jack pine treed on shallow peatland	0	0	0	0	0
	Low vegetation on mineral or thin peatland	19	0	126	0.1	145
	Tall shrub on mineral or thin peatland	1	0.1	6	0	7
	Tall shrub on shallow peatland	0	0.1	1	0	1
	Tall shrub on wet peatland	5	0	3	0	8
	Total Primary Habitat	31	1.4	200	0.1	226
	Total Terrestrial Area	755	86	1,583	68	2,492
	Habitat: Terrestrial	4.1%	0.1%	14.1%	0.1%	10.2%
Secondary Moose Habitat	Black spruce mixedwood on mineral or thin peatland	0	0	10	0	10
	Black spruce treed on mineral soil	19	0.3	102	9	130
	Black spruce treed on shallow peatland	311	46.0	339	35.3	731
	Black spruce treed on thin peatland	181	21.1	501	21.6	725

Table 5-1: Moose Habitat (ha) Overlapped by Components of the Keeyask Transmission Project

	Coarse Habitat	CP Route 1	Unit Transmission Lines	GOT Route Alternative Option B	Keeyask Switching Station	Total
Secondary Moose Habitat	Black spruce treed on wet peatland	17	0	52	0	69
	Low vegetation on shallow peatland	85	4.4	164	1.7	255
	Low vegetation on wet peatland	15	0	47	0	62
	Total Secondary Habitat	628	71.8	1,215	67.6	1,978
	Total Terrestrial Area	755	86	1,583	68	2,492
	Habitat: Terrestrial	83.2%	83.5%	76.8%	99.4%	79.4%
Total Moose Habitat	Total Secondary Habitat	659	67.4	1,415	67.6	2,232
	Total Terrestrial Area	755	86	1,583	68	2,492
	Habitat: Terrestrial	87.3%	78.5%	89.4%	99.6%	89.6%

The Keeyask Construction Power Station overlaps pre-existing human infrastructure and clearing associated with the construction of the north access road, thus no additional moose habitat will be lost.

The Unit Transmission lines footprint consists of 0.1% primary moose habitat and 83.5% secondary moose habitat. Because the footprint only encompasses an area of 86 ha, the amount of moose habitat altered is expected to be small.

The Generation Outlet Transmission lines footprint consists of 14.1% of primary moose habitat and 76.8% secondary moose habitat. Because the footprint only encompasses an area of 1,583 ha, the amount of moose habitat altered is expected to be small.

The Keeyask Switching Station footprint consists of 0.1% of primary moose habitat and 99.4% secondary moose habitat. Because the footprint only encompasses an area of 68 ha, the amount of moose habitat lost is expected to be small.

The Radisson Converter Station upgrades overlap pre-existing human infrastructure and clearing associated with current Radisson Converter Station site and consequently no moose habitat will be lost during construction.

Based on the overall results of habitat modelling, the Keeyask Transmission Project footprint consists of 10.2% of primary moose habitat and 79.4% secondary moose habitat. The total physical moose habitat altered or lost for all Project components encompasses an area of 2,492 ha, or approximately 4% of the Project Study Area. The effect of habitat loss (~0.5%) is expected to be small, compared with the amount of primary moose habitat available in the Moose Regional Study Area (465,018 ha).

Sensory disturbances (*e.g.*, traffic, machinery) could result in a loss of effective habitat, temporary abandonment of calving habitat, and disruption of movements. Moose will be scared off by the activity (Manitoba Hydro and Fox Lake Cree Nation Core Elder and Resource User Group Keeyask Transmission Project Workshop June 13, 2012). Moose exhibit a high level of calving site fidelity and do not easily abandon suitable areas (RRCS 1994); often returning once the disturbance ends (Colescott and Gillingham 1998). Moose cows and calves were often reported by workers during the construction of the Wuskwatim Generating Station, and overall moose activity levels during construction remained high throughout the access road construction period, indicating that construction activity does not affect all moose (Wuskwatim Power Limited Partnership 2011). Disruption of moose movements could occur through the avoidance of the Construction Power transmission line, Keeyask Construction Power Station, Unit Transmission lines, Keeyask Switching Station, and Generation Outlet Transmission lines sites during construction. Moose occasionally move across or along linear features, even during construction (Wuskwatim Power Limited Partnership 2011). Because moose do not easily abandon habitat due to sensory disturbance, and are likely to return when the disturbance ends, the effects of sensory disturbance and disruption of movements on moose in the Project Study Area are expected to be negligible to small.

Other Project effects on moose could include increased mortality hunting and predation, as the newly created ROW will allow for additional access into areas not previously accessible, possibly resulting in the reduction of a population (Coady 1982). Hunters include workers and local resource users. Increased site lines especially on wider ROWs such as the Generation Outlet Transmission lines, and more efficient movement of predators such as gray wolves could also contribute to moose mortality (Jalkotzy 1997). Gray wolves use cleared linear corridors as transportation routes and in order to hunt more efficiently (James and Stuart-Smith 2000). Similarly, potential effects will likely be reduced due to sensory disturbances by people, construction, and traffic during construction. With mitigation and the regulation and monitoring of moose harvest by Manitoba Conservation and Water Stewardship, the moose harvest will not likely exceed sustainable limits and is expected to have a negligible effect on the regional moose population.

Potential Project effects on moose also include mortality due to wildlife-vehicle collisions. The number of collisions with vehicles could increase due to increased traffic levels during construction. Wildlife-vehicle collisions can be influenced by adjacent habitats (Dussault *et al.* 2007; Christie and Nason 2004) as moose use certain habitats more than others. Due to the existing terrain along the ROW and cautionary speed limits, the risk of collisions is very low. While vehicles may occasionally collide with moose, particularly on the south access road, due to increased local construction traffic, such events are uncommon and will likely have a negligible effect on the regional moose population.

Mitigation measures for moose during construction include:

- An Access Management Plan will be developed for the Keeyask Transmission Project to reduce the effects of moose mortality from increased access and harvest in the Project Study Area;
- Vegetation buffers will be established on the transmission line ROWs as practicable to reduce the line of sight between hunters and moose;
- Firearms will be prohibited in camps and at work sites to reduce mortality due to hunting during construction; and
- Information about wildlife awareness will be provided for workers to reduce vehicle speeds and the risk of wildlife-vehicle collisions.

5.2.1.2 Operation

Potential Project effects on moose during operation include habitat alteration. No additional loss of moose habitat is expected during operation; however, vegetation on the ROW is expected to stabilize into low-growth plant communities over time. Periodically, these ROWs will require vegetation maintenance to maintain the low-growth plant communities, and this will alter habitat. Shrubland habitat types are favourable to moose for foraging (Richard and Doucet 1999) and moose will likely take advantage of the regenerating forage on the ROW (Peek *et al.* 1976; Banfield 1987; Rempel *et al.* 1997; Coady 1982; Pattie and Hoffman 1990; Peek 2007). This could result in a small increase in moose feeding habitat along the ROW (see Map 5–1); however, thermal cover could be reduced in some areas (Osko and Hilz 2004) over the long-term. The overall quality of moose habitat in the Project Study Area is not anticipated to change.

Potential Project effects on moose during operation also include sensory disturbance, disruption of movements, and habitat fragmentation. Annual inspections of the Construction Power transmission line, Unit Transmission Lines, and the Generation Outlet Transmission lines by ground or by air could disturb moose; however, such events will be brief and infrequent. Maintenance activities follow well-established guidelines (Keeyask Transmission Project Environmental Assessment Report Section 2), and effects of sensory disturbance on the regional moose population are expected to be negligible. Moose movements in the area could be disrupted due to habitat fragmentation and the presence of Project infrastructure. Moose are resilient to development features on the landscape (Laurian *et al*. 2008) and often use edge habitat (Dussault *et al.* 2005). As such, disruption of moose movements by the transmission line ROWs will likely be negligible.

Other Project effects on moose could include increased mortality. The cleared transmission line ROWs will likely increase hunter and predator access into the Project Study Area, which can result in increased moose mortality. Species such as gray wolves have been shown to use cleared linear corridors as transportation routes and in order to hunt more efficiently (James and Stuart-Smith 2000). Similarly, hunters can use clearings to access areas that were previously inaccessible. With mitigation, including the continued regulation and monitoring of moose harvest by Manitoba Conservation and Water Stewardship, the moose harvest will not likely exceed sustainable levels and is expected to have a negligible effect on the regional moose population. Collisions with vehicles could increase if moose are attracted to the Generation Outlet Transmission lines ROW adjacent to the south access road. While vehicles may occasionally collide with moose, such events are uncommon and will likely have a negligible effect on the local moose population.

Mitigation measures for moose during operation include:

- ROW access trails will be decommissioned, unless required for on-going maintenance, to minimize access-related effects from harvest and predation;
- If moose mortality is greater than anticipated, warning signs will be placed along the south access road near high-quality moose habitats to reduce the potential of wildlife-vehicle collisions; and
- The use of helicopters for maintenance activities on the transmission lines will be avoided near calving habitat from May 15 to June 30, to reduce effects of sensory disturbance on calving females and their young.

5.2.2 Caribou

5.2.2.1 Construction

Potential Project effects on caribou during construction include habitat loss or alteration (Table 5-2, Map 5–2). Based on the results of a desktop habitat modelling exercise, the Construction Power transmission line footprint consists of 74% caribou winter habitat. As the footprint only encompasses an area of 755 ha, the actual amount of winter habitat lost is expected to be small. No potential calving and rearing islands will be intersected by the Construction Power transmission line ROW (see Section 4.1.1.6).

Table 5-2: Caribou Winter Habitat (ha) Overlapped by Components of the Keeyask Transmission Project

Coarse Habitat	CP Route 1	Unit Transmission Line	GOT Route Alternative Option B	Keeyask Switching Station	Total
Black spruce treed on mineral soil	19	0.3	102	9	130
Black spruce treed on shallow peatland	311	46.0	339	35.3	731
Black spruce treed on thin peatland	181	21.1	501	21.6	725
Black spruce treed on wet peatland	17	0	52	0	69
Jack pine treed on mineral or thin peatland	6	0	41	0	47
Jack pine treed on shallow peatland	0	0	0	0	0
Tamarack- black spruce mixture on wet peatland	3	0	15	0	18
Tamarack treed on shallow peatland	11	7.7	24	0.3	43
Tamarack treed on wet peatland	14	0	2	0	16
Total Winter Habitat	562	75.1	1,076	66	1,791
Total Terrestrial Area	755	86	1,583	68	2,492
Habitat:Terrestrial	74%	87%	68%	98%	71%

The Keeyask Construction Power Station overlaps pre-existing human infrastructure and clearing associated with the construction of the north access road, thus no additional caribou habitat will be lost.

The Unit Transmission lines footprint consists of 87% of caribou winter habitat. As the footprint only encompasses an area of 86 ha, the amount of caribou winter habitat lost is expected to be small. No calving and rearing complexes are intersected by the Unit Transmission lines ROW.

The Generation Outlet Transmission lines footprint consists of 68% caribou winter habitat. As the footprint only encompasses an area of 1,583 ha, the amount of caribou habitat lost is expected to be small. No calving and rearing islands are intersected by the Generation Outlet Transmission lines ROW.

The Keeyask Switching Station footprint consists of 98% caribou winter habitat. As the footprint only encompasses an area of 68 ha, the amount of caribou habitat lost is expected to be small. No calving and rearing islands are in the Keeyask Switching Station footprint.

The Radisson Converter Station upgrades overlap pre-existing human infrastructure associated with the current Radisson Converter Station site and consequently no caribou habitat will be lost during construction.

Based on the overall results of habitat modelling, the Keeyask Transmission Project footprint consists of 71% caribou winter habitat. The total physical caribou winter habitat altered or lost for all components of the Keeyask Transmission Project encompasses an area of 1,791 ha, or approximately 3% of the Project Study Area. The effect of habitat loss (~0.2%) is expected to be small, compared with the amount of caribou winter habitat available in Zone 5 (849,079 ha).

Sensory disturbances from traffic, machinery, and people will likely result in avoidance of some winter habitat by caribou and disruption of movements. Habitat avoidance or temporary abandonment could result near construction activity (Shideler *et al.* 1986; Dyer *et al*. 2001). Caribou activity will likely decline within 2 km of construction zones (Wuskwatim Power Limited Partnership 2011), resulting in a loss of effective habitat. Individuals that move away from affected winter habitat will most likely find suitable habitat elsewhere in the Caribou Regional Study Area (Shideler *et al*. 1986; Dyer *et al.* 2001), and the overall effect of sensory disturbance will likely be negligible to small. Because clearing and most construction activities for the Construction Power transmission line, Unit Transmission lines, and Generation Outlet Transmission lines are expected to occur in winter, caribou calving activities will not be affected. Some calving island disturbance is expected for three potential calving and rearing islands located within 2 km of the Keeyask Switching Station. Calving will not be affected by construction sensory disturbances at the Keeyask Construction Power Station or at the Radisson Converter Station upgrade site because there is no calving habitat nearby.

Caribou mortality can be caused by factors including hunting, predation, and collisions with vehicles. During construction of the Construction Power transmission lines, Keeyask Construction Power Station, Unit Transmission lines, Keeyask Switching Station, and Generation Outlet Transmission lines, temporary access to each site will be developed along winter roads on, or in some cases immediately adjacent to, construction sites, increasing winter access and traffic. Hunting and predation could increase in the Project Study Area, as the Project will allow for additional access into areas not previously accessible (Nellemann *et al.* 2001). Species such as gray wolves use linear features to travel and to hunt (James and Stuart-Smith 2000). Greater hunting efficiency and a potential influx of predators could increase caribou mortality, which is a threat to some caribou populations (Environment Canada 2011). Increased site lines, especially on wider ROWs such as the Generation Outlet Transmission lines, and efficient movement for predators such as wolves may also contribute to caribou mortality (James and Stuart-Smith 2000). However, data from the Bipole III Transmission

Project suggest that caribou mortality due to predation is more common in burned habitat than on transmission line ROWs, and that population growth rates in disturbed areas are similar to those in remote unfragmented areas (Manitoba Hydro 2012).

Effects of improved access to the area could also include increased mortality due to hunting. Hunters could use the transmission line ROWs to access areas that were previously inaccessible. However, the Project Study Area overlaps only a small portion of Game Hunting Area 3, the area where licensed caribou hunting is permitted, and the limited number of resident licences available for caribou harvest is managed by the Province. The potential increase in caribou mortality due to workers hunting will be managed and the overall effect will likely be neutral. Domestic harvest could occur during construction, although with disturbances in the area, these locations are unlikely used by either caribou or hunters.

During construction, there is the potential for caribou collisions with construction vehicles traveling along the south access road and the ROWs. Collisions with vehicles are not generally considered an important source of caribou mortality (Jalkotzy *et al.* 1997; Environment Canada 2011) and due to the existing terrain along the ROW and cautionary speed limits, the risk of collisions is very low. Effects of mortality due to collisions with vehicles on the regional caribou population will likely be small and should be negligible with mitigation.

Mitigation measures for caribou during construction include:

- Borrow areas will be sited to avoid calving and rearing complexes and reduce habitat loss;
- Access roads will be routed to avoid calving and rearing complexes and reduce loss of effective habitat;
- An Access Management Plan will be developed for the Keeyask Transmission Project to reduce the effects on caribou mortality from increased access and harvest in the Project Study Area;
- Firearms will be prohibited in camps and at work sites to reduce mortality due to hunting during construction; and
- Warning signs will be placed along the access roads near caribou travel corridors and high-quality habitats to reduce the potential of wildlife-vehicle collisions.

5.2.2.2 Operation

Potential Project effects on caribou during operation include habitat alteration. No additional caribou habitat loss is expected during operation; however, vegetation on the Construction Power transmission line, Unit Transmission lines, and Generation Outlet Transmission lines ROWs is expected to stabilize into low-growth plant communities over time. Periodically, these ROWs will require vegetation maintenance to maintain the low-growth plant communities, and this will alter habitat.

Potential Project effects on caribou during operation also include sensory disturbance, habitat fragmentation, and disruption of movements. Line maintenance activities in spring could disturb females and their young during the calving period. A total of 26 potential calving and rearing islands occur with 1 km of the Construction Power transmission line, Unit Transmission lines, and Generation Outlet Transmission lines ROWs and an additional 39 islands occur within 1 to 2 km of them. Because line maintenance activities will be infrequent and short-term, effects of sensory disturbance on caribou will likely be negligible. Habitat fragmentation can affect the quality of caribou habitat and caribou movements throughout their ranges (Environment Canada 2011) (Map 5–3), particularly for summer residents and Pen Islands coastal caribou, which are the two main types of caribou found in the Project Study Area. Human developments can create barriers to caribou movements (Smith *et al.* 2000; Dyer *et al.* 2001; Sorenson *et al*. 2008). However, past projects including the Wuskwatim Transmission Line have had minimal to no effect on caribou movements or their use of core areas (Manitoba Hydro 2012). It is likely that caribou will continue to cross the ROWs in the long-term, but a small loss of effective habitat near the Construction Power transmission line, Keeyask Construction Power Station, Unit Transmission lines, Keeyask Switching Station, and the Generation Outlet Transmission lines is expected as a result of Project operations.

The cleared linear corridor will likely increase hunter and predator access into the Project Study Area, which could result in increased caribou mortality. Species such as gray wolves use cleared linear corridors for more efficient transportation and hunting (James and Stuart-Smith 2000). Similarly, hunters can use clearings to access areas that were previously inaccessible. Periodic influxes of coastal caribou into the area would likely result in a greater harvest. With mitigation, including the continued regulation and monitoring of caribou harvest by Manitoba Conservation and Water Stewardship, the caribou harvest will not likely exceed sustainable levels and is expected to have a negligible effect on the regional caribou population.

Mitigation measures for caribou during operation include:

- ROW access trails will be decommissioned, unless required for on-going maintenance, to minimize access-related effects from harvest and predation;
- Manitoba Hydro will work with Manitoba Conservation and Water Stewardship to maintain previously developed access control and hunter related signage in order to prevent excessive hunting;
- The use of helicopters for maintenance activities on the transmission lines will be avoided near calving habitat from May 15 to June 30, to reduce effects of sensory disturbance on calving females and their young; and,

- A plan is being developed to coordinate caribou mitigation and monitoring activities among Manitoba Hydro's northern developments, as well as with government authorities and existing caribou committees and management boards.

5.3 OTHER MAMMALS

5.3.1 SMALL MAMMALS

Small mammals are expected to experience limited habitat loss from clearing and sensory disturbance during construction, including roosting habitat for little brown myotis. Some roosting habitat may be created in temporary buildings set up for construction. Small mammals are expected to find suitable habitat throughout the Small Mammals Regional Study Area. Some small mammal mortality could occur during clearing of the rights-of-way.

During operation, no additional habitat will be lost. As vegetation regenerates along the Construction Power transmission line, Unit Transmission lines, and Generation Outlet Transmission lines ROWs, new habitats will be created and used by small mammals. New small mammal communities will develop on the ROWs and along edges. Habitats with low-growth vegetation will be dominated by species that do not require forest canopy cover (*e.g.*, meadow vole). No additional roosting opportunities are expected to be created for little brown myotis; however, edge habitat along the ROW may allow for increased feeding opportunities.

Mitigation measures for small mammals include:

- Organic material removed from temporarily cleared areas will be replaced to encourage re-growth of native vegetation and reduce habitat loss; and
- Construction camps and marshalling yards will be kept clean and free of garbage so as to not attract wildlife to the site.

5.3.2 AQUATIC FURBEARERS

Aquatic furbearers are expected to experience minor habitat loss from clearing and sensory disturbance during construction, as relatively few streams will be crossed by the Construction Power transmission line, Unit Transmission lines, and Generation Outlet Transmission lines ROWs. Additionally, some beaver may be removed from dammed stream crossings to facilitate clearing and construction. Aquatic furbearers are expected to find suitable habitat throughout the Furbearers Regional Study Area.

During operation, no additional habitat loss is expected. As vegetation regenerates along the ROWs, new browse is likely to be created for beaver. While some new access may be created for trappers, trapping pressure is not expected to increase substantially, as a limited number of registered traplines overlap the Project Study Area. The effects of trapping on aquatic furbearers are expected to be small in magnitude.

Mitigation measures for aquatic furbearers include:

- A 100 m buffer will be retained, where practical, around lakes, wetland, and creeks to minimize habitat loss for aquatic furbearers.

5.3.3 TERRESTRIAL FURBEARERS

As with moose and caribou, terrestrial furbearers are expected to experience some habitat loss and sensory disturbance during construction. Terrestrial furbearers are expected to find suitable habitat throughout the Furbearers Regional Study Area. In addition, some terrestrial furbearers such as red fox and arctic fox could become habituated to people if food and garbage are not properly managed. These potential effects are likely manageable with mitigation. Given the large home range of a single wolverine, it is unlikely that construction will have a measureable effect on the wolverine population.

During operation, no additional habitat loss is expected. As vegetation regenerates along the ROW, hunting opportunities may be created as small mammal populations begin to use habitat along the ROW. While some new access may be created for trappers, it is unlikely that trapping pressure will increase in any considerable amount because a limited number of registered traplines overlap the Local Study Area. The effects of trapping on terrestrial furbearers are expected to be small in magnitude. Finally, given the large home range as a single wolverine, it is unlikely that operation of the Project will have a measureable effect on wolverine.

Mitigation measures for terrestrial furbearers include:

- ROW access trails will be decommissioned where practical to minimize access-related effects such as harvest; and,
- Construction camps and marshalling yards will be kept clean and free of garbage so as to not attract wildlife to the site.

5.3.4 LARGE CARNIVORES

Large carnivores are expected to experience some habitat loss and sensory disturbance during construction, possibly at black bear and gray wolf dens. Large carnivores are expected to find suitable habitat throughout the Large Carnivores Regional Study Area. Other effects during construction include the potential for black bear to become habituated to people if food and garbage are not properly managed.

During operation, no additional habitat loss is expected. The creation of new linear corridors could facilitate movement and increase hunting efficiency for gray wolves, although decommissioning access trails where feasible will reduce this effect. Predator movements could become more frequent if snowmobiles are used on the Construction Power transmission line, Unit Transmission lines, and Generation Outlet Transmission lines ROWs for travel. The density of gray wolves in the Project Study Area is not expected to change because there is likely not enough caribou and moose biomass in the Project Study Area to support a dense predator population (Keeyask Hydropower Limited Partnership 2012). Because large carnivores occupy large home ranges, it is unlikely that operation of the Project will have a measureable effect on their populations.

Mitigation measures for large carnivores include:

- ROW access trails will be decommissioned where practical to minimize access-related effects;
- Firearms will be prohibited in camps and at work sites to reduce large carnivore mortality due to hunting during construction;
- Construction camps and marshalling yards will be kept clean and free of garbage so as to not attract wildlife to the site; and,
- Where possible, 100 m buffers will be established around active gray wolf and black bear dens within the project footprint to minimize the disturbance of animals during sensitive periods.

5.3.5 UNGULATES

Moose and caribou are the only ungulates in the Project Study Area. Effects for these VECs are described in Sections 5.2.1 and 5.2.2.

5.4 RESIDUAL EFFECTS

After mitigation, the Project is not expected to have significant adverse residual effects on mammal populations or their habitats. Predicted long-term residual effects include the following:

- Small alteration of habitat for caribou and moose along the Construction Power transmission line, Unit Transmission lines, Generation Outlet Transmission lines, and a small, long-term loss of habitat at the Keeyask Construction Power Station and Keeyask Switching Station;
- Small avoidance of Project infrastructure by caribou resulting in a loss of effective habitat;
- Periodic sensory disturbance effects to caribou and moose during operation resulting in small behavioural changes; and
- A small increase in regional access for predators and hunters resulting in a small increase in moose and caribou mortality.

These effects can be observed during the construction and operations phases of the Project. It is expected that Project activities will be reversible, as over time, biophysical disturbances due to the Project will be reversed by the natural succession of vegetation. Residual effects are expected to be of small magnitude after applying mitigation measures.

Table 5-3: Residual Effects of Keeyask Transmission Project Components

Potential Effect	Project Phase	Mitigation	Residual Effect	Assessment Characteristics
Moose				
Habitat loss and alteration	Construction & Operation	-routing of project components -rehabilitation of affected areas where possible	Decreased moose population in the Project Study Area for two or more generations due to reduced habitat and increased mortality Altered movements due to sensory disturbance	Step 1: Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Long-term Step 2: Not Required
Sensory disturbance, disruption of movement, and habitat fragmentation	Construction & Operation	-construction activities to occur in winter to avoid calving		
Mortality due to predation, hunting and wildlife-vehicle collisions	Construction & Operation	-vegetation buffers on the ROW -prohibition of firearms in camp -warning signs along roadsides -decommissioning of trails used during construction		
Caribou				
Habitat loss and alteration	Construction & Operation	-routing of project components -rehabilitation of affected areas where possible	Decreased caribou population in the Project Study Area for two or more generations due to habitat alteration and increased mortality Altered movements and distributional shifts due to sensory disturbance	Step 1: Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Long-term Step 2: Not Required
Sensory disturbance, disruption of movement, and fragmentation	Construction & Operation	-construction activities to occur in winter to avoid calving		
Mortality due to predation, hunting and wildlife-vehicle collisions	Construction & Operation	-prohibition of firearms in camp -warning signs along roadsides -decommissioning of trails used during construction		

Table 5-4: Residual Effects of the Keeyask Transmission Project by Project Component

VEC	Project Component	Phase	Residual Effects	Assessment
Moose	Construction Power and General Outlet Transmission	Operation	Increased hunter and predator access along cleared ROWs	Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Long-term
	All project components	Construction & Operation	Increased potential for animal-vehicle collisions based on higher traffic levels	Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Long-term
	All project components	Construction & Operation	Decline in moose population in the Project Study Area for two or more generations due to reduced habitat and ongoing habitat disturbances	Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Short-term
	All project components	Construction	Altered movements and distributional shifts within the Project Study Area due to sensory disturbances	Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Short-term
Caribou	Construction Power and General Outlet Transmission	Operation	Increased hunter and predator access along cleared ROWs	Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Long-term
	All project components	Construction & Operation	Increased potential for animal-vehicle collisions based on higher traffic levels	Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Long-term

Table 5-4: Residual Effects of the Keeyask Transmission Project by Project Component

VEC	Project Component	Phase	Residual Effects	Assessment
Caribou	All project components	Construction & Operation	Decline in caribou population in the Project Study Area for two or more generations due to reduced habitat and ongoing habitat disturbances	Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Short-term
	All project components	Construction	Altered movements and distributional shifts within the Project Study Area due to sensory disturbances	Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Short-term

5.5 INTERACTIONS WITH OTHER PROJECTS

The assessment of cumulative effects requires that adverse residual effects resulting from the Keeyask Transmission Project be evaluated for interactions with reasonably foreseeable future projects and human activities. The effects past and current projects and activities were described in part in the preceding sections as a component of the residual effects assessment for each VEC, and are evaluated further in this section.

Future projects that are considered in evaluating the residual effects of the Keeyask Transmission Project include:

- Development of the Keeyask Generation Project
- Development of the Bipole III Transmission Project
- Development of the Conawapa Generation Project and;
- Gillam Redevelopment.

5.5.1 Moose

5.5.1.1 Effects of Past and Current Projects and Activities

Effects of past and present projects on moose include habitat alteration and increased mortality from resource harvesting and predator access along existing linear features including roads, railway lines and trails. Prior to hydroelectric development, moose occurred between Split Lake and what is now Stephens Lake. Shoreline habitat loss and fluctuating water levels resulted in a decrease in the number of moose present, resulting in resource users tending to travel further during harvest. At present, moose appear to be common, widely distributed, and clustered in the Project Study Area, and the regional population appears to be increasing. Concerns have been expressed about the sustainability of moose populations, and as part of the Keeyask Generation Project TCN is preparing a Moose Harvest Sustainability Plan to guide the management of their Adverse Effects Agreement Access Program.

5.5.1.2 Cumulative Effects of the Project with Past and Current Projects and Activities

The main residual effects of the Project on moose in combination with past and current projects are a decreased population and altered movements. Moose abundance, distribution, and movements are likely to change during construction, primarily as a result of sensory disturbance from construction. It is highly likely that Project effects on moose will be negligible to small in the Project Study Area. Small changes in habitat are expected given the small footprint of the project and that moose will use the ROW to move and forage. Reduced habitat and increased mortality from increased hunter and predator access are expected to result in a minor decrease in the moose population in the Project Study Area for two or more generations. Gray wolf numbers are expected to change in response to changes in the moose population. Finally, a small change in cumulative effects measures, including intactness and fragmentation, is expected as a result of the Project. As part of the Keeyask Generation Project, TCN has prepared a Moose Harvest Sustainability Plan to guide the management of their Adverse Effects Agreement Access Program to ensure the sustainability of the moose population in the Split Lake Resource Management Area. The province is responsible for managing licensed harvest while recognizing the priority of Aboriginal harvesting rights. Therefore, only a small cumulative effect is anticipated for the regional moose population.

5.5.1.3 Cumulative Effects of the Project with Future Projects and Activities

Residual Project effects on moose are expected to overlap with the effects of reasonably foreseeable future projects including the Conawapa Generation Project, Bipole III Transmission Project, Keeyask Generation Project, and Gillam redevelopment. Although the Split Lake Resource Management Area moose population appears to be secure, recent declines in the abundance of moose in western and eastern Manitoba have occurred, where it is thought that access and harvesting are the main issues affecting these moose. Although minor changes including habitat alteration are likely to occur with each project, access issues and sustainable moose harvest are of particular concern. As part of the Keeyask Generation Project, TCN is preparing a Moose Harvest Sustainability Plan to guide the management of their Adverse Effects Agreement Access Program to ensure the sustainability of the moose population in the

Split Lake Resource Management Area. The province is responsible for managing licensed harvest while recognizing the priority of Aboriginal harvesting rights.

5.5.2 Caribou

5.5.2.1 Effects of Past and Current Projects and Activities

Effects of past and present projects on caribou include habitat alteration and increased mortality from resource harvesting and predator access along linear features. Habitat alteration and access effects from past and present developments (*e.g.*, hydroelectric development, linear developments) can depress populations that are periodically in decline from increased predation, and potentially from harvest over the entire migratory caribou range. Concerns have been expressed about the disappearance of large caribou herds in the region since the 1950s, and the limited return of caribou beginning in about the early 1990s and continuing today. Recent declines in migratory caribou and the sustainability of their populations are of further scientific concern.

Caribou have recently returned to the area and occasionally mix in the Project Study Area. Local First Nations distinguish a small group of woodland caribou from migratory barren-ground and coastal caribou herds in the Project Study Area. Summer resident caribou remain in the Project Study Area to calve, and are conservatively estimated to number 20 to 50 individuals in an area slightly broader than the Project Study Area that includes island habitat in Stephens Lake, however the long-term trend of this group of animals is unclear. The Qamanirjuaq barren-ground caribou population, which infrequently migrates into the Project Study Area, has declined since the 1980s (*e.g*., Beverly and Qamanirjuaq Caribou Management Board 2002; Campbell *et al*. 2010; Beverly and Qamanirjuaq Management Board 2011), while the Cape Churchill coastal caribou herd has increased in size since 2007 (*e.g.*, Abraham *et al*. 2012b; Manitoba Hydro 2012). The Pen Islands coastal caribou herd increased from the late 1970s to the mid-1990s, when it was estimated at 10,800 individuals (Abraham and Thompson 1998), and has since declined to approximately 10,000 individuals (Manitoba Conservation and Water Stewardship 2012c). Local First Nations are concerned about past and present habitat loss, fragmentation, predation, harvest, changes in movement patterns, and accidental mortality of summer resident caribou attributed to development.

5.5.2.2 Cumulative Effects of the Project with Past and Current Projects and Activities

Past and current project effects have resulted in regional habitat loss and alteration but most of these changes are limited to habitat affected by flooding along the Nelson River. The main residual effects of the Project on migratory caribou in combination with past and current projects are localized altered movements due to habitat fragmentation and sensory disturbance, and decreased populations due to increased mortality. Given the large ranges of migratory caribou that only periodically occur in Keeyask region, the effects of altered movements and mortality on these animals are considered negligible to small. Most effects of the Project will be negligible to small and affect two or more generations.

Summer resident caribou abundance, distribution, and movements are likely to be altered by the Project during construction and operation, primarily because of sensory disturbance near calving and rearing complexes. Small changes in habitat are expected compared to its regional availability and use by caribou. Predator hunting efficacy is predicted to change slightly as predators move along new linear features. Resource harvesting is not expected to change as there are currently numerous access corridors in the Project Study Area, and where the transmission lines are not expected to contribute substantially to access effects. Therefore, only a negligible to small cumulative effect for local caribou populations is anticipated from the Project in combination with past and present projects.

Scientific uncertainty exists where human disturbance could exacerbate long-term natural changes in populations and habitat, and where these on-going effects could be affected by climate change, could reduce habitat availability and limit abundance in caribou ranges. Local First Nations predict that with more development, caribou will most likely disappear from the area and not return for a very long time. There is further concern that caribou may not return at all.

5.5.2.3 Cumulative Effects of the Project with Future Projects and Activities

Residual Project effects on caribou are expected to overlap with the effects of reasonably foreseeable future projects including the Conawapa Generation Project, Bipole III Transmission Project, Keeyask Generation Project, and Gillam redevelopment.

Incremental habitat fragmentation effects for summer resident caribou from the Project in combination with future projects are a concern within the Project Study Area because of the scientific uncertainty associated with abundance and range use of these animals. For summer residents, the effect of cumulative habitat fragmentation will be small and is highly unlikely to result in a measurable change to the population.

Existing human and fire disturbance in the Project Study Area is already large, and may not support a non-migratory caribou population. The density of predators, however, is not expected to increase with a small increase in fragmentation because there is likely not enough caribou and moose biomass in the Project Study Area to support a dense predator population. As such, incremental habitat fragmentation effects from future projects are more likely to have a small effect on the summer resident caribou population, whether they are coastal caribou, boreal woodland caribou, or both.

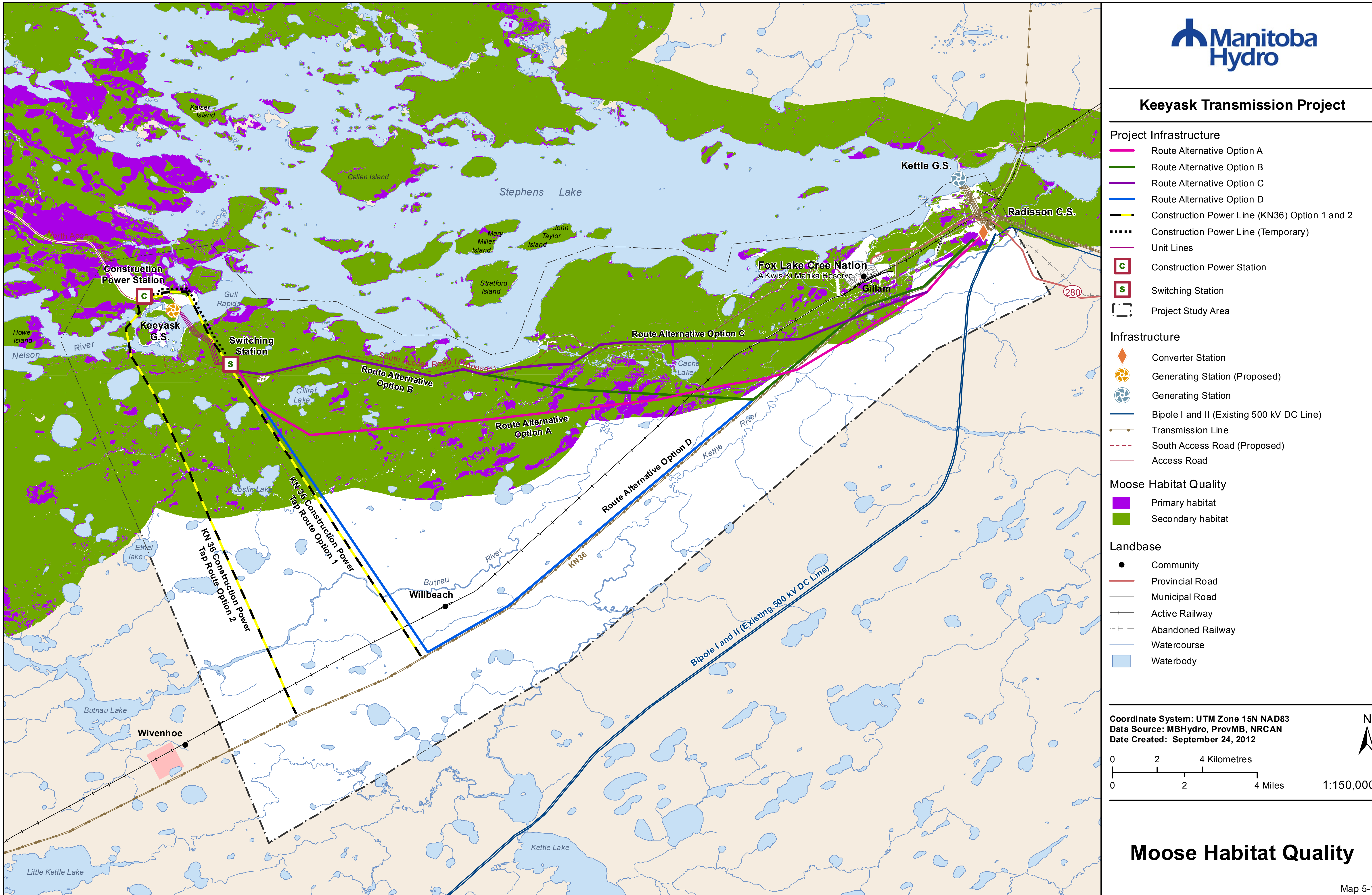
The management of access to and harvest of migratory caribou in the lower Nelson River area has a high scientific and social concern. Infrequent but potentially high harvest events, coupled with incremental habitat effects over a broad region, could result in a decrease and prolonged decline of coastal caribou populations in particular. All Project-related caribou mortality in association with other effects will be monitored to decrease the risk of cumulative effects. A plan is being developed to coordinate caribou monitoring activities among northern hydroelectric developments, as well as with government authorities and existing caribou committees and management boards.

5.6 MONITORING

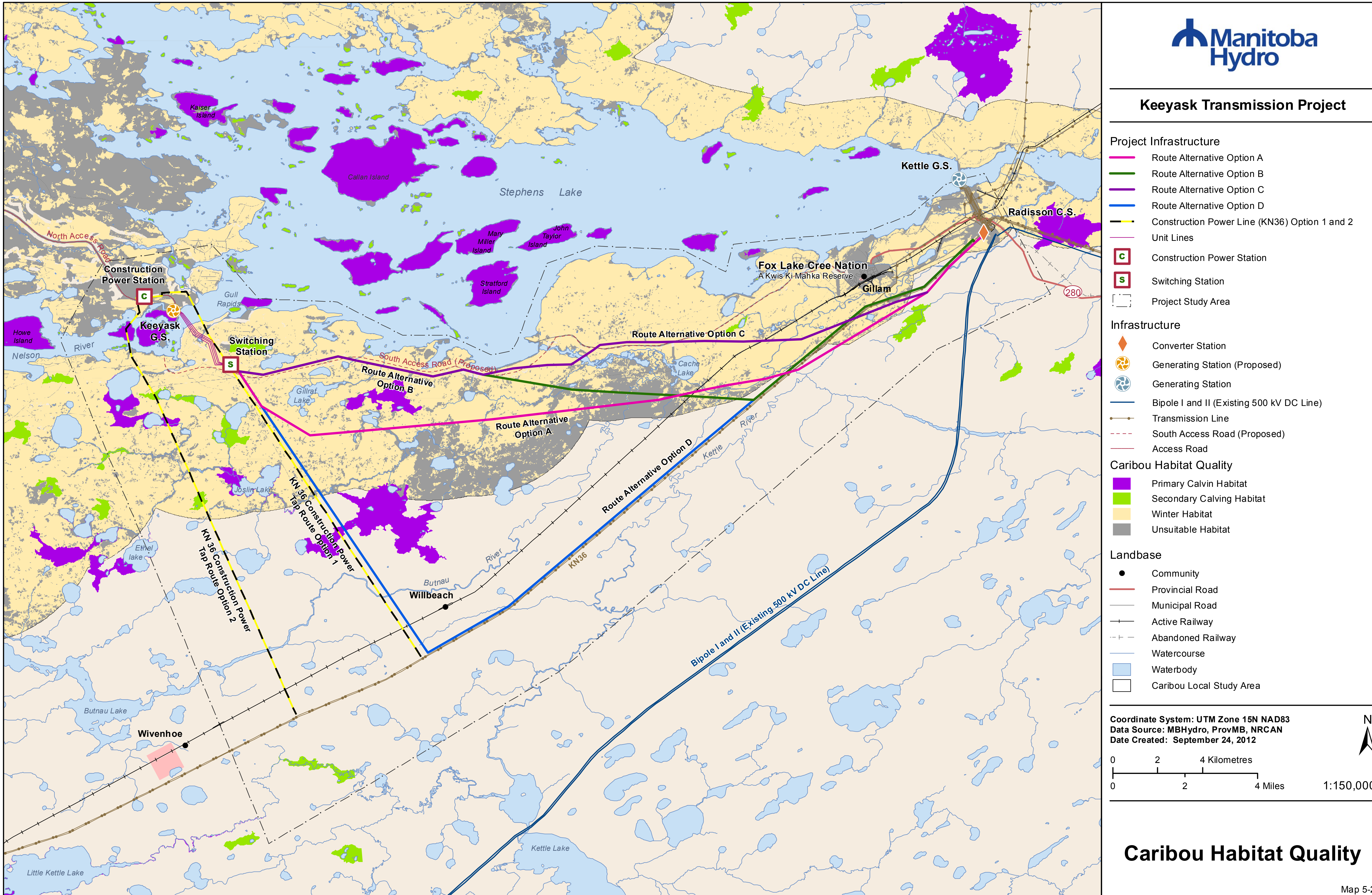
In order to verify the short-term and long-term effects of the Project on moose and caribou, the effectiveness of mitigation measures, and where there is higher uncertainty in predicting Project effects, monitoring will be required. Manitoba Hydro is responsible for ensuring that the mitigation measures prescribed in this report are implemented and verified through follow-up inspections, monitoring, and reporting.

Table 5-5: Monitoring for Mammals

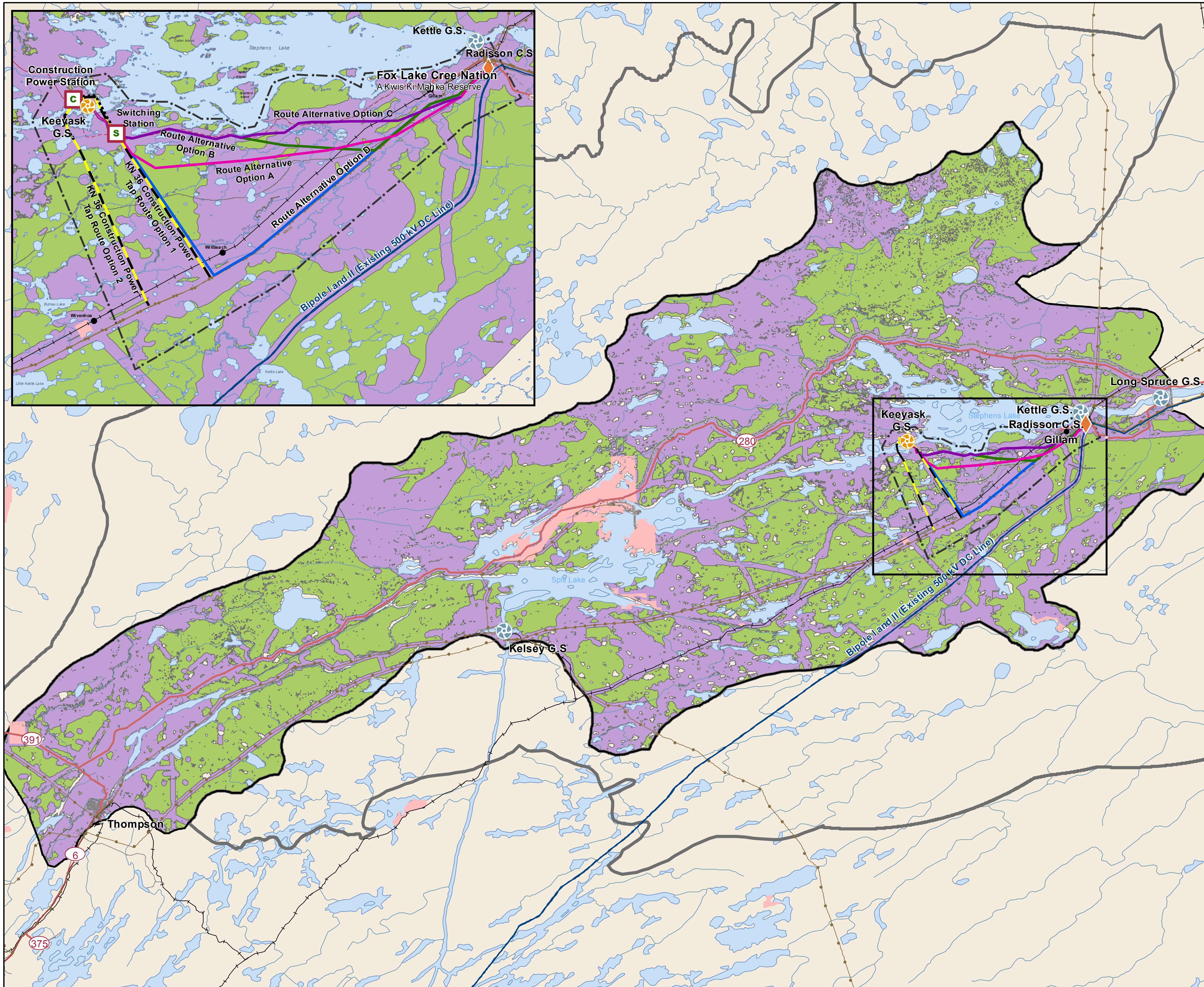
VEC	Issue/Rationale	Monitoring	Timelines
Caribou	• To verify the predicted effects of habitat alteration and disturbance during operation.	• Measure habitat alteration and use calving and rearing islands near the project Footprint.	Periodically during operation depending on the degree of effects.
		• Measure movements across the widest rights-of-way.	Periodically during operation depending on the degree of effects.
	• To verify the predicted effects of mortality during operation.	• Monitor harvest and predation effects associated with access.	Periodically during operation depending on the degree of effects.
Moose	• To verify the predicted effects of mortality during operation.	• Monitor harvest and predation effects associated with access.	Periodically during operation depending on the degree of effects.



Manitoba Hydro
Keeyask Transmission Project
Project Infrastructure
Route Alternative Option A
Route Alternative Option B
Route Alternative Option C
Route Alternative Option D
Construction Power Line (KN36) Option 1 and 2
Construction Power Line (Temporary)
Unit Lines
Construction Power Station
Switching Station
Project Study Area
Infrastructure
Converter Station
Generating Station (Proposed)
Generating Station
Bipole I and II (Existing 500 kV DC Line)
Transmission Line
South Access Road (Proposed)
Access Road
Moose Habitat Quality
Primary habitat
Secondary habitat
Landbase
Community
Provincial Road
Municipal Road
Active Railway
Abandoned Railway
Watercourse
Waterbody
Coordinate System: UTM Zone 15N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: September 24, 2012
0 2 4 Kilometres
0 2 4 Miles
1:150,000
N
Moose Habitat Quality
Map 5-1
Kaiser Island
Callan Island
Stephens Lake
Mary Miller Island
John Taylor Island
Stratford Island
Kettle G.S.
Radisson C.S.
Fox Lake Cree Nation
A Kwis Ki Mahka Reserve
Gillam
280
Construction Power Station
Keeyask G.S.
Gull Rapids
Howe Island
Nelson River
Switching Station
South Access Road (Proposed)
Route Alternative Option B
Route Alternative Option C
Route Alternative Option A
Route Alternative Option D
Cache Lake
Gillrat Lake
Joslin Lake
Ethel lake
KN 36 Construction Power Tap Route Option 1
KN 36 Construction Power Tap Route Option 2
Butnau River
Willbeach
Kettle River
KN36
Bipole I and II (Existing 500 kV DC Line)
Butnau Lake
Wivenhoe
Kettle Lake
Little Kettle Lake



Manitoba Hydro
Keeyask Transmission Project
Project Infrastructure
Route Alternative Option A
Route Alternative Option B
Route Alternative Option C
Route Alternative Option D
Construction Power Line (KN36) Option 1 and 2
Unit Lines
Construction Power Station
Switching Station
Project Study Area
Infrastructure
Converter Station
Generating Station (Proposed)
Generating Station
Bipole I and II (Existing 500 kV DC Line)
Transmission Line
South Access Road (Proposed)
Access Road
Caribou Habitat Quality
Primary Calvin Habitat
Secondary Calving Habitat
Winter Habitat
Unsuitable Habitat
Landbase
Community
Provincial Road
Municipal Road
Active Railway
Abandoned Railway
Watercourse
Waterbody
Caribou Local Study Area
Coordinate System: UTM Zone 15N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: September 24, 2012
N
0 2 4 Kilometres
0 2 4 Miles
1:150,000
Caribou Habitat Quality
Map 5-2
Stephens Lake
Callan Island
Kaiser Island
Mary Miller Island
John Taylor Island
Stratford Island
Kettle G.S.
Radisson C.S.
Fox Lake Cree Nation
A Kwis Ki Mahka Reserve
Gillam
280
Construction Power Station
Keeyask G.S.
Switching Station
Gull Rapids
Howe Island
Nelson River
North Access Road
South Access Road (Proposed)
Route Alternative Option C
Route Alternative Option B
Route Alternative Option A
Route Alternative Option D
Cache Lake
Gillrat Lake
Joslin Lake
Ethel Lake
KN 36 Construction Power Tap Route Option 1
KN 36 Construction Power Tap Route Option 2
Kettle River
Butnau River
Willbeach
KN36
Bipole I and II (Existing 500 kV DC Line)
Butnau Lake
Wivenhoe
Kettle Lake
Little Kettle Lake



Manitoba Hydro

Keeyask Transmission Project

Project Infrastructure

- Route Alternative Option A
- Route Alternative Option B
- Route Alternative Option C
- Route Alternative Option D
- Construction Power Line (KN36) Option 1 and 2
- Construction Power Line (Temporary)
- Unit Lines
- C Construction Power Station
- S Switching Station
- Project Study Area

Infrastructure

- Converter Station
- Generating Station (Proposed)
- Generating Station
- Bipole I and II (Existing 500 kV DC Line)
- Transmission Line
- North Access Road
- Proposed Access Road

Caribou Habitat

- Undisturbed caribou habitat
- Disturbed caribou habitat

Study Area

- Zone 5
- Caribou Regional Study Area

Landbase

- Community
- Provincial Road
- Provincial Highway
- Municipal Road
- Active Railway
- Abandoned Railway
- Watercourse
- Waterbody
- First Nation

Coordinate System: UTM Zone 15N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: Tuesday, September 25, 2012

N

0 15 30 Kilometres
0 7.5 15 Miles

1:750,000

Intact Caribou Habitat

Map 5-3

6.0 CONCLUSION

During the routing and site-selection process for the transmission lines for the Keeyask Transmission Project, alternatives routes for the Construction Power transmission line and Generation Outlet Transmission lines were assessed based on their potential effects on mammal species in the Project Study Area. Associated infrastructure, including Unit Transmission lines, the Keeyask Construction Power Station, Keeyask Switching Station, and the Radisson convertor station upgrade were also evaluated.

There were no substantial concerns with any of the alternative routes or with the associated infrastructure. The preferred route for the Construction Power transmission line was CP Route 1 primarily because it intersected fewer sensitive sites including caribou calving islands and streams. For the Generation Outlet Transmission lines, Route Alternative Options B or C were the preferred routes over A or D because either of these options did not intersect caribou calving islands and had less habitat and fragmentation effects on mammal habitat.

CP Route 1 and a modified routing of GOT Route Alternative Option B were the routes selected by Manitoba Hydro based on the overall site selection process, which gave consideration to biological effects, socio-economic effects, community concerns, cost, and engineering limitations.

Based on the selected locations for the transmission line ROWs and the associated infrastructure sites, the Project was not expected to substantially affect mammals or mammal habitat. With mitigation that includes the development of an access management plan, developing plans to coordinate caribou mitigation and monitoring activities among Manitoba Hydro's northern developments, the routing of access roads to avoid caribou calving islands, the restriction of hunting by project workers, the development of buffers to reduce the line of sight between hunters, predators and prey, and the placement of warning signs, predicted residual effects on VECs, including moose and caribou, were expected to be adverse, long-term and small. Monitoring was recommended to verify key elements of the effects predictions associated with mortality and habitat alteration.

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8.0 GLOSSARY

Abundance – the total number of individuals present, usually based on estimates, in a specific area.

Anthropogenic – something that is caused by humans.

Boreal forest − needle-leafed evergreen or coniferous forest bordering sub-polar regions.

Density-dependence – regulation of size of a population by mechanisms whose effectiveness increases as population size increases.

Ecosystem − all living organisms in an area and the non-living parts of the environment upon which they depend, as well as all interactions, both among living and non-living components of the ecosystem.

Environment − 1) the total of all the surrounding natural conditions that affect the existence of living organisms on earth, including air, water, soil, minerals, climate, and the organisms themselves; and, 2) the local complex of such conditions that affects a particular organism and ultimately determines its physiology and survival.

Habitat − the place where a plant or animal lives; often related to a function such as spawning, feeding, etc.

Indicator species – species, groups of species or species habitat elements that focus management attention on resource production, population recovery, population viability or ecosystem diversity; these species often have narrower habitat requirements that can be used to indicate the relative suitability of habitat for other species that share a similar preference *e.g.*, American marten is primarily a denizen of mature or overmature forest dominated by spruce.

Keystone species – species that have an effect on many other species in an ecosystem disproportionate to their abundance or biomass - can be predators, prey, plants, mutualists and habitat modifiers (*e.g.*, beaver, pileated woodpecker)

Mammal sign – physical evidence of animal presence such as tracks, fecal material, resting sites, and habitation features such as dens or burrows and indications of food consumption such as middens or predation sites. In this study, actual sightings of animals were also collected as mammal sign data.

Monitoring − measurement or collection of data to determine whether change is occurring in something of interest.

Push-up − a temporary shelter for muskrats composed of weeds and sticks above holes. They usually emerge from their bank burrows, into the water under the ice, and go on long foraging trips in search of food. When food is located, it is brought back to the push-up, which may be closer than the den, and consumed. The push-up is also used as a resting place.

Riparian – pertaining to anything connected with or immediately adjacent to the banks of a stream or other body of water. Riparian mammals, such as beaver, rely on the water and shorelines that characterize riparian habitats either continuously or seasonally for food, shelter and reproduction.

Snow interception cover – Closed-canopy coniferous forest habitat that intercept snow, provide shelter, and minimize radiation of heat to the open sky.

Taxonomy – the classification of organisms in a hierarchical system or in taxonomic ranks (***e.g.***, order, family, genus, species) based on shared characteristics or relationships inferred from the fossil record or established by genetic analysis.

Terrestrial – of or concerning the land. Terrestrial habitats are upland or non-aquatic habitats. Terrestrial mammals such as wolves depend primarily on upland or non-aquatic habitats for growth, reproduction and survival.

Umbrella species – species with large area requirements. Conservation of these species should automatically conserve a host of other species (*e.g*., grizzly bear).

APPENDIX A
Selection Criteria for Identification of Valued Environmental Components

INTRODUCTION

The Valued Environmental Component (VEC) criteria are described below for six mammal taxonomic groups (*i.e.*, Insectivores, Chiropterans, Lagomorphs, Rodents, Carnivores, and Artiodactyla) found in the Keeyask Transmission Project (Project) Study Area. Refer to Table A- 1 for a list of mammal species that could likely be found in the Project Study Area, with final rankings and cumulative scores. Habitat representations for these species are identified in Table A- 2.

INSECTIVORES

Those species belonging to Order Insectivora have a varied distribution and within North America include members of two families: Soricidae (shrews) and Talpidae (moles) (Wilson and Ruff, 1999). Species expected within the Project Study Area include only members of the Family Soricidae and include the masked shrew (*Sorex cinereus)*, American water shrew (*Sorex palustris)*, arctic shrew (*Sorex arcticus)* and pygmy shrew (*Sorex hoyi)*. These four species are considered widespread and are relatively abundant within Manitoba (Pattie and Hoffmann 1990).

As ecosystem components within the Project Study Area, shrews are found in a variety of habitat areas (Table A- 2) and predominately occur in forested and riparian areas where leaf litter and/or moss levels are present and insect levels are abundant (Wilson and Ruff 1999). Within the Project Study Area there is little socio-economic value tied to shrew species with exception to their existence within a larger functioning ecosystem where all species perform an important role in maintaining biodiversity. Based on the varying selection criteria used in selecting VECs for the Keeyask Transmission Project, shrew species ranked low based on meeting only a single selection criteria (Table A- 1). Due to their meeting only one of ten selection criteria, none were selected as VECs.

CHIROPTERANS

Chiropterans (bats) have a varied distribution worldwide and are broken into two sub orders: Microchiroptera and Megachiroptera; the former being present within the Project Study Area. The bat species in the Project Study Area belong to Family Vespertilionidae and include: little brown myotis (*Myotis lucifugus)* hoary bat (*Lasiurus cinereus)* and eastern red bat (*Lasiurus borealis*)*.* These species vary in distribution throughout Manitoba and range from infrequent (eastern brown bat) to common (little brown myotis) (Pattie and Hoffman 1990).

Habitat use by bats in the Project Study Area is linked to use of forested areas where they roost and riparian areas where insect prey is abundant (Pattie and Hoffman 1990). Selection criteria for bat species found in the Project Study Area indicated only two selection criteria being met; including being provincially regulated species (Manitoba Conservation and Water Stewardship 2012d) (Table A- 1). An additional selection criterion was added recently for little brown bat that includes potential federal regulatory requirements. COSEWIC (February 3, 2012) recommended that three bat species be listed as endangered because of large population declines attributed to the disease white-nose syndrome. One of these species, the little brown myotis, might be found in the Project Study Area. While bat species do add to the biodiversity of mammal species found in Manitoba's north, none were selected as VECs for assessing environmental impacts from the Project.

LAGOMORPHS

Species from Order Lagomorpha are found worldwide and include pika and rabbits (Wilson and Ruff 1999). Snowshoe hare (*Lepus americanus*) is the only rabbit species found in the Project Study Area and belongs to Family Leporidae*.* Within the Project Study Area snowshoe hare are widely distributed and are present in a wide range of habitats (Table A-2).

Beyond their role as an abundant prey species, snowshoe hare potentially serve an important socio-economic role as a trapped and harvested species and a species that encourages the growth of forest understory through its foraging behaviour (Pattie and Hoffman 1990). Although snowshoe hare play an important role as a prey item for mammalian carnivore populations and can inhabit a wide range of habitat types (Table A-2), due to its meeting only six of ten selection criteria (Table A- 1) they were not selected as a VEC.

RODENTS

Order Rodentia is represented by a worldwide distribution of more than 2,000 species (Wilson and Ruff, 1999). Within the Project Study Area, 13 rodent species can be found (Table A- 1), including: one member of Family Castoridae: beaver (*Castor canadensis)*, one member of Family Dipodidae: meadow jumping mouse (*Zapus hudsonius),* one member of Family Erethizodontidae: porcupine (*Erethizon dorsatum)*, six members of Family Muridae: deer mouse (*Peromyscus maniculatus)*, Gapper's red-backed vole (*Clethrionomys gapperi)*, northern bog lemming (*Synaptomys borealis)*, heather vole (*Phenacomys intermedius)*, muskrat (*Ondatra zibethicus*), meadow vole (*Microtus pennsylvanicus*) and four members of Family Scuridae: least chipmunk (*Tamias minimus)*, woodchuck (*Marmota monax)*, red squirrel (*Tamiasciurus hudsonicus)*, and northern flying squirrel (*Glaucomys sabrinus)*. With the exception of porcupine, the above listed species are generally widespread within the Project Study Area and none are federally regulated; although there are provincial regulations for handling red squirrels and beavers (Manitoba Conservation and Water Stewardship 2012d).

As rodent species are an ecologically diverse grouping, species habitat usage within the Project Study Area is varied (Table A- 2). Rodents are largely herbivorous and are important prey items to a variety of bird and mammal species (Pattie and Hoffman 1990). Rodent species recognized as playing important ecosystem roles include the beaver, considered a keystone species through its role as an ecosystem engineer and as a harvested fur-bearing species. Muskrat and woodchucks have also been harvested as fur-bearing species (Pattie and Hoffman 1990). Due to the relative adaptability of rodent species to various habitat types and the limited number of selection criteria met by these species (Table A- 1), only beaver was considered as a VEC, but was not selected.

CARNIVORES

Worldwide, 271 species are found within Order Carnivora (Wilson and Ruff, 1999). Of these 271 species, 16 are found within the Project Study Area including four member of Family Canidae: coyote (*Canis latrans)*, gray wolf (*Canis lupus)*, arctic fox (*Alopex lagopus)*, red fox (*Vulpes vulpes)*; two members of Family Ursidae: black bear (*Ursus americanus)* and grizzly bear (*Ursus arctos*); one member of Family Felidae: lynx (*Lynx canadensis);* and seven members of Family Mustelidae: American marten (*Martes americana)*, fisher (*Martes pennanti)*, ermine (*Mustela ermine)*, least weasel (*Mustela nivalis)*, mink (*Mustela vison)*, wolverine (*Gulo gulo)*, and river otter (*Lontra canadensis);* one member of Family Mephitidae*:* striped skunk (*Mephitis mephitis)* and one member of Family Procyonidae: raccoon (*Procyon lotor)*.

Habitat use by carnivore species is varied, with some species utilizing few habitat types *i.e.* raccoons and many more species utilizing multiple habitat types *i.e*. red fox, wolf, *etc*. Of carnivore species in the area, only wolverine and grizzly bears are federally regulated (as 'species of special concern' and 'extirpated' in the case of the case of the plains grizzly) (COSEWIC, n.d.a). Alternately, coyote, gray wolf, arctic fox, red fox, black bear, American marten, fisher, ermine, mink, wolverine, river otter, lynx, and grizzly bear are all provincially regulated (Manitoba Conservation and Water Stewardship 2012d).

While carnivore species typically ranked higher in meeting VEC selection criteria than shrew, bat, rabbit and rodent species (with exception to beaver), no predator species were selected as VECs. In addition to meeting few selection criteria, the adaptability of mammalian carnivores to varying habitat types precludes them being valuable indicators of habitat change in comparison to species which more heavily utilize specific habitat types.

ARTIODACTYLA

Of those 220 species worldwide belonging to Order Artiodactyla (even-toed ungulates), three are potentially located within the Project Study Area (Wilson and Ruff 1999). These three species belong to the deer family (Cervidae) and are caribou (*Rangifer tarandus),* white-tailed deer (*Odocoileus virginianus)*, and moose (*Alces alces).*

Habitat usage by cervid species in the Project Study Area vary in their selection of habitat. While habitat use by moose and white-tailed deer incorporates the use of aspen mixedwood, aspen mixture, and young regeneration habitat areas, caribou habitat use alternately incorporates tamarack mixture, tamarack pure, black spruce mixedwood, black spruce mixture, black spruce pure and jack pine pure areas (Table A- 2). The use of selection criteria to identify VECs indicated the highest rankings for caribou and moose (Table A- 1). This resulted in the selection of these species to be recommended as VECs to assess potential environmental impacts of the Keeyask Transmission Project.

VEC SELECTION

Based on the ranking of species using the predetermined selection criteria, caribou and moose were found to rank the highest among the criteria used for selection purposes (Table A- 1) and were selected as VECs for use in this study. The beaver also met a high number of selection criteria (eight of ten) as well as being a species representative of riparian habitat. Past hydroelectric project experience however, suggests that a relatively short transmission line right-of-way is unlikely to intersect with many beaver home ranges. As such, the value of its potential use as a VEC is diminished for describing potential habitat-related Project effects. Secondly, where moose also use riparian habitat, some redundancy of value as a VEC would be expected for these two species. For these reasons, the beaver was considered but it was not promoted to having VEC status in this assessment.

Caribou and moose are considered important among the mammal species present in the Project Study Area. Notably, caribou and moose have key habitat requirements relative to many of the other mammal species in the study area (Table A- 2). As such, these two species can represent the habitat requirements of many other wildlife species. This is mirrored in the reproductive strategies of moose and caribou relative to other species in that moose and caribou give birth to few young each season. This indicates the reliance of moose and caribou on stable environments relative to other species that alternately sustain population sizes, in the face of variable and unstable environmental conditions, through high birth rates (MacArthur and Wilson 1967; Smith and Smith 2001). Due to their reliance on a relatively narrow set of habitat and environmental conditions, and the relative importance placed on caribou and moose by society, these species are likely to perform well as VECs in identifying potential environmental changes from proposed project.

MOOSE

Justification:

- Important to people;
- Provincially regulated;
- Potential keystone species - important dietary item to gray wolves and black bears;
- Potential umbrella species - widespread throughout the province in forested and wetland regions;
- Potential indicator species - dependence on deciduous forests and swampy areas;
- Previously sampled in study area by WRCS;
- May face an increase in available habitat through Project-related effects;
- Potential for density-dependence related effects including increased chances of disease and parasite transmission; and
- Potential increase in species harvesting through increased hunter access.

Issues:

Potential effects due to:

- habitat loss and alteration of food and cover;
- changes in distribution and movements; and
- access-related issues including hunting and habitat fragmentation.

CARIBOU

Justification:

- Important to people;
- Federally and provincially regulated;
- Potential keystone species - important dietary item to gray wolves and black bears;

- Potential umbrella species - thought indicative of intact coniferous areas;
- Potential indicator species - reliance on old-growth coniferous forests;
- Previously sampled in study area by WRCS;
- May face an decrease in available habitat through project-related effects;
- Potential for density-dependence related effects including increased chances of disease and parasite transmission; and
- Potential increase in species harvesting through increased hunter access.

Issues:

Potential effects due to:

- habitat loss and alteration of food and cover;
- changes in distribution and movements;
- access-related issues including hunting and habitat fragmentation;
- landscape-level changes; and
- increases in alternate prey species (*i.e.*, moose) leading to locally higher predator species and predation effects.

Table A- 1: Mammal Ranking Selection Criteria for Species Most Likely to Occur in the Project Study Area

	Selection Criteria												
Species[1]	Importance to People	Federal Regulatory Requirement	Provincial Regulatory Requirement	Keystone Species	Umbrella Species	Indicator Species	Sampled in Project Study Area	Potential negative habitat related effects through loss of habitat and habitat alteration	Potential positive habitat related effects through gain of habitat and habitat alteration	Potential for density-dependence effects through competition for food resources and increased parasitism/disease transmission	Potential increase in species harvesting	Cumulative Total	Rank
Masked shrew									✓			1	10
American water shrew									✓			1	10
Arctic shrew									✓			1	10
Pygmy shrew									✓			1	10
Little brown myotis		✓	✓					✓				3	8
Hoary bat			✓					✓				2	9
Snowshoe hare	✓			✓			✓		✓	✓	✓	6	5
Least chipmunk								✓				1	10
Woodchuck									✓			1	10
Red squirrel			✓			✓	✓	✓				4	7
Northern flying squirrel						✓		✓				2	9
Beaver	✓		✓	✓		✓	✓		✓	✓	✓	8	3
Deer mouse									✓	✓		2	9
Gapper's red-backed vole									✓			1	10
Northern bog lemming									✓			1	10
Heather vole									✓			1	10
Muskrat	✓		✓				✓		✓	✓	✓	6	5
Meadow vole									✓			1	10
Meadow jumping mouse									✓			1	10
Gray wolf	✓		✓	✓	✓		✓		✓	✓		7	4
Arctic fox	✓		✓	✓	✓				✓	✓		6	5
Red fox	✓		✓	✓	✓		✓		✓	✓		7	4
Black bear	✓		✓	✓	✓		✓		✓	✓		7	4
American marten	✓		✓	✓	✓	✓				✓	✓	7	4
Fisher	✓		✓				✓			✓	✓	5	6
Ermine			✓							✓	✓	3	8
Least weasel							✓			✓	✓	3	8
Mink			✓				✓			✓	✓	4	7
Wolverine	✓		✓	✓				✓		✓	✓	6	5
River otter	✓		✓				✓			✓	✓	5	6
Lynx	✓		✓							✓		3	8
Caribou	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	10	1
Moose	✓		✓	✓	✓	✓	✓		✓	✓	✓	9	2

1. Porcupine, coyote, raccoon, striped skunk, and white-tailed deer were not considered as these species are at the edge of their ranges.

Table A- 2: Mammal Habitat in the Project Study Area

	Selection Criteria										
Species	Aspen Mixedwood	Aspen Mixture	Tamarack mixture	Tamarack pure	Black Spruce Mixedwood	Black Spruce Mixture	Black Spruce Pure	Jack Pine Pure	Low vegetation	Tall shrub	Young regeneration
Masked shrew[1]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
American water shrew[1]			✓						✓	✓	
Arctic shrew[1]			✓	✓		✓	✓		✓	✓	✓
Pygmy shrew[1]			✓	✓	✓	✓	✓		✓		
Little brown bat[1]	✓	✓			✓			✓			
Hoary bat[1]	✓	✓		✓	✓	✓	✓	✓			
Snowshoe hare[2]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Least chipmunk[1]	✓	✓		✓	✓	✓	✓	✓	✓		✓
Woodchuck[1]	✓	✓		✓	✓	✓	✓	✓	✓		✓
Red squirrel[1]	✓	✓	✓		✓	✓	✓	✓			
Northern flying	✓	✓		✓	✓	✓	✓	✓		✓	

Table A- 2: Mammal Habitat in the Project Study Area

	Selection Criteria										
Species	Aspen Mixedwood	Aspen Mixture	Tamarack mixture	Tamarack pure	Black Spruce Mixedwood	Black Spruce Mixture	Black Spruce Pure	Jack Pine Pure	Low vegetation	Tall shrub	Young regeneration
squirrel[1]											
Beaver[1]			✓						✓	✓	
Deer mouse[1]	✓	✓		✓	✓	✓	✓	✓	✓		✓
Gapper's red-backed vole[1]	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Northern bog lemming[1]			✓	✓					✓		
Heather vole[1]			✓						✓	✓	
Muskrat[1]									✓	✓	
Meadow vole[1]			✓						✓	✓	✓
Meadow jumping mouse[1]			✓						✓		✓
Gray wolf[1]	✓	✓			✓					✓	
Arctic fox[2]			✓	✓		✓	✓		✓	✓	✓
Red fox[1]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table A- 2: Mammal Habitat in the Project Study Area

Species	Selection Criteria										
	Aspen Mixedwood	Aspen Mixture	Tamarack mixture	Tamarack pure	Black Spruce Mixedwood	Black Spruce Mixture	Black Spruce Pure	Jack Pine Pure	Low vegetation	Tall shrub	Young regeneration
Black bear[1]	✓	✓		✓	✓	✓	✓	✓	✓		✓
American marten[1]					✓	✓	✓	✓			
Fisher[1]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ermine[1]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Least weasel[2]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mink[1]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Wolverine[1]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
River otter[1]			✓						✓	✓	
Lynx[1]	✓	✓	✓	✓	✓	✓	✓	✓			✓
Caribou[1]			✓	✓	✓	✓	✓	✓	✓		
Moose[1]	✓	✓			✓				✓	✓	✓

1. Modified from Kuhnke and Watkins (1999)
2. Pattie and Hoffman (1990)

APPENDIX B
Historical Occurrence of Mammal Species in the Keeyask Region

Common Name	Scientific Name	Breeds in Manitoba	Nature of Occurrence	Manitoba Distribution	Manitoba Abundance	Degree of Confidence in Manitoba Data	Most Likely Breeding Status in the Keeyask Region	Most Likely Distribution in the Keeyask Region	Expected Abundance in the Keeyask Region	Most Likely Species Rarity in the Keeyask Region	Found During Studies in the Keeyask Region
ORDER: INSECTIVORA (Insectivores)											
Masked shrew	*Sorex cinereus*	Yes	Resident	Very widespread	Very abundant	B	Breeding	Wide	Very abundant	Very common	Yes
American water shrew	*Sorex palustris*	Yes	Resident	Very widespread	Very abundant	C	Breeding	Wide	Scarce to Sporadic	Common	Yes
Arctic shrew	*Sorex arcticus*	Yes	Resident	Very widespread	Very abundant	C	Breeding	Wide	Sporadic	Common	Yes
Pygmy shrew	*Sorex hoyi*	Yes	Resident	Very widespread	Very abundant	C	Breeding	Wide	Sporadic	Common	Yes
ORDER: CHIROPTERA (Bats)											
Little brown myotis (bat)	*Myotis lucifugus*	Yes	Resident - Migratory	Very widespread	Very abundant (breeding) to scarce (non-breeding)	B	Breeding?	Wide	Scarce to Sporadic	Rare to uncommon	Yes? not confirmed
Eastern red bat	*Lasiurus borealis*	Yes	Migratory	Widespread	Sporadic (breeding)	C	Breeding?	Wide	Scarce to Sporadic	Rare	No
Hoary bat	*Lasiurus cinereus*	Yes	Migratory	Widespread	Sporadic (breeding)	C	Breeding?	Wide	Scarce to Sporadic	Rare	No

Common Name	Scientific Name	Breeds in Manitoba	Nature of Occurrence	Manitoba Distribution	Manitoba Abundance	Degree of Confidence in Manitoba Data	Most Likely Breeding Status in the Keeyask Region	Most Likely Distribution in the Keeyask Region	Expected Abundance in the Keeyask Region	Most Likely Species Rarity in the Keeyask Region	Found During Studies in the Keeyask Region
ORDER: LAGOMORPHA (Hares and Rabbits)											
Snowshoe hare	*Lepus americanus*	Yes	Resident	Very widespread	Very abundant	B	Breeding	Wide	Very abundant	Very common	Yes
ORDER: RODENTIA (Rodents)											
Least chipmunk	*Tamias minimus*	Yes	Resident	Very widespread	Very abundant	C	Breeding	Wide	Sporadic to Very abundant	Common to Very common	Yes
Woodchuck	*Marmota monax*	Yes	Resident	Very widespread	Very abundant	C	Breeding?	Narrow	Sporadic to Abundant	Rare to Uncommon	Yes Incidental
Red squirrel	*Tamiasciurus hudsonicus*	Yes	Resident	Very widespread	Very abundant	B	Breeding	Wide	Very abundant	Very common	Yes
Northern flying squirrel	*Glaucomys sabrinus*	Yes	Resident	Very widespread	Very abundant	C	Breeding	Wide	Abundant to possibly Very abundant	Very common	Yes Incidental
Beaver	*Castor canadensis*	Yes	Resident	Very widespread	Very abundant	B	Breeding	Wide	Very abundant	Very common	Yes
Deer mouse	*Peromyscus maniculatus*	Yes	Resident	Very widespread	Very abundant	C	Breeding	Wide	Very abundant	Very common	Yes
Gapper's red-backed vole	*Clethrionomys gapperi*	Yes	Resident	Very widespread	Very abundant	C	Breeding	Wide	Very abundant	Very common	Yes
Northern bog lemming	*Synaptomys borealis*	Yes	Resident	Very widespread	Very abundant	C	Breeding	Wide	Sporadic to possibly Abundant	Common to possibly Very common	Yes
Heather vole	*Phenacomys intermedius*	Yes	Resident	Very widespread	Very abundant	C	Breeding	Wide	Abundant	Very common	Yes

Common Name	Scientific Name	Breeds in Manitoba	Nature of Occurrence	Manitoba Distribution	Manitoba Abundance	Degree of Confidence in Manitoba Data	Most Likely Breeding Status in the Keeyask Region	Most Likely Distribution in the Keeyask Region	Expected Abundance in the Keeyask Region	Most Likely Species Rarity in the Keeyask Region	Found During Studies in the Keeyask Region
Muskrat	*Ondatra zibethicus*	Yes	Resident	Very widespread	Very abundant	B	Breeding	Wide	Abundant to Very abundant	Very common	Yes
Meadow vole	*Microtus pennsylvanicus*	Yes	Resident	Very widespread	Very abundant	C	Breeding	Wide	Very abundant	Very common	Yes
Meadow jumping mouse	*Zapus hudsonius*	Yes	Resident	Very widespread	Very abundant	C	Breeding	Wide	Very abundant	Very common	Yes
Porcupine	*Erethizon dorsatum*	Yes	Resident	Very widespread	Very abundant	C	Non-breeding?	Absent	Extirpated?	Absent	No
ORDER: CARNIVORA (Carnivores)											
Coyote	*Canis latrans*	Yes	Resident	Scattered	Very abundant	C	Breeding?	Narrow	Scarce	Rare	Yes
Gray wolf	*Canis lupus*	Yes	Resident	Very widespread	Abundant	B	Breeding	Wide	Sporadic to Abundant	Common to Very common	Yes
Arctic fox	*Alopex lagopus*	Yes	Migratory - Nomadic? (Occasional)	Scattered	Very abundant	B	Non-breeding	Narrow	Absent to Abundant	Rare to Uncommon	Yes Incidental
Red fox	*Vulpes vulpes*	Yes	Resident	Very widespread	Very abundant	B	Breeding	Wide	Abundant	Very common	Yes
Black bear	*Ursus americanus*	Yes	Resident	Very widespread	Very abundant	B	Breeding	Wide	Abundant to Very abundant	Very common	Yes
Grizzly bear (Plains)	*Ursus arctos*	No	Migratory - Nomadic? (Occasional)	Localized	NA	A	Non-breeding	Absent	Extirpated	Absent	No
Grizzly bear (Barren-ground)	*Ursus arctos*	No	Migratory - Nomadic? (Occasional)	Localized	NA	C	Non-breeding	Absent	Extirpated	Absent	No

Common Name	Scientific Name	Breeds in Manitoba	Nature of Occurrence	Manitoba Distribution	Manitoba Abundance	Degree of Confidence in Manitoba Data	Most Likely Breeding Status in the Keeyask Region	Most Likely Distribution in the Keeyask Region	Expected Abundance in the Keeyask Region	Most Likely Species Rarity in the Keeyask Region	Found During Studies in the Keeyask Region
Raccoon	*Procyon lotor*	Yes	Resident	Scattered	Very abundant	B	Breeding?	Narrow	Scarce	Rare	Yes
American marten	*Martes americana*	Yes	Resident	Very widespread	Very Abundant	B	Breeding	Wide	Sporadic to Very abundant	Common to Very common	Yes
Fisher	*Martes pennanti*	Yes	Resident	Widespread	Abundant	B	Breeding	Wide	Sporadic	Common	Yes
Ermine	*Mustela erminea*	Yes	Resident	Very widespread	Very abundant	B	Breeding	Wide	Abundant to Very abundant	Very common	Yes Incidental
Least weasel	*Mustela nivalis*	Yes	Resident	Very widespread	Very Abundant	B	Breeding	Wide	Abundant	Very common	Not identified to species
Mink	*Mustela vison*	Yes	Resident	Very widespread	Very Abundant	B	Breeding	Wide	Abundant to Very abundant	Very common	Yes
Wolverine	*Gulo gulo*	Yes	Resident	Very widespread	Abundant	B	Breeding	Narrow	Scarce to Sporadic	Rare	Yes
Striped skunk	*Mephitis mephitis*	Yes	Resident	Widespread	Very Abundant	B	Breeding	Wide	Scarce to Sporadic	Common	No
River otter	*Lontra canadensis*	Yes	Resident	Very widespread	Very Abundant	B	Breeding	Wide	Sporadic to Very abundant	Common to Very common	Yes
Lynx	*Lynx canadensis*	Yes	Resident	Very widespread	Very Abundant	B	Breeding	Wide	Abundant	Very common	Yes
ORDER: ARTIODACTYLA (Cloven-hoofed Mammals)											
Boreal woodland caribou	*Rangifer tarandus caribou*	Yes	Resident - Nomadic	Widespread	Abundant	B	Breeding?	Narrow	Scarce to Sporadic	Rare	Uncertain

Common Name	Scientific Name	Breeds in Manitoba	Nature of Occurrence	Manitoba Distribution	Manitoba Abundance	Degree of Confidence in Manitoba Data	Most Likely Breeding Status in the Keeyask Region	Most Likely Distribution in the Keeyask Region	Expected Abundance in the Keeyask Region	Most Likely Species Rarity in the Keeyask Region	Found During Studies in the Keeyask Region
Summer resident caribou	*Rangifer tarandus caribou*	Yes	Summer resident	Localized	Scarce to Sporadic	C	Breeding	Narrow	Scarce to Sporadic	Rare	Yes
Coastal caribou	*Rangifer tarandus caribou*	Yes	Nomadic	Localized	Scarce to Very abundant	B	Breeding?	Wide	Sporadic to Very abundant	Common to Very common	Yes
Barren-ground caribou	*Rangifer tarandus groenlandicus*	Yes	Nomadic	Localized	Scarce to Very abundant	B	Non-breeding	Wide	Sporadic to Very abundant	Common to Very common	Yes
White-tailed deer	*Odocoileus virginianus*	Yes	Resident	Scattered	Very Abundant	B	Non-breeding	Absent	Absent to Scarce	Absent	No
Mule deer	*Odocoileus hemionus*	Yes	Resident - Nomadic? -	Localized	Sporadic	C	Non-breeding	Absent	Extirpated	Absent	Yes Incidental
Moose	*Alces alces*	Yes	Resident	Very widespread	Very Abundant	B	Breeding	Wide	Sporadic to Abundant	Common to Very common	Yes

APPENDIX C
Mammal Field Data Summaries

METHODS

MAMMAL POPULATIONS SUMMER AND WINTER GROUND TRACKING SURVEY

Summer and winter ground tracking surveys were conducted in habitats within or near the footprints of the proposed Construction Power transmission line (two alternative routes, CP Route 1 and CP Route 2) and Generation Outlet Transmission lines (three alternative routes, GOT Route Alternative Options A, B, and C). The habitats selected for sampling included various types of riparian, coniferous, and deciduous habitats located between Gull Rapids and the transmission lines, (approximately 26 kilometres (km) south east of the proposed generating station) and Gull Rapids and Radisson Converter Station (approximately 45 km east of the proposed Keeyask Generating Station).Three summer surveys and one winter survey took place for the Construction Power transmission line sites. The summer surveys were completed between June 15 and June 20, July 3 and July 8, and July 23 and July 29. Three surveys also were completed for the generation outlet lines and took place between July 7 and July 16, July 27 and August 12, and August 24 and August 27. Winter surveys were completed between March 4 and March 10, 2010.

For the summer survey, a total of 90 construction power and 79 generation outlet line transects were sampled within 11 and 8 habitat types respectively, and distributed over the Keeyask Transmission Project Study Area (known as the Project Study Area) in proportion to habitat availability. Of these sites a subset was visited in the winter and consisted of 61 construction power transects and 58 generation outlet transects. Summer survey transects were comprised of 500 metre (m) thread lines placed approximately 60 centimetres off the ground with subsections created every 50 m. These 50 m subsections were created so that the line could be analyzed for variation within the 500 m line. Winter survey transects did not use thread as there was only one visit. All tracks observed in the snow with in 1 metre of the line were recorded. Several measurements including UTM location, species (track and scat data), sex, and age were recorded along each transect on the first visit. During the second and third visits of the summer surveys, only the locations of breaks in the thread and species information were collected. Results of this survey along the construction power and generation outlet lines can be found in Table C- 1 and Table C- 2.

MOOSE BROWSE SURVEYS

Moose browse information was collected based on Canfield (1941) and Hoskins and Dalke (1955) during the summer ground tracking studies along pre- determined ground tracking transects in the proposed Construction Power and Generation Outlet Transmission lines corridors. Two methods, uniformly distributed and browse encounter samples, were used to adequately describe moose browse activity throughout various habitats. The following categories were used to describe browse for the survey:

Category	Browse Amount
0	No browse in plot
1	1 to 3 stems with browse
2	4 to 10 stems with browse
3	11 to 20 stems with browse
4	21 to 50 stems with browse
5	50+ stems with browse

1. Uniformly Distributed Samples - At the 100, 200, 300, 400, and 500 m mark along each transect, a 1 x 1 meter plot was established, and the total number of browsed stems was recorded and categorized. Browse identified during the survey were categorized according to browse amount shown above.

2. Browse Encounter Samples - The first five signs of browse encountered along the transect were surveyed using 1 x 1 m plot. The total number of browsed stems was recorded and categorized. Minimum plot separation was 10 m apart. A UTM coordinate was collected at each plot. Browse identified during the survey were categorized according to browse amount shown above.

AERIAL SURVEYS IN RIPARIAN HABITAT

To help predict how changes in habitat may affect aquatic furbearer abundance and distribution in creeks and rivers along the construction power lines, aerial surveys were completed October 3, 2009 and March 30, 2010 along waterways adjacent to the construction power lines and generation outlet lines. Surveys ranged in distance from 0 km to approximately 6 km from the Nelson River. Two observers and one data recorder surveyed about 182 km of wetland, lake, and river habitat. All instances of beaver signs were recorded including lodges and their status (active or inactive), food cache presence or any other beaver activity. Signs of muskrat and other wildlife were recorded incidentally. Species or their signs observed during this survey can be found in Table C- 3.

CARIBOU CALVING ISLAND STUDY

Caribou calving islands in and adjacent to the construction power and generation outlet lines were surveyed in conjunction with other caribou calving island survey programs in the area between July 7 and 18, 2009. Crews surveyed habitats with characteristics similar to known caribou calving islands and caribou sign was identified. The goal of the study was to identify active and inactive calving islands in 2009. Islands were identified through a desk exercise using orthophotography after peatland complexes were identified by vegetation experts at

ECOSTEM then further identified through visual observations, and georeferenced. Each island was then visited by a technician and searched for caribou signs. Species recorded during this survey can be found in Table C- 4.

In 2010 and 2011 a total of 4 islands in lakes, 29 islands in complexes and 5 general complexes were surveyed using trail cameras and tracking transects to identify caribou activity. Cameras were deployed in early May and remained until October for both years, while tracking data was collected in May, July/August and September/October for both years. Moose activity was also recorded on these caribou calving island complexes.

RESULTS

MAMMAL POPULATION–SUMMER AND WINTER GROUND TRACKING SURVEY

CONSTRUCTION POWER TRANSMISSION LINE

During the summer ground tracking surveys, a total of 1,248 individual animal sign were observed on 90 Construction Power transmission line (Table C- 5) on two alternative routes (CP Routes 1 and 2) for a total length of 42,980 m and 85,960 square metres (m^2), respectively (Table C- 6).These two routes differed in the number of surveyed transects (CP Route 1 = 55, CP Route 2 = 35) due to the available habitat data at the time of the study design. The total length and coverage of transects found between CP Route 1 and CP Route 2 was 26,550 m and 53,100 m^2 and 16,430 m and 32,860 m^2, respectively.

A total of 402 individual signs were identified during the winter tracking surveys completed on CP Routes 1 and 2 (Table C- 7). The total length and area of the winter survey on the two alternative routes (CP Route 1 = 46, CP Route 2 = 8) were of 30,800 m and 61,600 m^2 respectively (Table C- 8). In all, signs from nine mammal species were identified on the construction power transects during the winter and summer surveys (Table C- 7).

Snowshoe Hare (*Lepus americanus*)

Snowshoe hare signs recorded in the summer were the second most observed signs for all transects with 197 observations resulting in a proportion of transects with snowshoe hare signs of 0.42 (Table C- 5). Overall mean sign frequency for snowshoe hare signs was 0.22 sign/100 m^2; with all observations occurring on visit one, as snowshoe hare signs were only recorded on the initial installation of thread. Almost twice as many signs were observed on CP Route 1 as CP Route 2 (120 and 77 observations respectively) but the sign frequency was the same at 0.22 signs/100 m^2 (Table C- 9). It is important to note however that summer tracking transects are less suited to assess snowshoe hare abundance than winter transects, as signs other than scat are more difficult to detect in summer and were inconsistently recorded. As snowshoe hare scat is generally scattered along a transect and it cannot be determined how many individuals it came from, summer data should be interpreted with caution. In winter, snowshoe hare comprised the largest number of signs observed during the surveys with 293 sign (226 signs on CP Route 1, 67 signs on CP Route 2) recorded on 33 transects (28 transects on CP Route 1, 5 transects CP Route 2) resulting in a proportions of 0.61 0.63 for CP Routes 1 and 2 respectively (Table C- 7).

Red Squirrel (*Tamiasciurus hudsonicus*)

Although the tracking surveys were not designed for detecting arboreal species, a total of 18 red squirrel signs was found on 5 transects resulting in a proportion of transects with red squirrel signs of 0.06 (Table C- 5). Overall mean sign frequency was 0.02 signs/100 m^2 (Table C- 5). The only red squirrel sign was observed during the first visit as red squirrel signs were only recorded on the initial installation of thread. Of the 18 red squirrel signs observed, 3 were found on CP Route 1 while 15 were observed on CP Route 2 for sign frequencies of 0.01 and 0.04 signs/100 m^2, respectively (Table C- 9). A total of 16 red squirrel signs were recorded on 3 CP Route 1 transects during the winter surveys for a proportion of transects with signs of 0.05 (Table C- 7).

Muskrat (*Ondatra zibethicus*)

Muskrat push-ups were observed during the March 31, 2010 aerial survey completed along and adjacent to the construction power transmission line. A total of 193 push-ups were identified and recorded. No sign of muskrat was observed during the summer or winter tracking surveys (Table C- 10).

Beaver (*Castor canadensis*)

Twenty-five beaver signs were observed on eight construction power line transects resulting in a proportion of transects with beaver signs of 0.09 (Table C- 5). The 25 observations resulted in a mean sign frequency of 0.03 signs/100 m^2 (Table C- 5). Beaver observations were only noted on the first survey as beaver signs were only recorded on the initial installation of thread. More than double the number of beaver signs was detected on CP Route 1 as compared to CP Route 2 (17 and 8 observations, respectively) however sign frequencies for each line were the same at 0.03 signs/100 m^2 (Table C- 9).

A total of 75 active and inactive beaver lodges were documented on water bodies on or adjacent to the construction power lines and generation outlet lines during the fall aerial survey. Most observations (71%) were on streams and 17% were on rivers (Table C- 10). Only 19 active lodges were observed during the survey (Table C- 10). No winter data was collected for beaver.

Gray Wolf (*Canis lupus*)

Observations of gray wolf signs were low with nine observations on nine transects resulting in a proportion of transects with gray wolf sign of 0.10 (Table C- 5). Overall mean sign frequency was 0.01 signs/100 m^2, with 0.01 signs/100 m^2 on visit one and a mean sign frequency of less than 0.01 signs/100 m/day for visits two and three (Table C- 8). Although the number of signs found on CP Routes 1 and 2 was similar (four and five observations, respectively) mean sign frequency on CP Route 1 was half of what was observed on CP Route 2 (0.01 and 0.02 respectively; Table C- 8). Only three wolf signs were observed during the winter surveys, all three on the same line, resulting in a proportion of transects with winter wolf signs of 0.02 (Table C- 6). All winter wolf signs were observed on CP Route 2.

Red Fox (*Vulpes vulpes*)

A total of six red fox signs was recorded on six of the CP Route ground tracking transects surveyed in summer, resulting in an overall proportion of transects with red fox signs of 0.07 (Table C- 4). Mean sign frequency for all visits was 0.01 signs/100 m^2 (Table C- 4). All red fox signs were found during the first visit. Four of the six signs were observed on CP Route 1 and two signs were found on CP Route 2 (Table C- 8). Both alternative routes had red fox sign frequencies of 0.01 (Table C- 5). Only one red fox sign was observed during the winter surveys for a proportion of transects with fox signs of 0.02 (Table C- 6).

Black Bear (*Ursus americanus*)

At total of 23 black bear signs were recorded on 16 of the construction power ground tracking transects surveyed in summer, resulting in a proportion of transects with black bear signs of 0.18 (Table C- 5). Overall mean black bear sign frequency was 0.03 signs/100 m^2 (Table C- 5) with 0.01 signs/100 m^2 on the initial visit and less than 0.01 signs/100 m/day for visits two and three (Table C- 5). The number of bear signs was similar for both CP Route 1 and CP Route 2 (n = 11 and n = 12, respectively) while sign frequency for CP Route 1 was half as much as CP Route 2 (0.02 and 0.04 signs/100 m^2, respectively; Table C- 9). Black bear signs were not observed during the winter surveys because they are generally inactive at that time of year.

American Marten (*Martes americana*)

Twenty-three American marten signs were found on 15 transects in summer, resulting in a proportion of transects with marten signs of 0.17 (Table C- 5). American marten had a mean sign frequency of 0.03 signs/100 m^2 and signs were only observed on the initial visit as marten signs were only recorded on the initial installation of thread (Table C- 5). Although the number of American marten observations was similar between CP Routes 1 and 2 (10 and 13 observations, respectively), CP Route 1 had half the sign frequency of CP Route 2 (0.02 and 0.04 signs/100 m^2, respectively; Table C- 4). A total of 43 American marten signs (32 signs on

CP Route 1, 11 signs on CP Route 2) were observed on 21 transects (19 and 3 transects for CP Route 1 and 2 respectively) during the winter survey along both CP Route 1 and CP Route 2 for a proportion of 0.41 and 0.38 for CP Route 1 and 2 respectively (Table C- 7).

Fisher (*Martes pennanti*)

Only one fisher sign was observed during summer ground tracking surveys, resulting in a proportion of transects with fisher signs of 0.01 (Table C- 5) and an overall mean sign frequency of less than 0.01 signs/100 m^2 (Table C- 5). The single fisher sign was observed on CP Route 1 (Table C- 8) during the first visit. No sign of fisher was observed during the winter survey.

Weasel (*Mustela* sp.)

A total of three weasel signs were observed on two transects resulting in a proportion of transects with weasel signs of 0.02 (Table C- 5). Overall mean sign frequency was less than 0.01 signs/100 m^2. Weasel signs were only observed on visit one on CP Route 2 for a sign frequency of less than 0.01 signs/100 m^2 (Table C- 8). One weasel sign was observed during the winter survey for a proportion of 0.02 (Table C- 7).

Mink (*Mustela vison*)

Only five mink signs were observed on four transects resulting in a proportion of transects with mink of 0.04 (Table C- 5). Mink had an overall mean sign frequency of 0.01 signs/100 m^2 with less than 0.01 signs/100 m^2 on visit one and less than 0.01 signs/100 m/day for visits two and three (Table C- 5). Of the five mink observations, four were located on CP Route 1 and one on CP Route 2 (Table C- 9). Mean sign frequency for both the CP Route 1 and CP Route 2 was relatively low at 0.01 and less than 0.01 signs/100 m^2, respectively (Table C- 8). Mink signs were not observed during the winter survey (Table C- 7).

River Otter (*Lontra canadensis*)

Twenty-seven river otter signs were observed on five transects resulting in a proportion of transects with otter signs of 0.06 (Table C- 5). River otter had an overall mean sign frequency of 0.03 signs/100 m^2, a visit one mean sign frequency of 0.03 signs/100 m^2 and a visit two and three mean sign frequency of less than 0.01 signs/100m/day (Table C- 5). River otter had more observations (n = 21) and a higher sign frequency on CP Route 1 (0.04 signs/100 m^2) than CP Route 2 (n = 6, 0.02 signs/100 $m^{2;}$ Table C- 7). River otter were also recorded in winter on three transects (nine signs total) resulting in a proportion of 0.02 and 0.25 for CP Route 1 and 2 respectively (Table C- 7).

Lynx (*Lynx canadensis*)

Eight lynx signs were observed on a total of six of the ground tracking transects surveyed in winter, resulting in a proportion of transects with lynx signs of 0.03 and a mean sign frequency of 0.00 and 0.08 on CP Route 1 and CP Route 2 respectively (Table C- 7). Seven of the eight signs were observed on CP Route 2 and one sign was found on CP Route 1. No lynx sign was observed during the summer tracking survey.

Moose (*Alces alces*)

Moose signs were the most commonly observed signs recorded during the summer construction power ground tracking surveys. A total of 858 moose signs were observed on 89 transects resulting in a proportion of transects with moose signs of 0.99 (Table C- 5). Moose had an overall mean sign frequency of 1.00 signs/100 m^2, a mean sign frequency of 0.91 signs/100 m^2 for the first visit and a mean sign frequency of 1.15 signs/100 m/day for visits two and three (Table C- 5). Of the 858 moose signs observed 475 were found on CP Route 1 while the remaining 383 were observed on CP Route 2 (Table C- 9). Moose signs were found on all but one transect and in all habitats surveyed (Table C- 11). The proportion of transects with signs to the total number of transects varied from 0.86 to 1.00 however this is likely due to a small sample size for some of the more uncommon habitats. Black spruce treed on thin peatland and black spruce treed on shallow peatland had the highest amount of observed moose signs (Table C- 12). Moose were also detected along the construction power line during the winter tracking survey completed in March 2010 (Table C- 7). A total of 28 signs were observed on 13 transects resulting in a proportion of transects with winter moose signs of 0.28 moose per transect surveyed and a mean sign frequency of 0.05 across all CP Route 1 winter transects. All moose signs observed in winter were located on CP Route 1 (Table C- 7).

Caribou (*Rangifer tarandus*)

A total of 53 caribou signs were detected on 17 of 90 ground tracking transects surveyed in summer 2009, resulting in a proportion of transects with caribou signs of 0.19 (Table C- 5). Caribou were the third most common signs observed during the surveys. Overall mean sign frequency for caribou was 0.06 signs/100 m^2 with a mean sign frequency of 0.05 signs/100 m^2 on the first visit and 0.08 signs/100 m^2 for visits two and three (Table C- 5). Of the 53 caribou signs observed 27 were found on CP Route 1 and 26 were observed on CP Route 2 however, CP Route 1's sign frequency was almost half of CP Route 2 (0.05 and 0.08 signs/100 m^2 (Table C- 9).

The majority of caribou signs were observed in black spruce treed on shallow peatland, black spruce treed on thin peatland and low vegetation on shallow peatland habitats (Table C- 13) and similarly between the initial visit and visits 2 and 3 (Table C- 14). Overall, proportions of transects with sign were low except for habitats with low sample sizes (Table C- 14).

A number caribou signs were observed identified on a number of islands surveyed in the Project Study Area during the 2009 survey in areas 34, 35 and 36 (Table C- 15, Table C- 16). Numbers of signs from females in each of the areas ranged from 7 to 9 while numbers of juvenile signs ranged from 7 to 12 (Table C- 16). Area 34 had the highest amount of caribou sign.

Caribou sign was not observed during the winter survey.

GENERATION OUTLET TRANSMISSION LINE

Animal signs from 12 species were observed on 80 Generation Outlet Transmission lines transects in both summer and winter tracking surveys (Table C- 17). Eight habitat types on three GOT Route Alternative Options (A, B and C) were surveyed in summer for a total length of 41,600 m and an area of 83,200 m^2 (Table C- 18). These three routes differed only slightly in the amount of surveyed transects (GOT Route Alternative Option A = 26, GOT Route Alternative Option B =28, and GOT Route Alternative Option C = 26), however one transect on GOT Route Alternative Option B was only surveyed during the initial visit reducing the total coverage for visits for two and three to 28,800 m^2 from a total of 29,300 m^2.

The total coverage for GOT Route Alternative Options A, B (23) and C (23) in winter was 13,400 m^2, 27,600 m^2 and 23,600 m^2, respectively, on a total of 58 transects (Table C- 19). In all, 787 signs were observed on 79 of the transects in summer (Table C- 20) while 1,066 signs were observed on 56 generation outlet transects in winter (Table C- 21).

Snowshoe Hare (*Lepus americanus*)

A total of 44 snowshoe hare signs was observed on 10 of the ground tracking transects surveyed in summer, resulting in a proportion of transects with snowshoe hare detected of 0.13 (Table C- 8). Overall snowshoe hare mean sign frequency was 0.02 signs/100 m^2 (Table C- 20). Snowshoe hare signs were only found during visit 1 and had a mean frequency of 0.05 signs/100 m^2 (Table C- 21). Snowshoe hare signs were observed on GOT Route Alternative Options A, B, and C with numbers of 12, 2, and 30, respectively for frequencies of 0.02, <0.01, and 0.04, respectively (Table C- 22, Table C- 23, Table C- 24). It is important to note however that summer tracking transects are less suited to assess snowshoe hare abundance than winter transects, as signs other than scat are more difficult to detect in summer. As snowshoe hare scat is generally scattered along a transect and it cannot be determined how many individuals it came from, summer data should be interpreted with caution.

Snowshoe hare signs were recorded frequently during the winter survey with a total of 785 observations on 41 transects resulting in a proportion of transects with snowshoe hare signs of 0.71 (Table C- 25). Snowshoe hare mean sign frequency varied between 2.26 0.56 and 1.01 signs/100 m^2 on GOT Route Alternative Options A, B, and C, respectively (Table C- 26, Table C- 27, Table C- 28).

Red Squirrel (*Tamiasciurus hudsonicus*)

Winter tracking surveys detected a total of 97 red squirrel signs was found on 24 transects resulting in a proportion of transects with red squirrel signs of 0.41 (Table C- 25). Overall mean sign frequency ranged from 0.29, 0.05 and 0.12 between GOT Route Alternative Options A, B, and C (Table C- 26, Table C- 27, Table C- 28). Red squirrel sign was not detected during the summer surveys.

Muskrat (*Ondatra zibethicus*)

Only one muskrat sign was observed on one of the ground tracking transects surveyed in summer, resulting in a proportion of transects detected with muskrat signs of 0.01 (Table C- 21). Muskrat mean sign frequency was less than 0.01 signs/100 m^2 and was only observed on visit one on one GOT Route Alternative Option A transect (Table C- 22, Table C- 23, Table C- 24). It is important to note that summer tracking studies are not designed to detect summer mammal signs. Muskrat push-ups were observed during the March 31, 2010 aerial survey completed along and adjacent to the construction power transmission line. A total of 79 push-ups were identified and recorded (Table C- 29).

Beaver (*Castor canadensis*)

Twenty-one beaver signs were observed on six transects resulting in a proportion of transects with signs detected of 0.08 (Table C- 20). Overall mean sign frequency was 0.01 signs/100 m^2 (Table C- 21), with visit one having a mean sign frequency of 0.02 signs/100 m^2. No fresh beaver sign was observed during visits two and three (Table C- 21). Beaver signs observed during the surveys ranged from 11 on GOT Route Alternative Option A to 2 on GOT Route Alternative Option B with mean sign frequencies for GOT Route Alternative Options A, B, and C equalling 0.01, less than 0.01 and 0.01, respectively (Table C- 22, Table C- 23, Table C- 24). No winter data was collected for beaver.

A total of 92 active and inactive beaver lodges were documented on lakes, ponds, rivers, and streams on or adjacent to the generation outlet lines, of which 83% were observed on streams (Table C- 29). Less than half of the lodges observed during the survey were active (n = 40; Table C- 29).

Gray Wolf (*Canis lupus*)

A total of 12 gray wolf signs were observed on 12 transects resulting in a proportion of transects with wolf signs detected of 0.15 (Table C- 20) and an overall sign frequency of 0.01 signs/100 m^2 (Table C- 21). All but one of the gray wolf sign was observed on the first visit resulting in a mean sign frequency of 0.01 signs/100 m^2 (Table C- 21). Of the gray wolf signs observed six were observed on GOT Route Alternative Option A, one was observed on GOT Route Alternative Option B and five were observed on GOT Route Alternative Option C resulting in mean sign frequencies of 0.01 signs/100 m² or less (Table C- 22, Table C- 23, Table C- 24). During the winter surveys, 5 wolf signs were recorded on 4 of the 58 transects surveyed for a proportion of transects with wolf signs of 0.07 (Table C- 25).

Red Fox (*Vulpes vulpes*)

Four red fox signs were observed on four of the ground tracking transects surveyed in summer, resulting in a proportion of transects where red fox signs was detected of 0.05 (Table C- 20). Overall mean frequency of red fox sign was less than 0.01 signs/100 m^2 (Table C- 21). Signs were only observed during visit one with a mean sign frequency of 0.01 signs/100 m^2 (Table C- 21). Of the four red fox signs observed during the surveys, three were detected on GOT Route Alternative Option A while one was detected on GOT Route Alternative Option C resulting in mean sign frequencies of less than 0.01 signs/100 m² (Table C- 22, Table C- 23, Table C- 24).

Black Bear (*Ursus americanus*)

A total of 20 black bear signs were observed on 17 of the ground tracking transects surveyed in summer, resulting in a proportion of transects with signs of 0.21 (Table C- 20). Overall, black bear had a mean sign frequency of 0.01 signs/100 m² (Table C- 21), a visit one mean sign frequency of 0.01 signs/100 m^2 (Table C- 21) and a visit two and three mean sign frequency less than 0.01 signs/100 m/day (Table C- 21). Most black bear signs were observed on GOT Route Alternative Option A (n = 11 observations) although mean sign frequency was similar between GOT Route Alternative Options A and B (0.01 signs/100; (Table C- 22, Table C- 23). Mean sign frequency for GOT Route Alternative Option C was less than 0.01 signs/100 m² (Table C- 24). As black bears are hibernating during the winter, no black bear signs were observed during the winter survey.

American Marten (*Martes americana*)

American marten signs were only observed during winter tracking with a total of 57 signs over 18 transects (Table C- 25). Approximately one third of the winter generation outlet lines had marten signs with a proportion of transects with signs of 0.31 (Table C- 25). Of the marten signs observed during the winter surveys, 8 were detected on GOT Route Alternative Option A while 18 were detected on GOT Route Alternative Option B and 31 were detected on GOT Route Alternative Option C, resulting in mean sign frequencies of 0.04, 0.06 and 0.11 signs/100 m² on GOT Route Alternative Options A, B, and C respectively (Table C- 26, Table C- 27, Table C- 28).

Weasel (*Mustela* spp.)

Weasel signs were only detected during the winter tracking surveys (Table C- 25) completed on GOT Route Alternative Options A and B (Table C- 26, Table C- 27) for an overall proportion of transects with signs of 0.12 and mean sign frequencies of 0.01 and 0.03 for GOT Route Alternative Options A and B, respectively (Table C- 26, Table C- 27).

Mink (*Mustela vison*)

Two mink signs were observed on one of the ground tracking transects surveyed in summer, resulting in a proportion of transects with signs detected of 0.01 (Table C- 20) and a mean sign frequency for visit 1 of less than 0.01 signs/100 m^2 (Table C- 21). Mink signs were only observed on visit one on GOT Route Alternative Option C (Table C- 24). One mink sign was observed on GOT Route Alternative Option B during the winter survey (Table C- 27).

River Otter (*Lontra canadensis*)

Five river otter signs were detected on one of the ground tracking transects surveyed in summer, resulting in a proportion of transects with river otter signs detected of 0.01 (Table C- 20). River otter signs had an overall mean sign frequency of less than 0.01 signs/100 m^2 and was only found during visit 1 with a mean sign frequency of 0.01 signs/100 m^2 (Table C- 21). River otter were only found on GOT Route Alternative Option A with a mean sign frequency of 0.01 signs/100 m^2 (Table C- 22). Winter tracking also detected river otter with 28 signs on 11 transects for a proportion of transects with signs on 0.19 (Table C- 25). River otter sign frequency was 0.03, 0.03, and 0.05 signs/100 m^2 on GOT Route Alternative Options A, B, and C respectively (Table C- 26).

Moose (*Alces alces*)

Moose signs were the most common sign observed during the surveys (Table C- 20). A total of 515 moose signs were observed on 77 ground tracking transects surveyed in summer, resulting in a proportion of transects with signs detected of 0.96 (Table C- 20). Overall, mean sign frequency for moose sign was 0.21 signs/100 m^2 (Table C- 21), with a mean sign frequency of 0.30 signs/100 m^2 for visit one and a mean sign frequency of 0.02 signs/100 m/day for visits 2 and 3 (Table C- 21). Moose signs on GOT Route Alternative Options A, B, and C were 252, 181, and 82 signs respectively with corresponding mean sign frequencies of 0.31, 0.21, and 0.10 signs/100 m^2 (Table C- 22, Table C- 23, Table C- 24). Moose signs were found in all eight habitats (77 transects) during both the initial visit and visits two and three (Table C- 21). During the first visit, the proportion of transects in all habitats where moose signs were observed was 0.70 while the proportion of transects in all habitats where moose signs were observed for visits two and three was 0.86 (Table C- 21).

Of the 514 moose signs that were detected the majority were recorded on black spruce treed on thin peatland, black spruce treed on shallow peatland, black spruce treed on mineral soil, jack pine treed on mineral or thin peatland and low vegetation on mineral or thin peat land (Table C- 30). Approximately half of all sign was recorded during the first survey (Table C- 31).

Proportions of transects were high for all habitat types however certain uncommon habitat types that had sign had small sample sizes.

A total of 40 moose signs on 17 transects were documented during the winter 2010 tracking transects (Table C- 25). Moose signs had a proportion of 0.29 on the winter transects. Mean sign frequency on GOT Route Alternative Options A, B and C were 0.05, 0.05 and 0.05 signs/100 m^2 respectively (Table C- 26, Table C- 27, Table C- 28).

Caribou (*Rangifer tarandus*)

Caribou signs were the second most abundant signs observed during the summer ground tracking surveys (Table C- 20). A total of 163 caribou signs were observed on 26 transects resulting in a proportion of transects with caribou signs of 0.33 (Table C- 20). Overall caribou sign frequency was 0.07 signs/100 m^2 (Table C- 21) with a mean sign frequency of 0.18 signs/100 m^2 on visit one and a mean sign frequency less than 0.01 signs/100 m/day for visits two and three (Table C- 21). The number of caribou signs detected on GOT Route Alternative Option A, B, and C was 36, 70, and 57, respectively resulting in mean sign frequencies of 0.04, 0.08 and 0.07 signs/100 m^2, respectively over three combined visits (Table C- 22, Table C- 23, Table C- 24). The majority of caribou signs (104) recorded on black spruce treed on mineral soil and black spruce treed on thin peatland habitats partially due to the large sampling of these habitats (Table C- 32). Also, most of the transects with caribou signs were sampled on the initial visit (150) while visit two and three had 13 transects with observed signs (Table C- 33).

Caribou sign was not observed during the 2010 winter survey.

CARIBOU CALVING ISLAND STUDY

A total of 10 caribou island complexes containing 23 islands were surveyed during the 2009 field season of which 18 were active (Table C- 13). Islands ranged in distance from 0 km to approximately 5.0 km from the construction power and generation outlet lines. A total of 75 caribou signs were found on the islands, of which 23 were determined to be female and 28 were determined juvenile.

Of the 4 islands in lakes, 29 islands in complexes and 5 general complexes that were surveyed using trail cameras and tracking transects a total of 21 complexes/islands with adult caribou and 8 complexes with caribou calves were recorded in 2010 and 2011 (Table C- 33). Generally, more caribou were detected in 2011 than in 2010 as more calving complexes were surveyed in 2011. Similarly for moose, more adults and calf signs were recorded in 2011 with 24 complexes/islands with adults and 12 complexes/islands with calves identified for both years (Table C- 35).

SPECIES AT RISK

None of the mammal species confirmed to occur in the Project Study Area is listed by the federal *Species at Risk Act* (SARA). The wolverine is listed as a species of special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Wolverines were very rare in the Project Study Area. No wolverine sign was detected during ground tracking surveys for either the construction power lines or the generation outlet lines.

Little brown myotis (*Myotis lucifugus*), which appears to be sparse in the Keeyask region, was thought to be widespread and secure throughout its range (NatureServe 2012) until very recently. An emergency order to list this species under SARA has been requested (COSEWIC 2012), and it is considered endangered by COSEWIC. No field surveys were conducted for this species.

MOOSE BROWSE SURVEYS

Moose browse was recorded on most habitat types found in the Project Study Area. Moose browse was observed at the greatest proportion of sites in tall shrub on riparian peatland and in tamarack-black spruce mixture on wet peatland habitat (Figure C- 1). Other habitat types where moose browse was prevalent included broadleaf treed on all ecosites, black spruce mixedwood on mineral or thin soils, low vegetation on mineral or thin peatland, and tall shrub on mineral or thin peatland. No browse was observed in marsh, shallow water, tall shrub on shallow peatland, or tamarack-black spruce mixture on riparian peatland. As moose mainly feed on shrubby vegetation in winter (Drucker *et al.* 2010) browse was expected in tall shrub habitats.

It should be noted that the sample design was developed using habitat characterization data that has since been updated and improved. Due to the abundance and paucity of certain habitat types in the areas sampled, the sample size of some habitat categories were small or not available for sample purposes. This resulted in over- and under-sampling of some habitat types.

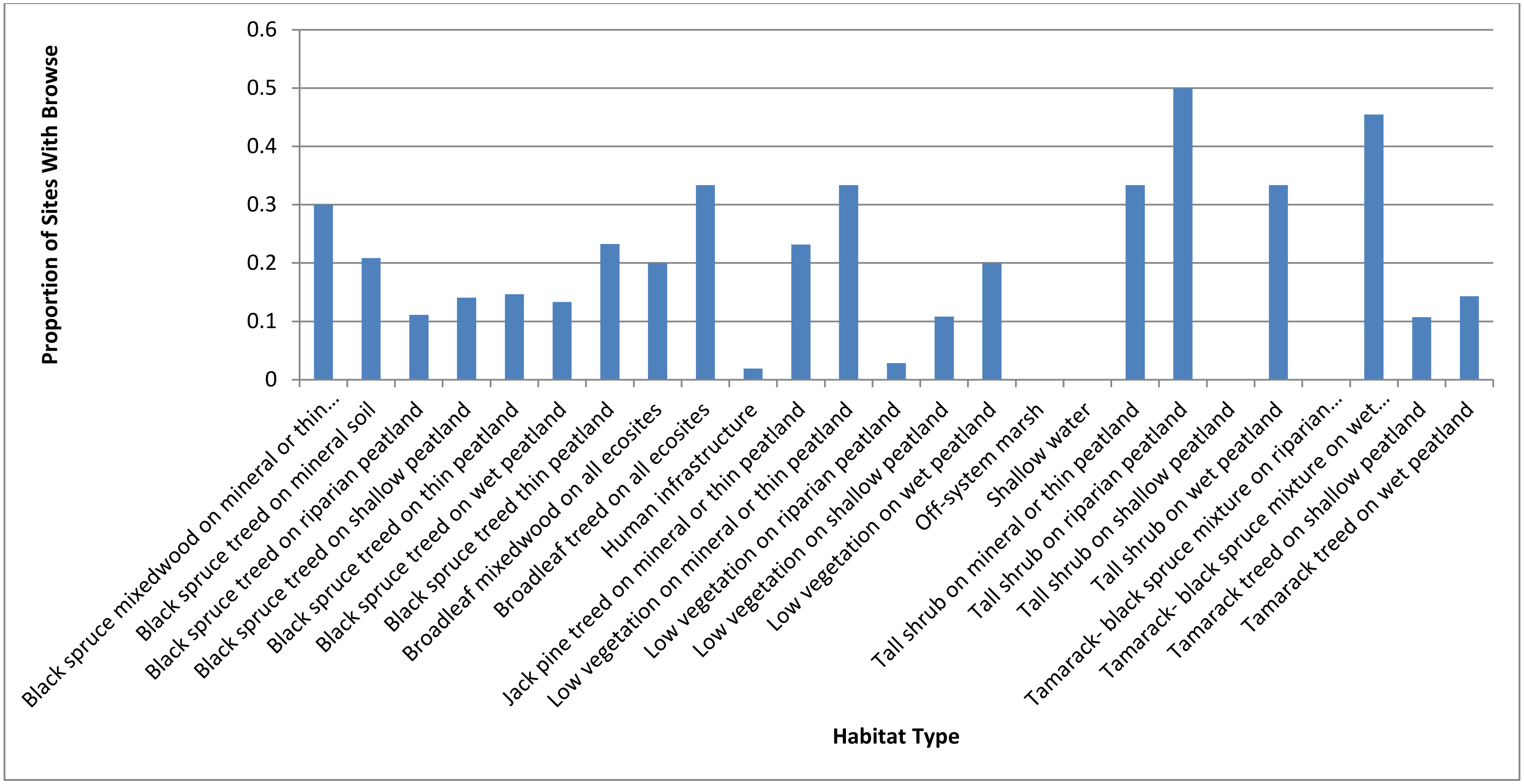

Figure C- 1: Moose Browse in Habitats in the Project Study Area

ALTERNATIVE ROUTE COMPARISONS

MAMMAL POPULATION–SUMMER GROUND TRACKING SURVEY

Construction Power Line

Overall, the relative abundance of most furbearer and caribou signs observed on the Construction Power transmission line routes was very similar with the exception of fisher, mink, red squirrel, river otter, and weasel; however, in all cases the number of signs was too small to make strong inferences between CP Route 1 and CP Route 2 (Figure 5). Even in the case of snowshoe hare where 61% were of all signs was observed on CP Route 1, sign frequency between the two routes were the same at 0.22 (Table C- 4). Like snowshoe hare signs, more moose signs were found on CP Route 1; however sign frequency for moose sign was higher on CP Route 2 (Table C- 4, Figure C- 2).

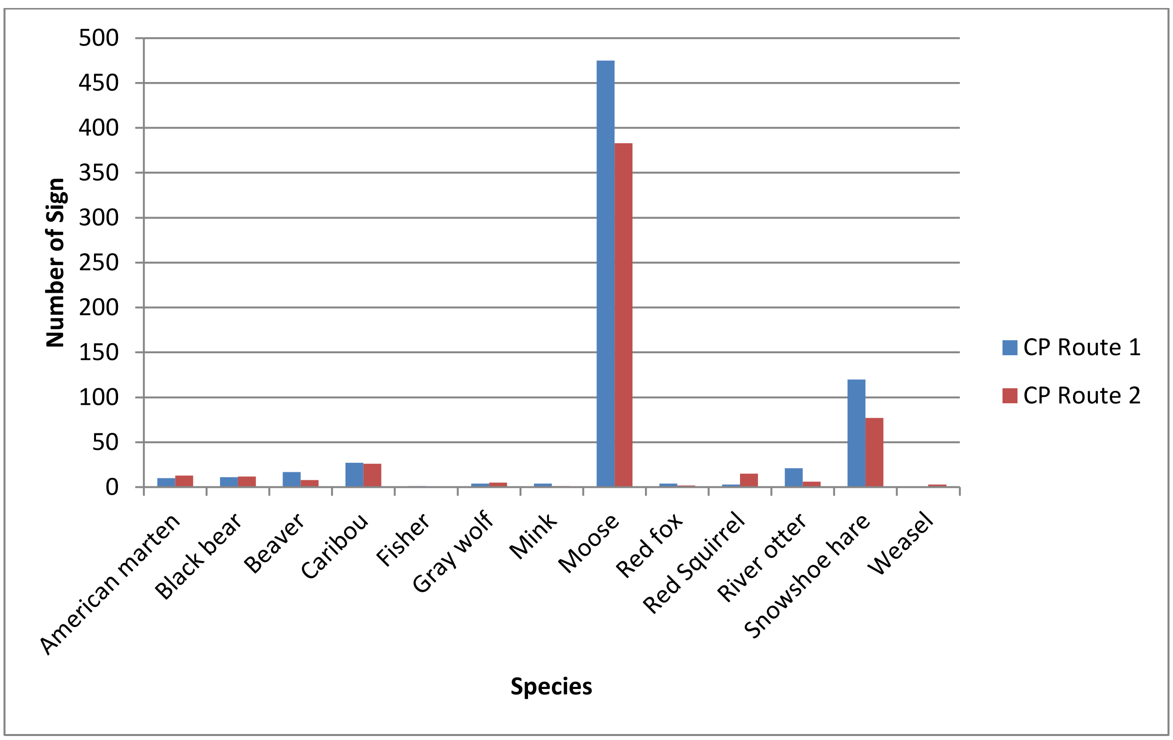

Figure C- 2: Number of Mammal Signs on Construction Power Transmission Line Routes 1 and 2

Generation Outlet Transmission Line

Forty-three percent of mammal signs found during the Generation Outlet Transmission lines ground tracking surveys was observed on GOT Route Alternative Option A, however, due to the length of the latter route, mean sign frequency was only 0.04 signs/100 m^2, whereas GOT Route Alternative Options B and C were 0.03 and 0.02 signs/100 m^2, respectively (Figure C- 3). The majority of moose signs, like the rest of the mammal signs, were found on GOT Route Alternative Option A (49%; Table C- 5 and Figure C- 3). However, unlike the other animal signs, moose signs had mean sign frequencies 50% and 200% higher than GOT Route Alternative Options B and C, respectively (Figure C- 3).

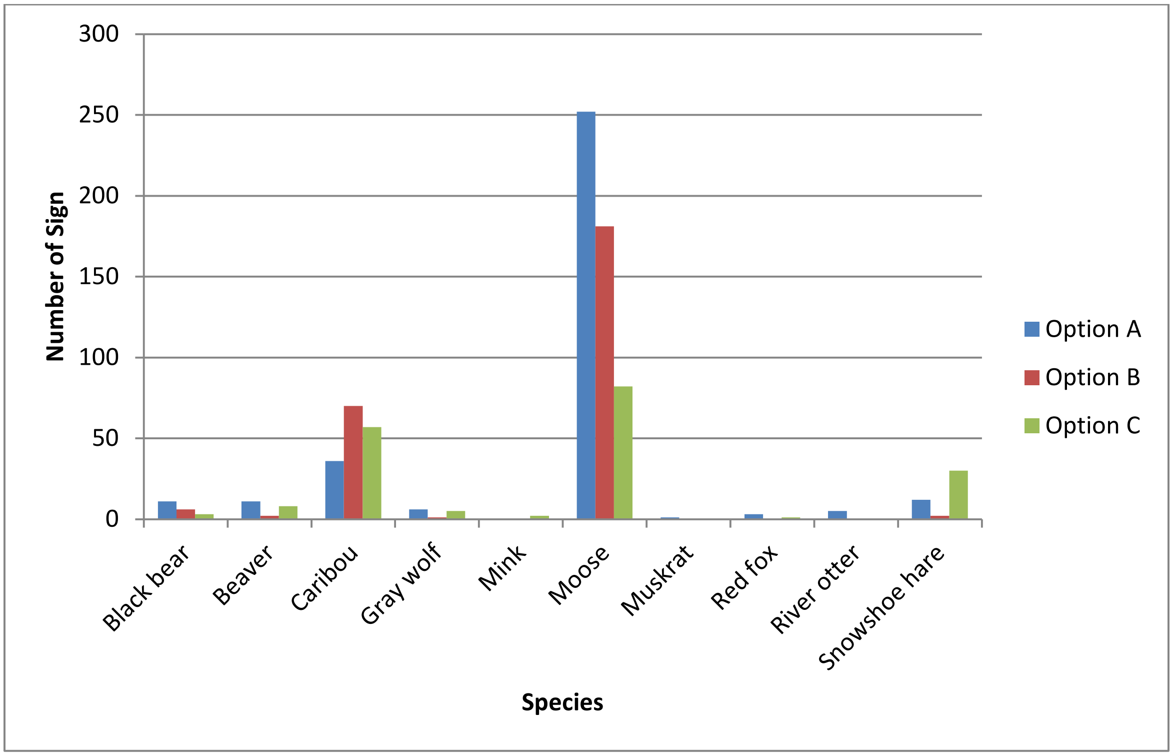

Figure C- 3: Number of Mammal Signs on Generation Outlet Transmission Line Route Alternative Options A, B, and C

MOOSE BROWSE SURVEY

Construction Power Transmission Line

The CP Route 2 sampling locations (n = 135) documented the largest proportions of browse when compared to CP Route 1 browse locations (n = 263) across most habitat types (Table C-36). Forest stands dominated by black spruce had the highest occurrence of browse. Low vegetation on shallow peatland and tamarack treed on shallow peatland had the lowest amount of browse sign.

Generation Outlet Transmission Line

Observations of browse were most common on GOT Route Alternative Options A and B compared to GOT Route Alternative Option C (Table C- 37). Black spruce and jack pine dominated stands appeared to have the most browse sign amongst all habitats sampled. Low vegetation on mineral or thin peatland also appeared to have more browse sign. Black spruce treed on riparian, shallow, or thin peatlands habitats appeared to have the lowest browse sign (Table C- 37), especially on GOT Route Alternative Options B and C.

Table C- 1: Mammal Signs Identified During the 2009 And 2010 Summer and Winter Tracking Transects on the Construction Power Transmission Lines

Common Name	Scientific Name
Snowshoe hare	*Lepus americanus*
Red squirrel	*Tamiasciurus hudsonicus*
Muskrat	*Ondatra zibethicus*
Beaver	*Castor canadensis*
Gray wolf	*Canis lupus*
Red fox	*Vulpes vulpes*
Black bear	*Ursus americanus*
Marten	*Martes americana*
Fisher	*Martes pennanti*
Weasel sp.	*Mustela spp.*
Mink	*Mustela vison*
River otter	*Lontra canadensis*
Lynx	*Lynx lynx*
Moose	*Alces alces*
Caribou	*Rangifer tarandus*

Table C- 2: Mammal Signs Identified During the 2009 and 2010 Summer and Winter Tracking Transects on the Generation Outlet Transmission Line

Common Name	Scientific Name
Snowshoe hare	*Lepus americanus*
Muskrat	*Ondatra zibethicus*
Beaver	*Castor canadensis*
Gray wolf	*Canis lupus*
Red fox	*Vulpes vulpes*
Black bear	*Ursus americanus*
Mink	*Mustela vison*
River otter	*Lontra canadensis*
Moose	*Alces alces*
Caribou	*Rangifer tarandus*

Table C- 3: Mammals and Mammal Signs Identified During the 2009 and 2010 Aerial Surveys Along the Generation Outlet and Construction Power Lines

Common Name	Scientific Name
Muskrat	*Ondatra zibethicus*
Beaver	*Castor canadensis*
Red fox	*Vulpes vulpes*
Moose	*Alces alces*

Table C- 4: Mammals and Mammal Signs Identified During the 2009 and 2010 Aerial Surveys Along the Generation Outlet and Construction Power Lines

Common Name	Scientific Name
Gray wolf	*Canis lupus*
Black bear	*Ursus americanus*
Moose	*Alces alces*
Caribou	*Rangifer tarandus*

Table C- 5: Species Detected Across 54 Construction Power Transmission Line Ground Tracking Transects During Three Visits in Spring and Summer 2009

Species	Number of Signs	Number of Transects With Signs	Mean Sign Frequency (signs/100 m^2)	Proportion of Transects With Signs	Standard Error
Snowshoe hare	197	38	0.22	0.42	0.05
Red squirrel	18	5	0.02	0.06	0.01
Beaver	25	8	0.03	0.09	0.02
Gray wolf	9	9	0.01	0.10	0.01
Red fox	6	6	0.01	0.07	<0.01
Black bear	23	16	0.03	0.18	0.01
Marten	23	15	0.03	0.17	0.01
Fisher	1	1	<0.01	0.01	<0.01
Weasel	3	2	<0.01	0.02	<0.01
Mink	5	4	0.01	0.04	<0.01
River otter	27	5	0.03	0.06	0.02
Moose	858	89	1.00	0.99	0.08
Caribou	53	17	0.06	0.19	0.02
Total	1,225	90	0.11	1.00	0.01

Table C- 6: Survey Length and Area Covered During the 2009 Spring and Summer Construction Power Transmission Line Ground Tracking Surveys

Line	Number of Transects	Total Length (m)	Total Coverage (m^2)
CP Route 1	55	26,550	53,100
CP Route 2	35	16,430	32,860
Total	90	42,980	85,960

Table C- 7: Species Detected Across Construction Power Transmission Line Ground Tracking Transects During One Visit in Winter 2010

	CP Route 1				CP Route 2			
Species	Number of Signs	Number of Transects With Signs	Sign Frequency (signs/100 m^2)	Proportion of Transects With Signs	Number of Signs	Number of Transects With Signs	Sign Frequency (signs/100 m^2)	Proportion of Transects With Signs
Snowshoe hare	226	28	0.42	0.61	67	5	0.80	0.63
Red squirrel	16	3	0.03	0.07	0	0	0	0
Gray wolf	3	1	0.01	0.02	0	0	0	0
Red fox	1	1	0.00	0.02	0	0	0	0
Marten	32	19	0.06	0.41	11	3	0.12	0.38
Weasel	0	-	0.00	-	1	1	0.01	0.13
River otter	3	1	0.01	0.02	6	2	0.06	0.25
Lynx	1	1	0.00	0.02	7	1	0.08	0.13
Moose	28	13	0.05	0.28	-	-	-	
Total	402	46	0.06	0.96	92	6	0.12	0.75

Table C- 8: Survey Length and Area Covered During the 2010 Winter Construction Power Transmission Line Ground Tracking Surveys

Line	Number of Transects	Total Length (m)	Total Coverage (m^2)
CP Route 1	46	25,600	51,200
CP Route 2	8	5,200	10,400
Total	54	30,800	61,600

Table C- 9: Species Detected on Construction Power Transmission Line Ground Tracking Transects During Three Visits in Spring and Summer 2009

	CP Route 1					CP Route 2				
Species	**Number of Signs**	**Mean Sign Frequency (signs/100 m^2)**	**Standard Error**	**Number of Transects With Signs**	**Proportion of Transects with Signs**	**Number of Signs**	**Mean Sign Frequency (signs/100 m^2)**	**Standard Error**	**Number of Transects With Signs**	**Proportion of Transects With Signs**
Snowshoe hare	120	0.22	0.06	22	0.4	77	0.22	0.07	16	0.46
Red squirrel	3	0.01	0.01	2	0.04	15	0.04	0.04	3	0.09
Beaver	17	0.03	0.02	4	0.07	8	0.03	0.01	4	0.11
Gray wolf	4	0.01	<0.01	4	0.07	5	0.02	0.01	5	0.14
Red fox	4	0.01	<0.01	4	0.07	2	0.01	<0.01	2	0.06
Black bear	11	0.02	0.01	8	0.15	12	0.04	0.01	8	0.23
Marten	10	0.02	0.01	8	0.15	13	0.04	0.02	7	0.2
Fisher	1	<0.01	<0.01	1	0.02	0	0	0	0	0
Weasel	0	0	0	0	0	3	0.01	0.01	2	0.06
Mink	4	0.01	<0.01	3	0.05	1	<0.01	<0.01	1	0.03
River otter	21	0.04	0.03	3	0.05	6	0.02	0.02	2	0.06
Moose	475	0.91	0.09	54	0.98	383	1.15	0.13	35	1
Caribou	27	0.05	0.02	10	0.18	26	0.08	0.04	7	0.2
Total	687	0.10	0.01	55	1	538	0.13	0.02	35	1

Table C- 10: Number of Muskrat Push-ups and Beaver Lodges Observed During the Construction Power Transmission Line Aerial Survey Fall 2009 and Spring 2010

Waterbody	Muskrat Push-ups	Total Lodges	Active Lodges	Inactive Lodges
Lake	193	1	0	1
Pond		8	0	8
River		13	6	7
Stream		53	13	40
Total	193	75	19	56

Table C- 11: Distribution of Moose Signs in Habitats on Construction Power Transmission Line Ground Tracking Transects Over Three Visits 2009

Habitat	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs
Black spruce mixedwood on mineral or thin peatland	9	1	1.00
Black spruce treed on mineral soil	5	3	1.00
Black spruce treed on riparian peatland	14	2	1.00
Black spruce treed on shallow peatland	133	28	0.96
Black spruce treed on thin peatland	171	29	1.00
Black spruce treed on wet peatland	10	3	1.00
Black spruce treed thin peatland	61	7	0.86
Broadleaf mixedwood on all ecosites	28	2	1.00
Broadleaf treed on all ecosites	1	1	1.00
Human infrastructure	81	10	1.00
Jack pine treed on mineral or thin peatland	16	6	1.00
Low vegetation on mineral or thin peatland	31	7	0.86
Low vegetation on riparian peatland	53	8	1.00
Low vegetation on shallow peatland	97	12	1.00
Low vegetation on wet peatland	23	7	1.00
Nelson River shrub and/or low vegetation on ice scoured upland	8	1	1.00
Shallow water	1	1	1.00
Tall shrub on mineral or thin peatland	18	1	1.00
Tall shrub on riparian peatland	2	2	1.00
Tall shrub on wet peatland	5	2	1.00
Tamarack- black spruce mixture on wet peatland	13	4	0.75
Tamarack treed on shallow peatland	64	5	1.00
Tamarack treed on wet peatland	14	2	1.00

Table C- 12: Distribution of Moose Signs in Habitats on Construction Power Transmission Line Ground Tracking Transects by Visit 2009

	Visit 1			Visits 2 and 3		
Habitat	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs
Black spruce mixedwood on mineral or thin peatland	1	1	1.00	8	1	1.00
Black spruce treed on mineral soil	3	3	0.67	2	3	0.33
Black spruce treed on riparian peatland	1	2	0.50	13	2	1.00
Black spruce treed on shallow peatland	60	28	0.79	73	28	0.79
Black spruce treed on thin peatland	82	29	0.72	89	29	0.83
Black spruce treed on wet peatland	3	3	0.33	7	3	1.00
Black spruce treed thin peatland	23	7	0.71	38	7	0.86
Broadleaf mixedwood on all ecosites	13	2	1.00	15	2	1.00
Broadleaf treed on all ecosites	1	1	1.00	0	1	-
Human infrastructure	42	10	0.90	39	10	0.90
Jack pine treed on mineral or thin peatland	10	6	1.00	6	6	0.67
Low vegetation on mineral or thin peatland	15	7	0.71	16	7	0.86
Low vegetation on riparian peatland	9	8	0.75	44	8	0.88

Table C- 12: Distribution of Moose Signs in Habitats on Construction Power Transmission Line Ground Tracking Transects by Visit 2009

	Visit 1			Visits 2 and 3		
Habitat	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs
Low vegetation on shallow peatland	33	12	0.75	64	12	0.92
Low vegetation on wet peatland	3	7	0.43	20	7	0.71
Nelson River shrub and/or low vegetation on ice scoured upland	6	1	1.00	2	1	1.00
Shallow water	1	1	1.00	14	1	1.00
Tall shrub on mineral or thin peatland	4	1	1.00	0	1	-
Tall shrub on riparian peatland	1	2	0.50	1	2	0.50
Tall shrub on wet peatland	0	2	-	5	2	1.00
Tamarack- black spruce mixture on wet peatland	5	4	0.75	8	4	0.75
Tamarack treed on shallow peatland	32	5	1.00	32	5	1.00
Tamarack treed on wet peatland	1	2	0.50	13	2	1.00

Table C- 13: Distribution of Caribou Signs in Habitats on Construction Power Transmission Line Ground Tracking Transects Over Three Visits 2009

Habitat	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs
Black spruce mixedwood on mineral or thin peatland	0	1	-
Black spruce treed on mineral soil	1	3	0.33
Black spruce treed on riparian peatland	1	2	0.50
Black spruce treed on shallow peatland	15	28	0.25
Black spruce treed on thin peatland	11	29	0.17
Black spruce treed on wet peatland	0	3	-
Black spruce treed thin peatland	1	7	0.14
Broadleaf mixedwood on all ecosites	1	2	0.50
Broadleaf treed on all ecosites	0	1	-
Human infrastructure	2	10	0.10
Jack pine treed on mineral or thin peatland	0	6	-
Low vegetation on mineral or thin peatland	0	7	-
Low vegetation on riparian peatland	6	8	0.13
Low vegetation on shallow peatland	12	12	0.17
Low vegetation on wet peatland	1	7	0.14
Nelson River shrub and/or low vegetation on ice scoured upland	1	1	1.00
Shallow water	0	1	-
Tall shrub on mineral or thin peatland	0	1	-
Tall shrub on riparian peatland	0	2	-
Tall shrub on wet peatland	0	2	-
Tamarack- black spruce mixture	1	4	0.25

Table C- 13: Distribution of Caribou Signs in Habitats on Construction Power Transmission Line Ground Tracking Transects Over Three Visits 2009

Habitat	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs
on wet peatland			
Tamarack treed on shallow peatland	0	5	-
Tamarack treed on wet peatland	0	2	-

Table C- 14: Distribution of Caribou Signs in Habitats on Construction Power Transmission Line Ground Tracking Transects by Visit 2009

	Visit 1			Visits 2 and 3		
Habitat	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs
Black spruce mixedwood on mineral or thin peatland	0	1	-	0	1	-
Black spruce treed on mineral soil	0	3	-	1	3	0.33
Black spruce treed on riparian peatland	0	2	-	1	2	0.50
Black spruce treed on shallow peatland	7	28	0.11	8	28	0.14
Black spruce treed on thin peatland	5	29	0.07	6	29	0.14
Black spruce treed on wet peatland	0	3	-	0	3	-
Black spruce treed thin peatland	0	7	-	1	7	0.14
Broadleaf mixedwood on all ecosites	0	2	-	1	2	0.50
Broadleaf treed on all ecosites	0	1	-	0	1	-
Human infrastructure	0	10	-	2	10	0.10
Jack pine treed on mineral or thin peatland	0	6	-	0	6	-
Low vegetation on mineral or thin peatland	0	7	-	0	7	-
Low vegetation on riparian peatland	0	8	-	6	8	0.13
Low vegetation on shallow peatland	11	12	0.08	1	12	0.08
Low vegetation on wet peatland	0	7	-	1	7	0.14

Table C- 14: Distribution of Caribou Signs in Habitats on Construction Power Transmission Line Ground Tracking Transects by Visit 2009

	Visit 1			Visits 2 and 3		
Habitat	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs
Nelson River shrub and/or low vegetation on ice scoured upland	0	1	-	1	1	1.00
Shallow water	0	1	-	0	1	-
Tall shrub on mineral or thin peatland	0	1	-	0	1	-
Tall shrub on riparian peatland	0	2	-	0	2	-
Tall shrub on wet peatland	0	2	-	0	2	-
Tamarack- black spruce mixture on wet peatland	1	4	0.25	0	4	-
Tamarack treed on shallow peatland	0	5	-	0	5	-
Tamarack treed on wet peatland	0	2	-	0	2	-

Table C- 15: Mammal Signs Identified During the Caribou Calving Island Study Adjacent to the Generation Outlet and Construction Power Transmission Lines

Common Name	Scientific Name
Gray wolf	*Canis lupus*
Black bear	*Ursus americanus*
Moose	*Alces alces*
Caribou	*Rangifer tarandus*

Table C- 16: Distribution of Caribou Signs in Areas 34, 35, and 37 During the Caribou Calving Island Study, July 2009

Area	Number of Complexes	Number of Islands	Total Number of Caribou Signs	Female	Juvenile
34	4	10	29	9	12
35	5	10	23	7	7
37	1	3	23	7	9
Total	10	23	75	23	28

Table C- 17: Mammal Signs Identified on the Generation Outlet Transmission Line Ground Tracking Transects 2009 and 2010

Common Name	Scientific Name
Snowshoe hare	*Lepus americanus*
Red squirrel	*Tamiasciurus hudsonicus*
Muskrat	*Ondatra zibethicus*
Beaver	*Castor canadensis*
Gray wolf	*Canis lupus*
Red fox	*Vulpes vulpes*
Marten	*Martes americana*
Black bear	*Ursus americanus*
Mink	*Mustela vison*
River otter	*Lontra canadensis*
Moose	*Alces alces*
Caribou	*Rangifer tarandus*

Table C- 18: Coverage of Habitat Types During the Generation Outlet Transmission Line Ground Tracking Surveys Summer 2009

GOT Route Alternative Option	Number of Transects	Total Length (m)	Total Coverage (m^2)
A	26	13,800	27,600
B	28	14,650	29,300
C	26	13,150	26,300
Total	80	41,600	83,200

Table C- 19: Coverage of Habitat Types During the Generation Outlet Transmission Line Ground Tracking Surveys Winter 2010

GOT Route Alternative Option	Number of Transects	Total Length (m)	Total Coverage (m^2)
A	12	6,700	13,400
B	23	13,800	27,600
C	23	11,800	23,600
Total	58	32,300	64,600

Table C- 20: Species Detected Across All Generation Outlet Transmission Line Ground Tracking Transects Over Three Visits Summer 2009

Species	Number of Signs	Number of Transects With Signs	Proportion of Transects With Signs
Snowshoe hare	44	10	0.13
Muskrat	1	1	0.01
Beaver	21	6	0.08
Gray wolf	12	12	0.15
Red fox	4	4	0.05
Black bear	20	17	0.21
Mink	2	1	0.01
River otter	5	1	0.01
Moose	515	77	0.96
Caribou	163	26	0.33
Total	787	79	0.99

Table C- 21: Species Detected on Generation Outlet Transmission Line Ground Tracking Transects by Visit Summer 2009

	Visit 1			Visits 2 and 3		
Species	Number of Signs	Mean Sign Frequency (signs/100 m^2)	Standard Error	Number of Signs	Mean Sign Frequency (signs/100 m/day)	Standard Error
Moose	255	0.30	0.04	260	0.02	<0.01
Gray wolf	11	0.01	<0.01	1	<0.01	<0.01
Beaver	21	0.02	0.01	0	-	-
Snowshoe hare	44	0.05	0.02	0	-	-
River otter	5	0.01	0.01	0	-	-
Mink	2	<0.01	<0.01	0	-	-
Muskrat	1	<0.01	<0.01	0	-	-
Caribou	150	0.18	0.05	13	<0.01	<0.01
Black bear	9	0.01	<0.01	11	<0.01	<0.01
Red Fox	4	0.01	<0.01	0	-	-
Total	502	0.06	0.01	285	<0.01	<0.01

Table C- 22: Species Detected on Generation Outlet Transmission Line Alternative Route Option A Ground Tracking Transects During Three Visits Summer 2009

Species	Number of Signs	Mean Sign Frequency (signs/100 m^2)	Number of Transects With Signs	Proportion of Transects With Signs
Snowshoe hare	12	0.02	3	0.12
Muskrat	1	<0.01	1	0.04
Beaver	11	0.01	3	0.12
Gray wolf	6	<0.01	6	0.23
Red Fox	3	<0.01	3	0.12
Black bear	11	0.01	10	0.38
Mink	0	0	0	0
River otter	5	0.01	1	0.04
Moose	252	0.31	26	1.00
Caribou	36	0.04	9	0.35
Total	337	0.04	26	1.00

Table C- 23: Species Detected on Generation Outlet Transmission Line Alternative Route Option B Ground Tracking Transects During Three Visits Summer 2009

Species	Number of Signs on Option B	Mean Sign Frequency (signs/100 m^2)	Number of Transects With Signs	Proportion of Transects With Signs
Snowshoe hare	2	<0.01	2	0.07
Muskrat	0	0	0	0
Beaver	2	<0.01	1	0.04
Gray wolf	1	<0.01	1	0.04
Red fox	0	0	0	0
Black bear	6	0.01	5	0.18
Mink	0	0	0	0
River otter	0	0	0	0
Moose	181	0.21	27	0.96
Caribou	70	0.08	12	0.43
Total	262	0.03	27	96

Table C- 24: Species Detected on Generation Outlet Transmission Line Alternative Route Option C Ground Tracking Transects During Three Visits Summer 2009

Species	Number of Signs	Mean Sign Frequency (signs/100 m^2)	Number of Transects With Signs	Proportion of Transects With Signs
Snowshoe hare	30	0.04	4	0.15
Muskrat	0	0	0	0
Beaver	8	0.01	2	0.08
Gray wolf	5	0.01	4	0.15
Red fox	1	<0.01	1	0.04
Black bear	3	<0.01	3	0.12
Mink	2	<0.01	1	0.04
River otter	0	0	0	0
Moose	82	0.10	24	0.92
Caribou	57	0.07	5	0.19
Total	188	0.02	26	1.00

Table C- 25: Species Detected on Generation Outlet Transmission Line Ground Tracking Transects Winter 2010

Species	Number of Signs	Number of Transects With Signs	Proportion of Transects With Signs
Snowshoe hare	785	41	0.71
Red squirrel	97	24	0.41
Gray wolf	5	4	0.07
Red fox	33	9	0.16
Marten	57	18	0.31
Weasel	13	7	0.12
Mink	1	1	0.02
River otter	28	11	0.19
Lynx	7	4	0.07
Moose	40	17	0.29
Total	1066	56	0.97

Table C- 26: Species Detected on Generation Outlet Transmission Line Alternative Route Option A Ground Tracking Transects During One Visit Winter 2010

Species	Number of Signs	Mean Sign Frequency (signs/100 m^2)	Number of Transects With Signs	Proportion of Transects With Signs
Snowshoe hare	350	2.26	9	0.75
Red squirrel	46	0.29	9	0.75
Gray wolf	4	0.03	3	0.25
Red Fox	2	0.01	1	0.08
Lynx	0	0	0	0
Marten	8	0.05	4	0.33
Mink	0	0	0	0
Weasel	2	0.01	2	0.16
River otter	5	0.03	2	0.16
Moose	8	0.05	5	0.42
Total	425	0.27	12	1.00

Table C- 27: Species Detected on Generation Outlet Transmission Line Alternative Route Option B Ground Tracking Transects During One Visit Winter 2010

Species	Number of Signs	Mean Sign Frequency (signs/100 m^2)	Number of Transects With Signs	Proportion of Transects With Signs
Snowshoe hare	160	0.56	15	0.65
Red squirrel	15	0.05	7	0.30
Gray wolf	1	0.00	1	0.04
Red Fox	1	0.00	1	0.04
Lynx	2	0.01	1	0.04
Marten	18	0.06	7	0.30
Mink	1	0.00	1	0.04
Weasel	11	0.03	5	0.22
River otter	8	0.03	4	0.17
Moose	15	0.05	8	0.35
Total	232	0.08	20	0.87

Table C- 28: Species Detected on Generation Outlet Transmission Line Alternative Route Option B Ground Tracking Transects During One Visit Winter 2010

Species	Number of Signs	Mean Sign Frequency (signs/100 m^2)	Number of Transects With Signs	Proportion of Transects With Signs
Snowshoe hare	275	1.01	17	0.74
Red squirrel	36	0.12	8	0.35
Gray wolf	0	0	0	0
Red Fox	30	0.10	7	0.30
Lynx	5	0.02	3	0.13
Marten	31	0.11	6	0.26
Mink	0	0	0	0
Weasel	0	0	0	0
River otter	15	0.05	5	0.22
Moose	17	0.05	4	0.17
Total	409	0.14	22	0.96

Table C- 29: Number of Muskrat Push-ups and Beaver Lodges Observed During the Generation Outlet Transmission Line Aerial Survey Fall 2009 and Spring 2010

Waterbody	Muskrat Push-ups	Total Lodges	Active Lodges	Inactive Lodges
Lake	79	8	2	6
Pond		4	1	3
River		4	2	2
Stream		76	35	41
Total	79	92	40	52

Table C- 30: Distribution of Moose Signs in Habitats on Generation Outlet Transmission Line Ground Tracking Transects Summer 2009

Habitat	Number of Signs	Number of Transects on Surveyed	Proportion of Transects With Sign
Black spruce mixedwood on mineral or thin peatland	8	2	1.00
Black spruce treed on mineral soil	70	16	1.00
Black spruce treed on riparian peatland	7	6	0.83
Black spruce treed on shallow peatland	85	20	0.95
Black spruce treed on thin peatland	103	24	0.96
Black spruce treed on wet peatland	10	8	1.00
Black spruce treed thin peatland	13	6	1.00
Broadleaf treed on all ecosites	9	1	1.00
Human infrastructure	4	1	-
Jack pine treed on mineral or thin peatland	63	12	1.00
Low vegetation on mineral or thin peatland	61	14	0.86
Low vegetation on riparian peatland	8	5	1.00
Low vegetation on shallow peatland	35	12	1.00
Low vegetation on wet peatland	18	2	1.00
Off-system marsh	1	1	1.00
Shallow water	1	1	1.00
Tall shrub on mineral or thin peatland	3	3	-
Tall shrub on riparian peatland	5	2	1.00
Tamarack- black spruce mixture on riparian peatland	2	2	1.00
Tamarack- black spruce mixture on wet peatland	2	1	1.00
Tamarack treed on shallow peatland	6	2	1.00

Table C- 31: Distribution of Moose Signs in Habitats on Generation Outlet Transmission Line Ground Tracking Transects Summer 2009

	Visit 1			Visits 2 and 3		
Habitat	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs
Black spruce mixedwood on mineral or thin peatland	4	2	1.00	4	2	1.00
Black spruce treed on mineral soil	42	16	0.81	28	16	0.63
Black spruce treed on riparian peatland	4	6	0.50	3	6	0.33
Black spruce treed on shallow peatland	50	20	0.65	35	20	0.90
Black spruce treed on thin peatland	50	24	0.63	53	24	0.83
Black spruce treed on wet peatland	1	8	0.38	9	8	0.75
Black spruce treed thin peatland	6	6	0.83	7	6	0.67
Broadleaf treed on all ecosites	6	1	1.00	3	1	1.00
Human infrastructure	4	1	-	0	1	-
Jack pine treed on mineral or thin peatland	31	12	0.42	32	12	0.92
Low vegetation on mineral or thin peatland	20	14	0.57	41	14	0.71
Low vegetation on riparian peatland	1	5	0.20	7	5	0.80
Low vegetation on shallow peatland	18	12	0.75	17	12	0.75

Table C- 31: Distribution of Moose Signs in Habitats on Generation Outlet Transmission Line Ground Tracking Transects Summer 2009

	Visit 1			Visits 2 and 3		
Habitat	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs
Low vegetation on wet peatland	7	2	1.00	11	2	1.00
Off-system marsh	1	1	1.00	0	1	-
Shallow water	0	1	-	1	1	-
Tall shrub on mineral or thin peatland	3	3	0.67	0	3	-
Tall shrub on riparian peatland	4	2	-	1	2	0.50
Tamarack- black spruce mixture on riparian peatland	0	2	-	2	2	-
Tamarack- black spruce mixture on wet peatland	2	1	1.00	0	1	-
Tamarack treed on shallow peatland	1	2	0.50	5	2	1.00

Table C- 32: Distribution of Caribou Signs in Habitats on Generation Outlet Transmission Line Ground Tracking Transects Over Three Visits Summer 2009

Habitat	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Signs
Black spruce mixedwood on mineral or thin peatland	3	2	0.50
Black spruce treed on mineral soil	58	16	0.44
Black spruce treed on riparian peatland	1	6	0.17
Black spruce treed on shallow peatland	3	20	0.10
Black spruce treed on thin peatland	46	24	0.33
Black spruce treed on wet peatland	5	8	0.25
Black spruce treed thin peatland	2	6	0.17
Broadleaf treed on all ecosites	10	1	1.00
Human infrastructure	0	1	-
Jack pine treed on mineral or thin peatland	7	12	0.17
Low vegetation on mineral or thin peatland	17	14	0.50
Low vegetation on riparian peatland	0	5	-
Low vegetation on shallow peatland	10	12	0.33
Low vegetation on wet peatland	0	2	-
Off-system marsh	0	1	-
Shallow water	0	1	-
Tall shrub on mineral or thin peatland	0	3	-
Tall shrub on riparian peatland	0	2	-
Tamarack- black spruce mixture on riparian peatland	0	2	-
Tamarack- black spruce mixture on wet peatland	0	1	-
Tamarack treed on shallow peatland	1	2	0.50

Table C- 33: Distribution of Caribou Signs in Habitats on Generation Outlet Transmission Line Ground Tracking Transects by Visit Summer 2009

	Visit 1			Visits 2 and 3		
Habitat	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Sign	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Sign
Black spruce mixedwood on mineral or thin peatland	3	2	0.50	0	2	-
Black spruce treed on mineral soil	52	16	0.31	6	16	0.19
Black spruce treed on riparian peatland	0	6	-	1	6	0.17
Black spruce treed on shallow peatland	1	20	0.05	2	20	0.05
Black spruce treed on thin peatland	45	24	0.29	1	24	0.04
Black spruce treed on wet peatland	5	8	0.25	0	8	-
Black spruce treed thin peatland	2	6	0.17	0	6	-
Broadleaf treed on all ecosites	10	1	1.00	0	1	-
Human infrastructure	0	1	-	0	1	-
Jack pine treed on mineral or thin peatland	6	12	0.08	1	12	0.08
Low vegetation on mineral or thin peatland	16	14	0.43	1	14	0.07
Low vegetation on riparian peatland	0	5	-	0	5	-
Low vegetation on shallow peatland	10	12	0.33	0	12	-
Low vegetation on wet peatland	0	2	-	0	2	-
Off-system marsh	0	1	-	0	1	-

Table C- 33: Distribution of Caribou Signs in Habitats on Generation Outlet Transmission Line Ground Tracking Transects by Visit Summer 2009

	Visit 1			Visits 2 and 3		
Habitat	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Sign	Number of Signs	Number of Transects Surveyed	Proportion of Transects With Sign
Shallow water	0	1	-	0	1	-
Tall shrub on mineral or thin peatland	0	3	-	0	3	-
Tall shrub on riparian peatland	0	2	-	0	2	-
Tamarack- black spruce mixture on riparian peatland	0	2	-	0	2	-
Tamarack- black spruce mixture on wet peatland	0	1	-	0	1	-
Tamarack treed on shallow peatland	0	2	-	1	2	0.50

Table C- 34: Distribution of Caribou Photos and Tracking Data on Caribou Calving and Rearing Islands in Lakes and Peatland Complexes from the Keeyask Generating Station and Keeyask Infrastructure Project Monitoring Programs in the Project Study Area

Study	Year	Age of Caribou/Number of Islands Surveyed	Islands in Lakes	Islands in Peatland Complexes	Peatland Complexes
Trail Camera	2010	Adult	0	2	3
		Calf	0	0	0
		Total Surveyed	4	3	4
	2011	Adult	0	2	2
		Calf	0	0	0
		Total Surveyed	0	2	2
	All Years	Adult	0	3	3
		Calf	0	0	0
		Total Surveyed	4	4	4
Ground Tracking	2010	Adult	0	1	1
		Calf	0	0	0
		Total Surveyed	4	12	4
	2011	Adult	1	15	3
		Calf	1	5	2
		Total Surveyed	3	22	3
	All Years	Adult	1	15	4
		Calf	1	5	2
		Total Surveyed	4	29	5
All Studies	2010	Adult	0	3	3
		Calf	0	0	0
		Total Surveyed	4	12	4
	2011	Adult	1	15	3
		Calf	1	5	2
		Total Surveyed	3	22	3
	All Years	Adult	1	16	4
		Calf	1	5	2
		Total Surveyed	4	29	5

Table C- 35: Distribution of Moose Photos and Tracking Data on Caribou Calving and Rearing Islands in Lakes and Peatland Complexes from the Keeyask Generating Station and Keeyask Infrastructure Project Monitoring Programs in the Project Study Area

			Islands in Lakes	Islands in Peatland Complexes	Peatland Complexes
Trail Camera	2010	Moose Adult	3	1	2
		Moose Calf	1	0	0
		Total Surveyed	4	3	4
	2011	Moose Adult	0	0	2
		Moose Calf	0	0	1
		Total Surveyed	0	2	2
	All Years	Moose Adult	3	1	2
		Moose Calf	1	0	1
		Total Surveyed	4	4	4
Ground Tracking	2010	Moose Adult	2	1	1
		Moose Calf	2	1	1
		Total Surveyed	4	12	4
	2011	Moose Adult	2	15	3
		Moose Calf	1	7	2
		Total Surveyed	3	22	3
	All Years	Moose Adult	3	16	3
		Moose Calf	2	8	2
		Total Surveyed	4	29	5
All Studies	2010	Moose Adult	1	2	2
		Moose Calf	0	1	1
		Total Surveyed	4	12	4
	2011	Moose Adult	2	15	3
		Moose Calf	1	7	2
		Total Surveyed	3	22	3
	All Years	Moose Adult	4	17	3
		Moose Calf	2	8	2
		Total Surveyed	4	29	5

Table C- 36: Moose Browse Observed in Habitats on Construction Power Transmission Line Routes 1 and 2

Habitat Type	CP Route 1			CP Route 2		
	Number of Plots	Number of Observations of Browse	Proportion of Plots	Number of Plots	Number of Observations of Browse	Proportion of Plots
Black spruce mixedwood on mineral or thin peatland	0	0	-	4	1	0.25
Black spruce treed on mineral soil	3	0	-	1	1	1.00
Black spruce treed on riparian peatland	0	0	-	8	1	0.13
Black spruce treed on shallow peatland	69	2	0.03	13	3	0.23
Black spruce treed on thin peatland	55	6	0.11	26	6	0.23
Black spruce treed on wet peatland	3	0	-	2	1	0.50
Black spruce treed thin peatland	2	0	-	21	7	0.33
Broadleaf mixedwood on all ecosites	5	1	0.20	5	1	0.20
Broadleaf treed on all ecosites	0	0	-	5	2	0.40
Human infrastructure	49	1	0.02	0	0	-
Jack pine treed on mineral or thin peatland	18	0	-	9	5	0.56
Low vegetation on mineral or thin peatland	6	2	0.33	6	1	-
Low vegetation on riparian peatland	4	0	-	18	0	-
Low vegetation on shallow peatland	39	4	0.10	12	3	0.25
Low vegetation on wet peatland	5	0	-	5	3	0.60
Off-system marsh	0	0	-	0	0	-
Shallow water	1	0	-	0	0	-
Tall shrub on mineral or thin peatland	4	1	0.25	0	0	-
Tall shrub on riparian peatland	2	2	1.00	1	1	1.00
Tall shrub on shallow peatland	0	0	-	0	0	-
Tall shrub on wet peatland	3	1	0.33	0	0	-
Tamarack- black spruce mixture on riparian peatland	0	0	-	0	0	-
Tamarack- black spruce mixture on wet peatland	8	4	0.50	0	0	-
Tamarack treed on shallow peatland	18	2	0.11	3	1	0.33
Tamarack treed on wet peatland	7	1	0.14	0	0	-

Table C- 37: Moose Browse Observed in Habitats on Generation Outlet Transmission Line Route Alternative Options A, B, and C

Habitat Type	A			B			C		
	Number of Plots	Number of Observations of Browse	Proportion of Plots	Number of Plots	Number of Observations of Browse	Proportion of Plots	Number of Plots	Number of Observations of Browse	Proportion of Plots
Black spruce mixedwood on mineral or thin peatland	-	-	-	6	2	0.33	-	-	-
Black spruce treed on mineral soil	21	5	0.24	20	7	0.35	27	2	0.07
Black spruce treed on riparian peatland	1	-	-	-	-	-	1	1	1.00
Black spruce treed on shallow peatland	27	11	0.41	11	2	0.18	22	2	0.09
Black spruce treed on thin peatland	21	5	0.24	19	2	0.11	36	4	0.11
Black spruce treed on wet peatland	3	1	0.33	4	-	-	3	-	-
Black spruce treed thin peatland	-	-	-	10	-	-	10	3	0.30
Broadleaf treed on all ecosites	-	-	-	7	2	0.29	-	-	-
Human infrastructure	-	-	-	-	-	-	4	-	-
Jack pine treed on mineral or thin peatland	28	8	0.29	8	3	0.38	6	-	-
Low vegetation on	11	2	0.18	15	8	0.53	4	1	0.25

Table C- 37: Moose Browse Observed in Habitats on Generation Outlet Transmission Line Route Alternative Options A, B, and C

Habitat Type	A			B			C		
	Number of Plots	Number of Observations of Browse	Proportion of Plots	Number of Plots	Number of Observations of Browse	Proportion of Plots	Number of Plots	Number of Observations of Browse	Proportion of Plots
mineral or thin peatland									
Low vegetation on riparian peatland	-	-	-	7	1	0.14	6	-	-
Low vegetation on shallow peatland	15	-	-	5	-	-	3	1	0.33
Low vegetation on wet peatland	4	1	0.25	6	-	-	-	-	-
Off-system marsh	-	-	-	2	-	-	-	-	-
Shallow water	1	-	-	-	-	-	-	-	-
Tall shrub on mineral or thin peatland	1	-	-	1	1	1.00	3	1	0.33
Tall shrub on riparian peatland	1	-	-	2	-	-	-	-	-
Tall shrub on shallow peatland	-	-	-	1	-	-	-	-	-
Tamarack- black spruce mixture on riparian peatland	-	-	-	-	-	-	1	-	-
Tamarack- black spruce mixture on wet peatland	2	-	-	1	1	1.00	-	-	-