Bipole III Transmission Project

Mammals Technical Report

Joro Consultants Inc. and Wildlife Resources Consulting Services MB Inc.
November 2011

Manitoba Hydro

Bipole III Transmission Project

Mammals Technical Report

Prepared by:

Joro Consultants Inc.

Wildlife Resource Consulting Services MB Inc.

Prepared for:

Manitoba Hydro

November 2011

TABLE OF CONTENTS

LIST OF MAPS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Manitoba Hydro has completed a Site Selection and Environmental Assessment (SSEA) and Environmental Impact Statement (EIS) as part of the environmental assessment process for the Bipole III Transmission Line Project (hereafter referred to as the Project). This report was prepared for Manitoba Hydro as one of several biophysical technical reports contributing to the larger environmental assessment and EIS for the Project. The seven mammal species selected as Valued Environmental Components (VECs) for the Project SSEA included boreal woodland caribou (*Rangifer tarandus caribou*), coastal caribou (*Rangifer tarandus*), and barren-ground caribou (*Rangifer tarandus groenlandicus*), beaver (*Castor canadensis*), American marten (*Martes americana*), moose (*Alces alces*), elk (*Cervus canadensis*), and wolverine (*Gulo gulo*). Grey wolves (*Canis lupus*) were also considered as a Linkage Species, due to the associated potential impacts of increased predation rates on ungulate VECs (caribou, moose, and elk) as a result of linear development. All caribou have been addressed in separate report (see *Bipole III Transmission Project - Caribou Technical Report [*Joro Consultants Inc., 2011]).

This study has made use of a variety of techniques for contribution to the effects assessment. Study methods for VEC species include literature review, GIS VEC habitat modelling, aboriginal traditional knowledge (ATK) interviews, aerial surveys, animal collaring and telemetry studies, ground surveys and trail camera studies. Additional unpublished information, specifically aerial moose surveys, was provided for use in this report by Manitoba Conservation. This report has includes data gathered up to March 31, 2011.

Based on analysis of collected data and review of academic literature, it was determined that the potential effect of the Project on VECs will vary across species. Results indicate that potential effects of the Project may include: VEC habitat loss and alteration; sensory disturbance due to construction, ongoing maintenance and access; habitat fragmentation; increased ungulate hunting; increased furbearer trapping; increased disturbance to mammals via increased ATV/snowmobile use along transmission line ROWs; possible increased disease transmission in ungulates; and increased wolf predation on ungulates.

Bear denning areas and mineral licks were identified as potential environmentally sensitive sites occurring in the Project area via ATK interviews; however, only general locations and no specific sites were identified for these environmentally sensitive sites. Once more specific sensitive site locations were identified; environmentally sensitive areas were mitigated for during the planning and routing process of the Project.

Based on analysis and potential environmental effects outlined in this report, residual effects of the Project on VEC species are anticipated to include loss or alteration of habitat; displacement of species through disturbance to the Project area; increased predator and human movements across the landscape; an increase in hunting and trapping of VEC species; and additional fragmentation/reduction of connectivity in potentially high use habitat areas. These residual effect are anticipated to varying across VEC species, project component and project phases. Overall, it is anticipated that with proper application of mitigation measures and ongoing monitoring that there will be no significant residual, irreversible effects of the Project on American marten, beaver, wolverine, moose or elk.

1.0 INTRODUCTION

1.1 Background

Manitoba Hydro is proposing to develop a new 500 kilovolt (kV) high voltage direct current (HVdc) transmission line, known as Bipole III (the Project), on the west side of Manitoba (Bipole III Study Area Alternative Routes Report, 2011a). The Project will consist of a HVdc transmission line originating at a new converter station to be located near the site of the proposed Conawapa Generating Station (GS) on the Nelson River and terminating at a second new converter station (Riel), to be located east of Winnipeg. The Project will also include new 230 kV transmission lines linking the northern converter station to the northern collector system at the existing 230 kV switchyards at the Henday Converter Station and Long Spruce GS. Each of the converter stations will require a ground electrode facility connected to the station by a low voltage feeder line.

Studies have concluded that a new transmission line and associated facilities would improve system reliability and reduce dependency on Dorsey Station and the existing HVdc Interlake corridor (Bipoles I and II). The Project would also establish a second converter station in southern Manitoba (Riel Station), to provide another major point of power injection into the transmission and distribution system. The Project will reduce line losses on the existing Bipoles I and II and provide additional transmission line capacity from north to south. As a result of the assessment of system reliability options and review by the Manitoba Hydro Electric Board and the Province of Manitoba, the Project will be routed on the western side of the province.

Wildlife Resource Consulting Services MB Inc. (WRCS) and Joro Consultants Inc. (Joro) have conducted the necessary mammal field studies to complete the Site Selection and Environmental Assessment (SSEA) for the proposed Project. The tasks identified to complete Manitoba Hydro's SSEA process included constraints identification and the analysis of both field data and available information of mammal distribution and abundance from literature and government sources that have contributed to the overall evaluation of alternative routes and the selection of a final preferred route (FPR). The assessment of environmental effects of the FPR has been conducted on a number of mammal valued environmental components (VECs) and includes the identification of mitigation opportunities and residual effects. These are summarized in the environmental impact statement (EIS) for the Project.

1.2 Project Description

The following is a summary of structures and project components associated with the Bipole III Transmission Project. Please see Appendix A (Project Infrastructure

Component Codes) and *The Bipole III Transmission Project – Project Description Report* (MMM Group, 2011) for further detail regarding project components.

1.2.1 Bipole III General Structure[1]

Two basic tangent structure types will be used for the straight line sections of the Project HVdc transmission line. In northern Manitoba, the line conductors will be suspended from guyed lattice steel structures. Guyed structure design and construction is beneficial in northern Manitoba as it can be adjusted to accommodate difficult or shifting foundation conditions, while also enabling periodic adjustment of the guys at their anchors, to accommodate for such movement. This is particularly important where permafrost may affect foundation stability and where construction access and maintenance may be hampered by difficult soil and terrain conditions. In the densely developed areas of southern Manitoba, self-supporting lattice steel structures will be used to reduce land acquisition requirement of tower foundations, reduce structural footprints and minimize potential impacts on adjacent farming practices.

1.2.2 Converter Stations

Two converter stations will be constructed at both ends of the Project. In the north, the new Keewatinoow Converter Station will include converters with associated equipment and ancillary facilities. This arrangement is required to terminate the 230 kV transmission line connections to the northern collector system, to convert the alternating current (AC) power from the collector system to dc power at the +/- 500 kV level and to provide the HVdc switching facilities necessary for termination of the new Project HVdc transmission line. The new southern converter station will include the HVdc switchyard facilities necessary to terminate the new HVdc transmission line. The southern station (Riel) will consist of the converters and the ancillary facilities required to convert the dc power from the Project transmission line to AC power at the 230 kV level which is necessary for injection into the southern receiving system. Although otherwise similar in concept to the Keewatinoow Converter Station, the Riel converter facilities will include synchronous compensators used for voltage control, strengthening the system, supporting the Project converters, and adding system inertia for stability (Manitoba Hydro, 2010).

---

[1]*NOTE: Section 1.2.1 to 1.2.5 – Project Description – are based on Bipole III Transmission Project: A Major Reliability Improvement Initiative provided by MMM (Date April 7, 2011).*

1.2.3 Ground Electrodes

Ground electrodes will be required at both the northern and southern Project converter stations to enable ground return of electric current in the event of monopolar operation. The electrode site selection process was an iterative process of identifying and evaluating sites. Thirteen candidate electrode sites were initially identified within 50 km (approximately 31 mi.) of the proposed Keewatinoow converter station and later expanded to include an additional ten sites on the basis of technical criteria (Manitoba Hydro, 2010). Final site selection was based on the SSEA process and involved aboriginal interests in the site selection (Manitoba Hydro, 2010). For the northern ground electrode two potential sites were considered acceptable for development. In rank order of technical preference, these sites are NES6 and NES7. The technically preferred site has been established as NES6, located within the Fox Lake Resource Management Area (See report- Bipole III Transmission Project: A Major Reliability Improvement Initiative, 2011, for further details).

The Riel ground electrode site selection process identified 11 candidate sites. Final site selection was based on the SSEA process, with potentially affected landowner's, residents, and affected stakeholders within the R.M. of Springfield. As a result of this process, Site SES1c a variation of SES1, ranked highest in technical review of the four alternatives and was selected as the final southern electrode site (See report- Bipole III Transmission Project: A Major Reliability Improvement Initiative, [Manitoba Hydro 2011a], for further details).

1.2.4 Connection Line between Electrode and Converter Station

The low voltage connecting line between the electrode and the converter station dc switchyard will be an overhead pole line strung with two conductors, similar in scale to a distribution line. The electrode line conductor will be similar to that of the pole conductor in the HVdc line. If the electrode site is situated along the access road, the electrode line is expected to be routed within the access road right-of-way (ROW) (Manitoba Hydro, 2010).

1.2.5 Collector Lines

Based on prior design experience in northern Manitoba, guyed lattice steel structures have been identified as the preliminary design standard for straight (tangent) sections of the 230 kV northern collector kV transmission lines. As for the northern portion of the Project HVdc line, guyed structures provide flexibility for tower construction and maintenance in difficult foundation and terrain conditions. Self-supporting lattice steel structures will be used for angle or dead-end towers where rock foundation conditions are present. Guyed lattice steel structures will be used in angle or dead-end locations where soil conditions are poor (Manitoba Hydro, 2010).

1.2.6. Site Access Roads

Site access roads will be used at various sites within the Project footprint (see Glossary), with the majority of existing and planned access routes occurring in the Northern Study Area. The majority of site access roads required for the Project are pre-existing road created through other projects and will be re-purposed for use in this project; however, some new site access roads will be required to be created for the Project. The roadway network will permit on-site tractor trailer access for site development and equipment installation and maintenance, as well as access for employees and smaller service vehicles. Access roads will be used by heavy construction equipment for the duration of the construction phase of the Project. Where access roads currently exist and can be rehabilitated for project use, rehabilitation and maintenance will be undertaken as soon as authorization for the Project is received. The extent of the required access road upgrading will under ongoing assessment.

Precise layout and design requirements for the access and haul roads will be determined on the basis of the contractors' proposed construction methodology and subject to Manitoba Hydro approval.

1.2.7. Borrow Sites

Aggregates required for use in foundation construction will generally be transported from established and appropriately licensed sources off-site. Suitable material for backfill of excavated organic soils may be hauled from newly developed borrow areas along the ROW. Typically, borrow pit locations will be located along the ROW to minimize environmental disruption, haul distances, and cost. Where suitable sources are not available along or close to the ROW, nearby deposits may have to be identified and the surrounding brush cleared to gain access to the line. Selection, development, and reclamation of new borrow sites will be undertaken in accordance with provincial regulations and with the approval of the local Natural Resources Officer and local government authorities. Where borrow pits are required, exposed soils will be reclaimed by promoting re-growth of native vegetation and other mitigation measures in accordance with *The Mines and Mineral Act* (1991).

1.3 Purpose

Approximately 75 percent of Manitoba Hydro's generating capacity is delivered to southern Manitoba via the existing HVdc Interlake corridor, which is shared by the Bipole I and II transmission lines. Due to the heavy reliance on one transmission corridor and a single converter station in the south (Dorsey), the system is vulnerable to extensive power outages from severe weather (e.g., major ice storms, extreme wind events, tornados), fires, or other events.

2.0 STUDY AREAS

The Project Study Area (see Glossary) for SSEA was determined by an alternate route evaluation process whereby routing options were identified and then ranked in sections by all disciplines of the EA process. The Local Study Area consisted of a three mile planning corridor with the final route consisting of a 66 m ROW (see Glossary). The resulting preferred route selected is approximately 1,380 km long and transects five distinct ecozones: Hudson Plains Ecozone; Taiga Shield Ecozone; Boreal Shield Ecozone; Boreal Plains; and Prairie Ecozone. In composition, these ecozones represent three percent, three percent, 37 percent, 35 percent and 23 percentof the Project Study Area respectively.

2.1 Study Area Ecozones

2.1.1 Hudson Plains

The Hudson Plains Ecozone in Manitoba is found in the northeast corner of the province along the southern edge of Hudson Bay. Peatlands and marshes dominate this poorly drained ecozone. Trees that do exist in this transitional area between the Arctic tundra and boreal forest are typically sparse, scattered, and stunted. Such tree species include black spruce (*Picea mariana*), white spruce (*Picea glauca*), and tamarack (*Larix laricina*) along drier ridges, and balsam poplar (*Populus balsamifera*), white spruce, and paper birch (*Betula papyrifera*) in sheltered areas along watercourses (Smith et al., 1998; Natural Resources Canada, 2007). Common mammals of the Hudson Plains Ecozone include American marten (*Martes americana*), arctic fox (*Alopex lagopus*), black bear (*Ursus americanus*), barren-ground caribou (*Rangifer tarandus groenlandicus),* coastal caribou (*Rangifer tarandus*), grey wolf (*Canis lupis*), lynx (*Lynx canadensis*), moose (*Alces alces*), and muskrat (*Ondatra zibethica*). Polar bears (*Ursus maritimus*) are common along the coast of the Hudson Bay (Smith et al., 1998; Natural Resources Canada, 2007).

2.1.2 Taiga Shield

The northwestern area of Manitoba is characterized by the features of the Taiga Shield Ecozone: rolling upland hills, lowland bog and fen peatlands, rocky outcrops, and glacial till forming eskers and kettle lakes. Stands of jack pine (*Pinus banksiana*), black spruce, and tamarack cover the southern portion of this ecozone and transition to the treeless Southern Arctic Ecozone in the north. White spruce, balsam poplar, and paper birch are found along protected areas lining waterways (Smith et al, 1998). Common mammals found in the Taiga Shield Ecozone include arctic fox, barren-ground caribou (*Rangifer tarandus groenlandicus*), black bear, brown lemming (*Lemmus sibiricus*), grey wolf, moose, polar bear, and weasel (*Mustela nivalis*) (Smith et al., 1998).

2.1.3 Boreal Shield

The Boreal Shield Ecozone 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. Soils in this ecozone are typically thin, cool, acidic, and have low nutrient availability. Wet, oxygen poor, organic soils underlie wetland areas (Smith et al., 1998; Environment Canada, 2000). Dominant vegetation cover includes closed stands of conifers, mostly white and black spruce, jack pine and tamarack. Broadleaf species including white (paper) birch, trembling aspen (*Populus tremuloides*), and balsam poplar are more abundant towards the south (Zoladeski et al., 1995). Common mammals found in this ecozone include American marten, beaver (*Castor canadensis*), black bear, fisher (*Martes pennanti*), grey wolf, lynx, mink (*Mustela vison*), moose, muskrat, snowshoe hare (*Lepus americanus*), striped skunk (*Mephitis mephitis*), white-tailed deer (*Odocoileus virginianus*), and woodland caribou (*Rangifer tarandus caribou*) (Smith et al., 1998; Environment Canada, 2000).

2.1.4 Boreal Plains

The Boreal Plains Ecozone extends from the south Interlake to the north Interlake and west to the Saskatchewan border, comprising approximately 15 percent of Manitoba's landscape. Unlike the Boreal Shield, this ecozone is not dominated by bedrock and has fewer lakes. Although mainly forested, a considerable amount of land has been converted to agriculture including crops, hay land, and pasture (Smith et al., 1998).

Mammals common to the Boreal Plains Ecozone in Manitoba are beaver, snowshoe hare, white-tailed deer, moose, elk (*Cervus canadensis*), red fox (*Vulpes vulpes*), coyote (*Canis latrans*), black bear, American marten, fisher, and lynx (Pattie and Hoffman, 1990; Smith et al., 1998).

2.1.5 The Prairies

The Prairies Ecozone, found in the south-west corner of the province, is mostly made up of agricultural lands including crops, hay lands, and pastures, with small pockets of forested habitats located along rivers, shelterbelts, homesteads, and various protected areas. Approximately nine percent of Manitoba's total landscape is comprised of Prairies Ecozone that contains significant concentrations of wetlands located in the Neepawa area and adjacent to major water bodies such as Lake Manitoba (Smith et al., 1998).

Common mammals found in this Manitoba ecozone include: elk, white-tailed deer, coyote, red fox, badger (*Taxidea taxus*), white-tailed jack rabbit (*Lepus townsendii*), eastern cottontail rabbit (*Sylvilagus floridanus*), striped skunk, Richardson's ground squirrel (*Spermophilus richardsonii*), red-backed vole, deer mouse (*Peromyscus* *maniculatus*), and northern pocket gopher (*Thomomys talpoides*) (Pattie and Hoffman, 1990; Smith et al, 1998).

2.2 Project Structures in the Local Study Area

The proposed Project northern converter station (Keewatinoow) and associated infrastructure including ground electrodes and lines, site access roads, and borrow sites for the Project is projected to lie within the Hudson Plain Ecozone and the southern converter station (Riel) in the Prairies Ecozone. The proposed HVdc transmission line runs in between these two converter stations as described above, passing through the Hudson Plain, Taiga Shield, Boreal Shield, Boreal Plains, and the Prairies Ecozones.

3.0 METHODOLOGY

3.1 Site Selection and Environmental Assessment Process

Manitoba Hydro Licensing and Environmental Assessment Branch (LEA) utilized the SSEA process to systematically assess biophysical constraints and opportunities in the routing and siting of the Project and its components. The EIS was also undertaken to assess the potential adverse effects of the Project and to identify appropriate mitigation measures to manage the residual effects of the proposed project on the environment. The specific objectives of the SSEA process were to:

- Provide a description of the proposed transmission facilities to all stakeholders and the public;
- Provide rationale for evaluating alternative routes and associated facilities in a technically, economically, and environmentally sound manner;
- Assess the potential impacts of the FPR and its associated facilities;
- Conduct the SSEA process with consideration of local input from potentially affected First Nations and other aboriginal communities, other communities and municipalities, land and resource users, interest groups, resource managers, and the public at large, in a responsive, documented and accountable fashion;
- Find practical ways to mitigate potential negative effects and enhance benefits; and
- Prepare an EIS that documents the results of the SSEA process.

Through Project Study Area characterization, the locations of sensitive biophysical, socio-economic and cultural features, technical (engineering), and cost considerations for transmission line routing were identified. The SSEA process utilized data from existing published sources, was supplemented by field studies, incorporated feedback from public and government involvement, and included consultation with First Nations and communities on aboriginal traditional and local knowledge.

Through the SSEA process, three alternative route corridors were identified. The alternative routes selected avoided significant sensitivities where possible and sought to minimize potential effects where avoidance was not possible or practical. A route selection matrix was developed to facilitate the evaluation of alternative routes on a segment-by-segment basis. The alternate routes were separated into 13 segments and evaluated and compared, by segment, considering geographic features, potential opportunities, technical considerations, and professional judgment.

During the course of the route selection process, several adjustments were made to the original alternative route segments based on additional input provided by the Environmental Assessment study team and various stakeholders (e.g., mining and agricultural interests).

A total of 28 factors were identified to evaluate the alternative routes. These factors included a full range of biophysical, socio-economic, land use, technical, and stakeholder considerations. Evaluation criteria were identified for each factor that would facilitate three-tier (high, medium, and low) ranking. Biophysical, socio-economic, and land use rankings were based on the degree to which the factor is affected. Technical rankings were based on the degree to which the factor is a constraint while stakeholder rankings were based on the nature and degree of response. A four-tier ranking (very high, high, medium, and low) was used for several biophysical factors where potentially significant implications on protected species and habitats were identified.

Stakeholder factors were applied to the segment rankings after the ratings were determined. Stakeholder, response criteria were based on both a numeric count and a general expert assessment of the negative or positive commentary provided for certain segments. General commentary provided (e.g. diagonal routes are not preferred) was considered in the evaluation of relevant segments. The objective of the stakeholder evaluation was to select route segments with the lowest level of concerns or most favoured as expressed by aboriginal groups, municipal governments, stakeholder groups, and the general public. A three tiered ranking system (fair, good, or poor) was based on numeric counts of comments provided plus expert assessment of feedback from all sources.

Aboriginal traditional knowledge (ATK) was considered separately under the various applicable biophysical, socio-economic, land use and stakeholder factors. Where ATK confirmed a scientific finding, no change in ranking was made, but a note to that effect was included for that particular segment. Where ATK provided additional information about any of the 28 factors, it resulted in a higher ranking than what was determined previously.

The conclusion of the route evaluation and analysis process resulted in the selection of a FPR for the Project.

3.2 Desktop Studies

3.2.1 Development of Habitat Cover Categories

In assessing potential routing options and residual effects of the FPR, a habitat-based assessment was undertaken using up to date imagery and land cover information over the entire Project Study Area. Due to the large geographic extent of the Project Study Area, several spatial habitat datasets were assessed to determine their utility in evaluating and modeling specific components of VEC mammal habitat. The Manitoba FRI has been used in the development of habitat suitability index models (HSIs); however, as the FRI was produced over several eras of data collection and processing, many of the FRI datasets were outdated attribute data and were not consistent among datasets. In some instances, critical attributes such as landscape age were not available in some regions and forest fire history was also not reflected in some of the datasets.

For the purpose of this project, a spatial ecological Geographic Information System (GIS) layer was specifically developed for the Project and was termed the Landcover Classification of Canada, Enhanced for Bipole (LCCEB). This layer is based upon the Landcover Classification for Canada (LCC) developed by the Canadian Forest Services (Wulder and Nelson, 2003). The LCC layer is a national vector database mapping layer that has been harmonized across the major Federal Departments involved in land management or land change detection (Agriculture and Agri-Foods Canada (AAFC), Canadian Forest Service (CFS), and Canadian Centre for Remote Sensing (CCRS)). Existing forest classifications and inventories are based primarily on aerial photography, whereas development of the LCC was done using remotely sensed imagery (Landsat data) as part of Earth Observation for Sustainable Development of Forests (EOSD) program. The enhanced version includes a further harmonization/integration of the National Stratification Working Group ecological framework database (Smith et al., 1998) to the ecodistrict scale and the addition of wetland features, Manitoba forest harvest layers, and forest fire layers. This provides attribute data that defines the landform, soil conditions, and fire and harvest records for the Project Study Area. The following list describes data layers spatially joined to the LCC database in ArcMap (ESRI©, 2011):

1. A comprehensive fire layer, including fire data obtained from the Manitoba Land Inventory (MLI) and Manitoba Conservation. Data were collected between 1926 and 2010 and as such have variable spatial resolution and reporting scale.

2. A 1:1 million-scale Manitoba Wetlands layer identifying wetland information for the province.

3. The Canadian Ecological Land Classification System, a 1:1 million national layer based on the National Stratification Working Group's Ecological Land Classification for Canada (Ecological Stratification Working Group, 1995), which divides Canada's natural landscapes into 15 terrestrial ecozones which are sub-divided into 53 ecoprovinces, 194 ecoregions, and 1,021 ecodistricts. For the Manitoba classification, ecodistricts are differentiated primarily on the basis of enduring features criteria such as landform composition, land-surface shape, textural group, soil development, and distribution of permafrost. Satellite data, Advanced Very High Resolution Radiometer (AVHRR), was also used to assist in identifying vegetation composition of the polygons. By utilizing enduring features as primary elements of the classification, the ecological stratification hierarchy is less subject to change over time thus the classifications are more persistent. Unlike administrative divisions (e.g. Forest Management Units (FMU)) the polygons of the national framework have associated ecological functions, sharing similar soils, and hydrology and growing conditions for forest productivity. These are the fundamental reporting units for the LCCEB.

4. A combined layer delineating forest harvest areas in the Project Study Area. This layer combines harvest data provided by Lousiana-Pacific, Tolko Industries Ltd., and Manitoba Conservation (MMM Group Limited, 2010). Scale and reporting over time varies with the earliest records dating to the 1960s for softwood harvest. Scale is assumed to be equivalent to digitized linework from aerial photography (1:15,000).

5. A FMU layer providing boundaries for the LCCEB, obtained from the Manitoba FRI database.

The primary attribute of the LCCEB is the landcover category associated with a particular polygon (Map 1). These landcover types identify the primary ecological cover condition of an area. The landcover classes developed were based on those used in the National Forest Inventory and were endorsed by the Canadian Forest Inventory Committee (CFIC). All of the habitat analysis and modeling in the Project Study Area for mammals was done using LCCEB categories. Models were developed for caribou calving and caribou wintering areas by characterizing landcover category area and spatial relationship metrics.

3.2.2 Identification of Mammal Valued Environmental Components and Constraints

It is not possible to describe and investigate every aspect of the terrestrial environment; therefore it was necessary to select an appropriate suite of mammal VECs species that represent the broad spectrum of ecosystem and social values found across the Project Study Area. The Canadian Environmental Assessment Agency (2009) identifies VECs as "any part of the environment that is considered important by the proponent, public, scientists and government involved in the assessment process. Importance may be determined on the basis of cultural values or scientific concern." Mammal VEC selections were made by the Project study team through a structured process assessing a number of key attributes (see Section 3.2.2.1 - VEC Selection Process).

The seven mammal species selected as VECs for the Project SSEA included boreal woodland caribou, coastal, and barren-ground caribou, beaver, American marten, moose, elk, and wolverine. Grey wolves were also considered as a Linkage Species, due to the associated potential impacts of increased predation rates on ungulate VECs (caribou, moose, and elk) as a result of linear development. Assessing the predator/prey relationships was considered an important element in the evaluation of population viability for VEC prey ungulates.

Caribou (boreal, coastal and migratory) are dealt with separately in the *Bipole III- Caribou Technical Report* (Joro, 2011). Boreal woodland caribou are a threatened species under the federal *Species at Risk Act* (SARA) and *The Manitoba Endangered Species Act* (MESA). Coastal and barren-ground caribou are also dealt with in this report given their close association to boreal woodland caribou.

3.2.2.1 Valued Environmental Component Selection Process

Mammal VEC selection criteria was comprised of several factors that included:

- importance to people – species important for hunting and trapping activities, as well as culturally significant species;
- regulatory requirements – federal and provincial legislation regulate both hunting activities and protect critical habitats for rare and endangered species;
- keystone species – a species that is critical in maintaining the structure of an ecological community and whose impact on a community is larger than would be expected based on its relative abundance (Paine, 1995);

- umbrella species – a species selected for making conservation-related decisions that indirectly protects many other species within the ecological community (Roberge et al., 2004);
- indicator species – a species that defines a trait or characteristic of the environment (Farr, 2002);
- model applications – data for a given species is present and available to construct and validate (if required) simple models; and
- habitat requirements – the various habitats required by each species for critical life stages such as food, cover, migration, overwintering, calving etc.

The following approaches were used to assess project effects on the mammal VECs for both the evaluation of alternative route segments and in assessing the environmental impacts of the FPR:

- development and use of a simple LCCEB derived model that identified the location of high quality habitat for each of the species (i.e., semi-open forest and natural edge adjacent to wetlands) relative to each Project Study Area segment;
- fragmentation and/or core habitat analyses for the sensitive species;
- calculation of total habitat by segment;
- calculation of habitat totals by ecodistrict;
- proportion of habitat intersected verses availability;
- maximum coverage included the distribution of the species in the Project Study Area; and
- context was derived by comparing potentially affected areas to availability within an ecodistrict.

Once the assessment method(s) were selected, a categorical risk ranking by segment of high, moderate, or low was completed. Table 1 provides and overview of VEC selection criteria, anticipated analysis, and impacts.

Table 1: Overview of Valued Environmental Components Selection Criteria, Anticipated Impacts, and Analysis

Valued Environmental Component (VEC) Selection Criteria	
Socio-cultural criteria	• Species provide cultural, social, scientific, spiritual, and economic benefits
Listing	• Provincially protected under the *Wildlife Act* or *The Endangered Species Act* (Manitoba) • Species are declining globally or are considered rare • Listed by SARA and/or MESA either as of "Special Concern" or "Threatened"
Biological and ecological criteria	• Keystone species • Indicator species
Information availability	• Sufficient data for habitat preference models and other modeling
General criteria	• Species distributions overlap with Project Study Area
Anticipated Direct, Indirect, and Cumulative Impacts	
Loss of forage	• Destruction/degradation along ROW • Habitat destruction during construction • Subsequent negative population and health effects from reduced forage availability
Range fragmentation and loss of functional habitat	• Reduced habitat use away from ROW due to disturbance • Avoidance of ROW and subsequent displacement • Potential reduction in range connectivity
Increased predation	• Increased access and speed of predators along the ROW • Increased predator numbers • Increased mortality of VEC ungulates
Deer and pathogen movement	• Northward deer range expansion • Possible transmission of *Parelaphostrongylus tenuis* to VEC ungulates
Human hunting	• Direct mortality of VEC ungulates • Decreased recruitment from hunting of adult females
Other impacts	• Increased sensory disturbance and mortality from cumulative effects of other development in the area • Potential landscape level negative habitat effects • Potential site-specific loss of important food and cover

Valued Environmental Component (VEC) Selection Criteria	
	• Potential positive habitat effects related to potential increases in food, cover, or edge habitat
Analysis Components	
Boreal woodland caribou (See Joro Technical Report on Caribou)	• Historical distribution • Known calving areas • Known core winter use areas • Habitat modeling for calving areas and winter use areas
Other mammals	• Habitat modeling for select VECs • Known moose concentration areas • Known wolverine concentration areas
Disturbance regime analysis	• Evaluation of increased access into previously remote areas
Ranking	• Independent segment ranking for boreal woodland caribou and other mammal VECs

3.2.3 Aboriginal Traditional Knowledge

Aboriginal traditional knowledge materials, including literature, data, and maps, were obtained from the following communities and reviewed (MMM Group Limited, 2011): Fox Lake Cree Nation, Dakota Plains, Dakota Tipi, Duck Bay, Camperville, Pine Creek, Waywayseecappo, Dawson Bay, Herb Lake, Barrows, Pelican Rapids, Cormorant, Thicket Portage, Pikwitonei, Chemawawin, Westgate, National Mills, Baden, Powell and Red Deer Lake.

Once collected, the ATK survey data were reviewed for species location information, species composition, and important features pertaining to the VECs. The locations of important sites and mammal habitats were also noted, especially in relation to the FPR.

Key person interviews were conducted in October 2010 with trappers across various locations within the proposed project route. Individuals from the Manitoba Trappers Association MTA zones 1, 4, 7 along with other distinct areas were interviewed by a representative of MMM Group using a list of pre-determined questions. The interview process was recorded by a tape recorder, notes were taken, and maps provided by MMM Group were used. The traditional ecological knowledge (TEK) collected from trappers during these interviews was provided to Joro Consultants Inc. Results of interviews were synthesized, summarized, and added to *Existing Environment* (Section 4.0) and *Environmentally Sensitive Areas/Sites* (Section 5.6).

Data pertaining to denning areas, migration corridors, and mineral licks were identified and incorporated into the mammal assessment found within the Project Preferred Route Corridor. Results specific to each species are discussed in Section 5.0.

3.3 Field Studies

Field studies included a combination of aerial surveys during winter and summer, as well as ground tracking. Trail cameras were used to detect the presence of various VEC species or other species/activities that may affect the analysis or prediction of the overall impacts of the Project transmission line and the associated infrastructure. The following sections provide a summary of the types of surveys conducted and the methods used. Due to the sprawling nature of the Project Study Area, which traverses several distinct ecoregions, it was necessary to adapt various field studies and techniques to the local environment, resulting in methodological differences between regions. Consideration was given to the various environmental settings, such as adapting surveys for remote boreal forest, transition agriculture/forested areas, or predominantly agricultural regions. The following sections describe the methods used to assess the VEC mammal species in order to determine any measureable parameters to support or justify environmental protection and mitigation.

3.3.1 Aerial Surveys

3.3.1.1 High-quality Moose Habitat Block Surveys

As part of the SSEA process, high-quality moose habitat was identified through a habitat modeling exercise described in Section 3.4. Potential high-quality winter moose habitat was defined as areas dominated by early successional vegetation, primarily shrub land occurring in post-fire landscapes. Aerial surveys were undertaken in four high-quality habitat blocks in 2010 to identify alternative routes intersecting high-density winter range (Map 2). All survey blocks were flown at 100% coverage for total count estimates. Total count surveys provide an unbiased and accurate estimate of population within the sample (Bookhout, 1996). Visibility bias estimates, assessing the degree to which visibility in various cover types affected the accuracy of moose population counts, were deemed unnecessary; cover and resultant visibility in all moose blocks were relatively uniform, and the objective of these surveys was to compare differences between alternative routes on wintering populations of moose, rather than to derive an accurate population count.

3.3.1.2 Manitoba Conservation Moose Surveys

Data from past aerial moose surveys were provided by Manitoba Conservation and included as background for the Existing Environment (Section 4.4.1). Aerial survey data were obtained for Game Hunting Areas (GHAs) (2A, 4, 5, 6, 6A, 7, 7A, 8, 10, 12, 15A, and 16) from 1967 to 2010 from Manitoba Conservation (Map 3). Aerial moose survey methodology used by Manitoba Conservation staff included population estimates and age/sex surveys.

3.3.1.3 Multispecies Surveys

Multispecies aerial transect distribution surveys were conducted across a number of boreal woodland caribou ranges, see *Bipole III Transmission Project- Caribou Technical Report* (Joro, 2011) in 2010 and 2011 to provide estimates of VEC winter distribution based on observations of animals and tracks (Map 4). Aerial surveys were conducted using either a helicopter with a crew chief and two observers or a slow-flying fixed wing Super-Cub aircraft and were flown systematically using 1.5 to 4 km grids within various ranges. Observations and tracks were recorded for caribou, moose, wolf, and wolverine.

All observations of tracks and animals were logged into navigational-quality handheld GPS units, stored in Garmin Data Base files (*.gdb files) and later converted to shapefile format in a GIS environment for further analysis. Separate distribution maps were generated for each species surveyed.

For moose, areas of high density were identified through a modified kernel analysis (Rodgers and Carr, 2005). All point locations of observed moose tracks and observations were analyzed using the ArcMap's (ESRI©, 2011) Home Range extension. This extension calculates a utilization distribution (UD) for point location data by applying a bivariate probability density function as a kernel over each point to derive an estimate of point density across the entire area occupied by point data. Areas with large concentrations of points (i.e. many observations of moose or moose tracks) contain larger volume concentrations than areas with a low density of point data. Density kernels were generated using GIS tools then mapped to highlight major concentrations of moose tracks in the survey blocks.

3.3.1.4 Final Preferred Route Mammal Stratification Surveys

Aerial transect surveys can be utilized to define sample strata that illustrate graduated levels of target species expectancy (Gasaway, 1986). The data derived from aerial transect surveys can be used to more effectively estimate populations of ungulates (Gasaway, 1986) as well as to characterize a landscape or area in terms of the relative densities of mammals (i.e. high, medium, and low). To identify areas of potential importance to mammals, a winter aerial mammal transect survey was undertaken along the entire length of the FPR to determine the distribution and relative abundance of VEC mammal species, including moose, elk, wolverine, and marten. The survey consisted of flying along the entire length of the FPR recording VEC observations, as well as a set parallel transects flown 2 km on each side of the entire FPR (Map 5). All surveys were conducted using fixed wing Super-Cub Aircraft with highly experienced observers. When significant concentrations of moose and elk were encountered, there was an attempt to survey more intensely within the bounds of the Local Study Area to conduct total counts of moose and elk to assist in defining residual effects in the EIS. All mammal observations were logged into navigational quality GPS units stored in a Garmin Data Base file (*.gdb file) and later converted into shapefiles for further analysis.

Track and observation data collected during the course of the aerial survey were processed using an adaptation of track mapping methodology (Mayle et al., 2000) to assess the relative density of observed species along the length of the FPR. The methodology adapted the principles of stratification as modified from Gasaway (1986), utilizing a sample design illustrating the differences in species presence and density along the FPR at regular 2 km intervals. At each 2 km interval along the FPR centre line, a point was generated in a GIS environment. A 2.5 km circular buffer was generated for each point. All species sightings and tracks falling within each buffer were counted and divided by the total circle area to produce a species density value for each buffer circle. The use of 2.5 km for the buffer diameter ensured that all animal and track observations within the 1 km transect were included in the species counts. The derived density value was used to generate new circles, using a weighted radius (2500 + (density x 5 m), and merged into a continuous density weighted buffer along the FPR. Maps were generated to illustrate the relative density of VEC mammal species along the FPR.

The relationship between existing access and moose densities along the FPR were assessed by comparing linear feature density to moose density. This was also integrated as part of a separate fragmentation analysis, see Bipole III- *Fragmentation Technical Report* (Joro, 2011). Map 6 illustrates the relationship of reduced moose densities with increased levels of fragmentation, which is thought to be a function of increased access for hunting (Crichton et al., 2004).

3.3.1.5 Wolf Telemetry

Telemetry allows for two advantages to wildlife research which cannot be provided through other research techniques: 1) it can identify individual animals; and 2) it can locate each animal when desired (Moen et al., 1997). Three distinct types of telemetry surveys are generally used in wildlife studies and include: (1) very high frequency (VHF) radio tracking; (2) Argos satellite tracking; and (3) Global Positioning System (GPS) tracking (Mech and Barber, 2002). For the purpose of assessing grey wolf as a linkage species, Argos telemetry was used to assess wolf movement in relation to linear corridors to gather any evidence of increased wolf movement associated with linear development supporting the hypothesis of in increased predation of moose and caribou. (James and Stuart-Smith, 2000).

In January 2010, 18 wolves were captured and equipped with Argos satellite tracking collars (Lotek Wireless Inc.) in locations throughout the Project Study Area (Map Series 100). Two of the initial 2010 collars remained active as of March 15, 2011, while eight were recovered in 2010. The remaining 8 were lost and not recovered. Thirty-three additional collars were deployed in winter 2011 (Table 2). Eight recovered collars from the previous season were redeployed, along with 25 new Argos collars. A total of 35 wolf collars were active as of march 15, 2011.

Capture and collaring of wolves were undertaken by Manitoba Conservation through the services of a custom capture company. Wolves were captured using aerial net gunning from a helicopter (Figure 1), rather than chemical immobilization. Once captured, basic measurements (total animal length, neck girth, sex, and coloration) and biological samples (hair and fecal) were taken (Figure 2). Argos tracking collars were then placed on the animals and then were released. Argos tracking collars use a VHF beacon to allow for relocation using standard radio telemetry methods. GPS locations are acquired every four to six hours and data are transmitted every nine days via the Argos satellite system and made available for the client through a web-based server (Telnet) or email from CLS America Inc. Wolf movements were monitored and home range and movement data were processed using ArcMap software (ESRI©, 2011).

Figure 1: Wolf Captured Using Aerial Net Gunning from a Helicopter by Heli Horizons Inc. Winter 2010

Figure 2: Captured Wolf Being Restrained For Collaring and Examination by Crew Members

During the course of grey wolf telemetry studies conducted for the Project, distribution and location of grey wolf packs combined with mortality and collar performance resulted in variable collar distribution across the Project Study Area.

Table 2 Wolf Collars Deployed in January of 2010 and January Of 2011 in Various Boreal Caribou Ranges.

Range	2010	2011	Active Collars
Harding Lake	4	11	12
The Bog	0	4	4
Wabowden	4	4	5
Wimapedi-Wapisu	5	10	10
Wheadon	5	0	0
Reed Lake	0	4	4
Total	**18**	**33**	**35**

3.3.1.6 Minimum Wolf Counts

Minimum wolf counts were undertaken in 2010 and 2011 over a large area between Harding Lake and The Pas (Map 7). The survey area included five identified caribou ranges. Counts were conducted by professional trackers in Super-Cub aircraft in January of each year. Waypoint locations and track files were recorded using hand-held GPS units for all wolf tracks and observations. Wolf tracks were followed until visual observation and a pack size count could be obtained. Pack sizes and individual wolf colours were recorded. For the purpose of the Project EIS study, packs were defined by groups of five or more animals. Based on other wolf monitoring, mean wolf pack size were approximately 3.5 animals, with a range of two to six animals on average and maximum pack sizes being approximately nine animals (Wydeven et al., 2003; Wydeven et al., 2009). Argos collared wolves were also tracked using standard VHF telemetry tracking to further locate packs, smaller groups and collared solitary individuals as part of the minimum count estimate.

3.3.1.7 Wolf Pack Range Delineation

Wolf pack home ranges were delineated based on the established associations between collared wolves and identified wolf packs. Minimum convex polygons (MCPs), also known as convex hulls, are a standard method of determining a species range based on species point location data. They are constructed using the peripheral data points with angles greater than 180 degrees (Mohr, 1947). The MCP provides a simple demarcation of total range extent; however, it does not illustrate changes or differences in habitat use within the overall range area. Based on the assumption that the movements of collared wolves associated with known packs were representative of pack movements, the generated MCPs were used to approximate range extent for applicable packs. Wolves observed during aerial surveys and capture work that were traveling with a collared wolf were counted, and classified as a pack. Wolf pack territories were estimated based on the range

3.3.1.8 Other Surveys

In March of 2010, an aerial survey was conducted along the Preliminarily Preferred Route (PPR) from east of Winnipeg to Red Deer Lake. The survey was conducted at an average of 1 km altitude and at an average speed of 150 km/h. The primary purpose of the survey was to verify the covertype of the LCCEB layer used to identify habitats of interest that would later be surveyed for mammals. Incidental observations of mammals (i.e. elk, moose, and grey wolf) and/or their related sign were also geo-referenced. In total 1,196 km of 1,384 km (86 %) of the Project Study Area was surveyed for this portion of the Project.

3.3.2 Ground Surveys

3.3.2.1 Furbearer Ground Validation Survey

Ground tracking surveys in the northern portion of the FPR were undertaken for marten and non-VEC furbearers for the purpose validating the aerial FPR mammal stratification survey data in areas of heavy conifer canopy. Surveys consisted of four sites each in The Pas and Thompson environs, and in three sites in the vicinity of Snow Lake. Surveys were undertaken to determine the effectiveness of aerial surveys in detecting the presence of marten and other furbearers in dense forest cover types.

Sites representing habitat types considered to be high-quality marten habitat, primarily dense coniferous cover with a thick canopy, were visually selected. At each site, 200 m transects were surveyed to confirm the presence or absence of marten and non-VEC furbearer tracks and animal observations. All track and animal observations were recorded in a handheld GPS unit. Primary forest cover type, understory species, percent canopy closure, and number of tracks and trails observed were recorded for each transect. Tracks were defined as a single set of tracks crossing a transect line, while several clearly defined, repeated sets of tracks traversing the same area were recorded as trails.

3.3.2.2 Mammal Tracking Surveys

3.3.2.2.1 Summer Mammal Tracking

Summer mammal tracking surveys were completed to assess the presence/absence and relative abundance of mammals in the more accessible areas located in the southern portion of the PPR. These surveys focused specifically on elk and moose. Summer mammal tracking transects were located and surveyed in August, September, and October of 2010 along the PPR from Gladstone to Red Deer Lake. Tracking transect locations were selected from aerial photos, orthophotos, FRI data, and GIS based maps. Transects were generally surveyed twice during two different tracking intervals approximately 20 days apart.

The initial summer mammal tracking surveys took place from August 10th to September 1st, 2010 and included 279 survey sites. Each site consisted of a pre-determined 500 m transect surveyed by qualified wildlife technicians using a GPS unit. Each 500 m transect was broken into ten 50 m segments, to which all signs and observations were attributed. During the first tracking interval, hip chain thread was strung at approximately knee height at all sites that were not active pasture. The thread established a time-line for subsequent tracking intervals. Animals observed beyond the thread were not counted, as this indicated that the animal had crossed the line since the first tracking interval. Transect tracking methodology was adapted from basic methodologies (Anderson et al., 1979; Cooperrider et al., 1986) to the local environment and was similar to that utilized in other studies (Thompson et al., 1989; McCrea, 2004; Alexander et al., 2005; Neufeld, 2006). During the first tracking interval, all mammal observations or signs of animals (including, but not limited to, tracks, trails, scat, dens, beds, fur, feeding sites, and audible calls) within 1 m of the transect centre line were recorded and geo-referenced with a GPS.

The second tracking interval took place from September 20th to October 2nd, 2010. This survey was designed to record mammal signs found in relation to thread breaks, which indicated that an animal had passed through the transect since the previous visit. When a break was encountered it was geo-referenced and the area was examined for signs that would indicate species, numbers of animals and approximate age class (e.g. yearling vs. adult) of animals that had crossed the line. A total of 194 sites were surveyed during the second tracking interval. There were fewer transects surveyed during the second interval than the first interval. Transects that we identified in the first interval as being located in active pasture or wetland areas were not revisited during the second interval. In addition to tracking surveys, an acoustic point count (Hagan et al., 1996) was conducted for ten minutes prior to starting each transect to survey for any auditory mammal sign (e.g. elk bugle).

3.3.2.2.2 Winter Mammal Tracking

Mammal track transect surveys were conducted from March 13th to 17th, 2010 at 45 locations between Gladstone and Swan River, and in January 2011 at 11 locations between Gilliam and Swan River along the FPR. At the time of the survey in 2010, the FPR had not been selected and as such the transect site selection was broadcast over several areas likely to be selected. The 2011 winter transects were a sample of the summer transects were selected to be within 1 km of the FPR and were chosen based on LCCEB information, aerial surveys, accessibility, known presence of livestock, and public ownership.

Similar methodologies were employed for the tracking transects as those used in the summer surveys. All signs of animal presence within 1 m of the centre line were recorded, with a particular focus on the VEC species, specifically the distribution and abundance for American marten, elk, moose, wolverine, and linkage species such as grey wolf. Owing to poor snow conditions at time of the survey, there were only a limited number of transects visited on a single occasion. Ground validation surveys were conducted specifically for marten at numerous sites, with a specific focus on habitat types considered to be high quality marten habitat under thick coniferous canopy. These data were used in conjunction with the aerial survey data and to confirm the expected presence and abundance of marten in these forest cover types.

Winter transect surveys were used to confirm presence/absence of mammal species in various habitat types. Site selection and suitability was determined by examining FRI maps and site evaluations. Transects flown in 2010 were located in a variety of habitats types including those dominated by broadleaf, coniferous, grassland, mixedwood, shrublands, and wetlands. Stratification and selection of winter transect surveys differed from summer surveys, as it was more effective to survey these areas for furbearer tracks during the winter owing to increased track visibility. Transects flown in the 2011 surveys were conducted in areas containing dense coniferous canopy within approximately 1 km of the FPR.

Surveys consisted of 250 m transects (Thompson et al., 1989). Two to three people walked the sites, following a straight compass bearing, staying within the selected forest cover. Distance travelled was measured via hip chain. All tracks, scats, and food piles found along or within three m of either side of transect were identified and recorded in a field book and GPS unit.

3.3.2.2.3 Analysis of Summer and Winter Mammal Tracking Results

While surveyors recorded all occurrences of mammal tracks (including hare, squirrel, marten, weasel, fox, coyote, and caribou), only VEC species observations were used for the purpose of this report. With sampled presence/absence information of species along transect routes surveyed in summer and winter mammal ground surveys, logistic regression analysis was used for transect data gathered in the southern portion of the FPR to indicate the selection and avoidance of habitat areas by studied species. Logistic regression models are a subset of generalized linear models that can be used to assess factors influencing the frequency and distribution of sampled species (Quinn and Keough, 2002; Zar, 2010). Forest Resource Inventory cover classes were overlaid with the transect routes surveyed. Species selection/avoidance of habitat was assessed using logistic regression to associate the presence/absence of species along transects with FRI-defined habitat variables. Separate analyses were performed for winter and summer tracking data.

All logistic regression calculations were performed using SYSTAT 13 for Windows (2009). Calculations were only performed for species present in excess of 20 times over sampled transects and with FRI habitat classes affiliated with sampled transects a minimum of ten times. This was done to retain some statistical power in evaluating the selection/avoidance of habitat by species and followed some trial and error in performing calculations. Positive Z scores are associated with species avoidance of habitat classes whereas negative Z scores are associated with species selection for habitat areas (Zar, 2010). Calculated p-values ≤ 0.10 are typically used to connote statistical significance and determining if actual selection or avoidance of habitat types is taking place.

3.3.3 Trail Camera Studies

Passive detection infrared trail cameras, a fairly new technology, were used as a tool to verify species presence and absence in various locations in the assessment of the Alternate Routes, the PPR, and FPR. This technology also allows for the study of the presence/absence of VEC species and other species of interest (e.g. wolves, lynx, and fox). Ultimately, this technology and the associated dataset are being used in this report to provide additional data contributing toward the effects assessment/analysis of VEC species.

Cameras were equipped with lithium batteries and four-gigabyte memory cards and were programmed to take five pictures of the target area per trigger (two pictures per second), on the aggressive setting. Cameras became re-armed immediately after each event (Figure 3).

Camera sites were selected in a GIS environment using LCCEB habitat overlays and by incorporating data from an earlier survey that had the locations of game trails, ATV trails, tracks, scat, or other mammal tracking data collected from the 2010 summer mammal tracking program.

In the northern portion of the Project Study Area, a total of 91 RECONYX ™ remote monitoring cameras were set up for variable durations from December 2009 to February 2011 (Map Series 200). Of these, 75 were Silent Image Professionals (PM35C31 and PM35M1) and 16 were rapid-fire models (PM75). Varying numbers of cameras were distributed across eight general locations, generally associated with boreal woodland caribou ranges: Hargrave Lake (10 cameras), Harding Lake (10 cameras), McLarty Lake (10 cameras), Reed Lake, (11 cameras), The Bog, (22 cameras), Wimapedi area (nine cameras), Wabowden area (10 cameras), and the Wuskwatim transmission line (nine cameras).

In the southern portion of the Project Study Area, a total of 80 RECONYX ™ remote monitoring trail cameras were set up to collect mammal presence, absence and abundance data in areas accessible by foot and following approval of varying property owners. Of these, 31 were Silent Image Professionals (PM35C31) and 49 were Hyperfire Professionals (PC800). Cameras were set up between The Pas and Gladstone (Map Series 200). Seventy-six of the 80 cameras were retrieved between December 7 and 20, 2010 as four cameras were lost as a result of theft. Trail cameras remained on station for an average period of 74 days.

Discretion was used in the event that a camera location was deemed unsuitable for monitoring large mammal activity. Seven camera clusters were moved to new locations in the same general habitat as the original waypoints and that were surveyed during the first tracking interval. The majority of cameras were placed on game trails and in open spaces. Where possible, cameras were recessed into the trees to make them less obvious to people and wildlife.

The default image quality settings were used and the cameras were capable of taking photographs day or night. Metadata associated which each photo included image name, trigger, date, time, moon phase, illumination, label, contrast, brightness, sharpness, sensitivity, temperature, light, battery, serial number, firmware, and image path. Derived data included location, species, activity, age, sex, individual identification (if possible), and comment.

All digital photographs were processed and analyzed separately using IrfanView 4.1 or RECONYX MapView Professional Version 3.0. When analyzing the photos, the source of the photo was defined as the animal or environmental event that triggered the photo activity. If an animal triggered the camera but disappeared at any time during the five photo burst, the source remained the same for each photo. The number of individuals was defined as the number of animals that appeared in each photo and were tallied according to events. A wildlife event began when a camera was triggered and lasted ten minutes whether or not the animal remained, left, or reappeared. Photographed animals were classified as either adult or juvenile where picture quality allowed the qualitative assessment of physiological features, including size, when picture quality allowed the qualitative assessment of physiological features. Where possible, unique identifiers were given to moose and elk based on distinguishable characteristics such as scarring, coloured patches, or antlers. The presence of antlers was also used to determine age and sex (Cooperrider et al., 1986; Høymork, 2002). For moose, the face colour and the presence of a vulva patch were also used to differentiate females from males (Cooperrider et al., 1986; Høymork 2002).

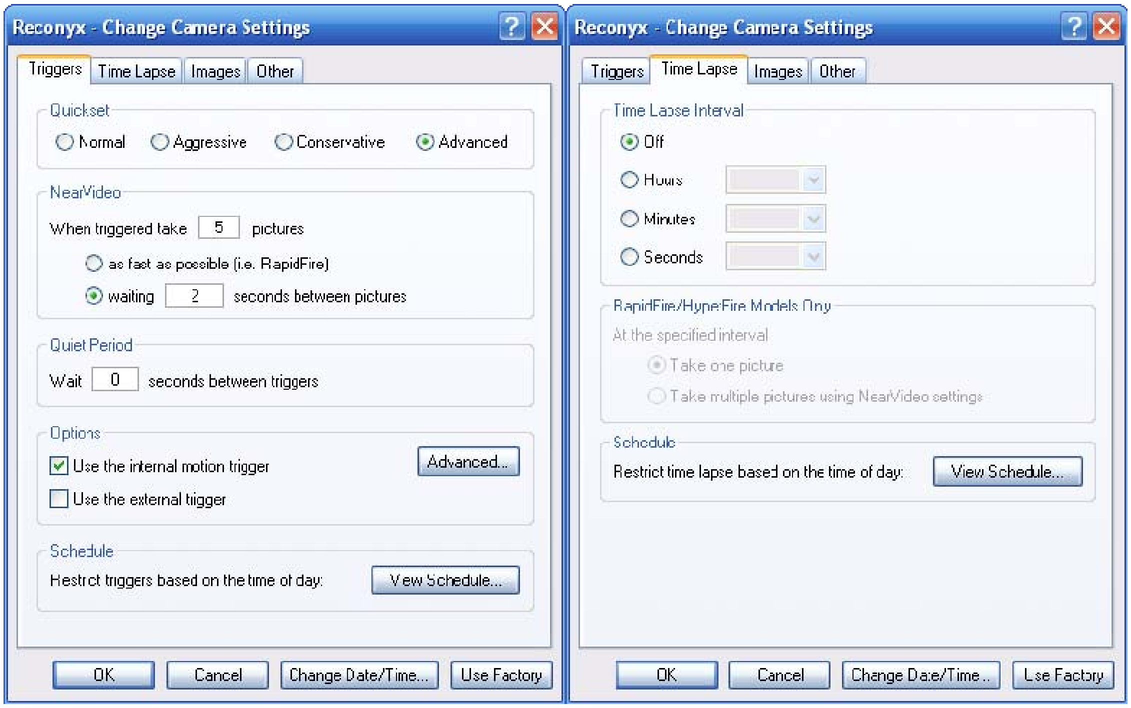

Figure 3 Reconyx camera settings

Once all photos were key-worded, the software exported all picture data into CSV table format. From this table, all data was sorted into the trail camera picture database, allowing it to be queried by range, site or assigned keyword. Lat/long and UTM coordinates are also included in the key-words which provides the ability to map any of the photos within the data base.

3.4 Modeling

3.4.1 Habitat Modeling Analysis and Constraints

The use of expert knowledge in developing predictive habitat models generally produces useful results for identifying and managing wildlife habitat (Edwards et al., 1996; Clevenger et al., 2002). However, this approach often requires fine-tuning following validation based on data collected in the field and statistical analyses (Stoms et al,. 1992; Block et al., 1994; Wintle et al., 2005). The identification of limiting habitat types for selected VEC mammal species within the Local Study Area was an important component in evaluating alternative routes and in the assessment of impacts for the FPR. The use of GIS-based habitat models developed from expert knowledge of species habitat requirements can be used to identify critical habitats (Edwards et al., 1996; Clevenger et al., 2002) and can produce results that are valuable in assessing and monitoring impacts on sensitive species.

In order to assess the potential effects of the Project HVdc Transmission Line on the mammal VECs, a habitat-based modeling method was developed utilizing the LCCEB. A query-based modeling approach was used, employing professional judgment of senior wildlife biologists (Joro and WRCS) to identify key habitat types and extract appropriate habitat combinations from attributes of the LCCEB. Models developed included beaver, American marten, moose, and elk. Most queries were based on LCCEB covertypes and, in the case of beaver, attributes of a detailed water layer was also queried and incorporated. Source coding for each model is found in Appendix B.

Each query was run in ArcGIS (ESRI©, 2011) as part of a Structured Query Language (SQL) statement identifying habitat types of a particular VEC in the LCCEB. The query-based habitat models were mapped within the extent of the Project Study Area. High-quality habitat was identified along the FPR and the abundance of these habitats relative to the surrounding environment was quantified. The following provides a summary of the habitat models developed.

3.4.2.1 Beaver

Beaver are found along the edges of small lakes and ponds and along slow moving rivers with nearby forests for building materials for dams and lodges. The beaver model used a combination of land age and covertype. A land age of broadleaf and mixed wood forests between five and 40 years were chosen to allow for tree sizes large enough to be used for browse and building materials. In addition, treed wetland and shrub covertypes of any age were included. Finally, these covertypes were only included if they were within 100 m from a waterbody 500,000 m^2 or smaller (Map 8).

3.4.2.2 American Marten

American marten prefer old growth forests for denning. The American marten model used a combination of land age and covertype. Specifically, the model consisted of coniferous forests and mixed wood forests equal to or greater than 60 years of age north of Riding Mountain National Park. These parameters are reflective of old growth mixed wood and coniferous forests (Map 9).

3.4.2.3 Moose

Moose are typically found in forested areas and edges, with tall shrubs for browse. The moose model included all tall shrubs in the Mid-boreal Upland and Aspen Parkland Ecoregions as well as all forest stands and tall shrubs between 10 and 60 years of age for the rest of the Project Study Area to allow for an adequate amount of time for forest regeneration which is considered quality moose browse (Map 10).

3.4.2.4 Elk

Elk are found in forests and along forest edge, where browse is most readily available. For the elk model, all forest types were used for the Aspen Parkland and Mid-boreal Upland Ecoregions while all forests younger than 50 years were used in the rest of the Project Study Area south of Snow Lake. In addition, all grasslands and perennial crops and pasture within 300 m of a forest edge were included (Map 11).

3.4.2.5 Wolverine

Wolverines exploit home ranges of 70 to greater than 1,000 km^2 and as a result, are not associated with distinct vegetation complexes or other habitat types (Whitman et al., 1986; Banci and Alton, 1990). Therefore, habitat modeling was considered inappropriate and was not completed for this VEC.

3.4.2.6 Constraints and Assessment Analysis

Project effects were assessed using two types of geo-spatial analysis: a GIS area-based assessment of the relative abundance of habitat within the Local Study Area in relation to surrounding ecodistricts, and an analysis of the linear intersection of the FPR to assess habitat fragmentation resulting from the construction and operation of the HVdc Transmission line.

For each VEC, the total area and proportion of modeled habitat were calculated for each ecodistrict within the Local Study Area and for the extent within the Project Study Area of all ecodistricts intersected by the FPR. This provided a measure of the proportional representation of habitat within the corridor and within the whole ecodistrict. To determine the abundance of habitat within the corridor in relation to the surrounding ecodistricts, the proportional representation of habitat within the corridor by ecodistrict was expressed as a percentage of the proportional representation of the same habitat within whole ecodistricts. The use of proportions, rather than areas, in comparing habitat abundance within the Local Study Area to the surrounding area served to correct for the effects of size variability between ecodistricts. In addition, the use of proportional area calculations in the Local Study Area for each high quality habitat type produced manageable numbers for comparison purposes, while the use of ecodistrict and FPR areas produced numbers too small to assess easily as a function of the minuteness of the area of the FPR in relation to whole ecodistricts. Linear measurements of the FPR intersecting patches of high quality habitat based on modeling results were summed for each ecodistrict to further assess potential impacts of the HVdc ROW.

The use of expert knowledge in developing predictive habitat models generally produces useful results for identifying and managing wildlife habitat (Edwards et al., 1996;

Clevenger et al, 2002). However, this approach often requires fine-tuning following validation based on data collected in the field and statistical analyses (Stoms et al,. 1992; Block et al., 1994; Wintle et al., 2005).

3.4.3 Model Validation

Habitat models were verified based on an analysis of field data from various sources, including aerial and field tracking surveys, through the use of statistical chi-square tests such as McNemar's test for paired-sample nominal scale data (Zar, 2010). The confidence in model applicability was tested through comparisons between the locations of observed mammal signs and modeled habitat where the presence and absence of each species inside and outside of modeled habitat areas was used to establish model validity. Field data utilized included fall and winter mammal sign surveys, trail camera studies, and results of aerial track surveys.

3.5 Assessment of Cumulative Effects

Cumulative effects assessment is an important step in determining the impact of anthropogenic and environmental factors on the long-term viability of the environment and its function as an ecosystem (Hegmann et al., 1999). Cumulative environmental effects can result when the environmental effects of a project are combined with the effects of other past, present and future projects or activities (Hegmann et al., 1999). While causal links can often be drawn between actions and consequences using the results of scientific studies and anecdotal reports, the consequences of multiple actions on the environment can be difficult to interpret. This is due to additive costs of cumulative actions as well as possible synergistic effects where resulting consequences can be relatively unique. In studying ecosystems this is often the case where varied aspects require consideration including past and present resource management regimes, species interactions, climactic conditions, variability based on geographic location, etc. (Hegmann et al., 1999).

The proposed Project is a large project with many project components including transmission lines, converter stations, ground electrode facilities, construction camps, construction power station, and marshalling yards. Each Project component may have environmental effects that may act cumulatively with the effects of other components as well as the effects of other projects and activities in the assessment area. The cumulative effects assessment conducted examined the potential impacts of the Project development on mammalian fauna alongside other residual environmental effects of other projects, development actions and environmental considerations. The cumulative effects assessment was undertaken to determine potential positive and negative effects on mammal species and the viability of species into the future. In conducting this assessment, VEC mammal species were used to identify habitat requirements, which can then be extended in the consideration of non-VEC species where required.

The Cumulative Effects Assessment (CEA) is a VEC-centered process which considers potential interactions of the Project with other projects and activities which may ultimately affect a VEC species. In addition to considering outside projects and activities affecting VEC species, project components may act cumulatively with other project components (e.g., transmission line, converter stations, and collector lines), and thus were considered during the CEA process.

The CEA for VEC species was carried out by initially identifying past, current, and future projects/ activities occurring in Manitoba which may overlap with the Project environmental effects. Potential cumulative effects were considered for those projects and activities anticipated to occur within the next 10 to 20 years (Hegmann et al., 1999). A list of projects/activities which were used for the VEC mammals cumulative effects assessment include forestry activities (Tolko Inc. and Louisiana-Pacific Inc.), mining activities (Crowflight Minerals Inc., HudBay Minerals Inc., San Gold Corporation, Tantalum Mining Corporation of Canada, Ltd., and Vale) and other Manitoba Hydro projects (Wuskwatim Transmission Project).

Once potential projects/sources for cumulative effects were identified, research was conducted to determine previously identified environmental, residual, and cumulative effects as identified by the company/organization conducting the project/activity. Sources for research included environmental impact assessments, forest management plans and government sources/websites, depending of the type of project researched. Potential residual/cumulative effects identified for each project were listed, and included as much detail as possible in listing the possible environmental, residual or cumulative effects for each species.

Once environmental and cumulative effects from projects (other than the Project) were identified, residual effects resulting from the Project were evaluated for their potential to contribute to cumulative effects on mammals in conjunction with other projects/activities. Expert knowledge and professional judgment was used to determine cumulative effects for mammal VEC species as a result of the Project in combination with other projects/activities. Identified potential cumulative effects were reported in Section 8.2 and discussed accordingly.

4.0 EXISTING ENVIRONMENT

The following section provides a description of the existing environment based on the results of desktop investigations and field studies. The results of modeling, assessing existing information and data derived from field studies provided the basis for assessing Alternative Routes and the FPR.

4.1 Mammals of the Project Study Area

A desk study revealed a total of 71 mammal species that are known to occur within the Project Study Area (Appendix C), eight of which have been provincially or federally listed (Appendix C; Burt and Grossenheider, 1980; Jones et al.,1985). Of the eight listed species, five have been classified as extirpated grizzly bear (*Ursus arctos*), pronghorn (*Antilocapra americana*), plains bison (*Bison bison*), grey fox (*Urocyon cinereoargenteus*), and swift fox (*Vulpes velox*) (SARA, 2002; MESA, 2010). However, it is important to note that these species have been observed and are rare or occasional visitors to the area (Pattie and Hoffmann, 1990). Of the remaining listed species, the boreal woodland caribou is listed as Threatened both federally under SARA and provincially under MESA, mule deer is listed as Threatened only provincially under MESA, and the wolverine is federally considered as a species of Special Concern. For the purposes of this EIS, caribou are dealt with in the *Bipole III Transmission Project-Caribou Technical Report* (Joro, 2011). Of the 71 species documented in the Project Study Area, six species were used as VEC species for analysis in this assessment/report (beaver, American marten, wolverine, elk, moose, and grey wolf [linkage species]). VEC species criteria and selection process is outlined in Section 3.2.2. The following is a description of fauna within the Project Study Area, with specific focus on VEC mammal species.

In the northeastern boreal and taiga ecozones, the land base is comprised primarily of vast uninterrupted tracts of boreal forest transitioning to taiga in the far north. The majority of the land base remains in its natural state, unaltered and undeveloped, and is largely inaccessible due to an extremely limited road network. The northwestern region encompasses a diverse landscape that includes parts of the Manitoba Lowlands and Canadian Shield natural regions. The area is dominated by boreal forest, lakes, and rivers, largely in a natural state. Mineral extraction, processing and exploration, commercial timber harvesting and processing, agriculture, resource based tourism (lodges and outfitting), and trapping are prevalent (Manitoba Conservation, 2010). Other predators in the northern portion of the Project Study Area include arctic, red fox, black bear, and mustelid species such as American marten, ermine (*Mustela erminea*), and mink. There were also observations of wolverine and track sign documented throughout the northern portions of the Project Study Area. Moose are found distributed throughout the boreal forest portion of the Project Study Area, with several significant concentrations observed within specific aerial survey blocks during the course of field studies. These moose concentration areas were typically associated with high quality remote habitats identified through LCCEB habitat modeling. These areas were characterized by habitat associated with tall shrub vegetation and regenerating post-burn forest. At least ten predation events of moose by wolves were observed during the surveys. Aerial surveys also coincided with a major initiative of caribou and wolf GPS collaring in the northern Project Study Area.

Located in the southern area of the FPR are the Boreal Plains and Prairie Ecozones which contain roughly two-thirds of the rural municipalities in the province and together comprise the second most populated area of the province next to the Red River region. Although ungulate occurrence is dominated by white-tailed deer in the south, it is also home to six of the seven known elk populations in the province and attracts significant numbers of resident and aboriginal (First Nation and Métis) hunters (Manitoba Conservation, 2010). Predators such as wolverines are uncommon in southern Manitoba; however, wolves, that were previously uncommon, have become more frequent in these agricultural zones in recent years. Other predators found in these ecozones include coyotes, red fox, black bear, and mustelid species such as ermine and mink. Although the American marten may be present, this species tends to become less common in the southern portions of the FPR. There are also significant problem wildlife issues in the southern portion that include flooding of private property and government roads by beaver, coyote and wolf depredation on live stalk as well as elk depredation on agricultural crops and stored forage.

Twenty different mammal species were also identified during the ATK process, many of which related to hunting and fishing activities. Table 3 lists the mammal species identified in the ATK surveys along with the data type (e.g., hunting locations). Location and uses of various species identified during ATK interviews can be found throughout this section.

Table 3 List of Mammal Species Identified During the Aboriginal Traditional Knowledge Surveys

Common Name	Genus	Species	Data Type
Hare	*Lepus*	*americanus*	Sightings, hunting locations
Red Squirrel	*Tamiasciurus*	*hudsonicus*	Sightings
Beaver	*Castor*	*canadensis*	Trapping locations
Muskrat	*Ondatra*	*zibethica*	Trapping locations
Lynx	*Lynx*	*lynx*	Trapping locations
Cougar	*Puma*	*concolor*	Sightings
Red Fox	*Vulpes*	*vulpes*	Sightings, hunting locations

Coyote	*Canis*	*latrans*	Sightings
Grey Wolf	*Canis*	*lupus*	Sightings, hunting locations
Black Bear	*Ursus*	*americanus*	Sightings, hunting locations, den sites
Wolverine	*Gulo*	*luscus*	Trapping locations
Marten	*Martes*	*americana*	Trapping locations
Fisher	*Martes*	*pennanti*	Trapping locations
Mink	*Mustela*	*vison*	Trapping locations
River Otter	*Lutra*	*canadensis*	Trapping locations
Plains Bison	*Bison*	*bison*	Sightings
Moose	*Alces*	*alces*	Sightings, hunting locations, mineral licks
Caribou	*Rangifer*	*tarandus*	Sightings, hunting locations
White-tailed Deer	*Odocoileus*	*virginianus*	Sightings, hunting locations, mineral licks
Elk	*Cervus*	*canadensis*	Sightings, hunting locations, mineral licks

4.2 Small Mammals

Small mammals serve as a main food source for furbearer species, including VEC and VEC linkage species outlined in this report (marten, wolverine, and wolf). The abundance and distribution of small mammals will influence the distribution and utilization of habitat by VEC and VEC linkage species.

The small mammal communities in the northern ecozones are similar to that in the southern ecozones. Small mammals are found throughout all habitats with many species adapted to the larger contiguous softwood treed bogs and wetlands. Snowshoe hare is the dominant species of hare in this area and woodchuck (*Marmota monax*) replaces ground squirrels as one of the larger fossorial species except for the most southerly portion of the northern Project Study Area where presences of the 13-lined ground squirrels (*Spermophilus tridecemlineatus*) have been recorded (Banfield, 1974).

In addition to these small mammal communities, bat hibernacula have been documented in areas surrounding the northern portion of the Project Study Area. Dubois and Monson (2007) documented the presence of a hibernaculum just outside the Project Study Area south of Ponton. This cave is primarily inhabited by little brown bats (*Myotis lucifugus*). Additionally, a bat hibernaculum was discovered near Moose Lake, north of The Pas during the summer of 2011. Research undertaken through the University of Winnipeg has listed species inhabiting this hibernaculum as mostly little brown bats, with some occurrence of northern long-eared bats (*Myotis septentrionalis*) (Willis, 2011). Population estimates for this hibernaculum is listed at approximately 7,500 to 8,200 individuals, with approximately one in fifty bats being the northern long-eared species (Willis, 2011).

In the south, the small mammal community consists of a variety of species of bats, mice, voles, shrews, squirrels, chipmunks, hares, and rabbits. In all, 41 species or roughly half of all mammals expected to occur in the Project Study Area are small mammals. Small mammals are found throughout all habitats in the Project Study Area and serve as key prey species for a variety of birds and larger mammals. None of the small mammals found in the Project Study Area are listed or rely on rare or critical habitats.

4.3 Furbearers

The distribution of furbearers in the province has been well documented through the use of harvest statistics. While the range of most of the species has remained consistent with that of 80 years ago, several species (i.e. badger, fisher, and marten) expanded their range during the mid-1970's (Stardom, 1986). Densities of species such as badger and long-tailed weasel have declined with intensive land use of their traditional range in southern Manitoba while species such as beaver and raccoon are present in much higher densities than those of 50 years ago (Stardom, 1986). Several species are important economically for the fur industry – specifically wolverine, bobcat (*Lynx rufus*), otter, and lynx. VEC furbearer species focused on in this report/assessment include beaver, American marten, wolverine, and grey wolf (linkage species).

Trapping records obtained from Manitoba Conservation (Manitoba Conservation unpublished data, 2009) identify a total of 18 furbearing species harvested from trap lines in the Project Study Area from 1996 to 2008 (Appendix D). In descending order of occurrence, the most common species trapped in the northern portion of the Project Study Area between 1996 and 2008 included beaver, American marten, and muskrat. Species that were rarely trapped included black bear and wolverine. With the exception of the western Registered Trapline (RTL) District and Southern Special Trapping Districts, there are no registered trap line sections in the southern portion of the Project Study Area. The south is covered by four Open Trapping Area Zones. Trapping records obtained from Manitoba Conservation (Manitoba Conservation unpublished data, 2009) identify a total of 22 furbearing species harvested from the Open Trapping Area Zones located in the Project Study Area from 1996 to 2008 (Appendix D). In descending order of occurrence, the most common species trapped in the southern portion of the Project Study Area between 1996 and 2008 included beaver, American marten, and muskrat. Species that were rarely trapped included black bear, bobcat, and wolverine.

4.3.1 Beaver

Beavers are semi-aquatic rodents associated with water systems such as lakes, creeks, rivers, and other water bodies. Beavers are ecosystem engineers and a keystone species that modify drainage regimes by engaging in vegetation-cutting and dam-building activities that have long-term effects on landscapes (Naiman et al., 1994). Beavers are known to increase habitat heterogeneity and increase the richness of herbaceous plants at the landscape level (Wright et al., 2002).

Beaver are abundant in the western and northern areas of Manitoba wherever water systems such as lakes, creeks, rivers, and other water bodies are present. Beaver populations tend to become less common in southern agricultural regions.

Beavers will consume almost any herbaceous or woody plants for food and show preference for a relatively small number of plants that include aspen and willow, among others (Northcott, 1971). Beavers select damming sites in stream sections with high shoreline densities of woody vegetation whose diameters range from 1.5 - 4.4 cm. Beaver habitat occupancy is best explained by the occurrence of woody vegetation, followed by stream gradients (Curtis and Jensen, 2004). Another important limiting factor is the presence of impounded water (Barnes and Mallik, 1997).

Beavers have few predators and the only known disease to affect the species in large numbers is tuleremia. (Bloomquist and Nielsen, 2008) found that in an unexploited beaver population, the largest number of explained mortalities occurred from tuleremia (20%), followed by predation (9 - 13%). The survival of kits may be primarily affected by food supply. Declining trends in trapper numbers, trapping bans in some areas, and the expansion of beavers into urban habitats has contributed to an increase in beaver populations since the 1950s (IAFWA, 2005).

Beavers can be a nuisance to humans, especially in roadside areas by contributing to road destabilization through the creation of dams and altering drainage regimes (Curtis and Jensen, 2004). A number of methods exist for deterring beaver from plugging culverts and altering water levels adjacent to roads, but all encounter limitations (Curtis and Jensen, 2004).

4.3.1.1 Mammal Tracking Surveys

Beaver are abundant across the Project Study Area and habitat is not limiting. In the southern portion of the Project Study Area, a total of 106 beaver signs were documented during winter tracking and aerial surveys completed in March 2010, with 101 of them detected during the aerial surveys (Table 4). Signs are defined as evidence of a mammal having passed through an area, including tracks, scat, browse and any other visible evidence which can be attributed to being left by a mammal (See Glossary).

In contrast, relatively few beaver signs were observed during summer mammal tracking surveys. One lodge and one dam were observed, as well as fallen trees. As beavers are commonly associated with aquatic habitats, few signs of their activity were expected on upland transects. Eight signs of beaver presence were found during the summer 2010 sampling session. All signs indicated browsing except for one instance where a beaver dam was observed. Sampled beaver sign locations occurred predominately in broadleaf pure habitat (N=3) although the frequency at which beavers were observed in all broadleaf habitat areas was low (1.1%). During winter sampling, four observations of beaver signs were recorded, two of which occurred in broadleaf mixed habitat areas with additional signs recorded in broadleaf pure and black spruce mixed habitats. The low sample size of beaver signs over the summer and winter sampling sessions precluded the use of logistic regression to indicate habitat preferences during these seasons.

Incidental sightings of beaver lodges also occurred during the 2010 waterfowl survey conducted by WRCS. During this survey, 11 beaver lodges were observed; nine in the Mid-boreal Lowlands Ecoregion with one observed in both the Lake Manitoba Plain and Interlake Plain Ecoregions. In addition, 11 muskrat lodges/push-ups were observed during the 2010 waterfowl survey; one in the Hayes River Upland, two in the Mid-Boreal Lowland, and eight in the Lake Manitoba Plain Ecoregions.

Table 4 Habitat Sampling Information for Beaver Following 2010 Summer and Winter Mammal Tracking Studies

	SUMMER SAMPLING			WINTER SAMPLING		
	Number of Transects	Number Sampled	Frequency	Number of Transects	Number Sampled	Frequency
Broadleaf mixed	26	0	0.0%	23	2	8.7%
Broadleaf pure	279	3	1.1%	218	1	0.5%
Black spruce mixed	34	1	2.9%	33	1	3.0%
Black spruce pure	72	2	2.8%	50	0	0.0%
Coniferous mixed	16	1	6.3%	18	0	0.0%
Jack pine mixed	4	0	0.0%	3	0	0.0%
Jack pine pure	8	0	0.0%	4	0	0.0%
Shrubs	2	0	0.0%	1	0	0.0%
Tamarack-Larch pure	21	0	0.0%	17	0	0.0%
White spruce pure	2	1	50.0%	2	0	0.0%
TOTAL	**464**	**8**	**1.7%**	**369**	**4**	**1.1%**

4.3.1.2 Trail Camera Studies

Beaver activity was observed at only one of the 91 trail camera sites deployed in the northern Project Study Area in 2010 (Table 5). Beaver activity consisted of 15 pictures of one beaver and all observations were recorded following the spring thaw. The observations were incidental, as the site was deployed for use in predator movement studies along a small creek, see *Bipole III Transmission Project- Caribou Technical Report* (Joro, 2011. The sex of the animal could not be determined through observation. Processing of trail camera results for 2011 is currently underway.

Table 5 Beaver Observations Recorded Through Trail Camera Studies in the Northern Portion Project Study Area in 2010

Site ID	Number of Observations	Number of Animals
BOG_7	15	1

4.3.1.3 Beaver Aboriginal Traditional Knowledge

Beaver were traditionally trapped and used for meat and hide. Trapping still occurs in many First Nation's communities in Manitoba: ATK gathered in interviews reported that beaver are actively trapped in Lake Winnipegosis area, Red Deer Lake, and the Wintering Lake areas. Beaver are also traditionally trapped in various locations across the Project Study Area; however, specific areas of trapping were withheld for confidential reasons. Traditional ecological knowledge gathered in interviews reported beaver are actively trapped in the areas of Mawdelsey Lake, Moondance Creek, Duck Mountain, Ochre River, Cranberry Portage, and Summerberry Marsh. One trapper reported that some beaver trapping occurs in the Cormorant area to control local water levels and use the meat as bait. See *Bipole III Transmission Project- Aboriginal Traditional Knowledge Technical Report* regarding ATK.

4.3.2 American Marten

American marten is a mustelid species associated with upland habitats. Marten exhibit large spatial requirements and narrow habitat use, and are vulnerable to trapping (Webb and Boyce, 2009). Marten are commonly trapped due to the ease with which they are captured as well as their high value relative to other furbearers. However, levels of harvesting have been in decline since the 1970s (Hodgman et al., 1994).

The species is associated with mature conifer-dominated forests with high canopy closure that exhibit complex vertical and horizontal woody structure (Chapin et al., 1997). Marten are an ecological indicator of forests featuring this structural complexity, and have been found to be abundant in undisturbed forests with large core areas (Webb and

Boyce, 2009). Marten abundance can be predicted based on data regarding capture and is also correlated with rodent abundance, as rodents are an essential food source (Flynn and Schumacher, 2009). The diet of the marten varies based on prey availability. In one study, marten diet (by percentage occurrence) consisted of 45% small mammals (voles, shrews, mice, etc.) and 31% larger mammals (grouse, hares), with the remainder consisting of small amounts other mammals, amphibians, eggs, berries, and bait (Cumberland et al, 2001).

Marten have very large home range sizes for their body mass, with males having larger home ranges than females (Buskirk and Mcdonald, 1989). Structures created by debris on the ground are generally selected as denning sites (Ruggiero et al., 1998). Research identified the most important denning structures to be rock crevices and snags, followed by red squirrel midden and logs. The logs and snags utilized tended to be large in size and associated with late-successional forests (Ruggiero et al., 1998). Coarse woody debris is also necessary to facilitate marten foraging and subnivean access to prey (Sherburne et al., 1994).

4.3.2.1 Final Preferred Route Mammal Stratification Surveys

During furbearer transects surveys flown parallel to the FPR, marten tracks were observed between Gillam to Dauphin Lake. Two hundred and seven (207) marten tracks were observed in this survey (Map 12). Marten distribution and relative population density derived from survey results (Section 3.3.1.4) were mapped along the FPR (Map 13).

4.3.2.2 Furbearer Ground Validation Surveys

Five marten track observations and one marten trail observation were recorded during furbearer ground validation surveys conducted within a 1 km buffer at various locations in the Northern Project Study Area (Table 6). Four of the five marten track observations, as well as the trail observation, were found on three of the four mammal tracks conducted in the vicinity of Thompson (Table 6) (Map 14). All marten signs were observed within spruce or spruce-pine stands, with canopy closure ranging from 10% to 90%.

Table 6 Marten Track Results from 2011 Furbearer Ground Validation Surveys Conducted Within 1 Km of the FPR

Area of Survey	Transect Number	Marten Tracks	Marten Trail	Forest Cover Type	Understory Type	% Canopy Closure
Thompson and Surrounding Area	One	2		Sparse spruce, some birch interspersed	Labrador Tea	20%
	Two	1	1	Very sparse Spruce	Labrador Tea, Williow, moss	10%
	Three	1		Sparse spruce	Alder, Birch, Tamarack	5% to 90% - Average 40%
	Four			Spruce	Labrador Tea, Birch	50% to 90%
Snow Lake and Surrounding Area	One			Spruce, some Aspen	Birch, Rose, Alder, Fir, A lot of Dead Stand, Labrador Tea	50% to 70%
	Two			Spruce, little bit of aspen	Labrador Tea and moss	80%
	Three			Tamarak- spruce mix	Birch, alder, Labrador Tea, willow	50%
The Pas and Surrounding Area	One	1		Pine, Spruce	Spruce, Labrador Tea	70%
	Two			Young pine stand	Pine	80%
	Three			Spruce	Labrador Tea	60% to 70%
	Four			Spruce	Labrador Tea, Moss	60% to 70%
Total Signs Observed		**6**	**1**			

4.3.2.3 Mammal Tracking Surveys

No American marten signs were recorded during the 2010 summer mammal tracking survey. However, 58 occurrences of American marten were recorded in the 2010 winter mammal tracking survey (Map 15, **Error! Reference source not found.**7). Of the 369 surveyed transects in the 2010 winter sampling survey, American marten were located in 15.7% of them. Overall, 24.0% of available black spruce pure habitats and 17.9% of broadleaf pure habitats sampled had American marten signs in them.

Table 7 Habitat Sampling Information for American Marten Following 2010 Summer and Winter Mammal Tracking Studies

	SUMMER SAMPLING			WINTER SAMPLING		
	Number of Transects	Number Sampled	Frequency	Number of Transects	Number Sampled	Frequency
Broadleaf mixed	26	0	0.0%	23	0	0.0%
Broadleaf pure	279	0	0.0%	218	39	17.9%
Black spruce mixed	34	0	0.0%	33	3	9.1%
Black spruce pure	72	0	0.0%	50	12	24.0%
Coniferous mixed	16	0	0.0%	18	1	5.6%
Jack pine mixed	4	0	0.0%	3	0	0.0%
Jack pine pure	8	0	0.0%	4	0	0.0%
Shrubs	2	0	0.0%	1	0	0.0%
Tamarack-Larch pure	21	0	0.0%	17	3	17.7%
White spruce pure	2	0	0.0%	2	0	0.0%
TOTAL	**464**	**0**	**0.0%**	**369**	**58**	**15.7%**

Logistic regression analysis to determine habitat preference by observed American marten indicated that none of the sampled habitat areas used in analysis were actively selected for or avoided by this species (Table 8).

Table 8 Results of Logistic Regression Analysis Indicating Habitat Preferences by American Marten Following 2010 Summer and Winter Mammal Tracking Studies

	SUMMER SAMPLING			WINTER SAMPLING		
	Frequency	Z-score	p-value	Frequency	Z-score	p-value
Broadleaf mixed	None sampled			0.0%	0.0	1.0
Broadleaf pure				17.9%	-0.8	0.4
Black spruce mixed				9.1%	0.3	0.8
Black spruce pure				24.0%	-1.4	0.2
Coniferous mixed				5.6%	0.6	0.5
Tamarack-Larch pure				17.7%	-1.2	0.2

4.3.2.4 Trail Camera Studies

Photographs of marten were recorded at eight of the 91 sites in 2010. The majority of photographs were recorded in the Reed Lake area (Map Series 300) Date and time of image capture, as well as expert opinion, were employed to differentiate between individual marten. Owing to the difficulty involved in identifying individual animals and determining sex, the number of individuals observed should considered approximate. A total of 195 photographs of marten were recorded and 14 animals were observed. Trail cameras results for 2011 are currently being processed.

Table 9 American Marten Observations Recorded Through Trail Camera Studies in the Northern Portion Project Study Area in 2010

Site ID	Number of Observations	Number of Animals
BOG_14	5	1
BOG_17	6	2
BOG_20	2	1
HARD_09	6	2
REED_3	138	24
REED_5	1	1
REED_7	27	4
Reed_9	10	1
Total	**195**	**36**

4.3.2.5 American Marten Aboriginal Traditional Knowledge

Aboriginal traditional knowledge gathered in interviews reported that marten is actively trapped in the Red Deer Lake and Wintering Lake areas. Marten were also traditionally trapped in various locations across the Project Study Area; however, specific areas of trapping were withheld for confidential reasons. Traditional ecological knowledge gathered in interviews reported marten is actively trapped in the Wabowden, Mawdesley Lake, Moondance Creek, and Duck Mountain. One trapper reported that in the Cormorant trapping area, marten populations were displaced for some time after the development of the transmission line and it took some time before the populations returned. See *Bipole III Transmission Project - Aboriginal Traditional Knowledge Technical Report* regarding ATK.

4.3.3 Wolverine

The wolverine (*Gulo gulo*) is a large terrestrial mustelid with a circumpolar distribution, associated with upland habitats. Wolverines are considered to be indicators of ecosystem health (COSEWIC, 2003). Wolverines require large areas and are naturally low in abundance (Dalerum et al., 2008). While the historic range of wolverine in Manitoba included the entire province, this species currently occupies the northern boreal forest (north of the 53° latitude); however, recent increases in the extent of the provincial range have been noted (COSEWIC, 2003). The species is listed by the Committee on the Status of Endangered Wildlife in Canada as a species of Special Concern in Manitoba, with population considered stable to increasing (COSEWIC, 2003). Increases are thought to have been occurring since the cessation of wolf poisoning in the 1970s, the establishment of a limited winter trapping season, and increases in the numbers of some caribou herds. Wolverine harvesting is expected to decline with ongoing declines in the number of active trappers (COSEWIC, 2003).

This species requires an adequate year-round supply of prey including rodents, snowshoe hare, and the carcasses of larger species such as moose, deer, elk, and caribou in winter (COSEWIC, 2003). Wolverines are most abundant where large ungulates are common and carrion is readily available in winter.

Denning is an essential component of the wolverine life cycle and occurs at higher elevations beneath rocks, logs, or snow, where snow cover persists into spring (COSEWIC 2003). Wolverines have naturally low fecundity, and therefore low population resiliency. Natural mortality is often caused by predation or starvation. Wolverines are preyed upon by bears, wolves, cougars, golden eagles, and other wolverines, and are often killed when competing for food at carrion sites. Human-caused mortality occurs from trapping, hunting, and road/railway kills (COSEWIC, 2003). Human-caused mortality may increase with settlement of remote areas.

Limiting factors for wolverine populations include harvesting of the animals, decline of essential ecosystem components such as moose, wolves, and caribou, habitat threats, and den disturbances (COSEWIC, 2003). Wolverines have a naturally low ability to repopulate vacant habitats. It has been recommended that as part of conservation measures, gene flow be restored between core and periphery populations (COSEWIC, 2003).

4.3.3.1 Multispecies Surveys

Five wolverine and 104 observations of wolverine tracks were recorded and mapped during January 2010 aerial transect surveys in the Project Study Area (Map 16). In 2011, 43 wolverine tracks were observed during multispecies (Map 17). The majority of tracks were seen in the Wheadon survey area (Wolverine **Observations 2010 and 2011**10).

Table 10 Wolverine Observations 2010 and 2011

	2010		2011	
Range*	**Observations**	**Tracks**	**Observations**	**Tracks**
Harding Lake	0	23	0	0
The Bog	0	2	0	0
Wabowden	0	1	0	4
Wapisu	1	1	0	0
Wimapedi	0	23	0	15
Wheadon	4	17	0	24

*37 additional incidental track sightings occurred outside of survey blocks in 2010

4.3.3.2 Final Preferred Route Mammal Stratification Surveys

Twenty-four wolverine track sightings were observed during the course of the FPR mammal stratification surveys (Map 18). The density buffer generated from these track observations (Section 3.3.1.4) was mapped to display wolverine distribution and relative abundance along the FPR (Map 19).

4.3.3.3 Trail Camera Studies

Six photographs of wolverine were captured at one camera site, representing a single individual (Table 11). Sex could not be determined based on the captured images. No wolverine were photographed within the southern portion of the Project Study Area.

Table 11 Wolverine Observations Recorded Through Trail Camera Studies in the Northern Portion Project Study Area in 2010

Site ID	Number of Observations	Number of Animals
HARD_1	6	1

4.3.3.4 Wolverine Aboriginal Traditional Knowledge

Aboriginal traditional knowledge gathered in interviews did not report any current interactions between wolverine and interviewed community members. Traditional ecological knowledge gathered in interviews reported wolverine is actively trapped in the Moondance Creek area. See *Bipole III Transmission Project- Aboriginal Traditional Knowledge Technical Report* regarding ATK.

4.4 Ungulates

Ungulates are important game species and prey species for a variety of predators. In the Project Study Area, they include migratory caribou consisting of coastal caribou (forest tundra ecotype), barren ground caribou, boreal woodland caribou, moose, and white-tailed deer. Mule deer (*Odecoileus hemionus*) also occur in the south-west portion of the Project Study Area in low densities. With the exception of woodland caribou, these species generally occupy, to various extents, all major habitats. These ungulates are an important game and prey species. Of the five species found in the Project Study Area, mule deer and boreal woodland caribou are both listed as threatened by the province of Manitoba (MESA, 1998) with the latter also listed as threatened under SARA (COSEWIC, 2002).

For the purpose for this technical report, ungulate VECs include moose and elk. Boreal woodland caribou, coastal, and barren ground caribou were also listed as VECs for the purpose of the Project EIS; in depth information, review and analysis can be found in the *Bipole III- Caribou Technical Report* (Joro, 2011).

The primary ungulates in the northern region of the Project Study Area are boreal woodland caribou and moose. Some elk and an increasing number of white-tailed deer have been observed in the northern region of the Project Study Area but these species are of lesser concern. It should be noted that potential range expansion of white-tailed deer along ROWs and other anthropogenic disturbance and clearings in the area may be of concern in the future. White-tailed deer are the most numerous ungulate found within the southern portion of the Project Study Area and in the Province of Manitoba (MDNR, 1997). White-tailed deer are found throughout the Project Study Area south of Red Deer Lake and likely occur at low to moderate densities near Red Deer Lake and at high densities near agricultural areas in the southern portion of the Project Study Area. White-tailed deer have been able to colonize southern and central Manitoba by following the development of agriculture (Goulden, 1981). Current estimates of the white-tailed deer population in Manitoba range between 150,000 and 160,000 animals (Government of Manitoba, 2010).

4.4.1 Moose

Moose range is extensive in Manitoba (Map 20) and they are being observed more readily in the prairie region (Manitoba Conservation, n.d.b.). Moose are commonly found in forest, shrub, and wetland habitats and occupy much of northern Manitoba (Banfield, 1987). In the south, they occupy areas adjacent to Duck Mountain and Riding Mountain (Pattie and Hoffmann, 1990). Populations are highly variable and have been reported at levels of 0.4 moose/km2 in high-quality habitats (Palidwor et al, 1995). Moose densities increase away from areas easily accessible to humans. The provincial moose population has increased from 28,000 in 1992 to about 32,000 currently, with an annual harvest of 1,500 individuals by licensed hunters and 3,000 by First Nations resource users (Palidwor et al., 1995). Moose populations in the western portion of the Project Study Area are in decline and there are a number of conservation hunting closures that have been implemented to rehabilitate moose numbers. Game hunting areas (GHAs) which have closed to allow for moose populations to recover from decline include GHAs 13, 13A,14, 14A, 26, 18, 18A, 18B and 18C. Additionally, parts/sections of GHA 2A, 4, 7A and 17A are closed to moose hunting. Other moose management methods being undertaken by Manitoba Conservation include the implementation of wolf trapping/management strategies in an attempt to reduce potential effects of predation on moose populations (Manitoba Conservation, 2010). First Nations and Metis have identified moose harvest as an important component of personal and community sustenance as well as providing opportunities for cultural enhancement. See *Bipole III Transmission Project- Aboriginal Traditional Knowledge Technical Report*.

Moose populations remain low in the Turtle Mountain, Duck Mountain, and GHA 26 areas, due in part to the slow recovery of these populations from losses to winter tick infestations in the west and to predator increased access created by expanding forest extraction activities and the creation of resource roads and trails in some areas (Manitoba Conservation, n.d.a). The moose population in Riding Mountain continues to increase. Moose populations in other areas of the province seem stable, although below carrying capacity, which is indicative of decreasing populations. Moose are associated with riparian habitat, especially areas featuring willow, a key forage species. In the absence of such habitat, moose select stands that originate after fire or logging, which features early successional vegetation (Doerr, 1983). Other important habitat qualities include areas for aquatic feeding, areas of coniferous cover, and mineral licks (Palidwor et al., 1995). Winter habitat is a critical component of moose range. Cover is beneficial because it helps reduce snow depths and provides relief from thermal stress associated with open areas (Bangs et al., 1985). Moose have been found to generally remain within 100 m of forest edge or cover when browsing in open areas (Bangs et al., 1985).

Moose are prey to wolves, but wolf predation alone does not limit moose populations (Palidwor et al., 1995). Wolves have been found to kill moose in locations which are further from forest edges than moose are generally found and in locations characterized by lower road densities (Kunkel and Pletscher, 2000). Moose populations are susceptible to infection by the parasite *Parelaphostrongylus tenuis*, which causes a disabling neurological disease which can end in death (Palidwor et al., 1995). The natural host for the disease is white-tailed deer and moose become susceptible when the habitats of the two species overlap. Moose are also susceptible to brucellosis and anthrax transmitted by livestock (Palidwor et al., 1995).

4.4.1.1 High-quality Moose Habitat Block Surveys

The results of high-quality moose habitat block surveys within the Project Study Area where variable between survey blocks (Table 12). Moose counts ranged from 21 to 292 for adult moose, with calf counts ranging from 7 to 33 animals (Table 12) (Map Series 400). Survey block area ranged from 662 km^2 for the smallest block to 6,097 km^2 for the largest, resulting in a minimum estimated moose density of 16 moose per 1,000 km^2 and 132 moose per 1,000 km^2.

Table 12: 2010 High Quality Moose Habitat Block Surveys

Survey Block	Adult Count	Calf Count	Total Count	Area Surveyed (km^2)	Moose Density per 1000 km^2
Wimapedi Lake	25	7	32	1,118	28.6
Webb Lake	21	9	30	1,856	16.2
North Thompson	292	33	325	6,097	53.3
The Pas	68	14	82	622	131.8

4.4.1.2 Manitoba Conservation Moose Surveys

In addition, surveys were conducted in northwestern region game hunting areas (GHAs) (2A, 4, 5, 6, 6A, 7, 7A, 8, 10, 12, 15A, and 16) (Map 3) from 1967 to 2010 (Manitoba Conservation, 2010).

The number of observed signs during Manitoba Conservation surveys ranged from 45 to 498. The most recent 2010 surveys were conducted in GHAs 6A and 7A, producing density estimations of 0.2 and 0.1 moose/km^2, respectively (Manitoba Conservation, 2010). Overall, moose density calculations for the North-western region range from 0.1 to 0.7 moose/km^2 (Manitoba Conservation, 2010). The two GHAs supporting enough data to determine general trends in moose density over time are GHAs 6 and 8. GHA 6 has shown steady declines in moose density from the 1980s to 2000s, estimating 0.5 moose/km^2 to 0.2 moose/km^2, respectively (Table 13). GHA 8 moose density has generally stayed steady across the 1970`s to 1990`s at approximately 0.3 moose/km^2 (Table 14). Average moose density across all GHAs surveyed in all years is approximately 0.2 moose/km^2

Table 13 Most Recent Moose Survey Results for North-Western Region Ghas*

GHA Surveyed	Most Recent Survey	Area km^2	Pop Est.	Moose/km^2	Bull/cow ratio	Calf/cow ratio	Number Observed
2A	1996	2,040	302	0.1	32:100	63:100	216
4	1996	1,016	301	0.3	82:100	60:100	200
5	1999	2,100	473	N/A	55:100	51:100	N/A
6	90-91	8,556	459	0.1	67:100	38:100	147
6A	2010	1,254	N/A**	0.2	N/A	N/A	190
7	1990	892	407	0.5	28:100	50:100	256
7A	2010	692	N/A	0.1	N/A	N/A	65
8	2000	6,975	665	N/A	64:100	58:100	N/A
10	1990	8,556	459	0.1	67:100	38:100	147
12	1999	857	320	0.4	45:100	43:100	N/A
15, 15A	1996	305.2	N/A	0.2	131:100	50:100	45
16	1986	3,152	412	0.1	N/A	N/A	75
Saskram WMA	1987	3,138	263	N/A	N/A	N/A	N/A

*Data Provided by Manitoba Conservation (2010)

**N/A: Information not available

Table 14 Summary of Ranges of Moose/Km^2 Estimates For Surveyed Game Hunting Areas with the Proposed Project Study Area from 1971 to 2010*

Game Hunting Area	1971-1980	1981-1990	1991-2000	2001-2010
2A			0.2	
4			0.2	
5		0.2	0.2 to 0.3	
6		0.5	0.4	0.2
6A				0.1
7		0.1		
8	0.3	0.2 to 0.3	0.3	
10			0.05	
12			0.1	
15, 15A			0.1	
Saskram WMA	0.5 to 0.7	0.4		

*Surveys were not conducted in every Game Hunting Area across all decades. Data Provided by Manitoba Conservation (2010)

Bull to cow ratios for this region ranged from 32:100 to 131:100, while calf to cow ratios ranged from 21:100 to 103:100. GHA 8 had the highest average calf to cow ratios across decades surveyed, with counts ranging from 65 to 103 calves/100 cows in the 1960's, to 24 to 73 calves/100 cows in the 1980s (Table 15). This trend suggests a general decline in moose recruitment from the 1960s to the 1990s for GHA 8. GHA 6 shows a similar decline in moose recruitment, gradually declining from 42 to 87 calves/100 cows, to 21 to 43 calves/100 cows from the 1960s to the 1990s (Table 15).

Table 15 Summary of Ranges of Number of Calves/100 Cows Observed in Game Hunting Areas with the Proposed Project Study Area from 1967 to 2000*

GHA	1967-1970	1971-1980	1981-1990	1991-2000
2A				50 to 62:100
4				63:100
5		21 to 63:100	31 to 72:100	57 to 60:100
6	42 to 87:100	19 to 77:100	31 to 52:100	21 to 43:100
7		39 to 63:100	41 to 85:100	
7A		39 to 63:100	41 to 85:100	58:100
8	65 to 103:100	38 to 85:100	24 to 73:100	73:100
10				38:100
12				75:100
15, 15A				43:100

*Surveys were not conducted in every GHA across all decades. Data provided by Manitoba Conservation (2010)

Information from Manitoba Natural Resources (Manitoba Conservation) also reported moose census results from 1983 to 1993 in northern natural resource areas (See Glossary for definition of natural resource areas) (Table 16). Censuses from these areas reported population estimates ranging from 860 to 1,588 moose across multiple resource areas. Calf to cow ratios varied from 33 to 102 calves per 100 cows across censured resource areas.

Table 16 Moose surveys across Northern Flood Agreement resource areas and Limestone area*

Combined Resource Areas Censured	Year	Population Estimate	Calf:Cow Ratio
Cross Lake, Norway House	1983/1984	1,576 +/- 500	77 to 102: 100
Nelson House, Split Lake	1984/1985	748	N/A**
Nelson House, South Indian Lake, Split Lake	1985	1,871 +/- 742	33 to 68:100
Nelson House, Split Lake	1986/1987	860	35: 100
Cross Lake, Norway House, Split Lake	1986/1987	1,156	35 to 59: 100
Limestone Area	1988	879	45:100
Norway House, Cross Lake, Nelson House	1993	1,588 +/- 277	58:100
Split Lake	2010	2,600 +/- 555	36:100

*Information summarized from Elliott (1985, 1987a, 1987b, 1989, 1993) and Knudsen and Didiuk (1985).

4.4.1.3 Multispecies Surveys

In addition to moose block surveys, moose observations were recorded during 2009 - 2011 multispecies surveys conducted within caribou ranges within the Project Study Area. See *Bipole III Transmission Project- Caribou Technical Report* (Joro, 2011). The number of individual moose observed during multispecies surveys varied across survey areas, ranging from four to 25 individuals in 2009, four to 48 animals in 2010 (Table 17), and five to 35 moose in 2011 (Table 18). In addition to adult counts, number of calves observed in 2011 ranged from zero to five. Moose track counts were also documented. The number of observed tracks ranged from 20 to 132 in 2009 and zero to 72 in 2010 (Table 17).

Based on these counts and observations, the relative distributions of moose were mapped using volume-based density kernel methods to identify concentrations of moose across the various ranges (Section 3.3 1.3) (Map Series 500).

Table 17 Summary of 2009-2010 Moose Observations and Tracks from Multispecies Surveys

Range	Year	Number of Track Observations	Number of Observed individuals
Gilliam	2009	20	4
The Bog	2009	132	25
Keeyask	2010	0	4
Wheadon-Wimapedi	2010	28	12
Wabowden	2010	30	11
Naosap	2010	72	48
The Bog	2010	0*	31

*Track observations were not recorded; however, tracks might have been present.

Table 18 Results for 2011 Moose Observations and Tracks From Multispecies Surveys within the Project Study Area

Range Surveyed	Adults	Calves	Total
Wimapedi Range	11	2	13
Wabowden Range	5	0	5
Wheadon Range	30	4	34
The Bog Range	35	5	40
Total	**81**	**11**	**92**

4.4.1.4 Final Preferred Route Mammal Stratification Surveys

During the FPR mammal stratification surveys flown in 2011, 366 track sightings were observed (Map 21). These results were utilized to generate a density buffer illustrating relative moose density and distribution in relation to the FPR (Map 22).

4.4.1.5 Mammal Tracking Surveys

In conducting summer mammal tracking, moose presence was confirmed on 40 sampling transects out of 464 sampled (8.6%). A total of 32 and 42 signs were observed on tracking transects in August and September of 2010, respectively. Moose signs were observed on 27 of 369 (7.3%) transects sampled during winter mammal tracking (Map Series 600). Thirty-seven moose signs were observed in December, 40 in January, and two in February of 2010. Based on available sampled moose habitat type information, tamarack-larch pure had high moose presence in both summer (19.1%) and winter (35.3%) sampling occasions (Table 19).

Table 19 Habitat Sampling Information for Moose Following 2010 Summer and Winter Mammal Tracking Studies

	SUMMER SAMPLING			WINTER SAMPLING		
	Number of Transects	Number Sampled	Frequency	Number of Transects	Number Sampled	Frequency
Broadleaf mixed	26	2	7.7%	23	3	13.0%
Broadleaf pure	279	21	7.5%	218	5	2.3%
Black spruce mixed	34	1	2.9%	33	3	9.1%
Black spruce pure	72	8	11.1%	50	7	14.0%
Coniferous mixed	16	2	12.5%	18	2	11.1%
Jack pine mixed	4	0	0.0%	3	0	0.0%
Jack pine pure	8	0	0.0%	4	0	0.0%
Shrubs	2	0	0.0%	1	0	0.0%
Tamarack-Larch pure	21	4	19.1%	17	6	35.3%
White spruce pure	2	2	100.0%	2	1	50.0%
TOTAL	**464**	**40**	**8.6%**	**369**	**27**	**7.3%**

Results of a logistic regression analysis based on summer and winter tracking surveys indicated no strong selection of a particular habitat type by moose (Table 11).

It can be noted that there may be an avoidance of broadleaf pure habitat areas, as indicated by a large positive Z-score. A large negative Z-score suggests selection for tamarack-larch pure stands in winter. In addition, during summer, there may be avoidance of black spruce mixed stands, as indicated by a large positive Z-score. However, none of these tendencies was present at a statistically significant level.

Table 20 Results of Logistic Regression Analysis Indicating Habitat Preferences by Moose Following 2010 Summer and Winter Mammal Tracking Studies

	SUMMER SAMPLING			WINTER SAMPLING		
	Frequency	Z-score	p-value	Frequency	Z-score	p-value
Broadleaf mixed	7.7%	0.6	0.5	13.0%	-0.3	0.8
Broadleaf pure	7.5%	1.0	0.3	2.3%	1.4	0.2
Black spruce mixed	2.9%	1.4	0.2	9.1%	0.1	0.9
Black spruce pure	11.1%	0.3	0.8	14.0%	-0.4	0.7
Coniferous mixed	12.5%	0.0	1.0	11.1%	-0.1	0.9
Tamarack-Larch pure	19.1%	-0.6	0.6	35.3%	-1.4	0.2

4.4.1.6 Trail Camera Studies

In the southern portion of the Project Study Area, moose were photographed (Figures 4 and 5) in 38 events across 15 cameras and 11 clusters (Appendix E). Moose observations were within the expected range with the northern-most observation recorded seven km northeast of Mafeking, while the most southern observation being ten km south of Pulp River (Map Series 700). After further review of the photos, a total of 21 bulls, 26 cows, and seven calves were recorded, for a total of 54 moose (Table 21). It is important to note, however, that this number is not indicative of the number of unique individuals photographed, as it is highly likely that an individual could have been photographed at multiple cameras. Using unique morphological features, a total of six unique moose, all bulls, were identified. Moose were photographed to the north, northeast, and east of Swan River, with one group being photographed to the northeast of Neepawa. Distances from Swan River ranged from 70.2 km to the north, 34.5 km to the northeast, and 54.5 km to the east, with the remaining cluster at a distance of 58.1 km to the northeast of Neepawa.

Table 21: Trail Camera Results for Moose

Camera	Number of Bull Moose	Number of Cow Moose	Number of Calf Moose	Total
009_33	1			1
009_34	1			1
122_27		2		2
154_14		1		1
159_51		1		1
241_16		1		1
257_51	1			1
270_29	3	4	1	8
270_31	2	2	1	5
273_07		1		1
273_10		2	2	4
274_20	2			2
285_32	4	8		12
285_33	5	1		6
286_B	2	3	3	8
Total	**21**	**26**	**7**	**54**

Figure 4: Trail Camera Picture of Bull Moose from the Harding Lake Area, December 2010

Figure 5: Trail Camera Picture of Cow and Calf Moose, Summer 2010

In the northern portion of the Project Study Area, photographs of moose were captured at 23 of the 91 trail camera sites in 2010 (Table 22). The majority of images were captured within The Bog boreal caribou range. See *Bipole III Transmission Project- Caribou Technical Report* (Joro, 2011). The total number of photographs was recorded, in addition to the number of bulls, cows, and calves. Sex was determined utilizing observed morphological features. As the majority of individuals could not be definitively identified, each new series of photographs were assumed to depict different animals. Based on this assumption, a total of 503 pictures were taken of bull moose and 23 bulls were identified. Thirty-five cows were identified from 943 pictures. A total of 20 calves were observed.

Table 22: Moose Observations Recorded Through Trail Camera Studies in the Northern Portion of Project Study Area in 2010

Site ID	Number Bull Observations	Number of Bulls	Number of Cow Observations	Number of Cows	Number Unkown Sex Observations	Number of Unkown Sex	Number of Calf Observations	Numbe r of Calves	Total Number of Observations	Total Number of Moose
BOG_1	0	0	20	1			0		20	1
BOG_10	12	1	39	2			24	1	75	4
BOG_11	141	9	212	4			44	3	397	16
BOG_12			177	2					177	2
BOG_13	10	1	10	1					20	2
BOG_2			5	1				1	5	2
BOG_7	100	2							100	2
BOG_8	52	1	2	1					54	2
BOG_9			16	2					16	2
HARD_05			10	1				1	10	2
HARD_08			64	2				2	64	4
HARD_09			32	3				3	32	6
HARD_10	20	1							20	1
HGL_07			25	1				2	25	3
MCL_2	24	3	18	1	2	1		1	44	6
MCL_03					5	1			5	1
MCL_05	144	5							144	5
REED_1			152	2				1	152	3
REED_2			84	2				1	84	3
REED_7					10	1			10	1
REED_10			5	1					5	1
WAB_10			17	4					17	4
WIM_08			55	4				4	55	8
Total	**503**	**23**	**943**	**35**	**17**	**3**	**68**	**20**	**1,531**	**81**

4.4.1.7 Moose Aboriginal Traditional Knowledge

Aboriginal traditional knowledge gathered in interviews reported that moose is actively hunted and found in a wide range of areas. These areas include: Wintering Lake, Red Deer Lake, McClarty Lake, lower Nelson River in the vicinity of Gillam, Setting Lake, Turtle Mountains, northeast of Swan River, and the north side of the Riding Mountains. Other moose hunting areas were recorded during ATK interviews, but were withheld from this report due to confidential agreements. In some communities, the fall moose hunt is noted as being a community wide event and used as a meat source for the community. Additionally, moose migration areas were identified in and around Duck Mountain Provincial Park. See *Bipole III Transmission Project - Aboriginal Traditional Knowledge Technical Report* regarding ATK (Manitoba Hydro, 2011b).

4.4.2 Elk

Elk populations in Manitoba are limited to several areas of upland forest in close proximity to prairie habitat (Jones et al, 1985; Pattie and Hoffmann, 1990). Province-wide, the elk population is estimated at 7,350 animals (Manitoba Conservation, n.d.c) (Map 23). The Duck Mountain herd remains stable at approximately 2,000 animals and the Porcupine Mountain herds remain stable at approximately 300 animals (Manitoba Conservation n.d.c). The Spruce Woods population remains at approximately 400 animals (Manitoba Conservation n.d.c). There are an estimated 100 elk at Red Deer Lake and an additional 250 in the Swan River Valley (Manitoba Conservation n.d.c). The South Interlake elk population is at approximately 800 animals (Manitoba Conservation n.d.c). The Riding Mountain area population is estimated at approximately 3,500 animals (Manitoba Conservation, n.d.c). The provincial elk population is stable with an annual harvest of about 300 animals (Manitoba Environment 1997) by licensed hunters. In 2009/10, a total of 2,718 elk licences were sold for resident rifle, archery, and landowner seasons (Manitoba Conservation 2010). First Nations harvest levels of elk are unreported.

Historically, the use of habitat within the Duck Mountain elk population has shown a strong year-round association with deciduous forests, grasslands, rangelands, and forage crops (Chranowski, 2009). Elk populations can thrive in managed landscapes, including those impacted by fire, grazing, and logging (Toweill and Thomas, 2002). Other important habitat qualities of elk habitat include mineral-rich forage and mineral licks (Toweill and Thomas, 2002). In Manitoba, agricultural cropland is typically avoided; however, this habitat type is often utilized post rut in November and before calving in April (Chranowski, 2009). Throughout the year elk showed a strong avoidance of roads and human disturbance, often occupying habitat greater than 200 m from a roadway (Chranowski, 2009). Elk are most often found in habitats within 800 m of a water feature, such as a stream, river, lake, or marsh (Chranowski, 2009).

Outside of the field studies for the Project, few elk have been reported in the vicinity of the FPR. An inventory of the Alonza Wildlife Management Area recorded elk scat and tracks in the aspen woodland habitat (Kowalchuk et al, 2000). Elk movements outside Riding Mountain National Park are triggered by deep snow and cold temperatures. Elk use areas outside the park more in spring and summer compared to winter (Rounds, 1976) and cow elk are found more often outside of the park than bulls (Brooke, 2007; Chranowski, 2009).

Mortality in elk is due largely to hunting, predation, disease, malnutrition, harassment, accidents, and extreme environmental conditions. For much of the 20th century, predation on adult elk was not considered an important mechanism of population regulation (Raedeke *et al.* 2002). Recently, wolves and other predators are reported to be increasingly influence in limiting or regulating ungulate populations (Raedeke et al., 2002). Natural predators may exert a substantial influence on specific adult age and sex classes of elk populations (Raedeke et al., 2002). In some areas, elk populations are affected by disease. Brucellosis and tuberculosis (*Mycobacterium bovis*) are the two most important diseases affecting elk population management today. Both are zoonotic diseases and are also transmittable to domestic livestock (Toweill and Thomas, 2002). In Manitoba, elk/human conflicts are prevalent throughout the region as elk feed on valuable crops and have the potential to spread bovine tuberculosis to domesticated bovine species (Brook, 2009). Although Chronic Wasting Disease (CWD) has not yet been detected in Manitoba, it is present in Saskatchewan and Alberta (Manitoba Conservation, 2010).

4.4.2.1 Mammal Tracking Surveys

A total of 13 elk signs (tracks and beds) were observed during the winter aerial surveys completed in March, 2010. Elk locations from these two aerial surveys are demonstrated in Map 24.

During summer mammal tracking, nine occurrences of elk were recorded from the 464 transects surveyed (1.94%) whereas no elk signs were recorded during the winter mammal tracking survey (Map Series 800). There is a possibility, however, that some of the unknown ungulate signs encountered actually belonged to elk; however, these could not be verified. Unknown ungulate signs such as beds, browse, or tracks, are signs which could not be identified to species but could be attributed to an ungulate. Within the summer sampling period, observation of elk signs predominately took place in broadleaf pure habitat areas (n=3) (Table 23). Other habitat areas where elk signs were observed included tamarack-larch pure (n=3), black spruce pure (n=2), and jack pine mixed (n=1). Due to the low number of elk occurrences documented through summer mammal tracking, logistic regression analysis was not applied to indicate habitat preferences of this species during this season.

Summer tracking studies found elk signs at 5 sites in habitats between Cowan and Mafeking, Manitoba in a variety of broadleaf, mixed, and coniferous habitats (Table 23). Only 11 elk sign were observed during the August 2010 tracking surveys. Elk signs were sparse with a mean frequency of 0.01 sign/100 m^2. No elk signs were observed in these same habitats during September 2010.

Table 23: Habitat Sampling Information for Elk Following 2010 Summer and Winter Mammal Tracking Studies

	SUMMER SAMPLING			WINTER SAMPLING		
	Number of transects	Number sampled	Frequency	Number of transects	Number sampled	Frequency
Broadleaf mixed	26	0	0.0%	23	0	0.0%
Broadleaf pure	279	3	1.1%	218	0	0.0%
Black spruce mixed	34	0	0.0%	33	0	0.0%
Black spruce pure	72	2	2.8%	50	0	0.0%
Coniferous mixed	16	0	0.0%	18	0	0.0%
Jack pine mixed	4	1	25.0%	3	0	0.0%
Jack pine pure	8	0	0.0%	4	0	0.0%
Shrubs	2	0	0.0%	1	0	0.0%
Tamarack-Larch pure	21	3	14.3%	17	0	0.0%
White spruce pure	2	0	0.0%	2	0	0.0%
TOTAL	**464**	**9**	**1.9%**	**369**	**0**	**0.0%**

4.4.2.2 Trail Camera Studies

Elk were photographed in 30 events across five cameras and three clusters (Map 25; Table 24) (Appendix E). Further review of the photos allowed for the identification of 63 elk (10 males, 49 females, and four calves); however, like moose, this number is not indicative of the number of unique individuals. Using morphological features, a total of five males and four females were identified. All elk that were photographed were 34.3, 34.4, 39.8, 40.2, and 40.3 km to the northeast of Swan River, Manitoba. There was a limited detection of elk northeast of Swan River. As expected, no elk were observed east of Riding Mountain along the preferred route, as this area is outside of the known elk range in the province (Map 23).

Table 24: Trail Camera Results for Elk

Camera	Number of Males	Number of Females	Calves	Total
241_15	2	30	4	36
241_16	1	10		11
248_A	3	9		12
250_74	2			2
250_82	2			2
Total	**10**	**49**	**4**	**63**

4.4.2.3 Elk Aboriginal Traditional Knowledge

Local Knowledge and ATK gathered in interviews discuss migration areas, wintering habitat, and summer and calving habitats that are located in or adjacent to Riding Mountain National Park and Duck Mountain Provincial Park. See *Bipole III Transmission Project - Aboriginal Traditional Knowledge Technical Report (*Manitoba Hydro, 2011b) regarding ATK. Within the Project Study Area, elk hunting activity occurs on the southeast and north sides of Riding Mountain National Park, and an area northeast of Swan River, Manitoba. Elk were also reported as being hunted by various communities, in various locations across the Project Study Area (specific hunting areas were withheld for confidential reasons).

4.5 Linkage Species

4.5.1 Grey wolf

Grey wolf range in Manitoba is extensive (Map 26). Wolves have historically occupied most of Manitoba and are generally distributed depending on the availability of prey species. Wolves are common throughout forested and tundra habitats and are becoming increasingly common along the fringes of agricultural areas (Manitoba Conservation 2010). Wolves generally live in packs ranging between two to nine animals (Mech, 1977; Fritts and Mech, 1981; Aidell, 2007). Wolf densities are influenced primarily by prey availability (Peterson and Page, 1988). Dens tend to be located near the core of a pack's range in pine-dominated forest and located away from water bodies (Ciucci and Mech, 1992).

Choice of prey is generally considered to be a result of behaviour transferred from older pack members to juveniles (Houts, 2000). Although large ungulates are their main prey in North America, wolves are opportunistic predators and feed on various species (Mech, 1970; Gese and Mech, 1991). Wolves prey more frequently on smaller mammals such as snowshoe hare, beaver, and muskrat; however they compose only a small part of the diet of Manitoba wolves. Ungulates supply 90% of the diet, though kills are less frequent. Wolves tend to kill old animals, juveniles, and calves (Boyd et al., 1994). However, wolves have been found to adapt to specific prey found within their habitat (Paquet and Carbyn, 2003).

4.5.1.1 Multispecies Surveys

Aerial wolf observations were recorded during 2009-2010 multispecies surveys conducted in caribou ranges within the Project Study Area (see *Bipole III Transmission Project - Caribou Technical Report* [Joro, 2011]). The number of individual wolves observed during the multispecies surveys varied across survey areas, ranging from zero to ten individuals in 2009 and zero to 27 animals in 2010 (Table 25) (Map 30). During the 2011 multispecies surveys, one wolf was located in the Wimapedi range, one wolf was located in the Wabowden range, eleven wolves were located in the Wheadon range, and ten wolves were located in The Bog range.

Table 25: Summary of Results for Wolf Aerial Surveys Conducted 2009-2010

Range	Year	Number of Track Observations	Number of Individuals Observed
Gillam	2009	13	0
The Bog	2009	23	10
Keeyask	2010	0	0
Wheadon-Wimapedi	2010	96	27
Wabowden	2010	16	0
Naosap	2010	51	24
The Bog	2010	36	0

4.5.1.2 Final Preferred Route Mammal Stratification Surveys

Wolf tracks observations were recorded during the FPR mammal stratification surveys. Seventy-five track sightings were observed and used to generate a density buffer along the FPR depicting wolf distribution and relative density (Section 3.3.1.4) (Map 28).

4.5.1.3 Minimum Wolf Counts

In 2010, within the greater than 39,000 km^2 survey area, 58 wolves were observed amongst 11 groups or as lone animals (Table 26; Table 27). An approximate density of just over one wolf per 1,000 km^2 was estimated. Six groups of greater than four animals were identified as packs (Section 3.3.1.6.) In 2011, within the survey area (also greater

Table 26: Wolf Survey Summary for 2010 And 2011

Year	Number of Groups	Total Count	Min. Group Size	Max. Group Size	Average Group Size	Area Surveyed (km^2)	Wolf Density (per 1,000 km^2)
2010	11	58	1	11	5.3	39,372	1.5
2011	20	83	1	12	4.2	39,372	2.1

Table 27: 2010 Wolf Packs within the Project Study Area

Pack Name	Group Size	Collars in Group	Wolf Pack Designation
White Stone Lake	11	0	Yes
Setting Lake	1	0	
Gustafson Lake	2	0	
Loonhead Lake	5	1	Yes
Lagimodiere Lake	2	0	
Dyce Lake	9	3	Yes
Moody Lake	5	1	Yes
Wimapedi River	11	2	Yes
Wapu Lake	3	1	
Mitishto River	3	0	
Muskego Lake	6	2	Yes
Total	**58**	**10**	

than 39,000 km^2), 83 wolves were observed amongst 20 groups or as lone animals (Table 28). Seven of the twenty groups contained at least five animals and were designated as packs (Section 3.3.1.6). An approximate density of two wolves per 1,000 km^2 was estimated. Ten collared wolves in 2010 and 27 wolves in 2011 were observed with surveyed groups. All designated packs, excepting the White Stone Lake pack surveyed in 2010, were associated with at least one collared wolf.

Table 28: 2011 Wolf packs within the Project Study Area*

Pack Name	Group Size	Collars in Group	Wolf Pack Designation
Muskego Lake	5	3	Yes
Odei River	6	3	Yes
Ridge Lake	8	4	Yes
Crowduck Bay	2	2	
Riel Lake	12	5	Yes
William Lake	1	0	
Smith Lake	2	0	
Saw Lake	9	5	Yes
McNeal Lake	8	3	Yes
Pakwa Lake	2	0	
Fish Lake	2	0	
North Setting Lake	2	0	
Wabowden Dump	2	0	
Rosenberry Lake	2	0	
Egg Lake	3	0	
Tullibee Lake	2	0	
Threepoint Lake	1	0	
Bison Lake	5	0	
Burr Lake	1	0	
Reed Lake	8	2	Yes
Total	**83**	**27**	

*As of March 15th, 2011

4.5.1.4 Wolf Pack Range Delineation

MCPs generated for all wolves associated with designated packs were mapped to delineate an approximate home range or these packs (Map 29). Pack size ranged from five to twelve, with between one and five collared wolves in each pack.

4.5.1.5 Mammal Tracking Surveys

During the summer survey, one instance of wolf scat and two instances of wolf tracks were recorded and were located in broadleaf pure, black spruce mixed, and jack pine mixed habitat areas. Presence of grey wolf was also observed on eight transects surveyed during the winter mammal sampling period and including the sampling in broadleaf pure (N=3), black spruce mixed (N=2), black spruce pure (N=2), and coniferous mixed (N=1) habitat areas (Table 29).

Table 29: Habitat Sampling Information for Grey Wolf Following 2010 Summer and Winter Mammal Tracking Studies

	SUMMER SAMPLING			WINTER SAMPLING		
	Number of Transects	Number Sampled	Frequency	Number of Transects	Number Sampled	Frequency
Broadleaf mixed	26	0	0.0%	23	0	0.0%
Broadleaf pure	279	1	0.4%	218	3	1.4%
Black spruce mixed	34	1	2.9%	33	2	6.1%
Black spruce pure	72	0	0.0%	50	2	4.0%
Coniferous mixed	16	0	0.0%	18	1	5.6%
Jack pine mixed	4	1	25.0%	3	0	0.0%
Jack pine pure	8	0	0.0%	4	0	0.0%
Shrubs	2	0	0.0%	1	0	0.0%
Tamarack-Larch pure	21	0	0.0%	17	0	0.0%
White spruce pure	2	0	0.0%	2	0	0.0%
TOTAL	464	3	0.7%	369	8	2.2%

4.5.1.6 Trail Camera Studies

Figure 6: Trail Camera Picture of Wolves from the Bog Area, December 2010

Wolves were photographed at 15 of 91 trail camera sites (Map Series 900) (Figure 6). The number of wolf pictures captured, and the number of individual wolves and groups of wolves observed were recorded for each site. Wolf age and sex of could not be definitively determined; therefore, each new series of photographs, defined by the date and time of the picture sequence, was assumed to represent different animals. Based on this assumption, a total of 652 pictures were recorded and 83 animals were observed. A total of 57 different groups were observed across the northern Project Study Area, with between one and 14 individual groups at each site.

Table 30: Wolf Observations Recorded Through Trail Camera Studies in the Northern Portion of Project Study Area In 2010

Site ID	Number of Observations	Number of Animals	Number of Groups
BOG_10	178	20	14
BOG_11	121	13	8
BOG_20	13	7	1
BOG_7	15	3	2
BOG_8	7	4	3
BOG_9	57	7	5
HARD_01	96	5	4
HARD_02	6	1	1
HARD_04	5	1	1
HGL_07	5	1	1
MCL_2	40	6	5
MCL_5	79	8	6
MCL_6	12	3	2
WAB_3	9	2	2
WAB_7	9	2	2
Total	**652**	**83**	**57**

4.5.1.7 Wolf Aboriginal Traditional Knowledge

Aboriginal traditional knowledge gathered in interviews reports that wolves were traditionally trapped and hunted by various communities, in various locations across the Project Study Area. Specific areas of trapping were withheld for confidential reasons. In addition to ATK, TEK gathered in interviews reported wolf harvesting as part of a future strategy for possibly mitigating effects of linear disturbance. See *Bipole III Transmission Project - Aboriginal Traditional Knowledge Technical Report* (Manitoba Hydro, 2011b) regarding ATK.

5.0 ENVIRONMENTAL EFFECTS ON VALUED ENVIROMENTAL COMPONENTS

The *Environmental Effects on Valued Environmental Components and Mitigation* Section 5.1 of this report was conducted in reference to research outlined in the *Existing Environment* (Section 4.0). This section aims to build on this knowledge through habitat modeling and analysis in order to predict potential impacts of the Project on the surrounding environment and associated wildlife.

The assessment of the potential environmental effects of the Project on wildlife was evaluated within the Project Study Area using a range of tools and analysis (Please see the *Methodology Section*). The four major components of this assessment include:

- biophysical description of the Project Study Area
- field studies
- wildlife habitat modeling
- literature review of potential effects

Potential environmental effects of the Project focused on VEC based assessment, with the exception of grey wolves which were analyzed as a VEC linkage species. As outlined in the methodology section, VEC species used for analysis included beaver, American marten, wolverine, moose, and elk. Grey wolves were also included in the analysis as a linkage species due to their influence on mammal populations via predator-prey relationships.

The VEC Effects Assessment was structured to address the environmental effects as outlined by the Cumulative Effects Assessment Practitioners Guide (Hegmann et al, 1999). Conclusions of the environmental effects were used to determine residual and cumulative environmental effects of the Project after the application of mitigation measures (Please see the *Methodology Section)* (Hegmann et al, 1999).

The Project route is anticipated to have a range of environmental effects on wildlife within the Project Study Area. While some of the effects on individual wildlife species are anticipated to be positive or neutral, some adverse effects on wildlife are also projected. Potential negative effects of the Project on wildlife are anticipated to be insignificant and mostly limited to sites at or near transmission line facilities. Mitigation measures outlined in this report are proposed to avoid or minimize adverse effects outlined in this section.

Appendix A provides a legend listing the abbreviations for the line coding used in the tables within this section.

5.1 Valued Environmental Components, Environmental Effects and Mitigation

5.1.1 Beaver

5.1.1.1 Effects on Beaver Identified From Literature

Of the literature surveyed, no studies specifically examining the relationships between beaver and development of linear corridors or ROWs have been completed. It is speculated by Manitoba Hydro (2010) that beaver will not be affected by ROW development unless structures such as dams or houses suffer directed effects, or if preferred foods or building materials such as aspen are removed within its home range. Beavers exhibit an apparent adaptability to changes in resource availability, which has led resource managers to assume that they are not negatively affected by management strategies designed for ungulates (Hood and Bayley, 2008). However, this may not be true in restricted habitats, where reduced selection of forage leads to competition. Beavers compete with some ungulates (such as elk) for vegetation. Where this occurs, beavers are overwhelmingly subject to either exploitative exclusion or competitive exclusion, with the latter leading to dramatic declines in the population in some circumstances (Hood and Bayley, 2008).

Beavers are a benefit to retain on the landscape as they promote the increased species richness of riparian vegetation (Wright et al., 2002) as well as birds (Aznar and Desrochers, 2008). Beaver-created wetlands may be an important tool in conservation of amphibian species (Stevens et al., 2007)

5.1.1.2 Effects on Beaver Identified via Habitat Analysis

Beaver habitat is not evenly distributed and is positively skewed toward the northern portion of the Project Study Area; 47% falls within the Hayes River Upland Ecoregion, while 86% is contained in only four of the eight ecoregions (Hayes River Upland, Churchill River Upland, Mid-Boreal Lowland and Hudson Bay Lowland) intersected by project infrastructure components. Based on the predictive model for high quality beaver habitat, a total of 79.7 km^2 of beaver habitat may be disturbed or altered for the Project Components (Table 31). This estimate includes the Local Study Area along the FPR. Map Series 1000 illustrates the extent of beaver habitat within the Local Study Area based on the predictive model.

Based on the predictive beaver habitat model, it is anticipated that approximately 7.3 km of beaver habitat will be intersected by the HVdc Transmission Line (**Error! Reference**

source not found.. In addition, the predictive beaver habitat model estimates that Henday-Long Spruce ROW will remove 0.1 km or less of beaver habitat (Table 32).

Based this analysis, no beaver habitat is anticipated to be removed/effected by the construction and operation of the Keewatinoow Converter Station and associated ROW, AC collector lines, northern ground electrode line and ROW Riel Converter Station, southern ground electrode, construction power site and line, and construction power camp.

Table 31: Total Area and Percentage of Beaver Habitat Based on the Predictive Model for the Local Project Study Area and Individual Infrastructure Component Footprints Summarized by Ecoregion

Ecoregion	Total Habitat Area (km²) within the Local Study Area	Percent of Total Habitat within the Local Study Area	Total Habitat Area (km²) within AC Collectors 310 m ROW	Percent of Total Habitat within AC Collectors 310 m ROW	Total Habitat Area (km²) within Construction Power Camp Footprint	Percent of Total Habitat within Construction Power Camp Footprint	Total Habitat Area (km²) within Construction Power Site Footprint	Percent of Total Habitat within Construction Power Site Footprint	Total Habitat Area (km²) within Keewaatinoow Converter Station Footprint	Percent of Total Habitat within Keewaatinoow Converter Station Footprint	Total Habitat Area (km²) within NES6 Footprint	Percent of Total Habitat within NES6 Footprint	Total Habitat Area (km²) within NES7 Footprint	Percent of Total Habitat within NES7 Footprint
Selwyn Lake Upland	0.9	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Churchill River Upland	11.8	14.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hayes River Upland	37.8	47.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mid-Boreal Lowland	9.8	12.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interlake Plain	4.1	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aspen Parkland	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lake Manitoba Plain	5.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hudson Bay Lowland	9.7	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	<0.1	<0.1	<0.1
Total	**79.7**	**100.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	<0.1	<0.1	**<0.1**	**<0.1**

Table 32: Total Length of Intercept between Beaver Habitat Based on the Predictive Model and Infrastructure Component Right-of-Ways Summarized by Ecoregion

Ecoregion	Total Length (km) of Habitat Intersected by the 66m FPR ROW	Total Length (km) of Habitat Intersected by L61K (Henday-Long Spruce) 60m ROW	Total Length (km) of Habitat Intersected by KN36 (Keewatinoow-Construction Power Site) 60 m ROW	Total Length (km) of Habitat Intersected by Northern Electrode Line 5 m ROW
Selwyn Lake Upland	0.0	0.0	0.0	0.0
Churchill River Upland	0.7	0.0	0.0	0.0
Hayes River Upland	3.4	0.0	0.0	0.0
Mid-Boreal Lowland	1.3	0.0	0.0	0.0
Interlake Plain	0.7	0.0	0.0	0.0
Aspen Parkland	0.0	0.0	0.0	0.0
Lake Manitoba Plain	1.2	0.0	0.0	0.0
Hudson Bay Lowland	0.0	<1	0.0	0.0
Total	**7.3**	**<1**	**0.0**	**0.0**

5.1.1.3 Summary of Effects on Beaver

Populations of beaver are widely distributed and are very abundant within preferred habitats in the Local Study Area. Beaver populations are not abundant along some portions of the FPR ROW due to lack of preferred habitat availability. Populations are prominent throughout most ecoregions, but tend to become more abundant in the Boreal Plains and Boreal Shield. Beaver habitats are common, occurring in nearly all water bodies and water courses.

Given the relatively small amount of habitat being removed for other project components, the majority of beaver habitat removed for the Project will be due to clearing and construction activities for the HVdc Transmission Line and AC collector lines (See Section 5.1.1.2). Clearing and construction activities undertaken in the winter have the potential to drain beaver ponds. Ponds that have been drained as a result of clearing and construction may result in potential mortality or stress to local beaver communities. However, clearing and maintenance activities may result in keeping habitat along the ROW at an early successional stage, where shrubs and young deciduous trees become a food source for beavers located in undisturbed ponds near the ROW. New access along the ROW could lead to a small increase in trapping opportunities and this may result in limited and localized beaver mortality related to trapping. Although the FPR intersects with many beaver populations throughout the different ecoregions within the Project Study Area, few individuals are anticipated to be affected by the Project infrastructure. While the number of beaver along the ROW is anticipated to decline, it is not anticipated that will translate to a significant decline at the population level along the route.

5.1.2 American Marten

5.1.2.1 Effects on Marten Identified via Literature

Forest fragmentation does not favour the abundance of the American marten (Kurki et al., 1998). Webb and Boyce (2009) found that areas where marten were consistently caught had less industrial disturbance than areas where marten were infrequently caught. However, active traplines were found to have less industrial truck and trail access than inactive traplines (Webb and Boyce, 2009). Road access facilitates industrial and recreational activities, contributing to increased fragmentation which is negatively associated with trapping success (Webb and Boyce, 2009). Despite this, increased access to an area allows for trappers to distribute their traps more extensively, increasing the overall probability of catching marten.

Population structure and habitat selection could be altered by even small disturbances (Hargis et al., 1999). Females rearing kits may be more sensitive to changes in habitat quality than other cohorts of martin populations (Katnik et al., 1994). In terms of food supply, the creation of small trails (2-6m wide) could improve access to prey for marten hunting small mammals (Corn and Raphael, 1992). Hargis et al. (1999) found that though small mammal densities are higher in areas cut by forestry, this did not feature an associated increase in captured marten in the area.

Marten generally avoid wide openings in forest cover (either natural or man-made) (Clark et al., 1987), but have been documented to occasionally use riparian areas, meadows (Spencer et al., 1983), and forest edges (Simon, 1980). If an area has been clear-cut or severely burned, it is often left unused by marten for approximately 15 years (Clark et al., 1987; Koehler and Hornocker, 1977; Soutiere, 1979; Manitoba Hydro, 2010). Marten have been documented to pass through forest openings up to 100 m, but generally do not hunt in them unless food or cover is available (Clark et al., 1987).

As habitats shrink and trapping access increases, marten populations are becoming more vulnerable (Webb and Boyce, 2009). It is advisable to ensure refugia from trapping exist, either in undeveloped areas or by prohibiting vehicle access to allow for recovery of overharvested populations (Flynn and Schumacher, 2009). It may be necessary to regulate trapping to maintain populations in landscapes easily accessible to humans (Hodgman et al., 1994). Additionally, habitat fragmentation can be reduced by coordinating construction of new roads as well as leaving 45% or more of a trapline or township in mature forest cover to maintain marten populations (Webb and Boyce, 2009).

Marten are known to be sensitive to disturbance (Forsey and Baggs, 2001; Manitoba Hydro, 2010) including disturbance created via construction, clear cutting, or vehicular activity within Marten ranges. Transmission lines and associated access routes may allow for an increase in off-highway and over-snow vehicles. The use of such vehicles has not been demonstrated to impact marten occupancy, sex ratios, or activity patterns in the immediate area, and as such is not thought to pose a significant threat to exposed American martens (Zielinski et al., 2008). To date, no peer review literature specifically evaluates the effects of transmission line corridors on Marten populations; however, literature regarding marten use of clear-cut areas suggests that marten will generally avoid these areas until overhead cover is allowed to regrow in the area (Clark et al., 1987).

5.1.2.2 Effects on Marten Identified via Habitat Analysis

Marten habitat was found to be concentrated in the northern portion of the Project Study Area, with 66% falling within the Hayes River Upland and a further 24% being contained in Mid-Boreal Lowland Ecoregion. Based on the predictive model for high-quality marten habitat, a total of 436.7 km^2 of marten habitat may be disturbed or altered by the Project Components (**Error! Reference source not found.**). This estimate includes the

Local Study Area along the FPR. 1100 illustrates the extent of marten habitat within the Local Study Area based on the predictive model.

Based on the predictive marten habitat model, it is anticipated that approximately 93 km of marten habitat will be intersected by the HVdc Transmission Line and 1.6 km of marten habitat will be intersected by the Henday-Long Spruce ROW (Table 33 and Table 34). It is also estimated that 2.2 km^2 of marten habitat in will be removed for AC collectors. Overall, it is anticipated that less than 0.1 km^2 of marten habitat in the Local Project Area will be removed for the northern electrode site.

Based on this analysis, no marten habitat is anticipated to be removed/ be affected via the construction and operation of northern ground electrode line and ROW, Keewatinoow Converter Station, construction power camp, construction power site and line, Riel Converter Station, and southern ground electrode site and line.

Table 33: Total Area and Percentage of American Marten Habitat Based on the Predictive Model for the Local Project Study Area and Individual Infrastructure Component Footprints Summarized by Ecoregion

Ecoregion	Total Habitat Area (km^2) within the Local Study Area	Percent of Total Habitat within the Local Study Area	Total Habitat Area (km^2) within AC Collectors 310 m ROW	Percent of Total Habitat within AC Collectors 310 m ROW	Total Habitat Area (km^2) within Construction Power Camp Footprint	Percent of Total Habitat within Construction Power Camp Footprint	Total Habitat Area (km^2) within Construction Power Site Footprint	Percent of Total Habitat within Construction Power Site Footprint	Total Habitat Area (km^2) within Keewaatinoow Converter Station Footprint	Percent of Total Habitat within Keewaatinoow Converter Station Footprint	Total Habitat Area (km^2) within NES6 Footprint	Percent of Total Habitat within NES6 Footprint	Total Habitat Area (km^2) within NES7 Footprint	Percent of Total Habitat within NES7 Footprint
Churchill River Upland	17.9	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hayes River Upland	286.1	65.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mid-Boreal Lowland	103.6	23.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hudson Bay Lowland	29.1	6.7	2.2	0.5	<0.1	<0.1	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0
Total	**436.7**	**100.0**	**2.2**	**0.5**	**<0.1**	**<0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.1**	**0.0**	**0.0**

Table 34: Total Length of Intercept between American Marten Habitat Based on the Predictive Model and Infrastructure Component Right of Ways Summarized by Ecoregion

Ecoregion	Total Length (km) of Habitat Intersected by the 66m FPR ROW	Total Length (km) of Habitat Intersected by L61K (Henday-Long Spruce) 60m ROW	Total Length (km) of Habitat Intersected by KN36 (Keewatinoow-Construction Power Site) 60 m ROW	Total Length (km) of Habitat Intersected by Northern Electrode Line 5 m ROW
Churchill River Upland	2.2	0.0	0.0	0.0
Hayes River Upland	60.5	0.0	0.0	0.0
Mid-Boreal Lowland	30.2	0.0	0.0	0.0
Hudson Bay Lowland	0.0	1.6	0.0	0.0
Total	**92.9**	**1.6**	**0.0**	**0.0**

5.1.2.3 Summary of Effects on Marten

Based on trapping records, aerial surveys, and ground observations, marten populations in the Project Study Area tend to be highest in the northern boreal forested regions. Population concentrations are also known from the Boreal Plains Ecoregion near Porcupine, Duck and Riding Mountain areas. These areas are dominated by fragmentation, habitat alteration, and habitat loss. Trapping mortality is expected to potentially affect marten populations most significantly within the Project Study Area. Marten population concentrations do not extend into the agricultural region of Manitoba.

Given the relatively small amount of habitat being removed for other project components, the majority of marten habitat removed for the Project will be due to clearing and construction activities for the HVdc Transmission Line and AC collector lines (See Section 5.1.2.2). Construction and operation of the Project are expected to have a negative impact on marten populations. Despite the higher presence of marten in the more northern ecoregions, analysis of the Local Study Area shows that highest impact of the project will be on marten habitat in the more southern marten populations, found in the Haynes River Upland and Mid-Boreal Upland Ecoregions. The clearing of forested areas for construction and operations, including that of the construction camp, power station, ground electrodes, and AC collector lines, will exacerbate effects stemming from the ROW alone. These effects will also be exacerbated through the clearing of forested areas for construction and operations, including construction power camp and construction power station footprints, ground electrodes and AC collector lines.

Mitigation measures for project effects on marten are limited and consist primarily of routing the proposed project away from marten habitat. Mitigation measures which may buffer effects of construction and operation include regulating marten trapping in heavily impacted areas to maintain populations. Additionally, future habitat fragmentation can be controlled by coordinating construction of new future roads and area development to reduce the removal of forest cover in marten habitat. Despite these measures, residual effects are still expected to exist within marten populations (Section 7.0).

5.1.3 Wolverine

Wolverines are listed by the Committee on the Status of Endangered Wildlife in Canada as a species of Special Concern in Manitoba, with populations considered stable to increasing (COSEWIC, 2003). Wolverines have large home ranges and generally do not have specific habitat characteristics associated with their home ranges. Due to these facts, impacts of the Project are not easily identified using LCCEB modeling. Potential effects of this project on wolverine populations will be derived from general aerial observations (Section 4.5.1) and literature review.

5.1.3.1 Effects on Wolverine Identified via Literature

Wolverines prefer undisturbed areas but home ranges often overlap traplines, recreational trails, and relatively busy roads (COSEWIC, 2003). When crossing roads, they select narrow crossings of less than 100 m (Austin, 1998). They are known to use snowmobile trails for travel, and will scavenge trapped animals and hunter kills (COSEWIC, 2003). Females that are denning are sensitive to disturbance, which can result in litter abandonment or den relocation (Barnes and Mallik, 1997; Heinemeyer et al., 2001).

Habitat loss continues to threaten populations (COSEWIC, 2003). Habitat alienation occurs from human activities, including recreation, and impacts behaviours such as travel, denning, and foraging. Major human transportation routes impede wolverine movement and gene flow (COSEWIC, 2003). Wolverine populations are also affected by the population levels of their prey species, especially ungulates, which are vulnerable to overhunting and habitat fragmentation.

5.1.3.2 Wolverine Observations within the Project Study Area

One hundred and seven locations of wolverine tracks and one wolverine observation were recorded and mapped during January 2010 aerial transect surveys in the Project Study Area (Map 16).

In 2011, multispecies surveys along the FPR observed 43 wolverine tracks. The largest number of tracks was identified in the Wheadon survey area. Map 17 shows the distribution of wolverine tracks from 2011. Wolverine tracks were also observed during multispecies surveys flown parallel to the FPR. Twenty-four additional track sightings were observed, and used to generate a density buffer along the FPR indicating wolverine concentrations (Map 18).

5.1.3.3 Summary of Effects on Wolverine

Given that this species is a wide ranging species with a large home range, no modeling was conducted on this VEC. Wolverine populations are located in the northern boreal forested regions of the Project Study Area, as derived from trapping records and aerial surveys. Based on recorded observations made during aerial tracking conducted over 2010/2011, the effects of the Project on wolverine populations within the FPR are expected to be minimal.

Despite wolverine tracks being found in the Project Study Area during aerial surveys, no major wolverine concentrations were located. Based on the wolverine locations described in Section 5.1.3.1, wolverine, due to their northern range, are only anticipated to be affected by northern project components and the HVdc Transmission Line. Where wolverine populations exist within the FPR, wolverines are expected to avoid disturbance during development. Wolverines are expected to avoid areas with major transportation routes and disturbance (e.g. major highways). Effects of the Project may include the disturbance of denning sites during the construction phase of the Project. Specific mitigation measures during the construction phase in areas containing wolverine denning sites (if a denning site is found) are outlined in Section 6.1. While the expected impact on wolverine populations is anticipated to be minimal, the presence of wolverines within the Project Study Area indicates that more follow-up and monitoring of wolverine populations within the Project Study Area is required. Effects on wolverine prey species, including rodents, as well as ungulate carcasses are expected to be limited.

5.1.4 Moose

5.1.4.1 Effects on Moose Identified via Literature

Moose may use ROWs and roads as corridors for movement, and frequently travel and forage along such linear clearings (Manitoba Hydro, 2010). If hunting occurs along these ROWs, moose will avoid them (Jalkotzy et al., 1997). In general, moose avoid human-related activity. The development of roads into new areas allows for hunting in previously inaccessible areas.

Transmission lines are expected to have little effects on the ability of moose to utilize available habitat. Early successional habitat created by the ROW appears to be of equal value to moose as the forest habitat was prior to bring disrupted. The construction phase may be disruptive to moose (Jalkotzy et al., 1997). Jalkotzy et al. outlined that pipeline construction was found to disrupt moose movement over relatively large areas along the route for days at a time. However, in the case of transmission line ROWs, habitat may actually become enhanced after construction due to an increased presence of suitable moose forage species along the ROWs and the surrounding forest (Richard and Doucet, 1999). Mortality associated with ROWs may occur due to an increase in human access along the corridor, which could result in an increase in hunting and poaching; however, this potentially occurs in only a fraction of ROW developments (Jalkotzy et al., 1997; Richard and Doucet, 2003). However, a study focusing on moose use of transmission line ROWs found increases in mortality not to be significant at the population level (Richard and Doucet, 1999). All influences are expected to be reversible upon project decommissioning.

5.1.4.2 Effects on Moose Identified via Habitat Analysis

Moose habitat availability is relatively evenly distributed throughout the central and northern portions of the Project Study Area and exists in all of the eight ecoregions intersected by the Project. In addition, aerial surveys conducted in the winters of 2010 and 2011 in the northern portion of the Project Study Area indicate that the FPR route is favorable for existing moose populations. The highest numbers of moose were observed north of the FPR with the largest population concentration situated in the Gillam area. Based on the predictive model for high-quality moose habitat, a total of 1,122 km^2 of moose habitat may be disturbed or altered by the Project Components (Table 35). This estimate includes the Local Study Area along the FPR. Map Series 1200 illustrates the extent of moose habitat within the Local Study Area based on the predictive model.

Based on the predictive moose habitat model, it is anticipated that approximately 254 km of moose habitat will be intersected by the HVdc Transmission Line, and 3.1 km of moose habitat will be intersected by the Henday-Long Spruce ROW, 1.2 km of moose habitat will be intersected by the Keewatinoow Construction Power site line ROW and 0.1 km of moose habitat will be intersected by the Northern Ground Electrode site line (Table 36). It is also estimated that 1.1 km^2 of moose habitat in will be removed for AC collectors. Overall, it is anticipated that less than 2.6 km^2 of moose habitat in the Local Project Area will be removed for Keewatinoow Converter Station, 0.2 km^2 for the construction power camp and 1.4 km^2 for the construction power site footprint (Table 35). Despite the number of intersecting project components, the total area of moose habitat within the Project footprint represents less than 5% of available habitat in the Project Study Area within the Hudson Bay Lowland Ecoregion and less than 1% of the total study area.

Based on this analysis, no moose habitat is anticipated to be removed/ be affected via the construction and operation of northern ground electrode site, Riel Converter Station and southern ground electrode site.

Table 35: Total Area and Percentage of Moose Habitat in the Local Project Study Area and Individual Infrastructure Component B. Footprints Summarized By Ecoregion (As Described via the Predictive Model).

Ecoregion	Total Habitat Area (km²) within the Local Study Area	Percent of Total Habitat within the Local Study Area	Total Habitat Area (km²) within AC Collectors 310 m ROW	Percent of Total Habitat within AC Collectors 310 m ROW	Total Habitat Area (km²) within Construction Power Camp Footprint	Percent of Total Habitat within Construction Power Camp Footprint	Total Habitat Area (km²) within Construction Power Site Footprint	Percent of Total Habitat within Construction Power Site Footprint	Total Habitat Area (km²) within Keewaatinoow Converter Station Footprint	Percent of Total Habitat within Keewaatinoow Converter Station Footprint	Total Habitat Area (km²) within NES6 Footprint	Percent of Total Habitat within NES6 Footprint	Total Habitat Area (km²) within NES7 Footprint	Percent of Total Habitat within NES7 Footprint
Selwyn Lake Upland	36.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Churchill River Upland	172.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hayes River Upland	209.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mid-Boreal Lowland	246.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interlake Plain	168.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aspen Parkland	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lake Manitoba Plain	137.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hudson Bay Lowland	147.8	0.0	1.1	0.1	0.2	<0.1	1.4	0.1	2.6	0.2	0.0	0.0	0.0	0.0
Total	**1,122.0**	**0.1**	**1.1**	0.1	0.2	<0.1	**1.4**	0.1	**2.6**	0.2	**0.0**	**0.0**	**0.0**	**0.0**

Table 36: Total Length of Intercept between Moose Habitat in the Local Project Study Area and Individual Infrastructure Component. Footprints Summarized By Ecoregion (As Described Via the Predictive Model)

Ecoregion	Total Length (km) of Habitat Intersected by the 66m FPR ROW	Total Length (km) of Habitat Intersected by L61K (Henday-Long Spruce) 60m ROW	Total Length (km) of Habitat Intersected by KN36 (Keewatinoow-Construction Power Site) 60 m ROW	Total Length (km) of Habitat Intersected by Northern Electrode Line 5 m ROW
Selwyn Lake Upland	7.5	0.0	0.0	0.0
Churchill River Upland	38.8	0.0	0.0	0.0
Hayes River Upland	56.9	0.0	0.0	0.0
Mid-Boreal Lowland	59.4	0.0	0.0	0.0
Interlake Plain	32.5	0.0	0.0	0.0
Aspen Parkland	0.8	0.0	0.0	0.0
Lake Manitoba Plain	30.7	0.0	0.0	0.0
Hudson Bay Lowland	27.1	3.1	1.2	0.1
Total	**253.6**	**3.1**	**1.2**	**0.1**

5.1.4.3 Summary of Effects on Moose

Moose habitat availability is relatively evenly distributed throughout the central and northern portions of the Project Study Area. Moose habitat exists in all of the eight ecoregions intersected by the FPR and other project components.

Given the relatively small amount of habitat being removed for other project components, the majority of moose habitat removed for the Project will be due to clearing and construction activities for the HVdc Transmission Line and AC collector lines (See Section 5.1.4.2.) Despite this, transmission lines are expected to have little impact on habitat ability for moose. Early successional habitat created by the ROW development appears to be of equal value to moose compared to the forest habitat prior to development. After construction, moose habitat may become enhanced due to the presence of suitable forage species.

The primary potential effect associated with ROWs is the potential for increased hunting which could reduce local moose populations (Richard and Doucet, 2003). This potential effect may only occur in a fraction of ROW development. Additional effects on moose populations may arise from increased predation from wolves as a result of their increased rate of movement along the ROWs. These effects are expected once the ROW has been cleared and would last the life of the Project. See Section 5.2 for further description of increased movement and predation by grey wolves. Mitigation measures may include actions to decrease wolf access along the Local Study Area. All influences and effects of the Project on moose are expected to be reversible upon project decommissioning.

5.1.5 Elk

5.1.5.1 Effects on Elk Identified from Literature

As elk tend to avoid linear features, such as roads, and generally remain at least 200 m from roads (Frair et al., 2005; Chranowski, 2009) there is the potential for alterations in elk movement. These effects, although thought to be short term, would be expected during the construction of the transmission line when transportation of equipment will be constant. After construction of the ROW and transmission line, browsing opportunities would be created in some areas, as shrubs and grasses are generally the first plants to re-colonize a disturbed area. Elk often take advantage of browse along disturbed areas in forestry cutblocks and along roadsides (Pattie and Hoffman, 1990). Generally the highest quality forage available for elk exists in old-growth forests, particularly during the summer (Happe et al., 1990).

Newly constructed transmission lines ROWs may increase elk mortality through hunting and predation. As the development of roads and access trails are created for the Project, new previously inaccessible areas are opened to hunting and can result in increased predation (Bergman, 2006; Chranowski, 2009). As with moose, wolves are able to cover more ground with the addition of the ROW, increasing potential wolf related elk mortality (Bergman, 2006). These effects are expected once the ROW has been cleared and would last the life of the Project. See Section 5.2 for further description of increased movement and predation by grey wolves.

White-tailed deer are a secondary host for the meningeal worm (Anderson, 1972; Schmitz and Nudds, 1994) and commonly transmit the disease to other cervids. The ROW may facilitate contact between white-tailed deer and elk, increasing the potential for transmission of this disease. Additionally, bovine tuberculosis has been found in elk populations in western Manitoba (Chranowski, 2009). As new corridors are created, elk are able to move easily through the region, increasing the chance for disease transmission among animals.

Noise related effects observed in elk populations from roads and other developments include disruption and alteration of seasonal migrations and/or daily movement patterns (Kuck, 1985; Irwin, 2002; Skovlin et al., 2002). When compared to undisturbed elk cow and calves, disturbed cow and calves will move larger distances, use larger areas, show an increase in the use of coniferous habitats, and begin to select less favourable habitats (Kuck, 1985). These effects would likely be present during construction of the ROW and transmission line and at a much lesser degree during operations.

Due to the increased vehicular traffic during the clearing and construction phases, an increase in vehicle collisions may occur. The increase in collisions would primarily be related to clearing of the ROW and construction of the transmission line and is not expected during operations.

5.1.5.2 Effects on Elk Identified via Habitat Analysis

Elk habitat is relatively evenly distributed between two major ecoregions in the southern portion of the Project Study Area; the Interlake Plain and the Lake Manitoba Plain. As a result of its southerly extent, elk habitat is not intersected by any project infrastructure, except in the FPR 66 m ROW (**Error! Reference source not found.** Based on the predictive model for high-quality elk habitat, a total of 371 km^2 of elk habitat may be disturbed or altered by the Project Components (Table 37). This estimate includes the Local Study Area along the FPR. Map Series 1300 illustrates the extent of elk habitat within the Local Study Area based on the predictive model. Based on this predictive model, it is anticipated that approximately 77 km of elk habitat will be intersected by the HVdc Transmission Line (Table 38). No elk habitat will be removed or affected by the construction and operation of AC collectors, construction power site and line, Keewatinoow Converter Station and associated ROW, construction power camp, northern ground electrode site and line ROW, Riel Converter Station, and southern ground electrode site and associated line ROW.

Table 37: Total Area and Percentage of Elk Habitat as Described by the Predictive Model for the Local Project Study Area and Individual Infrastructure Component Footprints Summarized by Ecoregion

Ecoregion	Total Habitat Area (km^2) within the Local Study Area	Percent of Total Habitat within the Local Study Area	Total Habitat Area (km^2) within AC Collectors 310 m ROW	Percent of Total Habitat within AC Collectors 310 m ROW	Total Habitat Area (km^2) within Construction Power Camp Footprint	Percent of Total Habitat within Construction Power Camp Footprint	Total Habitat Area (km^2) within Construction Power Site Footprint	Percent of Total Habitat within Construction Power Site Footprint	Total Habitat Area (km^2) within Keewaatinoow Converter Station Footprint	Percent of Total Habitat within Keewaatinoow Converter Station Footprint	Total Habitat Area (km^2) within NES6 Footprint	Percent of Total Habitat within NES6 Footprint	Total Habitat Area (km^2) within NES7 Footprint	Percent of Total Habitat within NES7 Footprint
Interlake Plain	18.2	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aspen Parkland	156.1	42.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lake Manitoba Plain	7.6	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hudson Bay Lowland	189.2	51.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**371.0**	**100.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Table 38: Total Area and Percentage of Elk Habitat as Described by the Predictive Model for the Project Study Area and Individual Infrastructure Component Footprints Summarized by Ecoregion

Ecoregion	Total Length (km) of Habitat Intersected by the 66m FPR ROW	Total Length (km) of Habitat Intersected by L61K (Henday-Long Spruce) 60m ROW	Total Length (km) of Habitat Intersected by KN36 (Keewatinoow-Construction Power Site) 60 m ROW	Total Length (km) of Habitat Intersected by Northern Electrode Line 5 m ROW
Interlake Plain	4.8	0.0	0.0	0.0
Aspen Parkland	27.6	0.0	0.0	0
Lake Manitoba Plain	1.3	0.0	0.0	0
Hudson Bay Lowland	43.1	0.0	0.0	0
Total	**76.8**	**0.0**	**0.0**	**0**

5.1.5.3 Summary of Effects on Elk

Elk habitat is relatively evenly distributed between the Prairie and Boreal Plain Ecoregions in the southern portion of the Project Study Area. As a result of its southerly extent, elk habitat is rarely intersected by project infrastructure. A limited elk range was detected northest of Swan River; however, no elk were observed near the preferred route east of Riding Mountain. Effects of the Project on elk and elk habitat are anticipated to be limited to clearing/construction and operation activities for the HVdc Transmission Line, given no elk habitat will removed for other project components (See Section 5.1.5.2.) In total, approximately 1.4% of elk habitat in the Local Study Area is expected to be cleared for the Project. As a result, the Project is expected to have a minimal effect on elk populations in Manitoba. As previously cited, alteration of movement patterns can be anticipated during noise related activities of construction, such as roads use/creation and construction of the ROW and transmission lines. These effects are expected during the construction phase of the transmission line when transportation of equipment and construction will be constant, yet short lived. After the construction phase, browsing opportunities will be created due to increased presence of suitable forage species along the ROW.

As with moose, creation of linear corridors via transmission lines ROWs may increase elk mortality through hunting and predation. Hunters often utilize ROWs to access areas previously difficult to reach in order to locate game species. Increased predation from wolves via their increased movement through use of ROWs is another potential effect of the Project. Mitigation measures for increased predation by grey wolves may include actions to decrease wolf access along the Local Study Area.

5.2 Grey Wolf (Linkage Species)

5.2.1 Effects on Wolves Identified via Literature

Linear corridor development in remote regions is noted to increase wolf access into formally remote caribou habitat (Jalkotzy, 1997). These corridors increase the movement of wolves into moose, caribou, and elk habitats. Wolves have a faster rate of travel and corridor development may potentially influence wolf travel routes, their overall distribution, and wolf-prey contacts and interactions (Thomas, 1995; James and Stuart-Smith, 2000; Courbin et al., 2009). Habitat alteration such as creation of linear corridors and ROWs can provide predators with increased access to previously safe places for prey species, decrease search times for prey, make prey escape more difficult, and improve wolf predation efficiency (Thomas, 1995; James and Stuart-Smith, 2000). James and Stuart-Smith (2000) found that when within caribou ranges, wolf locations were found to be 134 m closer to corridors than random points and telemetry locations of wolves were consistently closer to corridors. This study also found that caribou mortalities attributed to wolf predation were closer to linear corridors than live caribou locations and wolf predation sites were found to be 55 m closer to corridors than random points. It has also been previously found that the amount of human activity along linear corridors can influence the use these features by wolves, with corridors which receive less human use, such as remote transmission ROWs, more attractive as easy travel routes (Stein, 2000)

5.2.2 Summary of Effects on Wolves

Wolves are likely to not be impacted negatively by the development; however, wolves are linked to the viability of other VEC species. The increased mobility of wolves along linear corridors leads to higher rates of predation on VEC species in the proximity of the Project line and associated infrastructure.

Based on the literature, research has identified that the creation of ROW's and access roads, will provide travel routes for wolves to move into habitat that previous was difficult to access. As a result, it is anticipated that ungulate morality due to wolf predation will increase within and around the Project Study Area.

5.3 Access Routes

Proposed access routes were identified from orthophotos in an ArcMap GIS environment (ESRI©, 2011); however, these routes require ground-truthing to identify access constraints prior to final selection (See Bipole III Transmission Project Preliminary Construction Access Review, [Manitoba Hydro, 2011c]). As a result, detailed habitat analyses were not implemented in conjunction with the initial field studies, but will be carried out following ground-truthing and final selection of access routes. Total length of existing access and access routes requiring new clearing were calculated along the length of the FPR as a preliminary measure of the potential effects access has on mammal habitat.

Forty-four proposed site access roads/routes were identified. Thirty-nine followed existing linear disturbances, consisting primarily of forestry roads, cut lines, and mile roads, along their entire length (See Bipole III Transmission Project Preliminary Construction Access Review). The remaining four were digitized routes or route sections situated in areas lacking existing access. The total length of proposed construction access routes along the FPR was determined to be approximately 408 km, with 406 km of existing access and 2.4 km of new routes requiring clearing (Table 39).

Table 39: Length of Proposed Access Routes along the FPR

Access Route Category	Length (km) of Access Routes
Future	2.4
Existing	405.8
Total	**408.2**

Overall, it is anticipated that there will be some minimal sensory disturbance to VEC mammal populations via ongoing use of access roads during the construction and operation phases of the Project. However, based on this analysis and the limited amount of areas being cleared for new access routes, it is anticipated that new access routes will have little to no effect on VEC mammal populations.

5.4 Borrow Areas

As proposed, borrow areas and excavated material placement sites are not fixed and are subject to changes in location more so than other infrastructure components. As such, these sites were not included in the detailed site-specific habitat analyses used to assess other components. Instead, simple calculations and LCCEB covertype analyses were employed to derive a general idea of the amount and type of habitat that would be affected by borrow areas and excavation in the vicinity of the northern infrastructure construction.

Proposed borrow areas ranged in size from 0.02-0.6 km^2, with a total of 2.6 km^2 of proposed borrow areas identified in the Local Study Area. All of the borrow areas are situated in the vicinity of the Keewatinoow Converter Station and AC collectors (Table 40). In addition, 1.4 km^2 of excavated borrow material placement locations were identified, with individual sites having areas between 0.1 and 0.4 km^2 (Table 41).

The cover types identified included dense, open, and sparse coniferous forest; herb, shrub, and treed wetland; and tall shrubland, exposed land, and water. Cover types contained in proposed borrow areas were predominantly dense coniferous forest (38%) and tall shrubland (24%), with smaller components of exposed land and shrub wetland (11%). The dominant cover type for excavated material placement sites was tall shrubland, comprising 54% of placement sites. The secondary cover type identified for placement sites was treed wetland (17%).

Overall, it is anticipated that there will be some minimal sensory disturbance to VEC mammal populations via ongoing access to borrow sites during the construction phases of the Project. However, based on this analysis and the limited amount of areas being cleared/used for borrow sites, it is anticipated that borrow sites will have little to no effect on VEC mammal populations.

Table 40: Total Area (Km^2) and LCCEB Covertype Area within Proposed Borrow Area Sites

LCCEB Covertype Name	Borrow Site Areas (km^2)															Total Covertype Area	Covertype Percent of Total Borrow Area
	B-5-1	B-5-3	N - 10 - 1	N - 10 - 2	N - 3 Area - II	N - 4	N - 5	N - 6	N - 7 Area - I	N - 7 Area - II	N - 7 Area - III	N - 8	N - 9	Limestone Quarry Stockpile	"Mount Kumagai" Stockpile		
Water	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	<0.1	<0.1	1.3
Exposed Land	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.0	<0.1	0.0	0.0	0.0	<0.1	0.0	<0.1	<0.1	0.3	11.5
Shrub Tall	0.0	0.0	<0.1	0.0	0.1	0.0	0.0	<0.1	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.6	24.2
Wetland Treed	0.0	0.0	<0.1	<0.1	0.0	<0.1	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	3.9
Wetland Shrub	0.0	0.0	<0.1	<0.1	0.0	<0.1	<0.1	0.1	0.0	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.3	11.2
Wetland Herb	0.0	0.0	<0.1	<0.1	0.0	0.0	0.0	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.8
Coniferous Dense	<0.1	0.0	<0.1	0.0	0.0	0.4	0.3	0.2	<0.1	<0.1	<0.1	0.0	<0.1	0.0	0.0	1.0	37.7
Coniferous Open	0.0	0.0	<0.1	0.0	0.0	0.0	<0.1	<0.1	0.0	<0.1	<0.1	0.0	0.0	<0.1	0.0	0.1	5.1
Coniferous Sparse	0.0	<0.1	<0.1	<0.1	0.0	0.0	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	2.9
MixedWood Dense	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	1.4
Total Borrow Site Area (km^2)	**<0.1**	**<0.1**	**0.1**	**<0.1**	**0.2**	**0.5**	**0.4**	**0.6**	**<0.1**	**<0.1**	**<0.1**	**0.4**	**0.1**	**<0.1**	**<0.1**	**2.6**	**100.0**

Table 41: Total Area (Km^2) and LCCEB Covertype area aithin Proposed Excavated Borrow Material Placement Locations

LCCEB Covertype Name	LCCEB Covertype Area (km^2) for Borrow Excavated Material Placement Locations						Total Covertype Area	Covertype Percent of Total Excavated Material Placement Area
	1A	1B	1C	1D	1E	1F		
Exposed Land	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	6.2
Shrub Tall	0.0	0.1	<0.1	<0.1	0.4	0.2	0.8	53.8
Wetland Treed	0.1	<0.1	<0.1	<0.1	0.0	0.0	0.2	16.9
Wetland Shrub	<0.1	<0.1	<0.1	<0.1	0.0	0.0	<0.1	3.3
Coniferous Dense	0.0	0.0	<0.1	0.0	0.0	0.0	<0.1	1.9
Coniferous Open	<0.1	<0.1	<0.1	0.0	<0.1	0.0	<0.1	6.5
Coniferous Sparse	0.1	<0.1	<0.1	0.0	0.0	<0.1	0.2	11.4
Total Placement Location Area (km^2)	**0.3**	**0.2**	**0.2**	**0.1**	**0.4**	**0.2**	**1.4**	**100.0**

5.5 Summary of Effects for all Species

5.5.1 High Voltage Direct Current Transmission Line and Alternating Current Collectors Construction

High voltage direct current transmission line and AC collectors construction will affect small and medium-sized mammals through local level habitat loss. Home ranges for these mammals are smaller than those of larger mammals such as moose and elk. Habitat availability throughout the various ecoregions is not limiting for small and medium sized mammal populations. American marten, which tends to prefer mature forest (Witmer et al., 1998), may experience greater effects than species with more general habitat requirements, such as beaver (Schrecengost, 2009). Based on the limited amounts of habitat being removed for these species, it is anticipated that the effects of habitat removal will be minimal. Due to the extremely long lengths of the FPR there is potential for site specific effects to some species that may den or forage near specific sites along the FPR ROW.

Ungulate species are also anticipated to be affected by habitat loss via vegetation removal for the FPR ROW, but to a lesser extent than small to medium-sized mammals. Overall, moose and elk are anticipated to simply shift to using other extents of their home ranges as a response to any habitat removal occurring in the area. Important sites such as mineral licks, riparian travel corridors, and aquatic feeding sites have not been identified during any field studies and as part of pre-construction monitoring may be assessed where applicable. Additionally, local elk and moose movements across or along the ROW may be affected in the short-term by obstructions such as woody debris piles produced during forest clearing.

Sensory disturbance due to construction, clearing, and ongoing access of the transmission line by construction crews may result in short-term avoidance of the active Project Study Areas by mammals. Effects will likely be in the immediate vicinity of construction activity. The degree of avoidance will depend on the species and the frequency of vehicular traffic and is expected to vary as site preparation activity proceeds along the route. Larger species, and in particular moose and elk, may be temporarily displaced due to disturbance and access. There is also potential for increased movement of grey wolves along ROWs following construction, which is anticipated to result in increased predation on elk and moose populations. Overall, ROW clearing, tower erection, and construction activities are anticipated to result in long lengths of low-use, snow packed trails/linear features, providing opportunities for trail use of predators and as a result, increased predation rates within the Project Study Area.

Vehicle traffic may present a risk for wildlife-vehicle collisions and mortality, but speeds along access roads and trails associated with the Project will be limited due to speed limits or to large, slow-moving machinery. As such, few collisions with mammals are expected. Improved access to the area via access roads and trails may increase the mortality of ungulates, and moose in particular, as well as other species due to hunting and possibly trapping.

5.5.1.1 Operations

Operation of transmission lines and transmission line ROW may result in a number of effects on mammal species, including sensory disturbances, hunting, epidemic disease, and predation. Sensory disturbance due to ongoing maintenance of the ROW may result in short-term avoidance of a relatively small area by mammals. Maintenance activities of the transmission line and transmission line ROWs are anticipated to include periodic inspections and vegetation maintenance using helicopters, machinery, vehicles, and people. Effects from maintenance activities will likely be localized to the immediate vicinity of maintenance activity. The degree of avoidance will varying based on species and the frequency of activity and vehicular traffic and is expected to vary as site preparation activity proceeds along the route. Larger species, in particular moose and elk, may be temporarily displaced due to disturbance and access.

The ROW could improve hunter access and harvest of elk and moose populations. Additionally, improved access in some locations could result in improved subsistence harvest of wildlife. Provincial harvest management strategies are expected to be an important tool in ensuring stable game species populations. Similarly, access created by the ROW development may provide increased opportunities for trappers in areas that were previously remote and difficult to access. As a result, trapping mortality is expected to increase for beaver, marten and wolverine within the Project Study area; however, these effects will vary based on human population density in the Local Project Areas and trapping/resource use activities in various areas of the Project Study Area. There also may be some loss of functional habitat associated with sensory disturbances arising from recreational use (e.g., snowmobiles, ATVs) for mammals along the cleared ROW.

In addition, with increased public access to remote areas through the use of access roads, trails and ROWs, it is expected that the number of vehicle collisions/mammal mortality could increase and detour species away from active areas (Jalkotzy, 1997). However, it is unlikely that mammal/vehicle collisions will occur so frequently as to impact local populations.

White-tailed deer are a secondary host for the meningeal worm (Anderson, 1972; Schmitz and Nudds, 1994) and commonly transmit the disease to other ungulates. The ROW may facilitate contact between white-tailed deer and other ungulates (such as moose and elk), increasing the potential for transmission of this disease. Additionally, bovine tuberculosis has been found in elk populations in western Manitoba (Chranowski, 2009). As new corridors are created, ungulate species will be able to move easily through the region, increasing the chance for disease transmission among animals.

There is also potential for increased movement of grey wolves along ROW's following construction. Particularly, as ROW may result in long lengths of low use snow packed ROW behind or following the intensive clearing and construction activities, providing opportunities for enhanced predator movement. As wolves are expected to have greater access to prey habitat as they use the ROW as a movement corridor, there is an expected increase in predation, particularly in areas previously thought to be safe (Thomas, 1995; James and Stuart-Smith, 2000; Courbin et al., 2009). Areas of the ROW which are actively used are expected to be less used by wolves (Stein, 2000) than those in more remote regions.

5.5.1.2 Fragmentation

No additional habitat will be lost during the operation phase; however, fragmentation may remain an ongoing issue for species such as American marten, which generally prefer continuous mature forest (Whitmer et al., 1998). Fragmentation will persist along the transmission line through regular maintenance activities, which will divide habitat types, create edge effects and maintain transmission line habitat in early successional stage. Depending upon the degree of overlap of American marten home ranges with the transmission line, the Project will likely have a small, long-term effect on a small number of individuals. Movement of small and medium-sized mammals across the ROW may be impeded, either seasonally or year-round. Maintenance of vegetation at an early successional stage may benefit some mammal species, for instance deer, elk, and moose, whose browsing opportunities may increase along the ROW. The continual presence of the ROW and the presence of towers and conductors are expected to have a small, long-term effect on mammal utilization of the area.

After construction is complete and disturbance has ceased, the ROW will provide a movement corridor for predators such as coyote, red fox, and grey wolf for ease of travel and more efficient hunting. While this may benefit predators, mortality of prey species such as small mammals, rabbits and hares, and ungulates could increase.

Local deer, moose, and elk populations are anticipated to be primarily affected by the degree of access to the area by hunters. Improved access to the area via access roads, trails, and the ROW could lead to increased ungulate mortality. Increased use of the ROW by humans could result in avoidance of the area by predators, particularly grey wolves, which tend to avoid humans (Banfield, 1987). The physical presence of the transmission line and ROW are not expected to have a large impact on these species. The ROW may enhance movement of deer and improve access to existing habitat.

5.5.2 Keewatinoow Converter Station, Construction Power Camp, Construction Power Site, and Right-of-Way

For the Keewatinoow Converter Station, Construction Power Camp, Construction Power Site, and ROW, the VEC species anticipated to be potentially affected by this project component include American marten, moose and wolverine. The following is a description of these potential effects:

5.5.2.1 Construction

Based on analysis described in Sections 5.1.1 to 5.1.5 a limited amount of American marten, moose and wolverine habitat will be removed or affected via the construction of the Keewatinoow Converter Station, Construction Power Camp, Construction Power Site, and/or ROW ranging from 2.6 to less than 0.1 km^2, depending on species or component in question. Based on the limited amount of habitat being removed, it is anticipated that the effects of construction will be minimal.

Sensory disturbance due to construction, clearing, and ongoing access of the Project site by construction crews may result in short-term avoidance of the Keewatinoow Converter Station, Construction Power Camp, Construction Power Site and ROW by mammals during these activities. Effects will likely be in the immediate vicinity of construction activity. The degree of avoidance will depend on the species and the frequency of vehicular traffic and is expected to vary as site preparation activity proceeds. Larger species, in particular moose, may be temporarily displaced due to disturbance and access.

With increased public access to remote areas on trails and ROWs, it is expected that the number of vehicle collisions/mammal mortality and disturbance to VEC population could increase and detour species away from active areas at a local level (Jalkotzy, 1997). Despite this, it is unlikely that these disturbances will occur so frequently as to impact local populations.

5.5.2.2 Operation

Local VEC populations may be temporarily displaced during operations due to disturbance from vehicles accessing various Keewatinoow Project Components for maintenance and operation activities. The ROW and access roads associated with the Keewatinoow Converter Station may create new opportunities for moose harvest through improved access by hunters. Additionally, improved access in some locations could result in improved subsistence harvest of wildlife. Similarly, access created by the ROW may provide increased opportunities for trappers in areas that were previously remote. As a result, trapping mortality is expected to increase for beaver and marten within the Keewatinoow Local Project Area; however, these effects will vary based on human population density in the Local Project Area and trapping/resource use activities in the area. There also may be some loss of functional habitat associated with sensory disturbances arising from recreational use (e.g., snowmobiles, ATVs) for mammals along the cleared ROW.

Additionally, increased movement of grey wolves along ROW and access road associated with the Keewatinoow Project Components following construction may occur. Wolves are therefore expected to have greater access to prey habitat as they use the ROW as a movement corridor. Associated increasing in predation on ungulates, are anticipated (Thomas, 1995; James and Stuart-Smith, 2000; Courbin et al., 2009). However, areas which are actively used are expected to be less used by wolves (Stein, 2000) than those in more remote regions, and therefore, these effects may be limited for the Keewatinoow Local Project Area.

5.5.3 Riel Converter Station

Based on analysis outline in Sections 5.1.1 to 5.1.5, the construction and operation of the Riel Converter Station is not anticipated to effect VEC mammal species, due to the fact that VEC mammal ranges and high-quality habitat do not overlap with this site.

5.5.4 Ground Electrode Sites and Right-of-Ways

Based on analysis outline in Sections 5.1.1 to 5.1.5, the construction and operation of the Southern Ground Electrode Site (SGS1c) and associated ROW is not anticipated to effect VEC mammal species, due to VEC mammal ranges and high-quality habitat do not overlap with this component. For the Northern Ground Electrode site (NES6) and ROW, VEC species anticipated to be affected by this project component include American marten, beaver, moose and wolverine. The following is a description of potential effects on VEC mammal species anticipated for the Northern Ground Electrode site and ROW.

5.5.4.1 Construction

Based on analysis described in Sections 5.1.1 to 5.1.5 a limited amount of American marten, beaver, moose and wolverine habitat will be removed or effected via the construction or the Northern Ground Electrode site and/or associated ROW ranging from 0.3 to less than 0.1 km^2, depending on species or component in question. Based on the limited amounts of habitat being removed for these species, it is anticipated that the effects of habitat removal for this component will be minimal.

Sensory disturbance due to construction, clearing, and ongoing access of the Project site by construction crews may result in short-term avoidance of the Northern Ground

Electrode site and ROW by mammals during these activities. Effects will likely be in the immediate vicinity of construction activity. The degree of avoidance will depend on the species and the frequency of vehicular traffic and is expected to vary as site preparation activity proceeds. Larger species, in particular moose, may be temporarily displaced due to disturbance and access.

With increased public access to remote areas through the use of access roads, trails, and ROWs, it is expected that the number of vehicle collisions/mammal mortality and disturbance to VEC population may increase and detour species away from active areas at a local level (Jalkotzy, 1997). Despite this, it is unlikely that these disturbances will occur so frequently as to impact local populations.

5.5.4.2 Operation

Local VEC populations may become temporarily displaced due to disturbance occurring from vehicles used in the Local Project Area for maintenance and operation activities. The nature of ground electrode operation suggests that there will be little activity following construction.

5.5.5 Sites Access Roads

5.5.5.1 Construction

Small and medium-sized mammals will be affected by habitat loss at a local level, as their home ranges are smaller than those of larger mammals such as moose. Habitat availability throughout the various ecoregions is not limiting for small and medium sized mammal populations. American marten, which tends to prefer continuous mature forest (Witmer et al., 1998), may experience greater effects than species with more general habitat requirements, such as beaver (Schrecengost, 2009). Based on the limited amounts of habitat being removed for these species for this component, it is anticipated that the effects of habitat removal will be minimal.

Sensory disturbance due to construction, clearing, and use of access roads by construction crews may result in short-term avoidance of the active Local Project Areas by mammals. Effects will likely be in the immediate vicinity of construction activity. The degree of avoidance will depend on the species and the frequency of vehicular traffic and is expected to vary as site activity proceeds along the route. Larger species, in particular moose, may be temporarily displaced due to disturbance and access. There is the potential for increased movement of grey wolves along ROWs following construction, which is anticipated to result in increased predation on elk and moose populations.

5.5.5.2 Operation

The addition and maintenance of access roads could create new opportunities for moose harvest via improved access by hunters. Additionally, improved access in some locations could result in improved subsistence harvest of wildlife. Provincial harvest management strategies are expected to be an important tool in ensuring stable game species populations. Similarly, access created by access roads may provide increased opportunities for trappers in areas that were previously more remote. As a result, trapping mortality is expected to increase for furbearer species within the Project Study area; however, these effects will vary based on human population density in the Local Project Areas and trapping/resource use activities in various areas. There also may be some loss of functional habitat associated with sensory disturbances arising from recreational use (e.g., snowmobiles, ATVs) for mammals along access roads. In addition, with increased public access to remote area via increases access roads, it is expected that the number of vehicle collisions/mammal mortality could increase and detour species away from active areas (Jalkotzy, 1997). However, it is unlikely that mammal/vehicle collisions will occur so frequently as to impact local populations. Finally, there is also potential for increased movement of grey wolves along access roads following construction, which is anticipated to result in increased predation on moose populations.

5.5.5.3 Fragmentation

No additional habitat will be lost during operations; however, fragmentation may remain an issue for species such as American marten, which generally prefer continuous mature forest (Whitmer et al., 1998). Fragmentation will be maintained along access roads through regular maintenance activities, which will keep the habitat at an early successional stage. Depending upon the degree of overlap of mammal home ranges with the transmission line, the Project will likely have a small, long-term effect on small and medium-size mammals.

5.5.6 Borrow and Borrow Deposit Sites

5.5.6.1 Construction

Some habitat loss for VEC mammal species is anticpated due to the creation of borrow and borrow deposit sites; however, given that borrow and borrow deposit sites consist of an extremely small area relative to the rest of the Project Area, it is anticipated that effects due to this project component will be minimal to nil. Additionally, it is anticipated that there will be some sensory disturbance to VEC mammal populations within the project due to ongoing access to borrow and borrow deposit sites, yet, these effects are also anticipated to be minimal. Effects will likely be in the immediate vicinity of construction activity. The degree of avoidance will depend on the species and the frequency of vehicular traffic and is expected to vary as site preparation activity proceeds.

5.5.6.2 Operation

Based on the nature and function of borrow sites, no effects are expected to arise from borrow and borrow deposit sites during the operation phase of the Project.

5.5.7 Decommissioning

It is anticipated that all components of the proposed Project are fully reversible with the application of decommissioning mitigation (removal of equipment and foundations, re-vegetation, etc.). Over time, the biophysical disruptions resulting from the Project should be outweighed by ongoing naturally occurring variation (e.g., succession, wildfire) or by human activity (e.g., agriculture).

Established procedures are available for decommissioning temporary infrastructure or facilities (e.g., borrow pits, access trails, marshalling areas, mobile construction camps, etc.) are noted as follows:

- Methods of decommissioning transmission lines will entail dismantling the structures and salvaging or disposing of all steel structure components, as well as removing and salvaging the insulators, conductors and ground wires.

- Decommissioning of ROWs involves clean-up and/or remediation to a standard commensurate with local environmental conditions including existing land use and policy with respect to future development.

- Decommissioning of marshalling yards involves the removal of all new and used equipment and materials, dismantling of any ancillary equipment or structures, and the remediation of the yard property.

Based on the longevity of the existing Bipoles I and II, the Project HVdc transmission line is expected to be in service for a minimum of fifty years. Other identified transmission facilities (i.e., northern collector lines) are also expected to have a service life of at least fifty years. In the event that transmission lines are taken out of service, specific methods and procedures for decommissioning and salvaging the structures will meet regulatory and legislative requirements.

5.6 Environmentally Sensitive Areas/Sites

The construction and operation of transmission lines pose a small potential negative impact to most mammal species and their habitats. In areas where habitats are of low sensitivity, transmission line construction and operation will typically have a small negative effect and therefore constitutes a low risk. However, where an area is considered highly sensitive, due to isolation, scarcity, or importance for breeding (i.e. dens), even a small negative effect may present a higher risk to associated mammals.

Other environmentally sensitive sites for mammals, in relation to the Project, can be described as areas where there is an increased risk of mortality due to habitat loss, increased predation, and/or hunting effort. Transmission-related mortality results can be compared to other known causes such as habitat removal, hunting, epidemic disease, predation, or motor vehicle interactions.

Finally, sensitive sites that were identified through public consultation processes, including ATK consultations, have been incorporated in the environmentally sensitive area analyses.

5.6.1 Descriptions

Sensitive sites identified during ATK interviews and the environmental effects assessment processes were mitigated for during the planning and routing phase of the Project. The following provides site descriptions and mitigation measures for any environmentally sensitive sites that may be found during the construction phase of the Project.

Sensitive sites for mammals (Table 42) are defined as habitat features that are particularly important for the maintenance of species' life functions and where these features may be highly susceptible to transmission line construction and operation activities. These habitat features specifically include bear dens and mineral licks. Although a general location for a bear denning site and mineral lick area have been identified through ATK studies, specific locations/coordinates for many of these sites have not yet been identified. Dens and mineral licks require localized and intensive search efforts. These search efforts will be conducted during the pre-Project monitoring phase of the Project.

Although wolf and wolverine denning sites were not identified through the ATK interviews, these sites have been noted through literature reviews as being environmentally sensitive. These sites may be found within the Project Area and therefore, descriptions of these environmentally sensitive sites have been included. Mitigation measures for these environmentally sensitive sites (should they be found in the construction/Project Study Area) should be appropriately applied and can be found in Table 42: Environmentally Sensitive Sites for Mammals.

5.6.1.1 Wolf Denning Sites

Wolf dens are often dug into steep banks with sandy soils, though sometimes hollow logs or beaver lodges may be used if digging areas are not available. Breeding season varies

Table 42: Environmentally Sensitive Sites for Mammals.

ESS Name	ESS Description	Environmental Effects	Mitigation Measures
Bear den	Black bear dens identified from ATK interviews.	• Habitat loss; • disturbance of animals; • den abandonment	• Establish 25 m buffer surrounding den. Vegetation shall not be removed inside buffer zone. • Establish 500 m no disturbance buffer zone around active dens during early and late denning periods. Buffer may be reduced to 250 m during mid-denning period.
Wolf den		• Habitat loss; • disturbance of animals; • den abandonment	• Establish 50 m buffer surrounding den.
Wolverine den		• Habitat loss; • disturbance of animals; • den abandonment	• Establish 100 m buffer surrounding den.
Mineral lick	Mineral lick site for ungulates identified from ATK interviews.	• Nutrient loss potential impacting health; • Disturbance of animals; • Disruption of ungulate social network	• Establish 120 m buffer (minimum) around mineral licks. • Establish buffer around ungulate trails leading to mineral lick to allow for ungulate access and movement • Schedule disturbance/construction in late fall and/or early spring when ungulate activity at mineral licks is minimal • Conduct operations during mid-day hours due since mineral licks are predominantly used at night

regionally, but generally begins between April and May depending on the latitude (Fuller, 1989). Wolves use dens both before and after pups are born and pups can be moved out of den sites as early as June or 10-20 days after birth (Ballard et al., 1987). Wolves may return to the same den year after year. Active dens can be located by air or ground tracking by observing wolf movement in an area (Ballard et al., 1987; Ciucci and Mech, 1992). Den sites are generally abandoned in July with rendezvous sites used throughout August.

There is no clear consensus as to how serious the effects of human disturbance are on denning wolves and pups. Dens have been noted to be located away from human disturbance (highway expansion, built-up areas, roads, and agricultural land), with wolves selecting non-human modified landscapes over human modified areas when available within a 1.6 to 3.2 km radius (Kohn et al., 1999; Kaartinen et al., 2010). Human disturbance has been recorded to result in natal den abandonment (Ballard et al., 1987). There is emerging evidence that the likelihood of den relocation is directly related to the duration and intensity of human disturbance (Argue et al., 2008). Shifts in den sites can result in pup mortality, though the level is low. Disturbance is not known to affect the likelihood of wolves reusing home sites in subsequent years (Frame et al., 2007; Argue et al., 2008).

The Wisconsin Department of Natural Resources recommends closing areas within 100 m of dens and also recommends restricting use in the area between 100-800 m from dens from March 1 to July 31 (Wydeven and Schultz, 1992). Michigan wolf management plans also recommend seasonally protecting a zone 100-800 m around wolf dens and rendezvous sites from timber harvesting or road or trail construction.

5.6.1.2 Wolverine Denning Sites

Three types of areas have been implicated as important to wolverine breeding. These include natal dens which are used during parturition, maternal dens which are subsequently used until the kits are fully weaned, and rendezvous sites (Magoun and Copeland, 1998). Rendezvous sites differ from maternal dens in that they are not confined to a specific site but encompass a localized area and are usually along well-used travel sites or foraging routes (Copeland, 1996)

The use of reproductive dens begins from late February to early March (Harris and Ogan, 1997). Dens consist of long, complex tunnels in soft snow often associated with fallen trees or large rocks (Magoun and Copeland, 1998). The entrance is followed by a vertical tunnel extending one to five m to ground level, where kits are found on bare soil (Harris and Ogan, 1997). The dependability of thick snow cover during the denning period is thought to be essential (Magoun and Copeland, 1998). Both maternal and natal dens have been observed to be located predominantly in snowdrifts with extensive snow tunnel systems. Den locations can be ascertained by observing and following wolverines (Copeland, 1996). Distinguishing between natal and maternal dens is time-consuming and expensive, and may cause the animals to relocate (Magoun and Copeland, 1998).

The move from a natal den to a maternal den may occur when kits are as young as two weeks old and females may move kits three or more times before they are fully weaned. Den abandonment occurs in spring when daily temperatures rise above freezing for a number of consecutive days (Magoun and Copeland, 1998).

Human disturbance, both on foot and through the use of snowmobiles, is not implicated in natal den abandonment, but has been implicated in the movement of kits from maternal dens and rendezvous sites (Magoun and Copeland, 1998). Wolverines will not move kits from natal dens unless the dens themselves are disturbed, but will quickly move from maternal dens and rendezvous sites when detecting humans, including researchers, in the general vicinity of dens (Copeland, 1996; Magoun and Copeland, 1998). Over-snow vehicles and other forms of winter recreation may displace wolverines from potential denning habitat (Copeland, 1996). Forestry developments have identified wolverine dens and established a 100 m buffer zone of no-development encircling them. Sensitive sites later identified in the field to receive the same buffer as those located during the planning stage (Millar Western Forest Products, 2008).

Wolverines also create winter food caches beneath remnant snowdrifts, in swamps, and rocky screes, as well as under boulder talus (Magoun and Copeland, 1998).

5.6.1.3 Bear Denning Sites

Many studies have expressed concern about human activity impacting bear denning sites (Mannville, 1983; Peek et al., 1987; Mattson, 1990; Goodrich and Berger, 1994; Wiiget al., 1996; Linnell et al., 2000). The only activity that has been reported in response to den disturbance is abandonment (Linnell et al., 2000), which has been shown to be a direct cause in black bear cub mortality.

Linnell et al. (2000) found that the greatest proportion of black bear den abandonments is caused by human disturbance. Human disturbances which cause the highest risk of disturbing wintering denning sites and causing abandonment include research activities, winter recreation, industrial extraction activities, road and housing construction, and hydro-electric construction.

5.6.1.4 Mineral Licks

Mineral licks are an important habitat feature vital in ungulate ecology and have been recorded to be used by caribou, moose, deer, and elk (Klaus and Schmid, 1998; Rea et al., 2004). Mineral licks are generally characterized by well used trails leading to wet muddy springs or seepage areas (Tankersley and Gasaway, 1983; Jones and Hanson, 1985; Rea et al., 2004). It is thought that ungulate animals visit licks for mineral supplementation (Couturier and Barrette, 1988; Heimer, 1988; Rea et al., 2004). These areas are predominantly used from dusk until dawn, all year long, particularly in late spring and mid-winter (Fraser and Hristienko, 1981; Tankersley and Gasaway, 1983; Couturier and Barrette, 1988; Filus, 2002).

Mineral licks are stated to be extremely sensitive to impacts from land development activities (Weeks and Kirkpatrick, 1976; Reger, 1987; Bechtold, 1996; Dormaar and Walker, 1996). Since land management and industrial activities may disturb mineral licks and consequently impact ungulates, it is recommended that protective measures for licks be integrated into land use policy (Rea et al., 2004).

5.6.2 Locations

One environmentally sensitive site for mammals in the Project Study Area has been identified to date. A black bear denning area located near the FPR in the Lake Manitoba Plain Ecoregion (near Camperville) has been identified and is shown on Map 30. Though only one sensitive site has been listed here for mammals, other sensitive habitats have been previously suggested to be associated with known geographic features, such as riparian habitats, and river and creek crossings. Mitigation measures developed for the protection of stream crossings (e.g., buffers), will also help protect habitat for species that are associated with riparian areas (e.g., moose, beaver). A listing of river and creek crossings and protection measures that are likely to minimize potential effects to riparian mammal populations and their habitats can be found in the *Aquatic Technical Report* (North/South Consultants, 2011).

5.6.3 Environmental Protection Measures

Initial protection measures for sensitive sites were established during the alternative routing process. The route crossing the fewest sensitive areas was selected. For example, of the six mineral lick areas that were identified in ATK studies, all of these sites have been avoided by the FPR. For sensitive sites that are found during construction, three primary means of mitigation are proposed:

- establishment of buffers and vegetation protection measures near sensitive features;

- construction period restrictions; and
- decommissioning of access trails.

These and other mitigation measures are discussed in more detail in Section 6.0.

5.6.3.1 Mitigation of Effects on Bear Denning Sites

Linnell et al. (2000) outlined a number of protection measures which should be adopted to protect bear denning sites. These measures include:

- identification of black bear den concentrations prior to planned activity;
- den trees or natural cavities should be protected;
- winter activity (e.g. construction) should be minimized in denning areas;
- winter activity should be confined to regular routes to minimized the area disturbed;
- activity should avoid known bear dens by at least one km; and
- research activity involving the handlings of cubs in dens may lead to extra mortality and should be avoided in small populations.

5.6.3.2 Mitigation of Effects on Mineral Licks

While some mineral licks have been identified by ATK and were subsequently mitigated for during the routing process, there is a potential for other mineral licks to be found along the ROW during the construction phase of the Project. Should mineral licks be identified along the route, mitigation measures should be used. Specific mitigation measures for mineral licks have been outlined for a several provinces in Canada including British Columbia and Ontario. British Columbia, as an example, protects mineral licks to varying degrees, based on the discretion of the local environmental authorities (Government of British Columbia, 2004). Ontario recommends a minimum buffer of 120 m around mineral licks. The Government of Ontario also recommends a site specific approach to establishing buffers around mineral lick sites, taking into consideration ungulate access and movement (Ontario Ministry of Natural Resources, 1988).

Rea et al. (2004) outlined three aspects to consider when managing for disturbance around mineral licks: (1) protection of the mineral lick site; (2) maintenance of integrity and function of hydrological system fuelling the lick; and (3) minimizing disturbance in surrounding areas during ungulate visitation times.

Buffers are normally used to mitigate disturbance to mineral lick sites. Lick protection guidelines protect mineral lick trail networks, hydrological features, and adjacent ungulate foraging sites (Wiles and Weeks, 1986; Rea et al., 2004).

If development cannot be routed away from mineral lick sites, activities and corresponding disturbance should be scheduled in late fall and/or early spring when ungulate activity at mineral licks is minimal (Tankersley and Gasaway, 1983; Couturier and Barrette, 1988; Fraser and Hristienko, 1981; Rea et al., 2004). Operations should also be carried out during mid-day hours due to the fact that mineral licks are predominantly used at night (Rea et al., 2004). Monitoring and assessment of ungulate use of mineral lick sites is important for the management of these sensitive sites.

6.0 MITIGATION

The majority of negative effects of the Project on VEC habitat and populations in the Project Study Area were mitigated for during the planning and routing process. The following section provides additional various mitigation measures recommended for the mammal VEC species (Table 43). Many of the recommendations are generic for all components of the Project and are based on professional judgment and recommendations derived from the literature reviews conducted for this report.

6.1 Construction

Pre-project monitoring activities will be required to identify some sensitive sites, improve understanding of others, and provide additional mitigation recommendations where needed. These pre-monitoring activities should include:

- local mammal population studies at locations where the route has changed;
- surveys at identified sensitive sites such as dens and mineral licks; and
- surveys around construction sites/areas to scope for sensitive sites before activities/construction occurs.

As most offspring of terrestrial mammals are born in spring (Banfield, 1987), sensory disturbance affecting denning females may be minimized by limiting clearing and other noisy construction activities during parturition. Avoiding this critical period will help to ensure avoidance of most species' parturition times, including American marten. Sensitive sites such as mammal dens should be clearly marked prior to clearing and avoided where possible. In the northern areas disturbances from construction activities will occur during winter which will avoid the sensitive parturition period near potential VEC young sites. Mitigation measures developed for the protection and management for

Table 43: Valued Environmental Component (Mammals) Summary – Environmental Effects and Mitigation

Component	Environmental Indicator	Measurable Parameter	Environmental Effect	Mitigation Measures	Residual Environmental Effect
Beaver	Habitat	Percent loss of habitat Trapping success	Decreased beaver populations	Riparian habitat protection and management Use of riparian buffers in aquatic habitat	Beaver populations maintained within the natural range of variability
Marten	Habitat	Percent loss of habitat Trapping success	Decrease marten populations	Achieved through routing, avoidance of core coniferous habitat Conduct construction during non-breeding and rearing periods Reduce public access and vehicle speeds to heavily populated to reduce disturbance Regulate public access to heavily populated moose areas Communicate with trappers, reduce marten trapping if pop. severally declining	Marten populations maintained with the natural range of variability
Wolverine	Presence/absence	Trapping statistics and aerial survey counts	Overharvest through trapping and increased access	Avoidance of range routing avoidance of known winter concentration areas Establish 100 m buffer surrounding den if found. Communicate with trappers, reduce wolverine trapping if pop. severally declining	Populations maintained with the natural range of variability
Moose	Habitat Regional and local population status	Habitat Hunting statistics Population status	Overharvest as a result of increased access. Habitat loss and fragmentation	Route project away from known moose concentrations avoidance of high density moose areas during construction period Reduce public access to heavily populated moose areas to reduce hunting Regulate public access to heavily populated moose areas Reduce public access and vehicle speeds to heavily populated moose areas to reduce disturbance Riparian management Establish 120 m buffer (minimum) around mineral licks. Increase plantation of palatable forage species in ROW	Populations maintained with the natural range of variability.
Elk	Habitat Regional and local population status	Habitat Hunting statistics Population status	Overharvest as a result of increased access. Habitat loss and fragmentation	Achieved through routing. Avoidance of high density elk areas. Access management Riparian management Establish 120 m buffer (minimum) around mineral licks. Increase plantation of palatable forage species in ROW Reduce public access to heavily populated elk areas to reduce hunting Regulate public access to heavily populated elk areas Reduce public access and vehicle speeds to heavily populated elk areas to reduce disturbance	Populations maintained with the natural range of variability.

riparian and aquatic habitats, specifically use of buffers, will aid in the protection of VEC habitats. A listing of river and creek crossings and protection measures that are likely to minimize potential effects to riparian habitats can be found in the *Bipole III Transmission Project- Aquatic Technical Report* (North/South Consultants, 2011). Wildlife can become habituated to humans, particularly around food sources. Proper storage of food and disposal of waste reduces the likelihood that coyote, red fox, black bear, raccoon, and skunk will be attracted to areas of human activity. Informing all personnel associated with the Project of the hazards of feeding wildlife and the prohibition of such activity, could reduce nuisance wildlife in and around work and camp sites. Nuisance wildlife should be reported to the local Natural Resource Officer. Concentrating clearing and construction activity in winter will also reduce encounters with black bears, as they are generally inactive during this season.

Improved access to the area by roads, trails, and the ROW could lead to an increase in mammal mortality due to hunting and/or poaching. Manitoba Hydro will maintain access control onto the Project site and cooperate with Manitoba Conservation in measures that will protect excessive harvest in the area including signage and no hunting areas during construction to protect both workers and moose. Manitoba Hydro will work cooperatively on with Manitoba Conservation include access control through joint access management plan, hunting closures (Health Safety and Workplace Act) and hunter education or information initiatives with Manitoba Conservation to reduce the effects of overharvest and wastage. Hunting by Project personnel will be prohibited and firearms restricted in work camps and limit access to access roads for the Local Project Area by hunters during construction to minimize moose mortality.

6.2 Operation

Organic material removed from temporarily cleared areas can be re-distributed to encourage re-growth of native vegetation. Post-construction re-establishment of natural vegetation communities in disturbed areas, particularly borrow areas, work sites, and rock disposal areas, may replace habitat for some mammals that was lost during construction.

Mammal dens should be clearly marked and avoided during ROW and line maintenance. Maintenance should be conducted outside of ecologically sensitive periods such as spring, when parturition of most species occurs. Use within the Project site will be limited to reduce sensory disturbances and minimize functional habitat loss. Maximizing aerial/helicopter-based line inspection and maintenance would reduce the need for ground-based inspection, reducing disturbance in the area.

Maintenance of cool microhabitats adjacent to waterbodies (typically small creeks being traversed by the ROW) that contain abundant aquatic macrophytes could include maintenance of adjacent cover or danger tree removal only. Maintenance of riparian travel corridors would also benefit other wildlife including small and medium sized mammals and in particular furbearers.

Public access for recreational purposes, particularly hunting, is understood to result in the most detrimental disturbance effects of development corridors (Jalkotzy et al., 1997). Thus, one of the best tools to reduce the effects of disturbance corridors on wildlife is access management by controlling human use of the development corridor (Jalkotzy et al., 1997). Decommissioning temporary trails can limit access to the area by resource users, decreasing wildlife mortality in the area. Additional management tools to reduce the impacts of development corridors through access management include planning activities requiring access during periods of the year when disturbance may be reduced for particularly vulnerable species (Jalkotzy et al., 1997). Manitoba Hydro will work cooperatively on with Manitoba Conservation include access control through joint access management plan, hunting closures (Health Safety and Workplace Act) and resource user education or information initiatives with Manitoba Conservation to reduce the effects of access to these areas. Use of roads by staff should be restricted to essential trips and where possible (Jalkotzy et al., 1997). In addition, limiting public access to specific roads or linear corridors via gates may work to limit public access to specific areas. Community support and awareness is necessary if these measures are to be applied in the Project Study Area. Use of public consultation periods and other sources of communication with community and resource users (e.g. mail, public service announcements) will aid in such measures.

Increased predation from wolves facilitated by their increased movement along new ROWs is another expected effect of the Project. Mitigation measures to reduce the impact of increase wolf predation on ungulate populations are limited. Such mitigation measures include actions to decrease wolf access to/number of linear corridor in the Project Study Area, such as restricting access/detouring to linear corridors in specific area with fencing. Provincial harvest management strategies that regulate trapping and hunting activities will continue to play an important role in monitoring changes and reducing effects to populations of wolves, wolverines, and other species.

6.3 Decommissioning

It is anticipated that all components of the Project will be fully reversible with the application of decommissioning mitigation measures (removal of equipment and foundations, re-vegetation, etc.). Over time, the biophysical disruptions due to the Project should be outweighed by ongoing naturally occurring variation (e.g., succession, wildfire) or by human activity (e.g., agriculture).

7.0 RESIDUAL EFFECTS

For the purpose of this report, a residual environmental effect is defined as the resultant change in the environment after the application of mitigation measures (Hegmann et al., 1999). Once constructed and in operation, the residual effects associated with the Project should be neutral in nature. Potential changes in the distribution and abundance of species due to the development of the Project and ongoing maintenance may include:

- Loss or alteration of habitat associated with the placement of permanent structures such as the transmission line, converter stations, substations, etc.;
- Loss or alteration of habitat associated with facilitating the development of permanent structures associated with Project development i.e. roads, work camps, etc.;
- Loss of important or unquie VEC habitat, specifically environmentally sensitves sites;
- Displacement of species through mechanized processes deterring species use of particular areas during initial Project construction and ongoing maintenance;
- Increased predator and human movements across the landscape as a result of the maintenance of the cleared Project ROW creating accessible linear features; and
- Additional fragmentation/reduction of connectivity in potentially high use habitat areas.

The effects of the Project on mammal species should be considered in the context of species resilience to the presence of an additional large-scale landscape features. As the Project will extend over a considerable geographic area, it is expected many potential habitat types will be lost or altered. There is no indication, however, that these habitat areas are rare or significant to the persistence of the Project VECs. Mammal populations may increase or decrease and may undergo periods of movement and migration through varying naturally occurring factors including forest fires, predator-prey cycles, and intra-specific competition for home-range areas/mating rights. While mammal species will invariably be affected by the Project, these effects are minimal in scope. A summary table (Table 44) of the residual environmental effects on the VECs can be found at the end of this section.

7.1 Beaver

The Project ROW is expected to intersect a relative small amount (2%) of overall beaver habitat existing within the Project Study Area, resulting in minimal disturbance to beaver populations. Beaver habitat removal at the population-level is not anticipated to be affected as a result of the Project. A small amount of sensory disturbance is anticipated to effect beaver, but these effects are expected to be isolated to the construction phase of the Project. New or increased access along the ROW through access roads and use of the ROW as a cleared trail is anticipated to lead only to a small increase in trapping opportunities. However, it is expected to be limited and localized to the Project Area and immediate surroundings and to have only neutral effects on the population as a whole. Overall, the Project is expected to have minimally negative to no residual effects on beaver in the Project Area. Any residual effect which may be seen here are anticipated to be not significant.

7.2 American Marten

Construction and operation of the Project is expected to have a negative residual effect on marten populations. Combined components of the Project footprint are estimated to intersect approximately 10 percent of available marten habitat within the Project Study Area, which includes clearing of overhead forest-cover. A small amount of sensory disturbance is anticipated to effect marten, but these effects are expected to be isolated to the construction phase of the Project. Given that marten avoid crossing open areas and are sensitive to effects disturbances (Forsey and Baggs, 2001) it is anticipated that the construction and clearing of forest for the Project will have a minimally negative residual effect on regional marten populations.

It is anticipated that with increases in trapper access to previously remote areas via the use of the ROW and associated access roads, that trapping and mortality of marten will also increase within the Project Area. These effects are likely to be compounded by increased public use of the ROW and associated access roads, specifically snowmobiles, ATVs, campers, and resource users such as hunters, trappers, berry pickers, and First Nations members gathering traditional plants. These effects will vary based on human population density in the Local Project Area and trapping/resource use activities in various areas of the overall Project Study Area. These disturbances are anticipated to result in marten avoiding areas along the ROW and immediately adjacent areas during disturbance periods.

Based on effects listed here, it is anticipated that the Project will have minimally negative non-significant residual effects on American marten in the Project Area.

7.3 Wolverine

Based on aerial observations, the effects of the Project on wolverine populations are expected to be minimal. The main effects of the Project on wolverine are expected to be areas with major transportation routes and disturbance from construction activities. These effects are likely to be compounded by increased public use of the ROW and associated access roads, specifically snowmobiles, ATVs, campers, and resource users such as hunters, trappers, berry pickers, and First Nations members gathering traditional plants. These activities are anticipated to result in wolverine avoidance of frequently disturbed construction and publicly accessed areas. In addition, a small amount of sensory disturbance is anticipated to effect wolverine during project construction, however this effect is anticipated to be isolated to the construction phase of the Project.

Wolverine dens are generally considered to be environmentally sensitive sites (Millar Western Forest Products, 2008). Disturbance of wolverine denning sites during the construction phase of the Project is a potential effect which must be monitored during the construction phase of the Project. Specific mitigation measures for wolverine denning sites as outlined in Section 6.0 should be adhered to.

As identified with marten and beaver, increases in trapper access to previously remote areas via ROW and associated access roads, will increase trapping and mortality of wolverines within the Project Area. These residual effects vary based on trapper activities in the Project Area, and population movement in reaction to the Project development. Therefore, some minimal negative, non-significant residual effects are expected to occur for wolverines; however, these effects may be limited to periods of disturbance and many vary based on the trapping practices within specific areas.

7.4 Moose

The loss of habitat due to the construction of the Project will have a neutral effect on moose distribution and abundance where the range of moose and the Project Area coincide. It is expected that the clearing of habitat in preparation for transmission line ROW and its associated structures will deter mammal species, including moose, from the Project Area over the short-term when construction is occurring (Kuck, 1985; Irwin, 2002; Skovlin et al., 2002). Although forested areas will be cleared for the ROW, moose habitat may become enhanced due to the presence of palatable forage species growing in the newly cleared ROW. In addition, new linear corridors increase the capability of ungulate movement which may contribute to disease and parasite transmission.

By maintaining the Project ROW, there is an increased potential for predator/prey interaction between moose and wolves. The presence of cleared ROWs may make areas inhabited by moose more accessible to human hunters. In the northern portion of the study near Gillam, the increased access into the Wier River Valley may provide additional hunting opportunity as access will be created from the existing RC 60 line, along the new ROW to the Gillam highway. This may result in an increased harvest of moose in an area that was previously remote and inaccessible.

The Project ROW may also serve as a recreational trail used by snowmobiles, ATVs, campers, and resource users such as trappers, berry pickers, and First Nations members gathering traditional plants. With the increase of human presence, it is also expected that the number of moose-vehicle collisions may also increase and detour moose away from these areas (Jalkotzy et al., 1997). These human activities and disturbances may deter moose from remaining in an area.

Based on the dual nature of the positive and negative residual effects listed here, it is anticipated that the overall residual effects of the Project on moose populations will be minimally negative to nil and not significant.

7.5 Elk

The loss of habitat due to the construction of the Project will have a neutral effect on elk distribution and abundance where the range of elk and the Project Area coincide. It is expected that the mechanized clearing of habitat in preparation for the transmission line ROW and its various components will deter mammal species, including elk, from remaining in the area over the short-term when construction is occurring (Kuck, 1985; Irwin, 2002; Skovlin et al., 2002). These movements will not be permanent and will not affect elk distribution, as the Project Area is relatively small and the surrounding habitat areas for use by elk are not considered limited or otherwise inadequate. Overall the loss of habitat potentially used by elk through the construction of the Project amounts to 1.4% of the Local Study Area in the ecoregions where elk were found. In addition, a small amount of sensory disturbance is anticipated to effect elk during project construction, however this effect is anticipated to be isolated to the construction phase of the Project. Conversely, the clearing and conversion of densely forested areas, along the Project ROW, and formation of forest-edge habitat areas may actually create browse habitat with early successional stage vegetation preferred by this species.

By maintaining the Project ROW, there is an increased potential for predator/prey interaction between elk and wolves. The presence of cleared ROW's may make areas inhabited by elk more accessible to human hunters while also serving as recreational trails used by snowmobiles, ATVs, and campers. These effects may deter elk from remaining in an area but are expected to have a neutral effect on the population as a whole.

Based on the dual nature of the positive and negative residual effects listed here, it is anticipated that the overall residual effects of the Project on elk populations in the Project will be minimally negative, but not significant.

Table 44: Value Environmental Component Residual Environmental Effect Summary Table

1. Residual Environmental Effect	VEC Species Affected by Environmental Effect	2. Direction	3. Ecological Importance	4. Societal Importance	5. Magnitude	6. Geographic Extent	7. Duration	8. Frequency	9. Reversibility	10. Significance
Small but long term loss of wildlife habitat at Transmission stations.	Beaver	Negative	Medium	Medium	Small	Local Study Area	Short Term	Sporadic/Intermittent	Reversible	Not significant
	Marten	Negative	Medium	Medium	Medium	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Wolverine	Negative	High	Medium	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Moose	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Elk	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
Alteration of wildlife habitat use on or near the ROW.	Beaver	Negative	Medium	Medium	Small	Local Study Area	Short Term	Sporadic/Intermittent	Reversible	Not significant
	Marten	Negative	Medium	Medium	Medium	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Wolverine	Negative	High	Medium	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Moose	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant

1. Residual Environmental Effect	VEC Species Affected by Environmental Effect	2. Direction	3. Ecological Importance	4. Societal Importance	5. Magnitude	6. Geographic Extent	7. Duration	8. Frequency	9. Reversibility	10. Significance
	Elk	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
Small but long term fragmentation effects in a very low proportion of the overall ROW.	Marten	Negative	Medium	Medium	Medium	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Wolverine	Negative	High	Medium	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
Increased hunting mortality due to improved access to the surrounding area via the ROW.	Moose	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Elk	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
Increased trapping mortality due to improved access to the surrounding area via the ROW.	Wolverine	Negative	High	Medium	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Beaver	Negative	Medium	Medium	Small	Local Study Area	Short Term	Sporadic/Intermittent	Reversible	Not significant
	Marten	Negative	Medium	Medium	Medium	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
Sensory disturbance due to clearing and ongoing access during construction	Beaver	Negative	Medium	Medium	Medium	Project	Medium-term	Intermittent	Reversible	Not significant
	Marten	Negative	Medium	Medium	Medium	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant

1. Residual Environmental Effect	VEC Species Affected by Environmental Effect	2. Direction	3. Ecological Importance	4. Societal Importance	5. Magnitude	6. Geographic Extent	7. Duration	8. Frequency	9. Reversibility	10. Significance
phase	Wolverine	Negative	High	Medium	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Moose	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Elk	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
Sensory disturbance due ongoing public access to Project Area (e.g. snowmobiles, ATVs, campers)	Beaver	Negative	Medium	Medium	Small	Local Study Area	Short Term	Sporadic/Intermittent	Reversible	Not significant
	Marten	Negative	Medium	Medium	Medium	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Wolverine	Negative	High	Medium	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Moose	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Elk	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
Maintenance of cleared Bipole III ROW as transportation corridor for	Moose	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Elk	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant

1. Residual Environmental Effect	VEC Species Affected by Environmental Effect	2. Direction	3. Ecological Importance	4. Societal Importance	5. Magnitude	6. Geographic Extent	7. Duration	8. Frequency	9. Reversibility	10. Significance
predators, human hunters										
Increased predation via increased movement of grey wolves along ROW	Moose	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant
	Elk	Negative	High	High	Small	Local Study Area	Medium Term	Regular/Continuous	Reversible	Not significant

8.0 CUMULATIVE EFFECTS

Cumulative effects assessment is an important step in determining the impact of anthropogenic and environmental factors on the long-term viability of the environment and its function as an ecosystem (Hegmann et al., 1999). The *Cumulative Effects Assessment Practitioners Guide* (Hegmann et al 1999) defines cumulative effects as "changes to the environment that are caused by an action in combination with other past, present and future human actions." For the purpose of this report, cumulative effects will be examined in reference to spatial and temporal effects of past, current, and future projects/developments on VEC/VEC linkage species, on the landscape.

Cumulative effects associated with the Project transmission line structures are anticipated to include electrical effects (EMF), visual disturbance, loss of wildlife habitat, forest resources, and increased access (Wuskwatim Transmission EIS, 2003). Some of the effects identified (e.g., EMF and visual disturbance) are effectively limited to the immediate environs of the ROWs and sites (Wuskwatim Transmission EIS, 2003). Cumulative effects identified as more significant, occurring at a boarder, regional scale, such as wildlife habitat loss and increased access. Such effects are discussed here.

Dating back as far as 1958, there are various activities that have been undertaken within the Project Study area which may contribute to cumulative effects of the Project. These endeavors include forestry activities conducted by *Tolko Industries Ltd.* and *Louisiana-Pacific Canada Ltd.*, mining activities conducted by Crowflight Minerals Inc., HudBay Minerals Inc., San Gold Corporation, Tantalum Mining Corporation of Canada, Ltd., and Vale and the Wuskwatim Transmission Project conducted by Manitoba Hydro. It is anticipated that some, if not all, of these activities will continue to occur on the landscape, thus contributing to the potential cumulative effects on listed VEC/VEC linkage species. Given their intensive nature, these activities are also used as the spatial components for cumulative effects.

8.1 Other Projects In/Around the Project Study Area

Several projects may have the potential to contribute to cumulative effects in the Project Study Area. A summary of potential cumulative effects identified for wildlife populations existing in and surrounding the Project Study Area are indicated below:

8.1.1 Tolko Industries Ltd.

Manitoba first entered into Forest Management License (FML) Agreement 2 with Repap Manitoba Inc. in 1989. Forest Management License Agreement 2 and associated operations were transferred to Tolko in 1996. Tolko's forest management license (FML) area overlaps with the Churchill River Upland, Hayes River Upland, and Mid-Boreal

Lowlands Ecoregions. Tolko's forest management activities have been stated to have trans-boundary effects on wildlife, most notably on wide ranging species such as migrant birds, moose, and woodland caribou (Tolko Industries Ltd. - Forest Management, 2011). Effects of Tolko's activities on wildlife are identified as avoidance of areas of disturbances and avoidance of clear-cut areas (Tolko Industries Ltd. Forest Management, 2011). Adherence to practices and strategies defined in Tolko's Forest Management Plan (FMP) have been stated as adequate methods of management and mitigation for the these effects; however, cumulative effects of this project may not have been considered (Tolko Industries Ltd. Forest Management, 2011).

8.1.2 Louisiana-Pacific Canada Ltd.

Louisiana-Pacific (LP) entered into FML Agreement # 3 with the province of Manitoba in 1994, with LP beginning its operations in FML area 3 in 1996. Louisiana-Pacific's (FML) area overlaps with the a number of ecoregions, including the Mid-Boreal Uplands, Mid-Boreal Lowlands, Interlake Plain, and Lake Manitoba Plain Ecoregions. Louisiana-Pacific (LP) has identified the following environmental effects through their latest FMP as having potentially significant negative impacts in forest FML area 3 (Louisiana-Pacific Canada Ltd. Forest Management Plan, 2010).

Louisiana-Pacific has stated that its forestry practices are anticipated to have a negative effect on wildlife populations within its FML. Wildlife species that require old growth or late-seral stage forest are anticipated experience a reduction in available habitat. Such species include woodland caribou.

Minor forest fragmentation may result in a reduction of some wildlife species' populations. Marten habitats are anticipated to be reduced via avoidance of cleared forest areas, thus causing a reduction in marten populations and as a result, trapper income.

In addition to the potentially negative effects identified, LP also identified a number of possible residual effects (Louisiana-Pacific Canada Ltd. Forest Management Plan, 2010). LP stated that they are unclear whether any big game habitat created through the implementation of the FMP will result in net wildlife population increases. LP also stated that the habitat requirements of many of the wildlife species found in the study were unknown and therefore the effects of the FMP on these species were uncertain. In addition, the response of many classes of wildlife and vegetation to the mitigation measures outlined in the 2010 Annual Operating Plan have been determined to be unpredictable and therefore, wildlife response to these mitigation measures cannot be speculated with accuracy due to lack of data. It is unclear whether the habitat altered by the forest management plan will result in any net benefit to wildlife populations (specifically elk, moose, or deer) due to the potential development of browsing habitat. Another uncertain effect identified in LPs EIS is the extent of impacts on woodland caribou via increased softwood harvest levels, particularly in Swan Pelican Provincial Forest. Monitoring of caribou populations must be conducted in order to further understand these potential effects.

8.1.3 Wuskwatim Transmission Project

It is stated that the Wuskwatim Transmission Project will result in a minor loss of wildlife habitat during the course of ROW construction and fragments/removal of forested areas (Wuskwatim Transmission Project, 2003). The potential residual effects on wildlife habitat are stated to be minor in context of local areas and ecodistricts (Wuskwatim Transmission Project, 2003). These effects are expected to be minimal with the implementation of mitigation measures and the preparation of an environmental protection plan (Wuskwatim Transmission Project, 2003).

8.1.4 Mining

There are a number of mining operations currently active in Manitoba (Table 45). HudBay Minerals has also approved construction for the Lalor Mine (Snow Lake, Manitoba), with first production expected by 2012 and full production expected in late 2014.

Activities occurring within and around the immediate Project Area involve prospecting exploration, drilling, exploration, access roads, camps, and the establishment of mine sites. These activities result in the clearing of forested areas for activities/camp/construction sites and the creation of access roads. Activities associated with the mining exploration phase are covered off under a general permit issued by the Manitoba Conservation, with no EIS required to be submitted until the mine is ready to fully operate and extract (Manitoba Conservation, 2011). Mining related activities also create high level of disturbance, causing avoidance of terrestrial and avian species in the area (Weir et al., 2007).

Potential impacts of the mining activities within the Project Area have been stated to include clearing/disturbance of forested areas, noise disturbance (ventilation fans, generators and human activity), surface vibrations/noise related to underground blasting, waste disposal, and increased public access to previously remote areas (Bucko Mines EIS, 2004).

Table 45: List of Mining Companies Currently Operating in Manitoba (As of April 2011)*

Company	Mine	Location	Date Opened	Major Metals/Minerals Mined
Crowflight Minerals Inc.	Bucko Lake Nickel Mine	Wabowden	2009	nickel
HudBay Minerals Inc.	Trout Lake Mine	Flin Flon	1982	copper, zinc
	Chisel North Mine	Snow Lake	1998	copper, zinc
	777 Mine	Flin Flon	2000	copper, zinc
San Gold Corporation	Rice Lake Gold Mine	Bissett	2006	gold
	Hinge Mine	Bissett	2009	gold
Tantalum Mining Corporation of Canada, Ltd.	Tanco Mine	Lac du Bonnet	1969	spodumene, pollucite
Vale	Thompson mine T1 & T3	Thompson	1958	nickel, copper
	Birchtree Mine	Thompson	1968	nickel, copper

*Table from the Government of Manitoba's Innovation, Energy and Mines website. Accessed April 2011

8.2 Potential Cumulative Effects on Wildlife Within the Project Area

As demonstrated above, the majority of large scale resource related activities result in the wildlife avoidance of the cause of disturbance, whether the disturbance is the removal of forest, construction, or an increase in public access.

Anthropogenic activities involved in clearing forest (deciduous, coniferous, and mixedwood) areas will reduce the amount of usable elk, moose, wolverine, marten and to a lesser extent beaver habitat in the Project Area. This could include the clearing of forests through Tolko and LP's forestry activities in the Hayes River Upland, Interlake Plain and Mid-Boreal Lowland Ecoregions, and clearing of land for community developments, roads, mining and other infrastructure projects in all ecoregions. Effects of habitat removal many vary in degree from species to species, but overall the cumulative effect is anticipated to be negative.

As a result of habitat removal, habitat fragmentation is anticipated to affect species which have large home ranges, such as moose and elk. In addition, species which avoid cleared areas, such as marten, will also be strongly affected by habitat fragmentation. Activities involving clear-cutting and creation of roads (e.g. forestry and mining operations) are anticipated to strongly contribute to these effects. A small but long term cumulative effect from fragmentation is expected in the Project Area.

Increased public access is a negative cumulative effect anticipated with the Project. Cumulative effects include sensory disturbance via snowmobiles, ATVs, campers, hikers, trappers, and hunters, gaining access to wilderness areas previously difficult to access. The anticipated result of this effect is wildlife avoidance of heavily used wilderness areas. These effects will be further compounded by the mortality of wildlife due to trapping and hunting activities taking place in the Project Area. Access management and provincial harvest management strategies that regulate hunting will play an important role in monitoring changes in mammal population numbers and status. It is not expected that residual effects from the Project will interact or supplement cumulative effects currently existing from other development projects within the Project Study Area.

Regional planning for creation of access roads and lowering speed limits in active wildlife areas have been previously shown to reduce number of wildlife-vehicle collisions (Jalkotzy et al., 1997). It is also suggested that in relation to wildlife-vehicle collisions, construction crews vehicles should move in a convoy to reduce the chances of wildlife-vehicle collisions.

Ungulates in western Manitoba are often the subject of parasites and viruses. New linear corridors increase the capability of ungulate movement which may contribute to disease and parasite transmission. Monitoring disease by testing elk, moose, and deer may act as a method of monitoring the movement and transmission of disease and parasites.

Climate change conditions may include wetter spring seasons and drier, hotter summer seasons which could negatively impact elk and moose through ecosystem level changes in the food web and the availability of forage items. Milder winters may, however, benefit these year-round residents in limiting winter-kill mortality.

Grey wolf use of linear corridors for predation has been well documented by numerous authors. Linear corridors allow wolves to travel more efficiently and quickly. Linear corridors potentially influence wolf travel routes, their distribution, and wolf-prey contacts and interactions (Thomas, 1995; James and Stuart-Smith, 2000; Courbin et al., 2009). Linear corridor development in remote regions allows for increased access into formally remote habitat, thus increasing predation efficiency. Habitat alteration which provides increased access of predators into previously safe places for ungulate species makes searches for prey easier and increases the numbers of other ungulate species options for predation (Thomas, 1995; James and Stuart-Smith, 2000). The development of new linear corridors through clear cutting for forestry operations, development of access roads for prospect mining, or the development of the ROW for the Project will ultimately contribute to the increase in wolf movement and predation rate of prey species within the Project Area and surrounding area.

9.0 FOLLOW-UP/MONITORING

The purpose of follow-up is to verify the accuracy of environmental assessments and determine the effectiveness of mitigation measures (Hegmann et al, 1999). Follow-up is normally recognized as monitoring and the establishment of environmental management measures (Hegmann et al, 1999).

Follow-up monitoring is employed in cases where there is uncertainty about the effectiveness of the mitigation measures for a cumulative effect, or in cases where a cumulative effects assessment is based on a new and/or innovative approach (Hegmann et al, 1999). Given several cumulative effects are anticipated to occur with mammals within the Project Study Area, the following monitoring measures may apply.

In order to assess the potential cumulative effects the Project may have on mammal species, Manitoba Hydro, in collaboration with Manitoba Conservation and Joro Consultants Inc., are engaged in a series of mammalian monitoring programs. Data generated from annual surveys conducted by Manitoba Conservation on mammal species across all GHA's in the province are analyzed to assess changes in mammalian population size and their distribution over time. Winter aerial inventories for big game and furbearer species, hunter questionnaires (mail-out), biological specimen collection, and population simulation (Manitoba Wildlife and Ecosystem Protection Branch, 2011) are some of the strategies adopted to acquire valuable information used to assess the cumulative effects the Project may have on mammal species. Additionally, MB Hydro has employed Joro Consultants Inc. to conduct further extensive mammal monitoring programs which include winter mammal track surveys (3.0), trail camera studies (Section 3.0), caribou and wolf monitoring programs. See *Bipole III Transmission Project-Caribou Technical Report* (Joro, 2011), and the pilot furbearer trapping monitoring project (report to be submitted in June 2011). MB Hydro, through these ongoing monitoring efforts and collaborative partnerships foster a better understanding of the potential cumulative effects the Project may have on mammalian populations.

Additionally, monitoring trapping activities in and around the Project Area will aid in understanding mammalian responses to ROW construction and maintenance. Should a sharp decline in furbearer species be observed (such are marten, wolverine and their associated prey species), management options such as minimizing or restriction of trapping of declining species for a period of time to allow for recovery could be utilized (Jalkotzy et al., 1997). Monitoring activity should include investigating hunter harvest in and around the Project Area including the adjustment of tag allowances should a decline be seen in large game species.

As of April 2011, a new pilot program for monitoring and removing problem beaver populations in the province was announced by Manitoba Conservation. This beaver monitoring and management program will occur in the mid-central western region and the mid-central Interlake region. Collaborative efforts with MB Conservation should be taken on to assess the data generated from this new pilot program which will provide information regarding beaver populations and habitat use in Manitoba.

Future monitoring of areas experiencing heavy vehicle traffic for incidences of wildlife-vehicle collisions, particularly involving large game species (such as moose, elk, deer, caribou, bear) should be done. Adaptive management strategies should be adopted, such as the reduction of speed limits or a restriction placed on public use of access roads if wildlife-vehicle collision incidences increase (Jalkotzy et al., 1997).

In order to aid in the prevention of the spread of disease and parasites, such as bovine tuberculosis and *P. tenuis* (brain worm), sampling and monitoring of ungulate species could be undertaken.

The collaborative partnerships between regional planning authorities and the proponent will continue to be important for the future success of monitoring efforts. Additionally, coordination and communication with the public regarding monitoring programs and the potential effects of the Project on mammal populations should be used wherever feasible. Use of public consultation sessions, email-out questionnaires, and individual consultations with key resource users (such as First Nations, trappers, hunters, campers etc.) will provide valuable feedback and assist with effective monitoring of mammal movement and response to the Project. First Nations trappers and hunters could be consulted through personal interviews and/or email-out/mail-out survey for ATK with regard to mammal populations in the area. Information gathered through these means should be including in developing adaptive management measures.

10.0 CONCLUSIONS

10.1 Valued Environmental Components

Seven mammal VEC species were identified for Project Study Area. These included the following:

- Ungulates – boreal woodland caribou, coastal and barren-ground caribou, moose and elk.
- Furbearers – American marten, beaver, wolverine.

Grey wolf were also considered in this report as a VEC linkage species due to their influences and interaction with ungulate population dynamics in Manitoba. Given their threaten status in Manitoba and public interest, boreal woodland caribou, coastal and barren-ground caribou were reported on in their own separate report. See *Bipole III Transmission Project- Caribou Technical Report* (Joro, 2011).

For each VEC, the existing environment, historical data, habitat use, possible environmental effects arising from the Project, mitigation measures to offset possible environmental effects, and possible residual and cumulative effects arising from the Project were identified (where applicable).

10.2 Environmental Effects/Mitigation Measures

Potential environmental effects were identified for VEC mammal species within the Project Study Area. Potential effects included: VEC habitat loss and alteration; sensory disturbance due to construction, ongoing maintenance and access; habitat fragmentation; increased ungulate hunting; increased furbearer trapping; increased disturbance to mammals via increased ATV/snowmobile use along transmission line ROWs; possible increased disease transmission in ungulates; and increased wolf predation on ungulates.

A description of mitigation measures were outlined for each VEC and possible environmental effects associated with VECs. It is anticipated that if the recommended mitigation measures are implemented by Manitoba Hydro, there will be minimal to no effect of environmental effects on VEC mammal species existing within and around the Project Study Area.

Based on the environmental effects described here, it is anticipated that there will be no significant residual, irreversible effects of the Project on American marten, beaver, wolverine, moose or elk. Based on other projects and activities planning to occur in and around the Project Study Area, some possible cumulative effects on VEC mammal species were identified in this report. Possible cumulative effects on VEC mammal species were identified to mainly arise via habitat removal/alteration, habitat fragmentation, sensory disturbance, increased ungulate predation via increase wolf movement along linear corridors, and increased mammal mortality via hunting and trapping. Severity of these cumulative effects cannot be fully measured due to unknown response of wildlife to these activities and the unknown degree of spatial/temporal scales of activities which may occur within and around the Project Study Area.

10.3 Environmentally Sensitive Sites

Based on academic review, potential environmentally sensitive sites for mammals were identified as wolf denning sites, wolverine denning sites, bear denning sites and ungulate mineral licks. Of these potential environmentally sensitive sites, bear denning areas and mineral licks were identified as environmentally sensitive sites for the Project from ATK interviews; however, only general locations and no specific sites were identified for these sensitive sites. Once more specific sensitive site locations were identified, these environmentally sensitive areas were mitigated for during the planning and routing process.

Should environmentally sensitive sites be discovered during the construction phase of The Project, mitigation measures outlined in Section 5.6.3 – Environmental Protection Measures – are recommended to be applied in conjunction with provincial regulation.

10.4 Follow-up/Monitoring

Recommended mammal monitoring and follow-up activities will occur pre and post clearing and construction, and during operation and maintenance phases of the project. It is recommended that monitoring be conducted for environmentally sensitive sites identified in this report (bear denning site) and surveying continue pre and post construction to monitor for new environmentally sensitive mammal sites within the Local Project Area. Project components associated with potential environmental effects on mammal populations will be monitored for significant or unexpected changes in mammal populations.

The monitoring of the Project Components at varying phases of the Project lifespan will provide management data on the effectiveness of the mitigation measures identified and allow for adaptive management of mammal populations within the Project Study Area. Coordination and monitoring for mammal populations will occur in conjunction and cooperation with Manitoba Conservation, in consultation with the public and First Nations (where appropriate). The assessment of VEC mammal species will occur for the duration of the monitoring period as determined by Manitoba Hydro.

10.5 Data Sources/Limitations

Some limitations and gaps were identified for the data sources used for analysis of VEC mammal species use of habitat in the Project study area.

Some portions of the FPR were identified and finalized after the mammal studies had been conducted. The lack of data for this relatively small portion of the route is considered a gap for the mammal assessment and should be followed up with monitoring in these specific areas. Implications of these gaps/deficiencies are generally considered to be minor given these areas will be surveyed prior to clearing of the ROW. The use of mammal aerial surveys conducted to date provided flexibility for routing purposes within a surveyed area, and consequently some sections of the FPR which previously were not identified have already been surveyed as they still fell within the assessment area.

Regarding pre-construction surveying and monitoring, two types of access-related issues were encountered: 1) Permission was required to access privately owned land, which was not always granted; 2) Some remotely located sites could not be accessed effectively for assessment purposes. The largest gap related to access privately owned land occurred along the southern portion of the route, from Winnipeg to the Assiniboine River and was primarily related to summer and winter tracking surveys. The gaps/deficiencies related to private land access are considered minor, as they occur on privately owned land, a large portion of which is agricultural and are generally expected to be affected by the construction and operation of the project.

Site specific surveys for dens and mineral licks will be conducted prior to the clearing of the ROW, and as such, the gaps are considered minor.

10.6 Outstanding Information Requirements

The following outlines outstanding information requirements for the Project on mammal VEC species.

Due to the geographical expanse of the Project Study Area and the variability of both habitat based and species specific data, there are limitations to some of the data used in this technical report. Spatial data are limited in some of the northern study areas. The LCCEB was seen as an appropriate and consistent data set for evaluating habitat; however, FRI data was used in some cases to augment the LCCEB where data were available. Species specific data acquired from government and non-government sources were also used; however, these data were also not consistent across the Project Study Area. Field studies were conducted to supplement, and in some cases, provide the only base line data available. The approach to modeling VEC habitat, validated through field studies, is considered to be acceptable for the assessment undertaken for the Project EIS.

Some sections of the FPR were identified only after the mammal studies had been conducted. The lack of data at these new locations for a portion of the route may result in a small gap for the mammal assessment in these areas; however, the implications for gaps/deficiencies related to re-routing sections are expected to be minor given these areas will be surveyed prior to clearing of the ROW.

Methodologies for some preliminary analyses reported here are currently being refined based on initial results and the accumulating bank of survey data. These analyses will continue to be developed further in conjunction with long term monitoring studies.

Sensitive sites that are currently listed here (dens and mineral licks) were not specifically inventoried during surveys, but rather noted during ATK interviews. Site specific surveys for dens and mineral licks will be conducted prior to the clearing of the ROW, and as such, the gaps are considered minor.

11.0 REFERENCES

Aidnell, L. 2006. Assessment of corridors for movement of Grey wolf (*Canis lupus*) across rural land between two protected parks in south western Manitoba, Canada. M.Sc. Thesis. Natural Resource Institute, University of Manitoba: pp. 160.

Alexander, S. M., P.C. Paquet, T.B. Logan, and D.J. Saher. 2005. Snow-tracking versus radiotelemetry for predicting wolf-environment relationships in the Rocky Mountains of Canada. *Wildlife Society Bulletin*, *33*(4): pp. 1216-1224.

Anderson R.C. 1972. The ecological relationships of meningeal worm and native cervids in North America. *Journal of Wildlife Diseases, 8*: pp. 304-310.

Anderson, D. R., J.K. Laake, B.R. Crain, and K.P. Burnham. 1979. Guidelines for line transect sampling of biological populations. *The Journal of Wildlife Management, 43*(1): pp. 70–78.

Argue, A. M., K.J. Mills, and B.R. Patterson. 2008. Behavioural response of eastern wolves (Canis lycaon) to disturbance at homesites and its effects on pup survival. *Canadian Journal of Zoology, 86*(5): pp. 400-406.

Aznar, J.-C. and A. Desrochers. 2008. Building for the future: Abandoned beaver ponds promote bird diversity. *Ecoscienc*e, *15*: pp.250-257.

Ballard, W. B., J.S. Whitman, and C.L. Gardner. 1987. Ecology of an exploited wolf population in south-central Alaska.*Wildlife Monographs, 98*: pp.3–54.

Banfield, A.F.W. 1987. The Mammals of Canada. University of Toronto Press. Toronto, ON. 438 pp.

Bangs, E.E., S.A Duff, and T.N. Bailey. 1985. Habitat differences and moose use of two large burns on the Kenai Peninsula, Alaska. *Alces*, *21*: pp. 17-35.

Barnes, D.M. and A.U. Mallik. 1997. Habitat factors influencing beaver dam establishment in a northern Ontario watershed. *The Journal of Wildlife Management, 61*: pp. 1371-1377.

Bechtold, J. P. 1996. Chemical characterization of natural mineral springs in northern British Columbia, Canada. Wildlife Society Bulletin *24*: pp. 649-654.

Bergman E.J., R.A. Garrott, S. Creel, J.J. Borkowski, R. JaVe, F.G.R. Watson. 2006 Assessment of prey vulnerability through analysis of wolf movements and kill sites. *Ecological Applications 16*: pp. 273–284.

Block, W.M., M.L. Morrison, J. Verner, P.N. Manley. 1994. Assessing wildlife-habitat-relationships models: a case study with California oak woodlands. *Wildlife Society Bulletin, 22*(4): pp. 549-561.

Bloomquist, C.K. and C.K. Nielsen. 2008. Demography of unexploited beavers in southern Illinois. *Journal of Wildlife Management*, *74*: pp. 228-235.

Bookhout, T.A. (ed.) 1996. *Research and Management Techniques for Wildlife and Habitats.* The Wildlife Society, Bethesda, Maryland: pp. 740

Boyd, D.K., R.R. Ream, D.H. Pletscher, and M.W. Fairchild. 1994. Prey taken by colonizing wolves and hunters in the Glacier National Park area. *Journal of Wildlife Management*, *58*(2): pp. 289-295.

Brook, R.K. 2007. Elk – agricultural conflicts in the Greater Riding Mountain ecosystem: building bridges between the natural and social sciences to promote sustainability. Ph.D. dissertation. University of Manitoba, Department of Environment & Geography, Faculty of Graduate Studies, University of Manitoba.

Burt, W.H. and R.P. Grossenheider. 1980. Peterson Field Guide to Mammals. Houghton Mifflin Company. Boston, MA.

Buskirk, S.W., and L.L. McDonald. 1989. Analysis of variability in home-range size of the American Marten. *The Journal of Wildlife Management*, *53*(4):997-1004.

Canada Wildlife Act. 1985. (R.S., 1985, c.W-9) [online]. Available at http://laws.justice.gc.ca/eng/W-9/page-1.html. [Accessed March 22, 2010].

Chapin, T.G., D.J. Harrison, and D.M. Phillips. 1997. Seasonal habitat selection by marten in an untrapped forest preserve. *Journal of Wildlife Management*, *61*(3): pp. 707-717.

Chranowski, D.J. 2009. Cow elk ecology, movements and habitat use in the Duck Mountains of Manitoba. M.ES. Department of Environment & Geography, Faculty of Graduate Studies, University of Manitoba.

Ciucci, P., and L.D. Mech. 1992. Selection of wolf dens in relation to winter territories in Northeastern Minnesota. *Journal of Mammalogy*, *73*(4): pp. 899-905.

Clark, T. W., Anderson, E., Douglas, C., & Strickland, M. (1987). Martes americana. *Mammalian Species*, *289*: pp. 1-8.

Clevenger, A. P., Wierzchowski, J., Chruszcz, B., & Gunson, K. (2002). Identifying wildlife habitat linkages and planning mitigation passages. *Conservation Biology*, *16*(2): pp. 503-514.

Cooperrider, A.Y., R.J. Boyd and H.R. Stuart, eds. 1986. Inventory and monitoring of wildlife habitat. U.S. Dept. Inter., Bur. Land Manage. Service Center. Denver, Co. xviii: pp. 858

Copeland, J. P. 1996. Biology of the Wolverine in Central Idaho. M.Sc. Thesis. Wildlife Resources: University of Colorado. Pp. 152

Corn, J.G., and M.G. Raphael. 1992. Habitat characteristics at marten subnivean access sites. *The Journal of Wildlife Management*, *56*(3): pp. 442-448.

Courbin, N., D. Fortin, C. Dussault, and R. Courtois. 2009. Landscape management for woodland caribou: The protection of forest blacks influences wolf-caribou co-occurrence. Landscape Ecology. *24*: pp. 1375-1388.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2002. COSEWIC assessment and update status report on grey fox *Urocyon cinereoargenteus interior* in Canada. Committee on the Status of Endangered Wildlife in Canada [online]. Available at http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_grey_fox_e.pdf. [Accessed March 25, 2011].

COSEWIC. 2003. COSEWIC assessment and update status report on the wolverine *Gulo gulo* in Canada [online]. Available at http://www.sararegistry.gc.ca/document/dspText_e.cfm?ocid=486.

Cumberland, R.E., J.A. Dempsey, and G.J. Forbes. 2001. Should diet be based biomass? Importance of larger prey to the American Marten. *Wildlife Society Bulletin*, *29(4*): pp. 1125-1130.

Curtis, P.D., and Jensen, P.G. 2004. Habitat features affecting beaver occupancy along roadsides in New York State. *The Journal of Wildlife Management*, *68*(2): pp. 278-287.

Dalerum, F., B. Shults, K. Kunkel. 2008. Estimating sustainable harvest in wolverine populations using logistic regression. *The Journal of Wildlife Management*, *72*(5): pp.1125-1132.

Doerr, J.G. 1983. Home range size, movements and habitat use in two moose, *Alces alces,*populations in southeastern Alaska. *Canadian Field-Naturalist, 97* (1): pp.

79-88.

Dormaar, J. F., and B. D. Walker. 1996. Elemental content of animal licks along the eastern slopes of the Rocky Mountains in southern Alberta, Canada. Canadian Journal of Soil Science *76*: pp. 509

Dubois, J. E., & Monson, K. M. (2007). Recent distribution records of the little brown bat, Myotis lucifugus, in Manitoba and northwestern Ontario. *Canadian Field-Naturalist*, *121*: pp. 57-61.

Ecological Stratification Working Group. 1995. A National Ecological Framework for Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research and Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch, Ottawa/Hull. Report and national map at 1:7500 000 scale.

Edwards, T.C., E.T. Deshler, D.Foster, G.G. Moisen. 1996. Adequacy of wildlife habitat relation models for estimating spatial distributions of terrestrial vertebrates. *Conservation Biology*, *10*: pp. 263–270.

Environment Canada. 2000. Ecological assessment of the Boreal Shield Ecozone. Minister of Public Works and Public Services Canada. Ottawa, ON: pp. 90

Environment Canada. 2008. Scientific review for the identification of critical habitat for woodland caribou (*Rangifer tarandus caribou*), Boreal population, in Canada, August 2008. Environment Canada. Ottawa, ON: pp. 72. plus appendices.

ESRI 2011. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute.

Filus A. and L. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology. *6(1*): pp. 11.

Flynn, R.W., and T.V. Schumacher. 2009. Temporal changes in population dynamics of American Martens. *Journal of Wildlife Management*, *73*(8): pp. 1269-1281.

Frair J.L., E.H. Merrill, D.R. Visscher. D. Fortin, H.L. Beyer, and J.M. Morales. 2005. Scales of movement by elk (*Cervus elaphus*) in response to heterogeneity in forage resources and predation risk. *Landscape Ecology 20*: pp. 273–287.

Fritts, S.H. and L.D. Mech. 1981. Dynamics, movements, and feeding ecology of a newly protected wolf population in northwestern Minnesota. *Journal of Wildlife ManagementMonograms 45*: pp. 80

Fuller, T. K. 1989. Denning Behavior of Wolves in North-central Minnesota. *AmericanMidland Naturalist, 121*(1): pp. 184-188.

Gasaway, W. C., S. D. DuBois, D. J. Reed, and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Biological Papers University of Alaska, Fairbanks. No. 22.

Gese, E.M., and L.D.Mech. 1991. Dispersal of wolves (*Canis lupus*) in northeastern Minnesota, 1969-1989. *Canadian Journal of Zoology 69*: pp. 2946-2955.

Goodrich, J. and Berger, J. 1994. Winter recreation and hibernating black bears, *Ursus americanus*. Biological Conservation. *67:* pp. 105-110

Goulden, Herb. 1981. *The White-Tailed Deer in Manitoba.* Manitoba Natural Resources.

Hargis, C.D., J.A. Bissonette, and D.L. Turner. 1999. The influence of forest fragmentation and landscape pattern on American Martens. *Society*, *36*(1): pp. 157-172.

Harris, J. E., and C.V. Ogan. 1997. Mesocarnivores of Northern Californial Biology, Management, & Survey Techniques. Mesocarnivores of Northern California: Biology, Management, & Survey Techniques Workshop (p. 127). Arcata, CA: University of Berkeley, The Wildlife Society, California North Coast Chapter.

Hagan, J.M., Vander Haegen, W.M., and McKinley, P.S. 1996. The early development of forest fragmentation effects on birds. Conserv. Biol. *10:* pp. 188–202.

Heinemeyer, K.S., B.C. Aber, and D.F. Doak. 2001. Aerial surveys for wolverine presence and potential winter recreation impacts to predicted wolverine denning habitats in the southwestern Yellowstone ecosystem. GIS/ISC Laboratory, Dept. of Environmental Studies, University of California, Santa Cruz. 21pp. Web site: http://gis.ucsc.edu/Projects/gulo2000/gulo2000.htm [accessed January 2011].

Hegmann, G., C. Cocklin, R. Creasey, S. Dupuis, A. Kennedy, L. Kingsley, W. Ross, H. Spaling, and D. Stalker. 1999. Cumulative effects assessment practitioners guide. Prepared by AXYS Environmental Consulting Ltd. and the CEA Working Group for the Canadian Environmental Assessment Agency. Hull, Quebec. Pp. 143

Hodgman, T.P., D.J. Harrison., D.D. Katnik, and K.D. Elowe. 1994. Survival in an intensively trapped marten population in Maine. *The Journal of Wildlife Management*, *58*(4): pp. 593-600.

Hood, G.A, and S.E. Bayley. 2008. The effects of high ungulate densities on foraging choices by beaver (*Castor canadensis*) in the mixed-wood boreal forest. *Canadian Journal of Zoology*, *86(6*): pp. 484-496.

Houts, M.E. 2000. Modeling grey wolf habitat in Northern Rocky Mountains using GIS and logistic regression. Thesis. University of Kansas, Lawrence. USA.

Høymork, A., and E. Reimers, E. 2002. Antler development in reindeer in relation to age and sex Rangifer. *Rangifer*, *22*(1): pp. 75-82.

International Association of Fish and Wildlife Agencies(IAFWA). 2005. Potential Costs of Losing Hunting and Trapping as Wildlife Management Methods. Animal Use Issues Committee. Washington, DC.

Irwin, L.L. 2002. Migration. *North American elk: ecology and management*. Eds. D.E. Towell and J.W. Thomas. Smithsonian Institute Press. Washington, DC, USA.: pp. 493-513

Jalkotzy, M.G., P.I. Ross, and M.D. Nasserden. 1997. *The effects of linear developments on wildlife: A review of selected scientific literature*. Prepared for Canadian Association of Petroleum Producers, Calgary: pp. 1-354.

James, A.R.C. and A.K. Stuart-Smith. 2000. Distribution of Caribou and Wolves in Relation to Linear Corridors. *The Journal of Wildlife Management*. *64(1*): pp. 154-159

Jones, J.K. Jr., D.M. Armstrong, and J.R. Choate. 1985. Guide to mammals of the Plains states. University of Nebraska Press. Lincoln, NE. pp. 371

Joro Consultants Inc. 2011. Bipole III Caribou: Technical Report. Prepared for MMM Group and Manitoba Hydro. Winnipeg, MB.

Kaartinen, S., M. Luoto, and I. Kojola. 2010. Selection of den sites by wolves in boreal forests in Finland. *Journal of Zoology, 281*(2): pp. 99-104.

Katnik, D.D., D.J. Harrison, and T.P. Hodgman. 1994. Spatial relations in a harvested population of marten in Maine. *Journal of Wildlife Management*, *58(4*):600-607.

Klaus, G., and B. Schimd. 1998. Geophagy at natural licks and mammal ecology: a review. Mammalia *62*: pp. 481-497.

Koehler, G.M., and M.G. Hornocker. 1977. Fire effects in the on marten habitat Selway-Bitterroot wilderness.*Journal of Wildlife Management, 41*(3): pp. 500-505.

Kohn, B. E., Friar, J., Unger, D., Gehring, T., Shelley, D., Anderson, E., & Keenlance, P. (1999). *Impacts of a Highway Expansion Project on Wolves in Northwestern Wisconsin - Preliminary Findings* pp. 14

Kowalchuk, M., L. Schaldemose and J. Sveinson. 2000. Biodiversity inventory of Alonsa Wildlife Management Area and Alonsa PFRA Community Pasture. Technical Report No. 2000-05W. Wildlife Branch, Manitoba Conservation, Winnipeg, Manitoba. Pp. 124

Kuck L., G.L. Hompland, E.H. Merrill. 1985. Elk Responses to Simulated Mine Disturbance in Southeast Idaho.*Journal of Wildlife Management 49*(3): pp. 751-757.

Kunkel, K.E., and D.H. Pletscher. 2000. Habitat factors affecting vulnerability of moose to predation by wolves in southeastern British Columbia. *Canadian Journal of Zoology*, *157*: pp. 150-157.

Kurki, S., A. Nikula, P. Helle, and H. Linden. 1998. abundances of red fox and American marten in relation to the composition of boreal forest. *Journal of Animal Ecology*, *67*(6): pp. 874-886.

Linnell, J.D.C., J.E. Swenson, R. Anderson, and B. Barnes. 2000. How vulnerable are denning bears to disturbance? *Wildlife Society Bulletin. 28*: pp. 400-413.

Magoun, A. J., and J.P. Copeland. 1998. Characteristics of wolverine reproductive den sites. *The Journal of Wildlife Management*, *62*(4): pp. 1313-1320.

Manitoba Conservation. n.d.a. Temporary Closure on Moose Hunting Instituted in areas of Manitoba [online]. Available at http://news.gov.mb.ca/news/index.html?archive=2011-07-01&item=11937. [Accessed July 4th, 2011].

Manitoba Conservation n.d.b. Wild animals of Manitoba moose fact sheet [online]. Available at http://www/gov.mb.ca/conservation/wildlife/mbsp/fs/moose.html. {Accessed March 11, 2010].

Manitoba Conservation n.d.c. Wild animals of Manitoba elk fact sheet [online]. Available at http://gov.mb.ca/conservation/wildlife/mbsp/fs/elk.html. [Accessed March 11, 2010].

Manitoba Conservation. 2009.Unpublished data – Manitoba trapping results for Registered Traplines from 1996 to 2008. Provided with permission for use by Manitoba Conservation

Manitoba Conservation. 2010. Annual Report 2009-2010. Published by the Government of Manitoba, Winnipeg. Pp. 178

Manitoba Hydro. 2010. Fur, feathers, fins and transmission lines: How transmission lines and rights of way affect wildlife. Third edition. Editing and design by Marr Consulting Services. Original edition written by Robert P. Berger, Wildlife Resource Consulting. Images courtesy of Manitoba Hydro, Wildlife Resource Consulting and Marr Consulting Services. Published by Manitoba Hydro, Winnipeg: 90.

Manitoba Hydro. 2011a. Bipole III Transmission Project: A Major Reliability Improvement Initiative. Prepared for Manitoba Hydro. Winnipeg, MB.

Manitoba Hydro. 2011b. Bipole III Transmission Project – Aboriginal Traditional Knowledge Technical Report. Prepared for Manitoba Hydro. Winnipeg, MB.

Manitoba Hydro. 2011c. Manitoba Hydro Bipole III Transmission Project Preliminary Construction Access Review. Prepared for Manitoba Hydro. Winnipeg, MB.

Mayle, B. A., R.J. Putman, I. Wyllie. 2000. The use of trackway counts to establish an index of deer presence. *Mammal Review, 30*(3-4): pp. 233-237.

McCrea, A. C. (2004). Home range characteristics of sympatric moose and white-tailed deer in northern Minnesota. M.Sc. Thesis, Department of Fish and Wildlife Management, Montana State University. Pp. 92

Mech, L.D. 1970. The Wolf: The Ecology and Behaviour Of An Endangered Species. University of Minnesota Press, Minneapolis, USA.

Mech, L.D. 1977. Productivity, mortality and population trends of wolves in north-eastern Minnesota. *Journal of Mammalogy, 58*: pp. 559-574.

Mech, L.D., S.H. Fritts, G.L. Radde, W.J. Paul. 1988. Wolf distribution and road density in Minnesota. *Wildlife Society Bulletin*, *16*(1): pp. 85-87.

MESA (Manitoba Endangered Species Act). 1993. (C.C.S.M. c.E111) [online]. Available at http://web2.gov.mb.ca/laws/statutes/ccsm/e111e.php. [Accessed November 22, 2010]. See also http://www.gov.mb.ca/conservation/wildlife/sar/sarlist.html.

Minnesota Department of Natural Resources (MNDR). 1999. Minnesota Wolf Management Plan. Pp. 63.

MMM Group. 2010. The Bipole III Transmission Project – Project Description Report. Prepared for Manitoba Hydro. Winnipeg, MB.

Mines and Mineral Act. 1991. Government of Manitoba. Accessed August 15th, 2011. Available at:

http://web2.gov.mb.ca/laws/statutes/ccsm/m162e.php

Moen, R., J. Pastor, and Y. Cohen, 1997. Accuracy of GPS telemetry collar locations with differential correction. Journal of Wildlife Management. *61(2*): pp. 530-539.

Mohr, C. 1947. Table of equivalent population of North American small mammals. 37: *American Midland Naturalist*. Pp. 223-249.

Naiman, R.J., G. Pinay, C.A. Johnston, J. Pastor. 1994. Beaver influences on the long-term biogeochemical characteristics of boreal forest drainage networks. *Ecology*, *75*(4): pp. 905-921.

Natural Resources Canada. 2007. Forest Ecozones of Canada: Boreal Plains. Natural Resources Canada, Government of Canada [online]. Available at http://ecosys.cfl.scf.rncan.gc.ca/classification/classif11-eng.asp. {Accessed November 23, 2010].

Neufeld, L. M. 2006. *Spatial Dynamics of Wolves and Woodland Caribou in an Industrial Forest Landscape in West-Central Alberta*. M.Sc. Thesis, Department of Natural Resources, University of Alberta: Edmonton: pp. 169

Northcott, T.H. 1971. Feeding Habits of Beaver in Newfoundland. *Oikos*, *22*(3): pp. 407-410.

Palidwor, D.L., D.W. Schindler, and B.R. Hagglund. 1995. *Habitat Suitability Index Model - Moose Ver 2.0.* Manitoba Model Forest: pp. 151

Pattie, D.L. and R.S. Hoffmann. 1990. *Mammals of the North American Parks and Prairies*. Edmonton, AB. Pp. 600

Paquet, P.C., and L.N. Carbyn. 2003. Grey wolf (*Canis lupus*) and allies. In*Wild mammals of North America: biology, management and conservation*, Eds. G.A Feldhamer, B.C Thompson, J.A Chapman. 2nd ed. Johns Hopkins University Press. Baltimore, MD: 482-510.

Peek, J.M. 1987. Habitat relationships. In *Ecology and Management of the North American Moose*, 2nd edition. Edited by A.W. Franzmann and C.C. Schwartz.

Univeristy Press of Colorado. Boulder, CO. pp. 351-375.

Peterson, R.O., and R.E. Page. 1988. The rise and fall of Isle Royale wolves, 1975-1986. *Journal of Mammology*, *69*(1): pp. 89-99.

Quinn G.P. and M.J. Keough. 2002. Experimental design and data analysis for biologists.

Raedeke, K.J., J.J. Millspaugh, and P.E. Clark. Population Characteristics. In *North American Elk Ecology and Management,* 2002. Edited by D.E. Toweill and J.W. Thomas. Smithsonian Institution Press. Washington, D.C. pp 449-491.

Rea, R. V., Hodder, D. P., & Child, K. N. (2004). Considerations for natural mineral licks used by moose in land use planning and development. *Alces*, *40*: pp. 161-167.

Reger, R. D. 1987. Survey of minerals related information for selected mineral licks, Matanuska Valley Moose Range, Alaska. Public Data File 87-9. Division of Geological and Geophysical Surveys, University of Alaska, Fairbanks, Alaska, USA.

Richard, J.-G., and G.J. Doucet. 1999. Winter use of powerline rights-of-way by moose (*Alces alces*). *Alces*, *35*: pp.31-40.

Ruggiero, L.F., E. Pearson, and S.E. Henry. 1998. Characteristics of American Marten den sites in Wyoming. *The Journal of Wildlife Management*, *62*(2): pp. 663-673.

SARA (Species at Risk Act). 2002. (c. 29) [online]. Available at http://laws.justice.gc.ca/eng/S-15.3/page-1.html.

Schmitz O.J., and T.D. Nudds. 1994. Parasite-mediated competition in deer and moose: how strong is the effect of meningeal worm on moose? *Ecological Application, 4*(1): pp. 91-103

Sherburne, S.S., and J.A. Bissonette. 1994. Marten subnivean access point use: Response to subnivean prey levels. *The Journal of Wildlife Management*, *58(3*): pp.400-405.

Simon, T. L. 1980. An ecological study of the marten in the Tahoe National Forest, California. Unpubl. M.S. thesis, Cali-fornia State Univ., Sacramento, pp.187

Skovlin, J.M., P. Zager, and B.K. Johnson. 2002. Elk habitat selection and evaluation. In North American Elk: Ecology and Management. Edited by D.E. Toweill and J.W. Thomas. Smithsonian Institution Press. Washington and London. pp. 493-513.

Smith, R.E., H. Veldhuis, G.F. Mills, R.G. Eilers, W.R. Fraser, and G.W. Lelyk. 1998. Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba: an ecological stratification of Manitoba's natural landscapes. Technical Bulletin 1998-9E. Landscape Resource Unit, Brandon Research Centre, Research Branch, Agriculture and Agri-Food Canada. Winnipeg, MB.

Soutiere, E. C. 1978. The effects of timber harvesting on the marten. Ph.D. Thesis. Univ. Maine, Orono. Pp. 62

Spencer, W. D., R. H. Barrett, AND W. J. Zielinski. 1983. Marten, Martes americana, habitat preferences in the north-ern Sierra-Nevada, U.S.A. *Journal of Wildlife Management 47*: pp. 1181-1186.

Stantec. 2010. Bipole III Transmission Line Project: Summary Report for the Evaluation of the Alternative Routes – Soils and Terrain. DRAFT. Prepared for: MMM Group. Prepared by: Stantec Consulting Ltd. Stantec Project Number: 111257023. April 2010.

Stardom, R.R.P. 1986. Status of furbearers in Manitoba: A brief overview. MS Report *86 (12)*. Department of Natural Resources, Wildlife Branch. Pp. 24

Stein, J. (2000). *The Effects of Roads on Wolves and Bears Worldwide*. Yale University.

Stevens, C., C. Paszkowski, A. Foote. 2007. Beaver (*Castor canadensis*) as a surrogate species for conserving anuran amphibians on boreal streams in Alberta, Canada. *Biological Conservation*, *134(1*): pp. 1-13.

Stoms, D.M., F.W. Davis, C.B. Cogan. 1992. Sensitivity of wildlife habitat models to uncertainties in GIS data. *Photogrammetric engineering and remote sensing 58*(6): pp. 843-850.

SYSTAT 13. 2009. Systat Software

Tankersley, N. G., and W. C. Gasaway. 1983. Mineral lick use by moose in Alaska. Canadian Journal of Zoology *61*: pp. 2242-2249.

Thomas, D. 1995. A review of wolf-caribou relationships and conservation implications in Canada. Pages 261-273 *in* L.N. Carbyn, S.H. Fritts and D.R. Seip, editors. Ecology and Conservation of Wolves in a Changing World. Canadian Circumpolar Institute, Occasional Publication No. 35, University of Alberta, Edmonton, Alberta. 624 pp.

Thompson, I. D., I.J. Davidson, S. O'Donnell, and F. Brazeau. 1989. Use of track transects to measure the relative occurrence of some boreal mammals in uncut forest and regeneration stands. *Canadian Journal of Zoology*, *67*(7): pp. 1816-1823.

Toweill, D.E. and J.W. Thomas (eds). 2002. *North American elk: Ecology and management. A Wildlife Management Institute Book*. Smithsonian Institution Press, Washington: pp. 962

Webb, S.M., and M.S. Boyce. 2009. Marten Fur Harvests and Landscape Change in West-Central Alberta. *Journal of Wildlife Management*, *73*(6): pp. 894-903.

Weeks, H. P., and C. M. Kirkpatrick. 1976. Adaptations of white-tailed deer to naturally occurring sodium deficiencies. *Journal of Wildlife Management*. *40*: pp. 610-625.

Wikle, C. K. 2003. Hierarchical Bayesian models for predicting the spread of ecological processes. Ecology *84*: pp.1382–1394.

Wintle, B. A., M. A. McCarthy, K. M. Parris, AND M. A. Burgman. 2004. Precision and bias of methods for estimating point survey detection probabilities. Ecological

Applications 14:703–712. Wright, J. P., C.G. Jones, and A.S. Flecker. 2002. An ecosystem engineer, the beaver, increases species richness at the landscape scale. *Oecologia*, *132*(1): pp. 96-101.

Wulder, M.A. and T. Nelson. 2003. EOSD Land cover classification legend report, version 2. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, British Columbia. Canada. Pp. 83

Wydeven, A.P., Wiedenhoeft, J.E., Thiel, R.P., Schultz, R.N. Boles, S.R. Halls, W.H. Jr., and Heilhecker, E. 2003. Progress Report of Wolf Population Monitoring in Wisconsin for the Period of October 2002-March 2003. Wisconsin Department of Natural Resources Park Falls, Wisconsin. Pp. 46

Wydeven, A.P., Wiedenhoeft, J.E., Thiel, R.P., Schultz, R.N. and Boles, S.R. 2009. Progress Report of Wolf Population Monitoring in Wisconsin for the Period of October 2008-March 2009. Wisconsin Department of Natural Resources Park Falls, Wisconsin. Pp. 47

Zar, J.H. 2010. Biostatistical Analysis. 5th Edition. Upper Saddle River, NJ: Prentice

Hall, Inc.

Zielinski, W. J., K.M. Slauson, and A.E. Bowles. 2008.. Effects of off-highway vehicle use on the American Marten. *Journal of Wildlife Management*, *72*(7): pp. 1558-1571.

Endnotes

[1]Merriam-Webster Online Dictionary. Online at http://www.merriam-webster.com. Accessed November 23, 2010.

[2]Biology Dictionary Online. Online at http:www.biology-online.org/dictionary/Main_Page. Accessed November 23, 2010.

Personal Communications

Chranowski, D. 2009. Personal communication with Robert Berger, Wildlife Resource Consulting Services MB Inc., Brandon, Manitoba, September 9, 2009.

Willis, C. 2011. Personal communication with Jennifer Renton, Joro Consultants Inc., Winnipeg, Manitoba, August 11, 2011.

Glossary

Environmentally Sensitive Areas/Sites: habitat features that are particularly important in the maintenance of species' life functions, and where these features may be highly susceptible to transmission line construction and operation activities.

Footprint: Area covered by the project components, such as transmission lines, electrode lines, ROWs, converter station sites, ground electrodes or construction power stations.

Fossorial Species: Species adapted to digging

Habituate[1]: To make used to something.

Indicator Species: A species that defines a trait or characteristic of the environment (Farr, 2002).

Keystone Species: A species that is critical in maintaining the structure of an ecological community and whose impact on a community is larger than would be expected based on its relative abundance (Paine, 1995).

Lagomorph[1]: Gnawing herbivorous mammals of order Lagomorpha comprising the rabbits, hares and pikas.

Linkage Species: A species featuring for whom environmental effects are considered only as they relate to a valued ecosystem component with which the linkage species has significant interactions.

Local Study Area: Term used to describe the 3-mile wide corridor for the Project transmission line and the area surrounding the project components including AC Collector transmission line ROW, converter stations and ground electrodes,

Macrophyte[1]: A member of macroscopic plant life especially of a body fo water.

Mammal Sign: evidence of a mammal having passed through an area, including tracks, scat, browse and any other visible evidence which can be attributed to being left by a mammal.

Mustelid: Carnivorous mammals of family Mustelidae commonly known as the weasel family.

Natural Resource Area: Areas were first nations hunt and gather wildlife resources via Traplines, and areas containing rivers and lakes which were traditionally available and used by as a source of food supply and income by First Nations.

Parturition[2]: The act or process of giving birth.

Population Viability: The ability of a population to persist and to avoid extinction. Most regularly associated with rates of population birthrates and death rates.

Project Study Area: Defines the broadest area used to provide spatial context and comparison to the Project components.

Right-of-Way (ROW): The project footprint for transmission lines, electrode lines and cleared areas associated with these project structures.

Rutting: The mating season of ungulate mammals such as deer, elk, sheep, moose, and caribou.

Subnivean: Zone immediately beneath the snow layer.

Succession[2]: The progressive replacement of one dominant type of species or community by another in an ecosystem until a stable climax community is established.

Quadruped[2]: An animal having four feet, as most mammals and reptiles; often restricted to the mammals.

Sensitive Sites:

Umbrella Species: A species selected for making conservation-related decisions that indirectly protects many other species within the ecological community (Roberge et al., 2004).

APPENDIX A: PROJECT INFRASTRUCTURE COMPONENT CODES

Infrastrucure Component	ID Code	ROW Width (m)
Final Preferred Route	FPR	66
AC Collector Lines and Construction Power Line (Henday - Keewatinoow)	L61K, K61H, K62H, K63H, K64H, KN36	310
Construction Power (Keewatinoow to Construction Power Station)	KN36	60
AC Collector (Long Spruce - Henday)	L61K	60
Preferred Northern Electrode Site	NES6	N/A
Alternate Northern Electrode Site	NES7	N/A
Preferred Southern Electrode Site	SES1c	N/A
Alternate Southern Electrode Site	SES3	N/A
Northern electrode line	N/A	50

APPENDIX B: CODING FOR WILDLIFE MODELLING

The following is the source code associated with specific wildlife models described in Section X:

Beaver

("LAND_AGE" >= 5 AND "LAND_AGE" <= 40 AND ("COVTYPE" = 220 OR "COVTYPE" = 221 OR "COVTYPE" = 222 OR "COVTYPE" = 223 OR "COVTYPE" = 230 OR "COVTYPE" = 231 OR "COVTYPE" = 232)) OR "COVTYPE" = 81 OR "COVTYPE" = 82 OR ("COVTYPE" = 20 AND "F_AREA" < 500000)

American Marten

"LAND_AGE" > 60 AND "WET_TYPE" = 'Mineral' AND ("COVTYPE" = 211 OR "COVTYPE" = 231 OR "COVTYPE" = 212 OR "COVTYPE" = 232 OR "COVTYPE" = 213)

Moose

("ECODISTRIC" = 667 AND ("COVTYPE" = 82 OR "COVTYPE" = 81 OR "COVTYPE" = 83)) OR ("ECODISTRIC" = 669 AND ("COVTYPE" = 82 OR "COVTYPE" = 81 OR "COVTYPE" = 83)) OR ("REGION_NAM" = 'Aspen Parkland' AND ("COVTYPE" = 200 OR "COVTYPE" = 210 OR "COVTYPE" = 211 OR "COVTYPE" = 212 OR "COVTYPE" = 213 OR "COVTYPE" = 220 OR "COVTYPE" = 221 OR "COVTYPE" = 222 OR "COVTYPE" = 223 OR "COVTYPE" = 230 OR "COVTYPE" = 231 OR "COVTYPE" = 232 OR "COVTYPE" =233 OR "COVTYPE" = 50 OR "COVTYPE" = 51 OR "COVTYPE" = 52)) OR ("REGION_NAM" = 'Mid-Boreal Uplands' AND ("COVTYPE" = 200 OR "COVTYPE" = 210 OR "COVTYPE" = 211 OR "COVTYPE" = 212 OR "COVTYPE" = 213 OR "COVTYPE" = 220 OR "COVTYPE" = 221 OR "COVTYPE" = 222 OR "COVTYPE" = 223 OR "COVTYPE" = 230 OR "COVTYPE" = 231 OR "COVTYPE" = 232 OR "COVTYPE" =233 OR "COVTYPE" = 50 OR "COVTYPE" = 51 OR "COVTYPE" = 52)) OR ("LAND_AGE" >= 10 AND "LAND_AGE" <= 60 AND ("COVTYPE" = 200 OR "COVTYPE" = 210 OR "COVTYPE" = 211 OR "COVTYPE" = 212 OR "COVTYPE" = 213 OR "COVTYPE" = 231 OR "COVTYPE" = 232 OR "COVTYPE" = 221 OR "COVTYPE" = 222 OR "COVTYPE" = 223 OR "COVTYPE" = 50 OR "COVTYPE" = 51 OR "COVTYPE" = 52))

Elk

("REGION_NAM" = 'Aspen Parkland' AND ("COVTYPE" = 200 OR "COVTYPE" = 210 OR "COVTYPE" = 211 OR "COVTYPE" = 212 OR "COVTYPE" = 213 OR "COVTYPE" = 220 OR "COVTYPE" = 221 OR "COVTYPE" = 222 OR "COVTYPE" = 223 OR "COVTYPE" = 230 OR "COVTYPE" = 231 OR "COVTYPE" = 232 OR "COVTYPE" =233)) OR ("REGION_NAM" = 'Mid-Boreal Uplands' AND ("COVTYPE" = 200 OR "COVTYPE" = 210 OR "COVTYPE" = 211 OR "COVTYPE" = 212 OR "COVTYPE" = 213 OR "COVTYPE" = 220 OR "COVTYPE" = 221 OR "COVTYPE" = 222 OR "COVTYPE" = 223 OR "COVTYPE" = 230 OR "COVTYPE" = 231 OR "COVTYPE" = 232 OR "COVTYPE" =233)) OR ("LAND_AGE" <= 50 AND ("COVTYPE" = 210 OR "COVTYPE" = 211 OR "COVTYPE" = 212 OR "COVTYPE" = 213 OR "COVTYPE" = 220 OR "COVTYPE" = 221 OR "COVTYPE" = 222 OR "COVTYPE" = 223 OR "COVTYPE" = 230 OR "COVTYPE" = 231 OR "COVTYPE" = 232 OR "COVTYPE" = 233) OR "COVTYPE" = 110 OR "COVTYPE" = 122)

APPENDIX C: LIST OF MAMMAL SPECIES FOUND IN THE BIPOLE III STUDY AREA.

DEFINITIONS REGARDING PROVINCIAL, FEDERAL AND COSEWIC LISTINGS CAN BE FOUND FOLLOWING THIS TABLE

	Common Name	Genus	Species	Family	Provincial Listing	Federal Listing	COSEWIC	Occurrence Type
1	Masked Shrew	*Sorex*	*cinereus*	Shrews and Moles	N/A	N/A	N/A	Year-round inhabitant
2	Arctic Shrew	*Sorex*	*arcticus*	Shrews and Moles	N/A	N/A	N/A	Year-round inhabitant
3	Northern Water Shrew	*Sorex*	*palustris*	Shrews and Moles	N/A	N/A	N/A	Year-round inhabitant
4	Dusky Shrew	*Sorex*	*obscurus*	Shrews and Moles	N/A	N/A	N/A	Year-round inhabitant
5	Pygmy Shrew	*Microsorex*	*hoyi*	Shrews and Moles	N/A	N/A	N/A	Year-round inhabitant
6	Little Brown Myotis	*Myotis*	*lucifugus*	Bats	N/A	N/A	N/A	Year-round inhabitant
7	Keen Myotis	*Myotis*	*keenii*	Bats	N/A	N/A	N/A	Year-round inhabitant
8	Silver-haired Bat	*Lasionycteris*	*noctivagans*	Bats	N/A	N/A	N/A	Year-round inhabitant
9	Red Bat	*Lasiurus*	*borealis*	Bats	N/A	N/A	N/A	Year-round inhabitant
10	Big Brown Bat	*Eptesicus*	*fuscus*	Bats	N/A	N/A	N/A	Year-round inhabitant

	Common Name	Genus	Species	Family	Provincial Listing	Federal Listing	COSEWIC	Occurrence Type
11	Hoary Bat	*Lasiurus*	*cinereus*	Bats	N/A	N/A	N/A	Year-round inhabitant
12	Black Bear	*Ursus*	*americanus*	Bears	N/A	N/A	N/A	Year-round inhabitant
13	Grizzly Bear (Prairie population; Northwestern population)	*Ursus*	*arctos*	Bears	Extirpated	Extirpated	N/A	Occasional visitor
14	Raccoon	*Procyon*	*lotor*	Racoons and Coatis	N/A	N/A	N/A	Year-round inhabitant
15	Fisher	*Martes*	*pennanti*	Mustelids	N/A	N/A	N/A	Year-round inhabitant
16	Marten	*Martes*	*americana*	Mustelids	N/A	N/A	N/A	Year-round inhabitant
17	Least Weasel	*Mustela*	*rixosa*	Mustelids	N/A	N/A	N/A	Year-round inhabitant
18	Short-tailed Weasel	*Mustela*	*erminea*	Mustelids	N/A	N/A	N/A	Year-round inhabitant
19	Long-tailed Weasel	*Mustela*	*frenata*	Mustelids	N/A	N/A	N/A	Year-round inhabitant
20	Mink	*Mustela*	*vison*	Mustelids	N/A	N/A	N/A	Year-round inhabitant
21	River Otter	*Lutra*	*canadensis*	Mustelids	N/A	N/A	N/A	Year-round inhabitant

	Common Name	Genus	Species	Family	Provincial Listing	Federal Listing	COSEWIC	Occurrence Type
22	Wolverine	*Gulo*	*gulo*	Mustelids	N/A	Special Concern	Special Concern	Year-round inhabitant
23	Badger	*Taxidea*	*taxus*	Mustelids	N/A	N/A	N/A	Year-round inhabitant
24	Striped Skunk	*Mephitis*	*mephitis*	Mustelids	N/A	N/A	N/A	Year-round inhabitant
25	Coyote	*Canis*	*latrans*	Dogs, Wolves and Foxes	N/A	N/A	N/A	Year-round inhabitant
26	Grey Wolf	*Canis*	*lupus*	Dogs, Wolves and Foxes	N/A	N/A	N/A	Year-round inhabitant
27	Swift Fox	*Vulpes*	*velox*	Dogs, Wolves and Foxes	Extirpated	Endangere d	Threatened	Occasional visitor
28	Red Fox	*Vulpes*	*vulpes*	Dogs, Wolves and Foxes	N/A	N/A	N/A	Year-round inhabitant
29	Grey Fox	*Urocyon*	*cinereoarge nteus*	Dogs, Wolves and Foxes	Extirpated	Threatene d	Threatened	Occasional visitor
30	Bobcat	*Lynx*	*rufus*	Cats	N/A	N/A	N/A	Year-round inhabitant
31	Lynx	*Lynx*	*lynx*	Cats	N/A	N/A	N/A	Year-round inhabitant
32	Cougar	*Puma*	*concolor*	Cats	N/A	N/A	Data Deficient Nationally	Occasional visitor; Year-round inhabitant?

	Common Name	Genus	Species	Family	Provincial Listing	Federal Listing	COSEWIC	Occurrence Type
33	Woodchuck	*Marmota*	*monax*	Marmots	N/A	N/A	N/A	Year-round inhabitant
34	Richardson's Ground Squirrel	*Spermophilus*	*richardsonii*	Ground Squirrel	N/A	N/A	N/A	Year-round inhabitant
35	Franklin's Ground Squirrel	*Spermophilus*	*franklinii*	Ground Squirrel	N/A	N/A	N/A	Year-round inhabitant
36	Thirteen-lined Ground Squirrel	*Spermophilus*	*tridecemlineatus*	Ground Squirrel	N/A	N/A	N/A	Year-round inhabitant
37	Eastern Chipmunk	*Tamias*	*striatus*	Chipmunks	N/A	N/A	N/A	Year-round inhabitant
38	Least Chipmunk	*Tamias*	*minimus*	Chipmunks	N/A	N/A	N/A	Year-round inhabitant
39	Eastern Grey Squirrel	*Sciurus*	*carolinensis*	Squirrels	N/A	N/A	N/A	Year-round inhabitant
40	Eastern Fox Squirrel	*Sciurus*	*niger*	Squirrels	N/A	N/A	N/A	Year-round inhabitant
41	Red Squirrel	*Tamiasciurus*	*hudsonicus*	Squirrels	N/A	N/A	N/A	Year-round inhabitant
42	Northern Flying Squirrel	*Glaucomys*	*sabrinus*	Squirrels	N/A	N/A	N/A	Year-round inhabitant
43	Northern Pocket Gopher	*Thomomys*	*talpoides*	Pocket Gophers	N/A	N/A	N/A	Year-round inhabitant

	Common Name	Genus	Species	Family	Provincial Listing	Federal Listing	COSEWIC	Occurrence Type
44	Plains Pocket Gopher	*Geomys*	*bursarius*	Pocket Gophers	N/A	N/A	N/A	Year-round inhabitant
45	Beaver	*Castor*	*canadensis*	Beavers	N/A	N/A	N/A	Year-round inhabitant
46	Deer Mouse	*Peromyscus*	*maniculatus*	Mice	N/A	N/A	N/A	Year-round inhabitant
47	Northern Grasshopper Mouse	*Onychomys*	*leucogaster*	Mice	N/A	N/A	N/A	Year-round inhabitant
48	Southern Bog Lemming	*Synaptomys*	*cooperi*	Lemmings	N/A	N/A	N/A	Year-round inhabitant
49	Northern Bog Lemming	*Synaptomys*	*borealis*	Lemmings	N/A	N/A	N/A	Year-round inhabitant
50	Boreal Red-backed Vole	*Clethrionomys*	*gapperi*	Voles	N/A	N/A	N/A	Year-round inhabitant
51	Heather Vole	*Phenacomys*	*intermedius*	Voles	N/A	N/A	N/A	Year-round inhabitant
52	Meadow Vole	*Microtus*	*pennsylvanicus*	Voles	N/A	N/A	N/A	Year-round inhabitant
53	Prairie Vole	*Microtus*	*ochrogaster*	Voles	N/A	N/A	N/A	Year-round inhabitant
54	Yellow-cheeked Vole	*Microtus*	*xanthognathus*	Voles	N/A	N/A	N/A	Year-round inhabitant
55	Muskrat	*Ondatra*	*zibethica*	Muskrat	N/A	N/A	N/A	Year-round inhabitant

	Common Name	Genus	Species	Family	Provincial Listing	Federal Listing	COSEWIC	Occurrence Type
56	Western Jumping Mouse	*Zapus*	*princeps*	Jumping Mice	N/A	N/A	N/A	Year-round inhabitant
57	Meadow Jumping Mouse	*Zapus*	*hudsonius*	Jumping Mice	N/A	N/A	N/A	Year-round inhabitant
58	Woodland Jumping Mouse	*Napaeozapus*	*insignis*	Jumping Mice	N/A	N/A	N/A	Year-round inhabitant
59	Porcupine	*Erethizon*	*dorsatum*	Porcupine	N/A	N/A	N/A	Year-round inhabitant
60	Snowshoe Hare	*Lepus*	*americanus*	Hares	N/A	N/A	N/A	Year-round inhabitant
61	White-tailed Jackrabbit	*Lepus*	*townsendii*	Hares	N/A	N/A	N/A	Year-round inhabitant
62	Eastern Cottontail	*Sylvilagus*	*floridanus*	Rabbits	N/A	N/A	N/A	Year-round inhabitant
63	Elk	*Cervus*	*elaphus*	Deer	N/A	N/A	N/A	Year-round inhabitant
64	White-tailed Deer	*Odocoileus*	*virginianus*	Deer	N/A	N/A	N/A	Year-round inhabitant
65	Mule Deer	*Odocoileus*	*hemionus*	Deer	Threatened	N/A	N/A	Year-round inhabitant
66	Moose	*Alces*	*alces*	Deer	N/A	N/A	N/A	Year-round inhabitant

	Common Name	Genus	Species	Family	Provincial Listing	Federal Listing	COSEWIC	Occurrence Type
67	Boreal Woodland Caribou	*Rangifer*	*tarandus caribou*	Deer	Threatened	Threatened	Threatened	Year-round inhabitant
68	Barren Ground Caribou	*Rangifer*	*tarandus groenlandicus*	Deer	N/A	N/A	N/A	Seasonal inhabitant
69	Coastal Caribou	*Rangifer*	*tarandus*	Deer	N/A	N/A	N/A	Seasonal inhabitant
70	Pronghorn	*Antilocapra*	*americana*	Pronghorn	Extirpated	N/A	N/A	Occasional visitor
71	Plains Bison	*Bison*	*bison*	Bison, Sheep, Muskox	Extirpated	N/A	Threatened	Occasional visitor

The definitions for the COSEWIC, Endangered Species Act (ESA) - Manitoba and SARA listings are as follows:

COSEWIC Rank	Definition
Extinct	A species that no longer exists
Extirpated	A species no longer existing in the wild in Canada, but occurring elsewhere
Endangered	A species facing imminent extirpation or extinction
Threatened	A species likely to become endangered if limiting factors are not reversed
Special Concern	A species that is particularly sensitive to human activities or natural events but is not an endangered or threatened species
Data Deficient	A species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction
Not At Risk	A species that has been evaluated and found to be not at risk
MESA Rank	**Definition**
Extinct	Any species extirpated throughout its entire range
Extirpated	Any species once native to Manitoba that has disappeared through all of its Manitoba range. Extirpated species may still be found elsewhere in their range, or in captivity
Endangered	Any native Manitoba species threatened to disappear through all or most of its Manitoba range
Threatened	Any native Manitoba species likely to become endangered or at risk due to low or declining numbers in Manitoba if the factors affecting it don't improve
Vulnerable	Species not regulated under the Endangered Species Act but which could eventually be considered Endangered or Threatened if the factors affecting them do not improve
SARA Rank	**Definition**
Extinct	A species that no longer exists
Extirpated	A wildlife species that no longer exists in the wild in Canada, but exists elsewhere
Endangered	A wildlife species that is facing imminent extirpation or extinction
Threatened	A wildlife species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction
Special Concern	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats

APPENDIX D: TRAPPING RESULTS OF RTLS INTERSECTING THE FINAL PREFERRED ROUTE (FROM 1996 TO 2008)

Row Labels	Sum of BEAVER	Sum of BLACK BEAR	Sum of BOBCAT	Sum of COYOTE	Sum of ERMINE	Sum of FISHER	Sum of FOX, BLUE	Sum of FOX, CROSS	Sum of FOX, RED	Sum of FOX, SILVER	Sum of FOX, UNKNOWN	Sum of FOX, WHITE	Sum of LYNX	Sum of MARTEN	Sum of MINK	Sum of MUSKRAT	Sum of OTTER	Sum of RACCOON	Sum of SQUIRREL	Sum of WEASEL	Sum of WOLF	Sum of WOLVERINE
CAMPERDUCK	**3,136**	**22**		**182**	**269**	**297**		**5**	**111**	**2**		**1**	**40**	**475**	**306**	**14,828**	**167**	**38**	**759**	**34**	**19**	
	5			13	44	5		1	2				1	12	53		1	2	50		3	
BLOCK	3,131	22		169	225	292		4	109	2		1	39	463	253	14,828	166	36	709	34	16	
CORMORANT	**677**	**4**		**34**	**220**	**219**		**19**	**105**	**2**		**1**	**86**	**1,047**	**349**	**1079**	**172**	**2**	**268**	**66**	**9**	
2	109			9	5	15		2	14				22	156	51	30	22		41	21		
3	19				22	19		3	5				1	58	19	150	4		43	16	1	
4	2				4	2			8				4	20	13	16	2		4	9		
5	26			6	27	31		2	17				5	110	50	48	16		15		2	
6	106	1		5	9	42		4	14	1			16	52	104	187	26		33	9		
7	68			3	50	29		2	27	1		1	4	134	21	255	21		47		3	
8	73			9	36	24		3	13				27	192	32	170	19		41	9	1	
10	68				5	1								26	32	38	8		4	1		
11	158	2			23	30			2				1	241	12	26	43		6			
12	28	1		1	39	25		3	3				3	49	14	108	10	2	34		2	
31													3	3								
UNKNOWN	20			1		1			2					6	1	51	1			1		
CRANBERRY	**2,086**	**5**		**77**	**788**	**464**		**54**	**131**		**6**		**187**	**1274**	**1,302**	**759**	**651**	**2**	**339**	**18**	**91**	**6**
3	255			12	111	103		9	14				24	86	84	157	26		64	2	9	
4	90			3	25	26		2	4				1	4	68	130	43		4		1	
5	32				12	12							5	13	16		7		23	1	6	
6	56				3	1			1				1	3	5	13	14		3			
7	89			1	13	13			4				4	14	18	14	7		47			
8	106	1		8	178	28		8	19				18	92	89	7	35	1	6		3	
10	20				40	12			5				1	41	147		39		28			
14	145	3		15	38	19		3	2				17	150	29	1	30		1		5	
15	69				15	13		2	1				1	21	40	14	10		15		1	
17	55			1	1	3			4					4	30	7	13		6			1
22	174				40	56		7	28		6		32	322	200	118	141		74	12	44	3
23	222			1	64	18		5	10				4	107	138	92	71		4		13	
25	58			16	24				4				3	78	32	106	5				3	
26	69				14			4	4				2	21	21		4		2			
28	150			1	17	1		2	2				3	44	26		8		1			
29	126			7	54	16		5	8				45	91	147	6	71	1	41		5	2
30	52			1	17	13		1	4				3	5	30	2	18		6			
33	37			8	79	52			7				7	115	148	2	52		12		1	

Row Labels	Sum of BEAVER	Sum of BLACK BEAR	Sum of BOBCAT	Sum of COYOTE	Sum of ERMINE	Sum of FISHER	Sum of FOX, BLUE	Sum of FOX, CROSS	Sum of FOX, RED	Sum of FOX, SILVER	Sum of FOX, UNKNOWN	Sum of FOX, WHITE	Sum of LYNX	Sum of MARTEN	Sum of MINK	Sum of MUSKRAT	Sum of OTTER	Sum of RACCOON	Sum of SQUIRREL	Sum of WEASEL	Sum of WOLF	Sum of WOLVERINE
35	215			1	5	44		3	3				16	7	29	75	54					
36	46	1		2	37	34		3	7					49	4		2		2	3		
UNKNOWN	20				1									7	1	15	1					
CROSS LAKE	**41**	**1**		**1**		**2**		**1**	**4**				**17**	**41**	**4**	**9**	**1**					
ZONE OE	41	1		1		2		1	4				17	41	4	9	1					
EASTERVILLE	**260**	**2**		**65**	**74**	**395**		**15**	**83**				**42**	**188**	**144**	**4,681**	**363**	**5**	**91**	**33**	**17**	
9	1			4	5	30			3					7	8	33	37					
BLOCK	256	2		56	69	357		15	79				42	179	130	1,882	318	5	91	33	17	
UNKNOWN	3			5		8			1					2	6	2766	8					
FLIN FLON	**694**			**41**	**383**	**108**		**42**	**93**	**4**			**62**	**315**	**653**	**152**	**228**		**63**		**44**	**2**
1	198			19	101	23		20	36	2			11	68	123	19	45		6		10	
2	306			5	110	44		6	24				28	80	225	34	79				21	1
3	39				37	9			1				4	15	74	7	41		6		8	
4	144			1	123	31		5	11	1			19	139	220	64	63		38		4	1
5	2			3		1		2	7	1				1	3	12						
UNKNOWN									1													
YOUTH	5			13	12			9	13					12	8	16			13		1	
LIMESTONE	**122**			**1**	**12**	**1**		**18**	**48**	**5**		**77**	**15**	**2,029**	**48**	**84**	**19**		**5**		**7**	**8**
4	58				2	1		6	15	1		43	4	1,208	22	35	16		3		4	6
5	54				8			10	23	4		24	11	532	18	49	2				2	
6	5								2					46	1		1					
13	5			1	2			2	8			10		243	7				2		1	2
MOOSE LAKE	**120**			**16**	**5**	**44**		**2**	**15**				**4**	**189**	**14**	**1,580**	**38**	**1**	**11**	**22**	**5**	
3	80			3	2	8		1	7					33	1	49	5		1		4	
4	9			3		5			1					8	1	305	3				1	
5	6			5	3	2			2					40	4	14	23					
6	21			2		8							3	83	2	680	1	1	8	6		
OPEN B	4			3		19		1	5				1	16	4	350	6		2	16		
UNK																100						
UN						2								9	2	82						

Row Labels	Sum of BEAVER	Sum of BLACK BEAR	Sum of BOBCAT	Sum of COYOTE	Sum of ERMINE	Sum of FISHER	Sum of FOX, BLUE	Sum of FOX, CROSS	Sum of FOX, RED	Sum of FOX, SILVER	Sum of FOX, UNKNOWN	Sum of FOX, WHITE	Sum of LYNX	Sum of MARTEN	Sum of MINK	Sum of MUSKRAT	Sum of OTTER	Sum of RACCOON	Sum of SQUIRREL	Sum of WEASEL	Sum of WOLF	Sum of WOLVERINE
KNOWN																						
NELSON HOUSE	**3,209**	**3**		**12**	**202**	**136**		**67**	**167**	**21**		**49**	**320**	**4,844**	**1,050**	**1,046**	**352**	**3**	**308**	**35**	**46**	**28**
1	18				5							1	1	15	9	19	3		2			
2	6													4	1							
4	18			1				1					3	47	14		7		3			
5	69				5	1		1	1	1			10	30	7	5	13					
6	78				3	3		1	4			2	11	211	11		6			1	1	
7														11	1						1	
8	36				9			1	3			1	7	278	14	3	3		5			
9	108			1		6		5	4			2	29	245	26		9					
10	315			1	24	13		2	15	2		7	40	216	43	168	24	1	39		3	1
11	159	1			1	4		4	4				9	359	22	2	10			1	2	
12	433			2	5	15		3	6			2	19	206	110	111	34		12	9		1
13	87				3	4		2	2	2		3	6	155	13	65	11		13		14	
14	16					1							2	28	3		1					
15	16					4			1	2			5	21	7		1					
16	12					1			1			1	1	13	4	30	3					
17	135				3	11		2	8	1			12	392	93	41	11		7		1	1
18	27												1	5	2	1	1					
19	14													9	3	16	1					
21	1				1			1	1				2	96	5		3		4		2	2
22	42				3	1		1		1		4	6	176	37	4	11		31		4	1
23	76				10	3		2	4				9	115	32	57	21		42			2
24	116					6		2	6	1		7	3	355	119	2	13		1			2
28	46				3	1		1	5	2			7	83	24		5		3			
33	35					2		2	3				2	61	20	210	4					
35	44				10				2				3	74	39	30	4		2	9		
37	71			4	27	17		7	23	5		3	17	165	73	3	30		16		3	8
39	313	1			12	21		8	9	2		11	31	432	79	47	39		14	3	4	2
40	62					3		2					5	39	13	16	4					
41	7								1					11			1					
42	88				3			2	2			2	8	68	15	11	7		3		1	1
43	14					1								15		10						
46	294				6	6		3	7				41	149	20	21	13			4		2
47	16												1	6	1	3	1					
49	263	1			13	1		7	19	2		1	5	263	116	141	28		30	6	1	1
53	150			3	56	10		7	36			2	23	469	70	30	28	2	73	2	9	3
62_63	17					1							1	14	4		1		8			
64_65																						1

Row Labels	Sum of BEAVER	Sum of BLACK BEAR	Sum of BOBCAT	Sum of COYOTE	Sum of ERMINE	Sum of FISHER	Sum of FOX, BLUE	Sum of FOX, CROSS	Sum of FOX, RED	Sum of FOX, SILVER	Sum of FOX, UNKNOWN	Sum of FOX, WHITE	Sum of LYNX	Sum of MARTEN	Sum of MINK	Sum of MUSKRAT	Sum of OTTER	Sum of RACCOON	Sum of SQUIRREL	Sum of WEASEL	Sum of WOLF	Sum of WOLVERINE
UNKNOWN	7													8			1					
PIKWITONEI	**1,341**	**4**		**5**	**231**	**73**		**23**	**67**	**4**		**18**	**293**	**2,701**	**745**	**1,869**	**399**	**2**	**360**	**7**	**34**	**14**
25	95	2		2	16	7		2	5				3	199	55	95	6	2	34	1	1	1
40	244			1	56	11		5	11	1		1	15	253	107	621	37		100		3	4
42	72				11	14		1	3			2	41	257	126	74	50		28		5	2
44	69				18	5			4	1		1	28	342	61	6	35		52		13	
46	119				4	8		2	6				1	113	30	13	28				3	
47	89			1	2				3			4	23	248	24	10	93					
50	305	1			110	13		5	22			4	91	543	174	597	54		106	6	2	2
56	6				6	1			1				4	91	19	1	2		26			
57	197				1	10		5	8	1		5	55	176	91	408	80		14		2	
58	43			1	7	4		2	2	1			27	346	42	5	7				4	5
65	102	1						1	2			1	5	133	16	39	7				1	
PUKATAWAGON	**1,822**	**1**		**1**	**50**	**76**		**29**	**47**	**6**		**2**	**79**	**1,229**	**424**	**706**	**165**		**71**	**3**	**25**	**6**
1	162				2	8		3	8	1		1	4	117	80	74	26		5		4	
2	100					1		1	3	2			4	53	19	95	8			3		
3	429				4	11		1	5	1			4	137	35	158	22		11			2
4	15																					
6	19				5	2		1	3	2			4	58	13		7		20		11	1
7	74				24	5		3	11				19	288	110	1	23		3		8	1
8	41					6		2					1	13	7	29	7				2	
9	152					9			3				2	65	25	48	13					
10	65												5	24	4	11	3					
11	48					1		1						11		3	2					
12	120				4	6							9	112	17	102	8		10			
13	158	1				8		9	1				8	55	21		8					
19	59					1		1	1					7	10	4	2					1
20	3					3							5	19	4	8	1					
29					1									9	5		1		1			
44	367			1	6	14		7	8			1	14	235	65	167	32		19			1
YCTA														12								
YTCA	10				4	1			4					14	9	6	2		2			
REDEER-SHOAL RIVER	**9,523**	**3**		**305**	**675**	**636**		**15**	**124**	**2**			**105**	**1,180**	**626**	**14,544**	**458**	**180**	**3,875**	**265**	**64**	
BL	9,523	3		305	675	636		15	124	2			105	1,180	626	14,544	458	180	3,875	265	64	

Row Labels	Sum of BEAVER	Sum of BLACK BEAR	Sum of BOBCAT	Sum of COYOTE	Sum of ERMINE	Sum of FISHER	Sum of FOX, BLUE	Sum of FOX, CROSS	Sum of FOX, RED	Sum of FOX, SILVER	Sum of FOX, UNKNOWN	Sum of FOX, WHITE	Sum of LYNX	Sum of MARTEN	Sum of MINK	Sum of MUSKRAT	Sum of OTTER	Sum of RACCOON	Sum of SQUIRREL	Sum of WEASEL	Sum of WOLF	Sum of WOLVERINE
OCK																						
SHERRIDON	**3,976**	**11**	**12**	**17**	**343**	**223**		**41**	**127**	**9**			**374**	**1,924**	**1,455**	**1,828**	**697**	**2**	**131**	**46**	**35**	**6**
1	905	3	12	1	23	34		7	24				78	353	158	99	64		12	11		1
3	42			1									3	13	9		3					
4	187			1	2	14		4	6	1			17	106	59	107	35					
5	302				19	8		2	6				24	72	106	71	65			25		
6	87				3	3			2				2	13	30	7	8	1	5			1
7	2							1					8	3	1		1					
9	81					3			1					11	20	27	21				1	
11	22				5			1	1				2	24	5		4					
12	169					8		1	2				25	44	62	234	30				3	
13	186				66	5		4	3	1			14	163	114	18	29		6		3	
14	217				2	13		2	6				6	97	130		36				13	1
16	146					8		1	4	1			2	10	26	145	8					
17	61					1			1				3	3	6	46	6					
18	126			1	19	31		1	3				24	120	100	79	79				2	
19	69					10		3	7				10	36	43	34	25					
20	104				2	6		1	4	1			11	39	47	13	18		18			
22	470	7		7	186	54		7	41	3			53	573	400	223	200	1	80		13	2
23	134					1		2	3				33	76	18	17	3					1
25	142			3		3							19	17	15	303	19					
26	448	1		3	3	11		1	5				16	108	65	238	41		5	10		
27	43					5		2	7				22	27	38							
97	33				13	5		1	1	2			2	16	3	167	2		5			
SNOW LAKE	**2,336**	**11**		**23**	**1,084**	**198**		**37**	**167**	**3**			**370**	**2,417**	**1,456**	**1,846**	**483**	**5**	**1,315**	**4**	**37**	**16**
1	98			4	28	17		2	18				35	251	27	13	15				1	
2	20					4			4				5	48	9	15	5					
6	63			2	62	10		2	20				13	140	68	320	16		73		7	1
11	22				4									33	7	46	2		20			
12	143			2	52	19		4	9				20	123	180	420	20		54			
13	105			2	79	12		3	10				39	87	136	98	39		39		2	2
14	466			1	152	24		3	11	1			27	136	164	210	66		64		6	1
15	208			2	152	26		6	37	1			48	270	170	182	34		263		1	
16	54			7	27	2		2	7					87	29	72	7		28		1	
19	147				55	1		1	6				25	74	39	7	17		75		1	2
21	75	3			30	8			3				17	72	110	45	29		3			1
22	39				23	9			5	1			8	84	54	1	3				2	
23	88				82	14		1	2				28	85	110	60	49	5	211		2	
24	139				214	16		2	11				27	305	77	85	58		334		4	3

Row Labels	Sum of BEAVER	Sum of BLACK BEAR	Sum of BOBCAT	Sum of COYOTE	Sum of ERMINE	Sum of FISHER	Sum of FOX, BLUE	Sum of FOX, CROSS	Sum of FOX, RED	Sum of FOX, SILVER	Sum of FOX, UNKNOWN	Sum of FOX, WHITE	Sum of LYNX	Sum of MARTEN	Sum of MINK	Sum of MUSKRAT	Sum of OTTER	Sum of RACCOON	Sum of SQUIRREL	Sum of WEASEL	Sum of WOLF	Sum of WOLVERINE
26	37				30	7		1	7				6	151	111	105	18		24			
29	49			2	10	5		1	1				7	34	26	3	21				2	
31	156			1	19	11		4	8				27	87	14	62	11		17		3	
33	11					2								19	3							
11_18	13				1			1						40	1		1				2	
4_32	186	2			13	3			2				31	152	72	34	25		31	4	3	
7_9	201	6			11	6		1	3					82	43	24	43		1			4
8/16/2007					9	1							6	7	2		3		3			
UNKNOWN	16				31	1		3	3				1	50	4	44	1		75			2
SPLIT LAKE	**3,594**	**5**		**9**	**64**	**103**	**2**	**179**	**416**	**43**		**456**	**200**	**13,397**	**1,344**	**929**	**540**		**157**	**26**	**65**	**25**
10	25			1		4		4	27	9		55	4	1,321	38		3				5	2
11	95					3		4	9	1		2	15	214	43	25	16					
12	352			1	25	15		17	35	1		22	8	495	140	195	17		39	7	6	
13	504				4	12		15	38	5		12	13	1,456	131	52	105			1	8	2
14	148				3	6		1	8			21	8	756	53	11	20		6			
15	43					1		1	2			18	4	232	13	3	7					
16	95					5		2	3			4	2	269	36	10	19					
17	71					6	1	16	51			29		766	23		17				12	
18	101				5	4		25	58	6		83	12	1574	52	5	14				6	3
20	31	1												50	8	37	4		2		1	
21	52					2		1	7			20		279	14	2	4				3	2
22	109					5		3	6			23	2	410	24	22	15					
23	108					2		6	6	1		14	1	290	52	14	22				5	2
24	13								2			4	1	70	8		4					
25	155				8	3		11	7	1		11	20	629	134	65	47			3	1	
27	576	1			13	8	1	12	24	2		26	56	1,041	139	338	69		41	2	2	9
28	42				2	2		4	5	1		6	17	261	78	6	2		4	4		
29	115								1			1	1	144	39		18					
30	9								3					50	4		5					
31	86					2		2	4	1		9		384	51	26	5					
32	135	1				4		18	28	6		9	14	327	47	18	12		1		4	1
33	2											6		74	11		3					
34	10					2			1				2	53	4		3					
35	6								1					31	9		2					
36	78					2		15	22			22	2	398	49	6	36		14		4	
38	36					1		5	1			1	1	104	20	2	8					
39	40								2			1		35	1	6	10					

Row Labels	Sum of BEAVER	Sum of BLACK BEAR	Sum of BOBCAT	Sum of COYOTE	Sum of ERMINE	Sum of FISHER	Sum of FOX, BLUE	Sum of FOX, CROSS	Sum of FOX, RED	Sum of FOX, SILVER	Sum of FOX, UNKNOWN	Sum of FOX, WHITE	Sum of LYNX	Sum of MARTEN	Sum of MINK	Sum of MUSKRAT	Sum of OTTER	Sum of RACCOON	Sum of SQUIRREL	Sum of WEASEL	Sum of WOLF	Sum of WOLVERINE
40									1					38	2		1					
41	4								6					160	16		2				1	
42	10							2	21	2		10		286	16		3				4	1
43								2	2					20	1							
45	22											4		54			4					
64												1		82	1							1
65	29	1		7		8		9	25	6		35	4	763	26	2	21		34		1	
66	26					1		2						9		24	3					
70	464				4	4		2	10	1		2	13	257	55	60	19		16	9	2	2
75	2	1				1						5		15	6							
THICKET PORTAGE	**1,326**	**5**		**12**	**173**	**98**		**22**	**82**	**6**	**2**	**13**	**47**	**1,417**	**576**	**380**	**250**	**1**	**79**	**18**	**40**	**11**
10	104				5	9			2				4	66	63	9	10		2			
11	72				2	6			2			2	1	153	48	1	15		6			
14	145					5		1	4					208	80	16	11		10	3		
26	107								1				1	98	40	87	48					
29	148	2		4	32	16		9	20	2	2	1	11	229	48	47	55		35		5	4
30	297	1		2	132	34		6	16	2		4	22	387	219	36	65	1	26	15	1	4
32	349	2		6	2	28		6	37	2		5	8	260	48	95	37				33	3
33	104											1		16	30	89	9				1	
WABOWDEN	**1,204**	**3**		**5**	**233**	**63**		**25**	**89**	**4**		**4**	**241**	**2,117**	**828**	**695**	**272**		**41**	**30**	**25**	11
3	102			2	5	6		2	10				38	178	65	21	24		2			
6	155			1	39	8		1	16				32	192	161	126	42		3	18	10	4
9	88			1	9	4		1	4			2	27	171	92		31		1		2	
11	138				2	15		3	9			1	44	296	132	21	50				3	4
12	58								1					33	5	7	6				1	
13	138				29	5		4	9			1	14	232	47	199	10		1	9	1	
16	80	3			7	4			3	1			8	125	93	30	21				1	
17	90				35	4		1	7				34	176	51	2	27		7			3
18	48				24	1			1				5	79	11	28	2		1			
19	51			1	30	10		2	8	1			11	288	78	216	26		21		1	
21	256				53	6		11	21	2			28	347	93	45	33		5	3	6	
Grand Total	3,546 7	80	12	806	4806	3,136	2	594	1,876	111	8	621	2,482	36,784	11,324	47,015	5,255	241	7,873	607	563	133

APPENDIX E: SPECIES LOCATED AT EACH TRAIL CAMERA LOCATION DEPLOYED SUMMER 2010

Site	Location	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8	Species 9	Species 10	Species 11
The Bog	bog_1	caribou	moose	sandhill crane	unknown							
The Bog	bog_2	caribou	moose	mink								
The Bog	bog_3	caribou	ruffed grouse									
The Bog	bog_4	caribou										
The Bog	bog_5											
The Bog	bog_6	caribou										
The Bog	bog_7	beaver	moose	mallard	canada goose	wolf						
The Bog	bog_8	caribou	moose	bear	wolf	lynx	sandhill crane	white tailed deer				
The Bog	bog_9	caribou	moose	bear	wolf	sandhill crane	white tailed deer	rabbit				
The Bog	bog_10	caribou	moose	bear	wolf	sandhill crane	white tailed deer	lynx	human			
The Bog	bog_11	bear	coyote	fisher	human	lynx	mink	moose	rabbit	squirrel	white tailed deer	wolf
The Bog	bog_12	caribou	moose	bear	unknown							
The Bog	bog_13	caribou	moose	bear	hawk	small bird						
The Bog	bog_14	caribou	marten	whiskey jack								
The Bog	bog_15	caribou	sandhill crane									
The Bog	bog_16	caribou	sandhill crane									
The Bog	bog_17	marten										
The Bog	bog_18	caribou	bear	hawk								
The Bog	bog_19	caribou										
The Bog	bog_20	caribou	marten	sandhill crane	wolf	unknown						
The Bog	bog_21	sandhill crane										
The Bog	bog_22	caribou	sandhill crane	hawk								
McLarty Lake	MCL_1	bear	lynx	rabbit	sandhill crane	white tailed deer	unknown					
McLarty Lake	MCL_2	caribou	bear	cotote	lynx	moose	sandhill crane	wolf				

McLarty Lake	MCL_3	moose						
McLarty Lake	MCL_4	caribou						
McLarty Lake	MCL_5	moose	bear	wolf	coyote	human	unknown	
McLarty Lake	MCL_6	caribou	wolf	sandhill crane	lynx	whiskey jack		
McLarty Lake	MCL_7	hawk	sandhill crane	unknown				
McLarty Lake	MCL_8	caribou	bear					
McLarty Lake	MCL_9	caribou	sandhill crane					
Wuskwatim	WUSK_ 1	sandhill crane	red fox					
Wuskwatim	WUSK_ 2	sandhill crane	red fox					
Wuskwatim	WUSK_ 3	caribou	sharptaile d grouse					
Wuskwatim	WUSK_ 4	sharptailed grouse	red fox					
Wuskwatim	WUSK_ 5	red fox	hawk	unknown	unknown bird			
Wuskwatim	WUSK_ 6	red fox	sandhill crane					
Wuskwatim	WUSK_ 7							
Wuskwatim	WUSK_ 8	caribou	red fox	owl	small bird			
Reed Lake	reed_1	caribou	moose	bear	human	canada goose		
Reed Lake	reed_2	caribou	moose	bear	human	canada goose		
Reed Lake	reed_3	caribou	bear	lynx	marten	squirrel	woodchuc k	unkown
Reed Lake	reed_4	caribou	bear					
Reed Lake	reed_5	caribou	marten					
Reed Lake	reed_6	caribou						
Reed Lake	reed_7	caribou	bear	moose	marten	unknown		
Reed Lake	reed_8	caribou	white tailed deer					
Reed Lake	reed_9	caribou	marten					
Reed Lake	reed_10	caribou	bear	moose	lynx			
Reed Lake	reed_11	caribou						
Harding Lake	hard_1	caribou	bear	wolf	grouse	sandhill crane	wolverine	

Harding Lake	hard_2	caribou	bear	wolf	sandhill crane			
Harding Lake	hard_3							
Harding Lake	hard_4	caribou	wolf	lynx				
Harding Lake	hard_5	caribou	moose	wolf	sandhill crane			
Harding Lake	hard_6	sandhill crane						
Harding Lake	hard_7	bear	song bird					
Harding Lake	hard_8	bear	moose					
Harding Lake	hard_9	caribou	moose	bear	red fox	marten	grouse	sandhill crane
Harding Lake	hard_10	caribou	moose	bear	hare			
Wimapedi	wim_01	caribou	sandhill crane	song bird				
Wimapedi	wim_02	caribou	sandhill crane					
Wimapedi	wim_03							
Wimapedi	wim_04	bear	sandhill crane					
Wimapedi	wim_05	caribou	sandhill crane					
Wimapedi	wim_06	caribou	bear					
Wimapedi	wim_07	sandhill crane						
Wimapedi	wim_08	moose	hawk					
Wimapedi	wim_09	caribou						
Wabowden	wab_01							
Wabowden	wab_02	caribou	bear	hawk				
Wabowden	wab_03	caribou	wolf	sandhill crane	hawk			
Wabowden	wab_04	caribou	owl					
Wabowden	wab_05	caribou						
Wabowden	wab_06	sandhill crane	crow					
Wabowden	wab_07	lynx	wolf	sandhill crane	song bird			
Wabowden	wab_08	caribou	crow	sandhill crane	song bird			
Wabowden	wab_09	caribou	hawk	sandhill crane				
Wabowden	wab_10	moose	hawk					

Hargrave Lake	HGL_01	caribou	hawk	sandhill crane		
Hargrave Lake	HGL_02	sandhill crane				
Hargrave Lake	HGL_03	caribou	hawk	lynx		
Hargrave Lake	HGL_04	caribou	sandhill crane			
Hargrave Lake	HGL_05	caribou	red fox			
Hargrave Lake	HGL_06	sandhill crane	hawk			
Hargrave Lake	HGL_07	moose	wolf	red fox	sandhill crane	hawk
Hargrave Lake	HGL_08	sandhill crane	rabbit			
Hargrave Lake	HGL_09					
Hargrave Lake	HGL_10	sandhill crane	owl			

APPENDIX F: TECHNICAL REPORT MAPS

Bipole III Transmission Project
Mammals Technical Report

Map Series