BIPOLE III TRANSMISSION PROJECT:

OPERATIONAL PHASE MAMMAL MONITORING PROGRAM TECHNICAL REPORT YEAR 6 (2019/20) –

PART B

JUNE, 2021

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EXECUTIVE SUMMARY

The following Mammal Monitoring Program Technical Report forms Part B for Year 6 on analyses of field work associated with mammal Valued Ecosystem Components (VEC's) identified by the Bipole III (BPIII) Transmission Project ('the Project'). This report provides analyses for data collected during the Operational phase (mid 2018 – 2020) and provides further comparisons and narratives to pre-project and construction period analyses. Part A and B contribute to the annual monitoring framework for annual reporting of the mammal monitoring studies undertaken to assess project effects at both a local and landscape scale through each phase, including the Construction and Operation of the Project. Project effects were identified in the Environmental Impact Statement (EIS) and are described below and have been summarized in previous reports for the Mammals Monitoring Program Technical Reports for Years 1-5 (2016, 2017; 2018; 2019; 2020), and Part A (2019-2020).

Overall project effects have been identified as follows and are also identified in Part A (Year 6):

Habitat alteration, population ecology and community dynamics:

1. *Effectiveness of mitigation measures and management activities; and*
2. *Progress toward achieving Project commitments and monitoring objectives.*

Ongoing evaluation of annual monitoring results are intended to inform an adaptive management process by:

1. *Providing the necessary information to allow for the implementation of adaptive mitigation measures, when and where necessary, to minimize significant effects (e.g., mortality, disturbance) to local mammal populations;*
2. *Facilitating modification of the monitoring design to improve rigor, sampling efficiency and/or duration; and*
3. *Adjusting for unforeseen Project effects encountered.*

Based on the commitments outlined by Manitoba Hydro (MB Hydro) in the Project EIS, the overall objectives of the mammals monitoring program include:

1. *Expanding baseline knowledge of select VEC species interacting with the Project, including estimates of population distribution, population abundance, habitat use and movement patterns, and identification and fidelity of critical habitat sites;*
2. *Ensuring compliance with regulatory requirements and EIS commitments;*
3. *Monitoring and measuring VEC responses to the Project Right-of Way (ROW) creation, Construction, and Operation, including disturbance / avoidance from sensory disturbance, direct and functional habitat loss, changes in population vital rates or demographics, and/or changes in predator-prey community dynamics;*

4. *Ensuring that mitigation measures, management activities, and restoration / enhancement measures are implemented;*
5. *Monitoring the level of success or effectiveness of mitigation measures with respect to reducing ROW effects on VECs; and*
6. *Identifying, measuring, and then mitigating and monitoring any unforeseen effects.*

Reports to date have provided analyses on forest-tundra and boreal woodland caribou (Cape Churchill and Pen Island herds) and barren-ground caribou (Qamanirjuaq herd). Detailed monitoring, including aerial moose population estimates for important moose areas are also found in previous monitoring reports as described above.

Part A includes effects monitoring conducted, and the associated results for the Operational phase of the Project for data collected in Year 6. Part A includes results of analyses conducted on the following:

- **Boreal Caribou Recruitment Surveys** in three potentially effected boreal woodland caribou ranges (The Bog, N-Reed, and Wabowden ranges) to assess predator and ungulate overlap as a potential for increased predation risk from grey wolf, and to compare results with the remote Charron Lake Range, which has little anthropogenic disturbance.
- **Replication of Ungulate-Wolf Winter Distribution Surveys** in three potentially effected boreal woodland caribou ranges and the Charron Lake Range, to also assess and compare predator and ungulate overlap as a potential for increased predation risk from grey wolf.
- **Replication of Multi-Species Aerial Survey** along transects paralleling the BPIII segments N1, N2, N3, N4, and north half of C1. Coarse scale assessment of ungulate and grey wolf overlap to assess predation risk was undertaken through kernel density estimates. Use and/or avoidance of the ROW included the analysis of distance and density values.
- **Winter Ground Track Transect Surveys** were replicated on 39 transects as part of Operation monitoring.
- **Human Access** along Multi-Species Aerial Transects was evaluated to assess potential disturbance along the BPIII ROW during Operation.

Specific Caribou Monitoring Objective (BPIII Environmental Monitoring Plan)

The following describes the overall monitoring objectives and activities that were identified in the BPIII Environmental Monitoring Plan for caribou (MB Hydro 2018). These include the expansion of baseline knowledge and investigating the influence of disturbance-related effects at local and range/population scales. In summary, these monitoring objectives have been achieved and Project-related effects have been evaluated and contrasted between pre, during, and after-Construction data. The monitoring activities to date have contributed significantly to the baseline knowledge of caribou and have increased the understanding of potential effects related to the Project.

BPIII Environmental Monitoring Plan Objectives for Caribou

- Expand the baseline knowledge of annual and seasonal distribution, abundance, and population characteristics of boreal woodland and coastal caribou populations interacting with the Project;
- Investigate the influence (extent and magnitude) of disturbance-related Project effects on local abundance and distribution of boreal woodland caribou. The use of a reference range (Charron Lake) will allow for effects of the Project to be disseminated from natural variation. This requires the use of complementary field and analytical methods and a variety of parameters at two different scales.

Overall Summary of Results and Achievement of Monitoring Objectives

Overall, the results of 6 years of monitoring have contributed significantly to the objective of expanding the baseline knowledge on caribou through the Construction and Operational phases of the Project. The studies conducted to assess disturbance-related Project effects through these phases have illustrated that no significant effects have been observed at either the local or range scale. Significant changes in distribution patterns and population status, including local abundance, mortality, and recruitment among the ranges studied, has not been observed. Some annual variations in distribution have been observed, however, these are expected considering natural variability in caribou behaviours, as well the rotation of collars on individual animals through time due to natural mortality and maintaining minimum collared individuals on an annual basis. Throughout the 6-year monitoring period, there have been no detectable or significant effects on local abundance or general distribution of caribou through the seasonal analyses that have been undertaken. Field and analytical methods on the Charron Lake range have facilitated comparisons to potentially affected ranges and support conclusions of no significant effects during Construction or Operation on caribou populations from the Project.

At the local scale, monitoring has assessed the spatial dynamics of displacement/avoidance-neutral or positive- through telemetry studies, aerial surveys, and trail camera studies. Response and occupation have been assessed during all Project phases, and indicators (as described in the Monitoring Plan) include site fidelity, habitat selection, seasonal habitat use, mortality rates (predators, roads/vehicle collisions), and evaluation of occupancy and movement dynamics for all phases of the Project. Path trajectory and distance-based assessment were used to determine if any detectable influenced behavior occurred within and adjacent to the Project Zone of Influence (ZOI). Factors affecting local scale analysis and conclusions include the proximity of the Project to existing linear features such as roads, rail lines, and preexisting transmission lines. Caribou collaring objectives were achieved through the monitoring period, resulting in collar replacements due to collar life span and mortalities, and contributed to minor differences in some analyses. However, overall patterns of local-scale effects have not been observed, and these patterns of use are similar between Pre-construction, Construction and Operation phases.

At the range/population scale, the P-Bog, Wabowden, N-Reed, and Charron Lake are the main reference caribou ranges: The Charron Lake range provided a baseline control population to compare population indicators for both a remote and undisturbed population. Population abundance and recruitment, in relation to changes in human access, hunting, predation, and other mortality risks (such as vehicle collisions), have been assessed throughout all phases of the Project. These indicators were valuable in the determination of population state such as occupancy/seasonal distribution (calving, rearing and overwintering habitats), movements, home range size, and population abundance/viability, through the assessment of vital rates (i.e., recruitment and survival). These assessments provided evidence of caribou populations remaining stable throughout the monitoring period, with no major changes in range-use or core-use areas through all phases of the Project and support the conclusions to date presented in both Part A and B Year 6 monitoring report.

Summary of Caribou Monitoring Results

The following is a summary of results for Year 6 Monitoring and include a narrative on comparisons to previous monitoring results from Construction and Pre-construction data. Detailed results are found in Section 5.

Range Use (Caribou)

Distributions of annual and seasonal range areas for each monitored population have not shifted since the monitoring program was initiated, and largely show similar patterns of distribution from year to year. Range distribution for all caribou populations in 2019/20 fell partially or completely, within the 2010-2019 range extents, for both overall home range distribution, core overwinter, and calving ranges. The average home range and seasonal range use size for caribou varied across ranges, as illustrated by the high variation in total home range, calving range, and overwintering ranges. The annual and seasonal ranges for Charron Lake caribou are significantly larger than those of P-Bog or Wabowden and are not significantly different in most years. Reductions in total home range area and habitat use overlap between Construction phases and is attributed primarily to seasonal variation in the number of active collars, as well as significant turnover in monitored animals between the Construction and Operation phases of the Project. Very few, if any, individual animals have telemetry records that extend across both Construction and Operation phases, due in large part to no collar deployments in 2017 or 2018.

Site Fidelity

Results for the 2019/2020 Operation phase period are very similar to those reported previously. Patterns of fidelity in the analyses follow those expected based on caribou biology. At the population-level pre-parturition movements are generally large as animals move (in some cases over very large distances) to their preferred calving locations. In May there is generally a strong fidelity behaviour as females start calving. At this time, both mean inter-annual distance is low (propensity to return to the same location each year) and confidence intervals are narrow (tendency to return and remain close to these locations). Over the course of the summer and into fall, movements increase with confidence limits, but still demonstrate strong fidelity. There is evidence for 2019/2020, as found in previous years, in strong site fidelity during calving.

Many of the same patterns at the population scale are seen at the local (monthly) scale. The patterns observed between different ranges are more likely due to inherent differences in range size, and landscape patterns. The P-Bog range is strongly bounded by landscape features such as large waterbodies (Cedar Lake) and landforms such as the Long Point moraine; the Wabdowen range has similar geophysical constraints, as well as other woodland caribou populations. Charron Lake animals have a large range with multiple core areas.

Zone of Influence

Previous reports suggest a narrow Zone of Influence (ZOI) of approximately 1 to 2 km during the Construction phase in the P-Bog range (MMPTR 2019) and a short ZOI of approximately 1 to 2 km for the pre-existing linear corridor present during the Pre-construction phase in the Wabowden range, as well for the widened corridor created through Project Construction (Wood 2019).

This pattern of reduced use of habitat adjacent to the ROW has continued into subsequent years of Operations. For both ranges, caribou locations occurrences were reduced within the first 2 km of the Bipole III alignment relative to areas farther away. While this could be a model effect, it may be an actual pattern in the data that may not be entirely the influence of the Bipole III alignment. In the Wabowden range, an existing railway, predating the alignment appears to act as a significant barrier to movement and has been for some time. This relationship appears in Pre-, During- and Post-construction, although there are more telemetry locations north of the ROW Pre-construction.

Crossing Analysis

In the P-Bog range, when comparing the actual number of crossings to simulated total crossings for each animal, none of the collared caribou cross or avoid the ROW more or less than expected or previously report during the construction period. When comparing the observed total number of crossing to the per-animal distribution created in the simulations, no animal significantly avoided the ROW. The total number of crossings for all other animals were well within the distribution of random crossings observed. At the population-level, the distribution of mean total number of crossings for the P-Bog simulations was compared to the observed mean total crossings for that range, and the test of avoidance was not significant. In P-Bog, there is no strong evidence at the individual and population level that caribou are avoiding the ROW. This finding may support mitigation efforts, since many of the observed crossings in this range occur at mitigated sites (see mitigation section below).

The caribou in these ranges display strong site fidelity as demonstrated in the fidelity analysis. Animals collared on one side of the alignment may not cross because of fidelity to that particular area. This may be an important factor in explaining the pattern of movement observed for the Wabowden range. Habitat selection and fidelity are confounded with barrier effects and determining which of these three factors best explains the difference between observed and CRW crossings should be examined in the future.

Mitigation Effectiveness Monitoring

In previous reports: 2016 to 2018, caribou in the P-Bog range crossed the ROW at mitigated areas more frequently than non-mitigated areas, but it was found in the 2018-2019 season that caribou did not choose to use the mitigation areas as often as was predicted and/or as observed in previous years. It was speculated that low sample size, or a reduction in sensory disturbance following Construction phase completion, might explain those results. In 2019 a collar redeployment program ensured that an adequate number of individuals were being tracked, and with additional years of data, sample size is greatly improved. The results suggest that mitigated crossings were used significantly more than non-mitigated crossings ($p = 0.0015$). These 2019-2020 results reflect the trends from 2016-2018 with higher crossing rates at mitigated sites.

Moose

Overall, moose monitoring objectives include determining changes in moose distribution, population trends over time, wolf and human presence, effects on vehicle collisions, and habitat (browse). In addition, MB Hydro committed to- and provided support to- Manitoba Agriculture and Resource Development (ARD) in a Moose Stewardship Study, which included moose population assessments through aerial surveys, as well as supporting researchers, public, and indigenous communities towards moose conservation in the western region of the Project.

Results from multi-species surveys (Part A) and trail camera studies have not identified any observable effects related to increased predation, human access, or disturbance.

The data from moose surveys conducted by the Province of Manitoba in 2020 provided on the ARD website (https://gov.mb.ca/sd/pubs/fish_wildlife/hunting/2020biggame_results.pdf) are summarized in Table 7 and Figure 22. In both the Porcupine Hills (GHA 13/13A) and Duck Mountains (GHA 18/18A/18B/18C) areas, moose populations appear to be at- or above- their long-term means. In these areas, hunting closures and other management activities have been in effect since 2011. Populations have been increasing slowly following these management prescriptions. As moose populations in GHAs 13/13A and 18/18A/18B/18C have been increasing during the Pre-construction and early Operation phases of Bipole III, there is no evidence of an impact. However, it is hard to determine direct effects of the ROW based on these data. Clearly, reduction of mortality through harvest closures has proved to be an effective management tool, and may continue to be, to mitigate impacts of climate change and other stressors on the moose population.

Several hypotheses identified in the Monitoring Plan are expected to be addressed in future years, including browse availability and vegetation management to benefit moose, and assessing long-term abundance and distribution of moose throughout the region. Through the course of monitoring, it has been determined that moose mortality due to vehicle collisions is not an issue, and no mortalities associated with the Project have been documented.

Trail Camera Analysis

Deployment and analysis of trail camera data are contributory to the overall monitoring objectives and provide information on the distribution of ungulates, predators, furbearers and human activity. A total of 70 trail cameras (36 on ROW, 34 at 1500m from ROW) deployed in 2019/20 yielded a total of 729 recordings. Of these, 428 wildlife recordings of 12 different species were logged. Overall occurrence of wildlife was found to be similar between on-ROW (48.1%) and off-ROW (51.9%). In instances where occurrences were significantly different, the data indicated significantly more on-ROW occurrences in all cases but one. In comparison, Construction stage observations found a greater proportion of observations occurring off the ROW. With the completion of Construction activities, and a relative decrease in overall activity and disturbance on the ROW, it can be expected that wildlife habitat use on-ROW would increase relative to during the Construction stage. Human activity was noted in 65 recordings (excluding camera maintenance), with the most prominent being commercial truck (n=18) and snowmobile/all-terrain vehicle (ATV; n=24) traffic. Construction equipment (n=15), helicopter (n=11), and personal light duty vehicles (n=6) were also noted. All human activity observations occurred during winter months, except for two observations during May, indicating that frost free travel is extremely limited along the Project.

Furbearers

Key monitoring activities for furbearers identified in the Monitoring Plan included monitoring trapping activity and furbearer distribution and occurrence through trail camera studies. An analysis of furbearer trapping harvest reports for the Operation stage of the Project (2018/2019 and 2019/2020) shows a substantial decrease in total harvest for nearly all species assessed, and across all segments of the ROW, compared to the Construction phase. For nearly all species and construction segments, similar decreases in total harvest have been noted from Pre-construction to Construction, and again to Operation stages. When considering the mean annual number of trapping licenses issued for each time period, similar- though less- decreases in species harvest exist. This decrease in both total mean annual harvest and annual harvest per license issue is reflected in the mean number of trapping licenses issued annually, which has similarly decreased from an average of 456 licenses issued per year during the Pre-construction phase, to 246 licenses per year during Construction (46.1% decrease), and 30 licenses issued per year during Operation (93.4% decrease). This decrease is substantial, and likely reflects decreases in market value of pelts and associated trapper effort noted over the past few years, as the economic sustainability of the trapping industry has severely diminished.

When comparing distribution and abundance of furbearers from trail camera studies during Construction and Operation, there are similar trends in these data. During operation, coyote, wolf, fox, Canada lynx, and hare were observed closer to the ROW. Compared to the Construction period, wolf and fox showed preference for the ROW. When considering all years of data collection spanning Pre-construction, Construction, and operation, and the results of monitoring from ground transect surveys (Part A Report), camera trap, and trapping records, the Project effects on furbearers is minor to undetectable. The monitoring program did demonstrate that there was a slight increase in the species abundance along the ROW after Construction, which would be expected as this was a short-term disturbance, and habitat is available for those species in proximity to the ROW.

Monitoring and Mitigation Recommendations

As per the Monitoring Plan, this is the last year of field data collection. Some recommendations are provided below.

For caribou, attrition of functional collars and reduced sample size will affect the efficacy of future comparisons in Construction and Operation analyses. A review of functional collars is recommended prior to future analyses, and it is possible that winter 2020-2021 data may be useful in the contribution of additional knowledge and further reporting on comparing caribou response during Construction and Operation for some analyses such as crossing mitigation sites in the P-Bog range.

For moose, continue to include ARD survey results to verify population status through Operation and consider other moose management implications to population response (hunting). Future assessment of MH funded research and hypothesis testing as described above. Assess future Keeask moose survey data in relation to the Project.

For furbearers, consider the utility of ongoing harvest monitoring in light of significant variation in trapping effort. Evaluate remaining trail camera deployments and continue to monitor human use where deployments exist.

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LIST OF ACRONYMS

ATV	All-Terrain Vehicle
ARD	Manitoba Agriculture and Resource Development
BACI	Before-After-Control-Impact (Design)
BBMM	Brownian Bridge Movement Model
CRW	Correlated Random Walk
EIS	Environmental Impact Statement
GHA	Game Hunting Area
GPS	Global Positioning System
MB Hydro	Manitoba Hydro
MB Gov	Government of Manitoba
LOS	Line of Sight
N-Reed	The Reed portion of the Naosap-Reed boreal woodland caribou population
P-Bog	The Bog portion of the Pasquia-Bog boreal woodland caribou population
RSF	Resource Selection Function
ROW	Project Right-of-Way
UD	Utilization Distribution
VEC	Valued Ecosystem Component
WMA	Wildlife Management Area
ZOI	(Project) Zone of Influence

1.0 INTRODUCTION

As described in Part A, Manitoba Hydro (MB Hydro) was granted an Environment Act License by the Government of Manitoba (MB Gov 2013) on August 14, 2013 for the Construction, Operation, and maintenance of the Bipole III (BPIII) Transmission Project (the 'Project'). Clearing for the Project began during the winter of 2013-14, the Construction phase was completed in July 2018, and the Project is now in the Operational phase.

Terrestrial mammal Project effects focused on caribou, moose, and furbearers (CEC 2013). The regulatory review of the Environmental Impact Statement (EIS) identified various potential negative effects as a result of the Project Construction and Operation. For ungulates, concerns were related to habitat alteration, access, and human activity that could lead to displacement and higher than normal rates of mortality known as apparent competition.

The theory of 'apparent competition' was first advanced by Bergerud (1967) to explain observed and negative population response of predator and prey. Holt (1977) presented a general mathematical framework to explain how dynamic functional relationships between two prey species, that share a common food-limited predator, could lead to a shift in the equilibria density of the predator, and differentially impact the population densities of each prey species. This theory is known to explain the decline of woodland caribou populations that have been exposed to higher wolf densities arising from disturbance and human development (Bergerud and Elliot 1986). More recently, the theory has been adopted to account for several woodland caribou population declines throughout various boreal and southern mountain caribou ranges in Canada, based on the premise that widespread anthropogenic landscape disturbances (e.g. forest harvesting, energy exploration, and development) favoured higher moose and wolf population densities on the periphery of caribou ranges, thereby effecting a shift in the equilibria balance (Serrouya 2019; Holt et al. 1994).

Mammal Valued Ecosystem Components (VECs) were selected based on their ecological, cultural, and economic importance and associated potential effects related to the Project. These included boreal woodland caribou, forest-tundra woodland caribou, barren-ground caribou, moose, elk, white-tailed deer, grey wolf, black bear, and furbearers (including beaver, wolf, wolverine, and marten).

2.0 MONITORING OBJECTIVES AND FRAMEWORK

Monitoring objectives described below include those for both Part A and Part B reports. The objectives of the overall monitoring plan are to:

- Confirm the nature and magnitude of predicted environmental effects as stated in the EIS;
- Assess effectiveness of mitigation measures implemented;
- Identify unexpected environmental effects of the Project, if they occur;
- Identify mitigation measures to address unanticipated environmental effects, if required;
- Confirm compliance with regulatory requirements including approval terms and conditions; and
- Provide baseline information to evaluate long-term changes or trends.

The BPIII mammals monitoring program provides a framework to address multiple assessment objectives for each mammal VEC. These include spatial and temporal monitoring activities for each phase of the Project to assess if potential effects identified in the EIS and regulatory review are measurable and if mitigation and adaptive management actions have accomplished their objective to minimize potential effects relative to disturbance, displacement, increased mortality, or negative population responses via apparent competition.

Specifically, detailed monitoring objectives for caribou for all phases of the Project are found in Appendix 1 Table 1-Appendix 1 Table 2.

Based on the commitments outlined by MB Hydro in the Project EIS, the overall objectives of the mammals monitoring program include (Mammals Monitoring Program Technical Report Year 5 (2020):

1. *Expanding baseline knowledge of select mammal VECs interacting with the Project including estimates of population distribution, population abundance, habitat use and movement patterns, identification, and fidelity of critical habitat sites.*
2. *Ensuring compliance with regulatory requirements and EIS commitments.*
3. *Monitoring and measuring select mammal VEC responses to Project Right-of-Way (ROW) Construction and Operation including disturbance / avoidance from sensory disturbance, direct and functional habitat loss, changes in population vital rates or demographics, and/or changes in predator-prey community dynamics.*
4. *Ensuring that mitigation measures, management activities, and restoration / enhancement measures are implemented.*

5. *Monitoring the level of success or effectiveness of mitigation measures with respect to reducing ROW effects on mammal VECs.*
6. *Identifying, measuring, and then mitigating and monitoring any unforeseen effects.*

2.1.1 Boreal Woodland Caribou

Caribou monitoring plan objectives as described in Part A and included in this Part B report (Appendix 1 Table 1) are to:

1. Expand baseline knowledge of distribution, abundance and population characteristics of boreal woodland caribou interacting with the Project.
2. Investigate Project influence on woodland caribou at local and range (P-Bog, Wabowden, N-Reed, and Charron Lake) scales.
3. Assess effectiveness of mitigation measures.
4. Investigate the influence of Project effects on mortality (predation and/or hunting and/or vehicle collisions) on boreal woodland caribou (P-Bog, N-Reed, Wabowden, Charron Lake populations), forest-tundra woodland caribou (Penn Islands and Cape Churchill populations) and barren-ground (Qamanirjuaq) caribou populations interacting with the Project.

2.1.2 Human Access

Human access as presented in Part A, the monitoring plan objectives (Appendix 1 Table 2) are to assess changes in access to the Project area by humans.

2.1.3 Adaptive Framework Management

Adaptive Management was originally developed in the late 1970's as a formal, rigorous stepwise scientific tool to assist managers in the design, implementation and testing of management prescriptions that have a degree of uncertainty and risk (Holling 1978). Adaptive Management, by definition, is the process of defining management problems, hypothesizing how ecosystems work, identifying affordable paths to reduce uncertainty and risk, comparing results with predicted outcomes. The identification of information gaps, adapting with refined approaches to monitoring is a basic principle of Adaptive Management (Lancia et al. 1996).

There are constraints including sufficient time and resources to reduce ecological uncertainties and risks, and equally to reach out to stakeholders in meaningful ways at each and every step from problem identification to the refinement of future actions to maximize both support and acceptance (Walters 1986). Adaptive Management in the context of the BPIII monitoring program has involved annual review of monitoring results with regulators to determine efficiencies in data collection and analysis to provide direction or modification to the monitoring program.

The BPIII Biophysical Monitoring Plan (MB Hydro 2018) includes the implementation of adaptive management strategies that have guided and informed Project mitigation activities (habitat management and timing of Construction phase activities) and modifications to monitoring to minimize potential Project effects and create efficiencies relative to survey designs and effort throughout the various phases of the Project. Adaptive Management principles and objectives for the BPIII Monitoring Project have been outlined in previous reports and include:

1. *Baseline monitoring is intended to identify temporal and spatial variability within an ecosystem, biological community, or population to understand the historical range of variability prior to disturbance by BPIII. Baseline monitoring will continue in areas prior to Construction phase and clearing the ROW. After Construction, baseline monitoring will be focused in reference areas outside of the Project ZOI (Zone of Influence).*
2. *Effects monitoring investigates the influence (extent and magnitude) of disturbance-related Project effects on the habitat, population and/or community level components for each mammal VEC. Reference or control sites will be used where feasible to allow for effects of the Project to be disseminated from natural variation. Assessment of pre-disturbance condition to post-disturbance is used to assess the Project effects and mitigation effectiveness.*
3. *Effectiveness monitoring is conducted by measuring or estimating the effectiveness of mitigation measures, management activities, habitat restoration and enhancement measures. Where mitigation measures are not providing adequate protection for mammal VECs or their habitat, monitoring results will be used through a passive adaptive management framework to modify or identify new strategies to employ.*
4. *Implementation monitoring will be undertaken to ensure that mitigation measures were implemented as specified in the EIS, technical reports and EA License and that activities are compliant with applicable provincial and federal environmental legislation. Implementation monitoring is used to track the implementation of mitigation measures, management activities, and ecological restoration and enhancement measures identified in the EIS commitments. This inspection is largely completed by environmental inspectors overseeing the Construction of the ROW.*

2.2 **Study Design**

The Operational monitoring conducted in year 6 are based on the commitments described in the BPIII Biophysical Monitoring Plan (2018). As outlined above, emphasis includes monitoring on boreal woodland caribou, moose, predation (apparent competition), loss of functional habitat due to disturbance and effects on furbearers on three main components: (1) Habitat Effects; (2) Population Effects; and (3) Community Effects.

The following Section describes the details of monitoring activities for the components of this report including analysis of trail camera data and caribou telemetry.

3.0 MONITORING ACTIVITIES

Operational monitoring activities and analysis have replicated, and augmented, previous surveys conducted within the Boreal Shield and Boreal Lowlands Ecozones (Map 1; See Appendix 2). Monitoring activities conducted through the life of the Project to date include:

- **Pre-monitoring (2013/14)** - conducted by MB Hydro in 2013/14, including review of existing information and acquisition of baseline datasets from the Project EIS regulatory review, associated technical reports, and the BPIII Transmission Project Biophysical Monitoring Plan (MB Hydro 2018).
- **Construction Phase (2014 to 2018)** - Annual mammals monitoring reports were prepared and submitted to regulating authorities for all years of construction (Mammals Monitoring Program Technical Report Years 1-5 (2015, 2016, 2017, 2018, 2019).
- **Operation Phase (mid 2018 – winter 2020)** - data was quantified and compared from caribou telemetry, trail cameras, moose surveys, and furbearer harvest.

4.0 METHODS

The following section summarizes field and analytical methods used to quantify and compare results from primarily the second year of the Operational phase (January 2019 to October 2020).

4.1 Boreal Woodland Caribou

Two woodland caribou ranges (P-Bog and Wabowden), that have been identified as potentially affected by the BPIII Project, have animals currently being monitored using satellite GPS collars. In addition, Charron Lake a range far removed from the Project, with little anthropogenic disturbance, has been selected as a reference for comparisons of population demography and predator risk. Map 2 (See Appendix 2) provides an overview of the study areas for these ranges where aerial recruitment surveys and ungulate/predator distribution surveys have been conducted.

4.1.1 GPS Satellite Telemetry Studies

GPS satellite collar telemetry studies were initiated for the Project in 2010 and are currently underway in four woodland caribou ranges. Two of the woodland caribou ranges (P-Bog, Wabowden) interact with the Project and have been included in the monitoring program to assess the extent (if any) that the Project alters movement dynamics of woodland caribou within each of these ranges. Caribou within the N-Reed range have not demonstrated frequent interaction with the Project footprint since the monitoring program was initiated in 2014. Charron Lake is included in the monitoring program as a reference range that is isolated from the Project, as well as other forms of cumulative disturbance (e.g., mining and forestry). These ranges were all delineated through long term monitoring data of satellite collared caribou and defined by MB Gov (2015). Telemetry was continued in Year 6 of this monitoring program; no new collars were deployed in Year 6, thus analysis relied on those collars still active (Charron Lake n = 18; Wabowden n = 19 and P-Bog n = 21 caribou ranges).

A Before-After-Control-Impact (BACI) study design has been implemented to assess for potential shifts in behaviour relative to baseline conditions observed during the Pre-construction period and/or the reference location, as well as across all phases of the Project including;1) Pre-construction; 2) during Construction; and; 3) Post-construction. Specifically, monitoring objectives for the woodland caribou satellite telemetry program are to:

1. Quantify whether there are any shifts in annual or seasonal range use through Project phases. Shifts in range use can indicate responses to disturbance or suggest adaptation to variation in local abiotic or biotic factors.

2. Quantify whether there are any shifts in levels of site fidelity to annual and/or seasonal ranges areas through different phases of the Project. Abandonment of traditionally used areas can indicate responses to disturbance.
3. Quantify resource selection functions and use RSF models to control for habitat related variation in ZOI.
4. Determine whether there is a detectable ZOI around the Project demarcating the change in behaviour of caribou relative to the Project location.
5. Determine whether the Project has caused a barrier to movement on the landscape.
6. Quantify the extent to which caribou are using or benefitting from mitigative tools installed on the landscape such as vegetation leave areas.

Annual and seasonal range use and site fidelity analyses were completed for all ranges. Analysis of the ZOI around the Project was completed for the Wabowden and the P-Bog ranges for both the Pre- construction, Construction phases and the first year of Operation. Too few animals in the N-Reed range have spent enough time in proximity to the Project to quantify the ZOI for this range. ZOI analysis will not be undertaken for the Charron Lake range as it is not impacted by the Project and is a reference range.

In the Wabowden range, the Project widened an already pre-existing linear corridor providing the unique opportunity to examine the response of caribou to the widening of an existing linear disturbance. A ZOI around this linear feature could have been in the Pre-construction period, prior to the Project widening it. Subsequently it was decided that the analysis would; 1) assess whether there was a ZOI associated with the pre-existing linear feature during the Pre-construction phase and then 2) assess the extent to which the ZOI changed as a result of the Project installation during the Construction and Operation phases.

In the P-Bog range, aside from some limited areas adjacent to Highway 10, the Project created a largely new corridor on the landscape allowing for the assessment of the response of caribou to the creation of a new corridor. Accordingly, the analysis assessed whether there was a ZOI around the Project during the construction phase.

4.1.1.1 Range Use

Kernel analysis was undertaken on the 2020 telemetry data set provided to Joro by MB Hydro. The kernels were developed from Utilization Distributions (UD)s using the adehabitatHR package (Calenge, 2006) in CRAN-R (R Core Team 2020). These were used to generate isopleths or relative probabilities of occurrence to identify the annual home range for each GPS collared animal and the relative probabilities of use within that home range. This includes a home range analysis based on a 90% UD isopleth using all 2019/20 telemetry data, as well as analyses of core calving and overwintering ranges, based on a 70% UD isopleth derived from telemetry data specific to those seasonal periods. Core over-wintering areas included telemetry data from December 1 to

February 28, and core calving areas included data from May 1 to June 30, which is consistent with previous analyses. Kernels were also be used in defining areas to be included as part of the Zone of Influence analysis.

Range use was compared with previous results and mapped. This analysis represents a transition for algorithms developed in ArcGIS to the more robust methods provided in adehabitatHR that allow calculation of statistics of overlap. For each range, a study area extent encompassing all animals and buffered by 20 km was selected for a grid surface with a cell size of 100 m x 100 m. The smoothing parameter h was calculated as part of a preliminary analysis and evaluated to develop a final parameterized model for calculation of the overlap statistics. These statistics allow for a robust comparison of range use to determine those areas that are critical for most animals over the entire year versus areas that are of seasonal importance.

4.1.1.2 Site Fidelity

As in previous years, Joro followed similar methods to Schaefer et al. (2000) to define fidelity through the propensity for consecutive year locations of an individual to be closer together than random pairs of locations from satellite collared caribou. The total population range is defined as the total area encompassing all locations of satellite collared animals within each respective range (i.e., Wabowden, P-Bog, N-Reed and Charron Lake) that were assessed.

This was accomplished through an analysis of null expectations of fidelity (random pairs of locations for animals by month and by range) compared to empirically based distances between consecutive year locations for each caribou. To accomplish this, GPS locations from the existing caribou telemetry database were pooled by month and year, and random pairs of points were selected in CRAN-R and the Euclidean distance was calculated. All animals within a range were pooled for each month as in previous reports and used to get a mean expectation by month for the random (null model). To achieve a sample size for random distances similar to the number of observed animals, 20 random pairs were selected and used in mean distance calculations and this was repeated 10,000 times to achieve full randomization. Pooling by month during randomization incorporates changes in overall range-use that occur during the year.

For the observed pattern of distances between consecutive years, the harmonic mean of monthly range use for each collared caribou was calculated. The Euclidean distance between harmonic means (2019/2020) for each month and for each animal was determined. Mean, standard deviation, and confidence intervals were calculated by month. Means from the randomization procedure were compared to actual mean locations for each month by animal and range to determine site fidelity.

As in previous years, this analysis was repeated at the range-level by pooling animals by year and range prior to making random selections in the randomization procedure. The monthly observed distances were not modified in this analysis, but a pooled range-level null model was generated.

This does not incorporate monthly changes in range-use during randomization, and instead reflects monthly range use relative to total range use.

Site fidelity is evident when the mean and confidence interval for actual distances observed between years by month is less than the mean random expectation between years (either by month or at the range-level). Trends in site fidelity for Operation years 2019/2020 were compared to the results for both the Pre-construction (2010 to 2014), Construction (2014 to 2018), and the first year of Operation (2018/19), as published. Larger distances between monthly harmonic means from year to year indicate weaker fidelity, while smaller distances between harmonic means indicates stronger fidelity.

Based on past monitoring results, the Charron Lake range is essentially undisturbed and is included for comparison with ranges intersected by the corridor. The results from the above-described analysis will be utilized to compare, where possible, Pre-construction, Construction and Operation site fidelity. This will be presented at the population/range level.

4.1.1.3 Zone of Influence

The ZOI is the defined as a region that extended around a feature in which animals' behaviour, habitat selection and distribution is different relative to areas further from a disturbance feature (Johnson et al. 2005, Johnson and St. Laurent 2011, Boulanger et al. 2012). Because this zone occupies a larger area of the landscape than that directly disturbed, and because different ZOI (and their extents) exist for each disturbance type, they can potentially result in cumulative effects on wildlife (Johnson & Russell 2014, Dyer et al. 2001, Vors et al. 2007, Quinonez-Pinon et al. 2007, Leblond et al. 2014, Polfus et al. 2011 and Dussault et al. 2012). Reduced occurrence of wildlife adjacent to a disturbance can be used as a direct measure of ZOI.

In previous years, Project ZOI within Wabowden and P-Bog ranges was quantified using a linear regression with habitat and distance predictors. A ZOI was determined for each range, with Wabdowden representing an existing corridor and P-Bog a new corridor. The model developed in previous years determined that a ZOI extending within 1-2 km from the alignment was present for both ranges into the Operation phase. As this model predicted a reduced occurrence of caribou within this zone, Joro did a direct test of occurrence by examining the density of telemetry locations within the ZOI and adjacent landscape. While the model types and parameters are different, the same relationships should exist, and thus results from the two approaches should reinforce each other and form a robust analysis of the ZOI.

Based on previous results, Project ZOI was assessed within the Wabowden and P-Bog ranges where there are a large number of caribou locations within 10 km of the Project, collected in previous years, as well as the 2020 telemetry data set. The Wabowden range generally parallels areas of previously existing linear development, and P-Bog ranges have sections that include new ROWs that parallel existing linear development and areas of newly created corridors. Our approach separately examined these areas and calculated ZOI for both types of development. The N-Reed range no longer has caribou that are actively monitored for this analysis.

In this report, for both the P-Bog and Wabdowden ranges, the area of range use intersecting the corridor was determined and the number of caribou telemetry points within concentric distance buffers of 250 m was calculated following Schindler et al. (2007). These were expressed as density per buffer interval, and a polynomial model was fit to the density by distance relationship in CRAN R.

We examined the patterns of occurrences from the corridor out to a distance of 10 km and found (as in previous years) that the ZOI was within 2 km from the corridor. Most occurrences beyond 6 km reflected other patterns of range use and habitat features. To reduce potential overfitting of the model by incorporating higher order terms to account for these trends, the final polynomial models were fit to the first 6 km, where disturbance effects are most pronounced. A stepwise Akaike Information Criteria or AIC approach was used to determine the optimal order of the polynomial model and number of parameters. The final model was performed using the function poly. Model and model residuals were calculated. Trends in density were then examined to see if the corridor influenced rates of occurrence and whether patterns observed were similar to previous years.

4.1.1.4 Crossing Analysis

The avoidance of linear disturbance result in barrier effects restricting movement within ranges (Schindler et al. 2007). This can be assessed through crossing analysis, where actual crossing movements of individuals are compared to the number of crossings that might be expected by randomly moving caribou. To account for sequential correlation, while also incorporating randomness, Correlated Random Walks (CRW)s are often used (Turchin 1998).

This analysis used the files created for the Brownian Bridge Movement analysis (see below) in CRAN-R using package adehabitatLT. This package generates ltraj objects that summarize observed step lengths (distance move between telemetry fixes) and direction. This provides base input into correlated random walk models where either step length is randomly selected from the observed distribution of steps or direction is randomly selected or both. By using the observed trajectories and trajectory structure, each random movement path started at the same location as its paired caribou movement path, with the same chronological series of distance movements or bearings. For the results reported here, a randomly determined bearing was used between each movement. However, the entire process was automated in CRAN R and we also evaluated all possible models by randomizing distance, and both distance and bearing between movements, to determine if results were consistent. Paths developed using CRW have the same overall appearance as actual movements, but without the same site fidelity and habitat use as actual animals. The spatial predicate intersect was used to determine if a CRW crossed the Bipole III alignment. This was repeated 100 times for each animal in the P-Bog and Wabdowden range. The number of CRW that crossed the corridor was determined, and figures illustrating example CRW paths generated by the analysis are provided.

Summary of actual animal crossings includes the number of animals in the range crossing the alignment, number of crossings, and means and standard deviation. These were compared with the number of CRW crossings for each range. These results, in addition to an example of barrier effects caused by linear features unrelated to Bipole III, are discussed.

4.1.1.5 High Use Areas - Brownian Bridge Movement Models

In standard kernel habitat use models, point locations are treated as discrete, and do not include habitat used as part of movement. Movement corridors are a critical component of high use habitat and may be impacted by disturbance. The Brownian Bridge Movement Model (BBMM) model estimates the probability density function for habitat use between observed locations by dividing the timesteps into smaller intervals than recorded in the original data. Rather than connecting these using straight segments, a Brownian movement model is used based on model parameters that reflect existing movement. Movement paths in this report were quantified using BBMM's similar to previous reports, to identify population level movement paths during 2019/2020 Operation phase mapped in relation to the ROW for P-Bog and Wabowden and in relation to overall landscape for Charron Lake.

The packages adehabitatLT and adehabitatHR (Calenge 2006) were used to determine the Brownian Bridge estimator in CRAN R (R Core Team 2020). To accomplish this the telemetry for each animal in each range was examined and converted into trajectory (ltraj) objects in package adehabitatLT. There are number of functions to create, evaluate, and clean trajectories provided by this package, in particular those that can fix and standardize timestamps. BBMM are sensitive to the time steps in the observed data, and these structures are ideal. They can also be used as input to other movement models such as Correlated Random Walks (see above) and to estimate Brownian model parameters.

Once the trajectories were standardized by time step, existing movements were analyzed using the liker function to estimate Brownian parameter sigma1. A range-level spatial extent was developed, and each trajectory for each animal was analyzed using the kernelbb function in package adehabitatHR. The model result is a spatial UD that represents the probability (between 0 and 1) that an individual enters a raster cell. The size and extent of the total raster grid included the total extent of all the movement paths, set to a resolution of 200 x 200 m (4 ha). Previous reports indicated that this resolution was an ideal trade-off for processing time while providing high resolution imagery. Because Joro automated this in CRAN R, we examined several different cell resolutions including 100, 250, and 500 m and compared them. Overall UD were similar, so the 200 m cell size used in previous years was retained for consistency in reporting. It should be noted that cell resolution does not change the movement corridors identified in the analysis, and instead provides more fine grain detail in the core areas, which do not meet the definition of corridor movements.

Population level high-use areas were identified by combining the UD for each animal, where each cell was given a value based on the number of animals that used that cell during the 2019/2020 Operation phase. These were expressed as percentage for comparison across ranges, and a colour ramp was applied to identify caribou low to high use areas. The 2019/2020 Construction phase maps were visually assessed and compared with those previously reported.

4.1.1.6 Effectiveness of Vegetation Mitigation Analysis

There are two types of vegetation clearing that have been undertaken within caribou ranges for the purpose of mitigating potential barrier effects caused by the ROW:

1. Full ROW Clearing (non-mitigated) – large vegetation cleared from the entire ROW to a width of 50 m. Full ROW clearing was applied in areas that were not designated as sensitive for caribou.
2. Centreline Clearing (mitigation) – large vegetation cleared only from the centerline of the ROW, although this clearing also includes removal of trees taller than the 40% line of sight (LOS) angle to the edge of the ROW and beyond. Along these sections of the ROW there are more trees and shrubs remaining following construction.

Centreline clearing was applied in areas previously used by caribou and attempted to leave as much vegetation structure as possible, with the goal of reducing the width of the open area. It is considered a form of mitigation, as this provides more cover for caribou and thus reduces the barrier effect of the ROW. Therefore, if the mitigation strategy is effective, we would expect to see caribou continue to use these areas to cross the Project more than sections with full clearing.

In the P-Bog range, the site-specific locations of the vegetation mitigation prescriptions are known. Analysis has been undertaken to assess the extent to which these mitigation areas effectively facilitated movement across the ROW (comparison of mitigated to unmitigated areas within the range) and are described in previous reports. In this report, we compare the proportion of mitigated crossings to unmitigated crossings from observed caribou. If caribou are crossing at mitigated areas, a higher proportion of mitigated crossings for observed caribou may be expected. To emulate previous analyses, speed of movement across the ROW was calculated and compared in mitigated and unmitigated areas. Based on preliminary results, tests of significance were undertaken to determine if there are any differences in animal behaviour (travel speed) across mitigated and unmitigated sites.

In the Wabowden range, mitigation was applied to the entire length of the ROW within the range. Therefore, a comparison of mitigated versus unmitigated areas was not undertaken as described in previous Wood (formerly AMEC) reports (Mammals Monitoring Program Technical Report Years

1-5; MMPTR 2016, 2017, 2018, 2019, 2020). However, crossing analysis was performed to determine the barrier effect of the ROW.

4.2 Moose

Data collated from moose surveys conducted in 2020 was compiled for Porcupine Hills (Game Hunting Area - GHA 13/13A) and Duck Mountains (GHA 18/18A/18B/18C). This information is available through the Manitoba Agriculture and Resource Development (ARD) website (https://gov.mb.ca/sd/pubs/fish_wildlife/hunting/2020biggame_results.pdf). Information in this publicly available report were summarized, tabulated, and graphed to trends that may relate to potential effects of the BPIII line on these populations, recognizing that moose conservation efforts (hunting closures) and other management activities have been in effect.

4.3 Trail Camera Analysis

The purpose of camera trapping is to monitor Project disturbance effects on mammal species and relative predator distribution at fine scale by comparing occurrence and distribution near the Project ROW vs away from the Project ROW across seasons and Project phases. Joro has been provided trail camera data that includes 729 records (May-1919 to Feb-2020) collected from 70 trail cameras deployed across the Bipole III ROW, including 36 cameras positioned on the ROW, and 34 cameras positioned at a point 1500m from and facing the ROW (Figure 1). Camera trap data includes caribou, moose, large predator (wolf, black bear, and wolverine), white-tailed deer, and furbearer occurrence relative to the ROW. Human activity is also included in this database. These data will be synthesized and compared to previous analyses to the extent possible. Due to low sample size during this period, statistical analysis is limited, thus descriptive statistics are used in providing additional narratives in other sections related to Project effects.

4.4 Furbearers

Annual records of trapline licensing and harvest reporting were provided by ARD. Data were reviewed and summarized in comparison to statistics from previous years, including Pre-construction (2010-November 2014), Construction (December 2014 – August 2018) and Operation (September 2018 – 2020) stages of the Project. Data was analyzed by species based on both total harvest (mean animals per year) as well as in proportion to the number of licenses issued each year (mean animals/license per year).

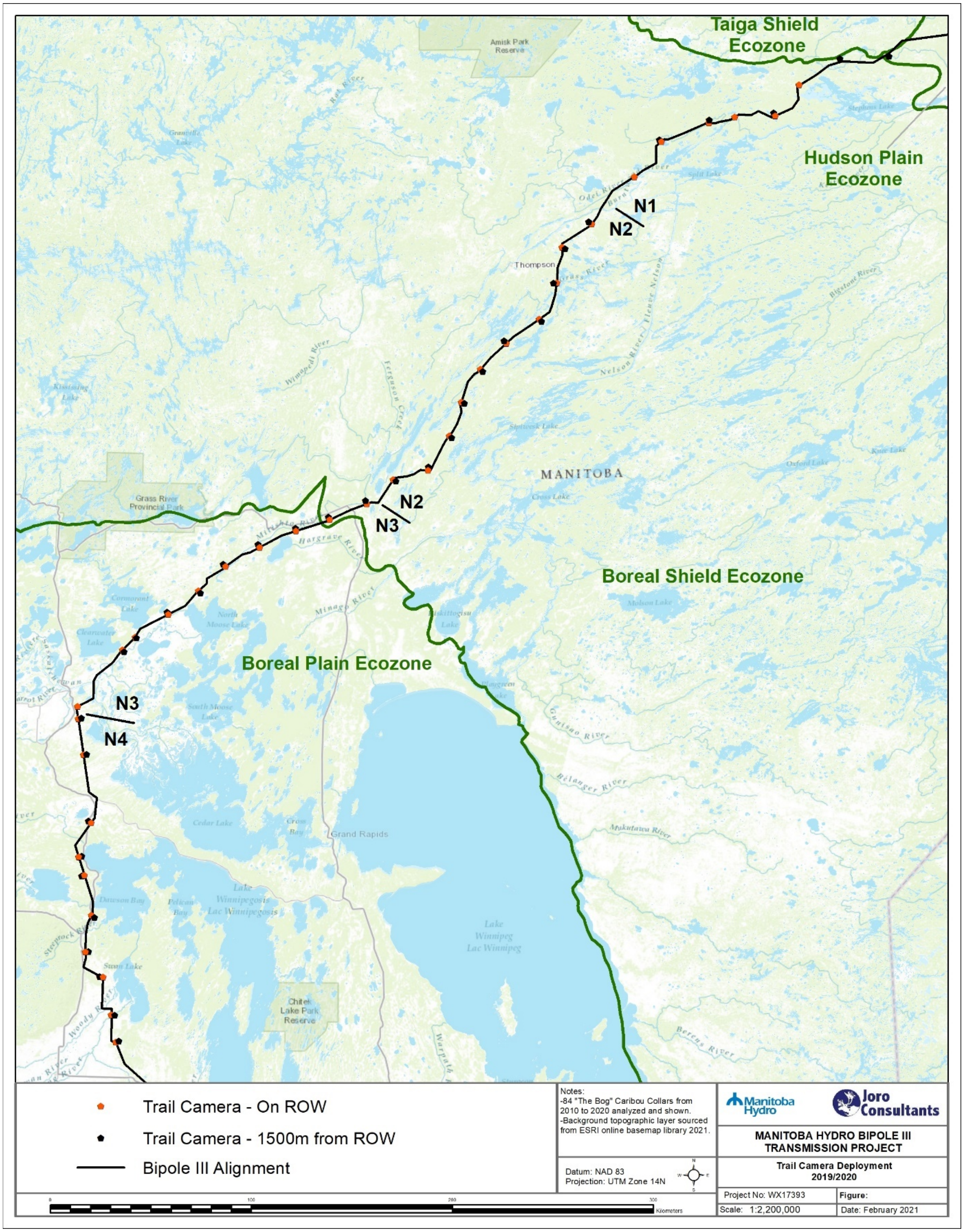

Figure 1: Trail camera trap deployment for the 2019-2020 field season. Includes cameras positioned on the ROW (orange) and cameras positioned at 1500m from and facing the ROW (black).

5.0 RESULTS

5.1 Boreal Woodland Caribou

The monitoring program for 2019/2020 involved two boreal woodland caribou ranges (P-Bog, and Wabowden) intersected by the Bipole III Transmission Project that still have actively monitored individuals and population as reference (Charron Lake). Summaries are provided below, analyses specific to the Bipole III Transmission Project (e.g., crossings) include only the P-Bog, and Wabowden ranges, while all others include all three ranges. Table 1 and Figure 2 below provides a summary of active collars by ranges for comparison and contextual review.

Table 1: Active collars for each range by year (Charron Lake, Wabowden and P-Bog)

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
CHAR	1	23	24	14	9	23	22	19	10	22	18
WAB	10	13	22	21	20	25	24	16	7	22	19
P-BOG	16	22	22	24	22	23	22	15	10	21	21
Deployed	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
CHAR	1	22	12	0	0	22	6	0	0	18	0
WAB	10	6	14	9	6	13	7	0	0	20	0
P-BOG	16	8	10	8	10	9	7	0	0	19	0
Mortality	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
CHAR	0	10	9	6	6	7	2	4	2	4	4
WAB	2	5	6	11	6	6	7	8	2	5	2
P-BOG	2	8	7	11	7	7	5	3	4	5	0

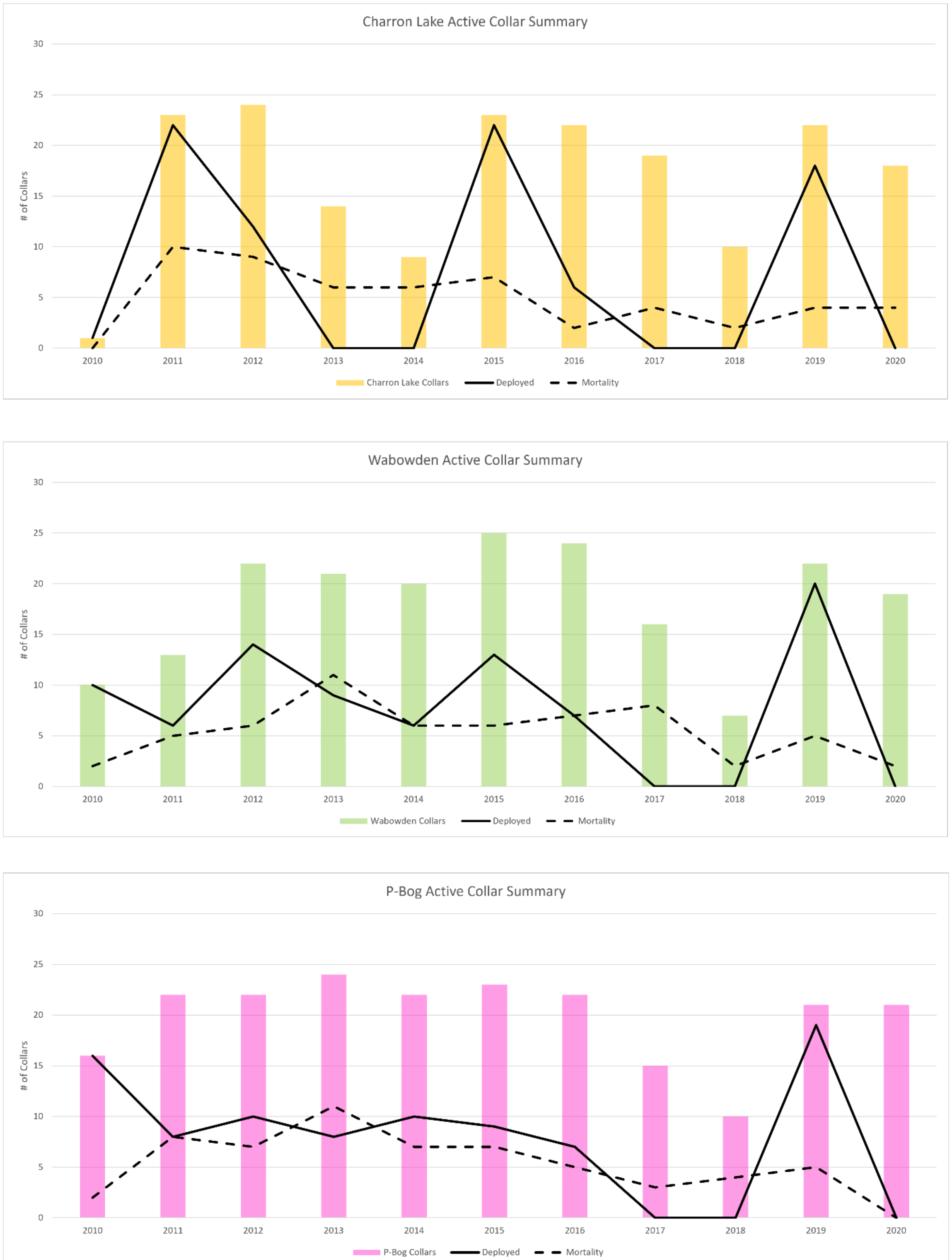

Figure 2: Summary of annual active caribou telemetry collars for each population, including the total number of active collars, the number of collars deployed each year, and the number of collars that experienced mortalities in each year of the Project

5.1.1.1 Range Use

Distributions of annual and seasonal range areas for each monitored population have not shifted since the monitoring program was initiated and largely show similar patterns of distribution from year to year. Range distribution for all caribou populations in 2019/20 fell partially or completely within the 2010-2019 range extents for both overall home range distribution (Figure 3-Figure 5) and core overwinter (Figure 6-Figure 8) and calving ranges (Figure 9-Figure 11). The average home range and seasonal range use size for caribou varied across ranges as illustrated by the high variation in total home range (Table 2), calving range (Table 3) and overwintering range (Table 4) area coverage for each range. The annual and seasonal ranges for Charron Lake caribou are significantly larger than those of P-Bog or Wabowden ($P<0.05$). Annual and seasonal range sizes between Wabowden and P-Bog caribou are not significantly different in most years.

Reductions in total home range area and habitat use overlap between Construction phases (Table 2-Table 4) was noted in all three populations. This can be attributed primarily to seasonal variation in the number of active collars, as well as significant turnover in monitored animals between the Construction and Operation phases of the Project. Very few if any individual animals have telemetry records that extend across both Construction and Operation phases, due in large part to no collar deployments in 2017 or 2018 (Table 1, Figure 2).

Table 2: Percent overlap of home range extent between Project phases (Preconstruction: 2010 – November 2014; Construction: December 2014 – August 2018; Operation September 2018 – present).

	% Overlap of Home Range (90% Utilization Distribution)			Total Home Range Area (km²)
Charron Lake	**Preconstruction**	**Construction**	**Operation**	
Preconstruction	100.00	47.35	33.24	7,377.75
Construction	-	100.00	41.37	5,747.74
Operation	-	-	100.00	3,645.09
P-Bog	**Preconstruction**	**Construction**	**Operation**	
Preconstruction	100.00	56.12	39.64	3,094.25
Construction	-	100.00	57.81	2,228.34
Operation	-	-	100.00	1,558.99
Wabowden	**Preconstruction**	**Construction**	**Operation**	
Preconstruction	100.00	84.55	63.06	2,348.36
Construction	-	100.00	61.22	2,671.13
Operation	-	-	100.00	1,851.98

Table 3: Percent overlap of calving range extent between Project phases (Preconstruction: 2010 – November 2014; Construction: December 2014 – August 2018; Operation September 2018 – present).

	% Overlap of Calving Range (70% Utilization Distribution)			Total Home Range Area (km²)
Charron Lake	**Preconstruction**	**Construction**	**Operation**	
Preconstruction	100.00	24.96	21.65	2,329.21
Construction	-	100.00	33.08	1,807.82
Operation	-	-	100.00	1,479.47
P-Bog	**Preconstruction**	**Construction**	**Operation**	
Preconstruction	100.00	40.25	31.16	1,271.53
Construction	-	100.00	37.77	867.83
Operation	-	-	100.00	617.53
Wabowden	**Preconstruction**	**Construction**	**Operation**	
Preconstruction	100.00	54.46	51.47	663.66
Construction	-	100.00	42.76	1,056.04
Operation	-	-	100.00	794.52

Table 4: Percent overlap of overwintering range extent between Project phases (Preconstruction: 2010 – November 2014; Construction: December 2014 – August 2018; Operation September 2018 – present).

	% Overlap of Overwintering Range (70% Utilization Distribution)			Total Home Range Area (km^2)
Charron Lake	**Preconstruction**	**Construction**	**Operation**	
Preconstruction	100.00	41.70	32.77	2,259.25
Construction	-	100.00	52.36	1,596.37
Operation	-	-	100.00	1,102.86
P-Bog	**Preconstruction**	**Construction**	**Operation**	
Preconstruction	100.00	49.22	42.26	678.51
Construction	-	100.00	55.03	398.90
Operation	-	-	100.00	373.72
Wabowden	**Preconstruction**	**Construction**	**Operation**	
Preconstruction	100.00	49.24	18.19	315.05
Construction	-	100.00	34.63	551.71
Operation	-	-	100.00	211.87

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Figure 3: P-Bog Caribou Population Home Range Extent. Showing 90% utilization distribution of collared caribou in 2019/2020 (green), compared to similar calculations from 2010 – 2019 (pink).

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Figure 4: Wabowden Caribou Population Home Range Extent. Showing 90% utilization distribution of collared caribou in 2019/2020 (green), compared to similar calculations from 2010 – 2019 (pink).

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Figure 5: Charron Lake Caribou Population Home Range Extent. Showing 90% utilization distribution of collared caribou in 2019/2020 (green), compared to similar calculations from 2010 – 2019 (pink).

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Figure 6: P-Bog Caribou Population Calving Range Extent. Showing 70% utilization distribution of collared caribou in 2019/2020 (pink), compared to similar calculations from 2010 – 2019 (orange).

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Figure 7: P-Bog Caribou Population Overwintering Range Extent. Showing 70% utilization distribution of collared caribou in 2019/2020 (pink), compared to similar calculations from 2010 – 2019 (turquoise).

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Figure 8: Wabowden Caribou Population Calving Range Extent. Showing 70% utilization distribution of collared caribou in 2019/2020 (pink), compared to similar calculations from 2010 – 2019 (orange).

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Figure 9: Wabowden Caribou Population Overwintering Range Extent. Showing 70% utilization distribution of collared caribou in 2019/2020 (pink), compared to similar calculations from 2010 – 2019 (turquoise).

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Figure 10: Charron Lake Caribou Population Calving Range Extent. Showing 70% utilization distribution of collared caribou in 2019/2020 (pink), compared to similar calculations from 2010 – 2019 (orange).

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Figure 11: Charron Lake Caribou Population Overwintering Range Extent. Showing 70% utilization distribution of collared caribou in 2019/2020 (pink), compared to similar calculations from 2010 – 2019 (turquoise).

5.1.1.2 Site Fidelity

Fidelity to an area is the tendency of individuals to stay in or return to, the same areas over time. For non-migratory species this tendency, is to remain in the same core area and when movement does occur, to return to those same areas. In temperate regions with strong seasonal climates, many of these movements cycle seasonally. Comparison of seasonal movements across years can be used to gauge fidelity, but this requires some assessment of potential displacement relative to actual displacement. Fidelity can be inferred if the confidence interval for observed inter-annual differences is less than the 95% confidence intervals for empirical means per month (Figure 12-Figure 14).

Results for the 2019/2020 Operation phase period are very similar to those reported previously. The 95% confidence interval for observed interannual distances is generally below the mean for the null model (randomized paired distance model) for both local monthly and population-level scales. This indicates fidelity of actual caribou to specific areas is high relative to random expectation. However, for both local scale (monthly) and population-levels, the confidence interval do in some instances overlap the null model. This typically occurs early in the year, likely because of both sample size effects (January) and longer movements (between February and April) as females begin to disperse prior to calving. In terms of sample size, a significant recollaring effort in February-March 2019 was undertaken and this maintained a constant sample size for each year overall, but the number of individuals paired between years, especially in January and February, are low. In the most extreme case, for January in the Wabowden range, there was only a single animal that was paired between 2019 and 2020 and a confidence interval could not be calculated. The other ranges had more paired animals, but these were still few (3 and 4 for P-Bog and Charron Lake respectively). Other instances where the 95% confidence overlaps the null model are associated with pre-calving dispersal, with Charron Lake having pronounced overlap. In this range some females can move over 40 km to a calving location, and this take place over the several weeks. These large movements over relatively short intervals greatly increase the variance and confidence interval. This interval contracts sharply at calving.

Patterns of fidelity in the analyses follow those expected based on caribou biology. At the population-level pre-parturition movements are generally large as animals move (in some cases over very large distances) to their preferred calving locations. In May there is generally a strong departure from the null model as females start calving. At this time, both mean inter-annual distance is low (propensity to return to the same location each year) and confidence intervals are narrow (tendency to return and remain close to these locations). Over the course of the summer and into fall, movements increase with confidence limits, but still demonstrate strong fidelity. There is evidence for 2019/2020, as found in previous years, in strong site fidelity during calving.

Many of the same patterns at the population scale are seen at the local (monthly) scale. Because randomizations at this scale use paired samples over shorter periods of time in more geographically constrained areas, the randomized distance means more closely follow the observed means and confidence interval in the early part of the year prior to dispersal. Large deviation in the spring and later summer demonstrates the fidelity of females to specific areas, and the higher degree of dispersion of females over the period. During calving, females spread out across the range – but in the same location each year. Randomized pairs have no such fidelity, and because females are over-dispersed at this time, very large mean distances are possible for those calculated in the null expectation. Patterns of high fidelity to specific sites by individuals with isolation from other conspecifics are thought to minimize predation risk to females and calves (Ferguson et al. 1988). Individuals calving in isolation reduces predator detection and overall reduces predation risk in the population (Bergerud 1996, Leclerc et al. 2012).

The patterns observed between different ranges are more likely due to inherent differences in range size, and landscape patterns. The P-bog range is strongly bounded by landscape features such as large waterbodies (Cedar Lake) and landforms such as the Long Point moraine; the Wabdowen range has similar geophysical constraints, as well as other woodland caribou populations. Charron Lake animals have a large range with multiple core areas. While the monthly pattern of change is similar to the other ranges, the confidence limits tend to be broader, reflecting the more uniform spread and multiple core areas of the monitored population of individuals.

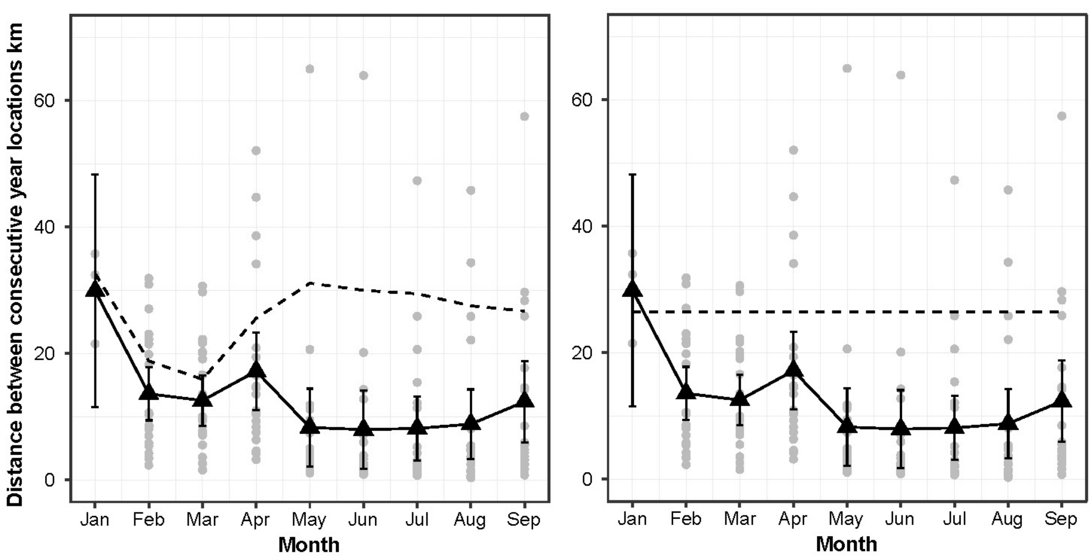

Figure 12: Fidelity Results for the Bog Range (left: local scale; right: population scale). Grey dots represent the inter-annual distance between monthly harmonic mean locations and the triangles and bars indicate the mean and 95% confidence intervals.

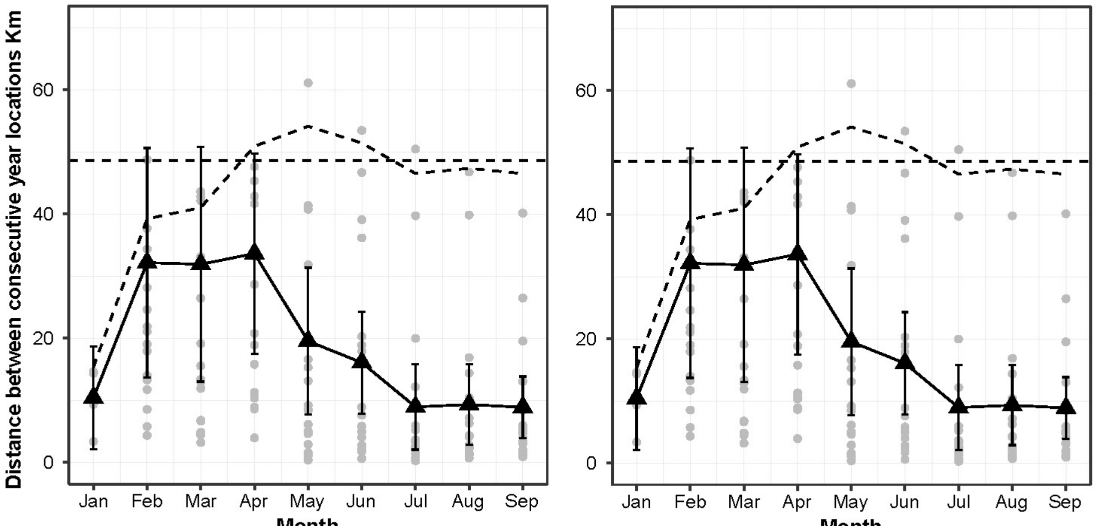

Figure 13: Fidelity Results for Charron Lake Range (left: local scale; right: population scale). Grey dots represent the inter-annual distance between monthly harmonic mean locations and the triangles and bars indicate the mean and 95% confidence intervals for those observations. The left and right figures differ only in terms of the dashed lines which represent the null expectation obtained from randomization. At the local scale these were obtained using monthly range use and at the population scale, all potential pairs of locations with the range were used.

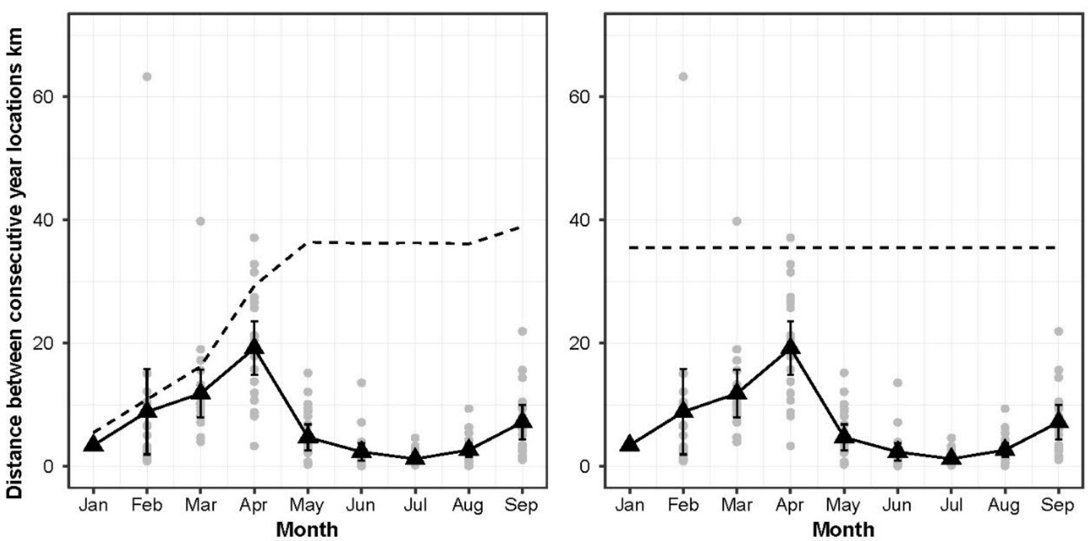

Figure 14: Fidelity Results for Wabowden Range (left: local scale; right: population scale). Grey dots represent the inter-annual distance between monthly harmonic mean locations and the triangles and bars indicate the mean and 95% confidence intervals for those observations. The left and right figures differ only in terms of the dashed lines which represent the null expectation obtained from randomization. At the local scale these were obtained using monthly range use and at the population scale, all potential pairs of locations with the range were used.

5.1.1.3 Zone of Influence

Previous reports suggest a narrow Zone of Influence (ZOI) of approximately 1 to 2 km during the Construction phase in the P-Bog range (MMPTR 2019) and a short ZOI of approximately 1 to 2 km for the pre-existing linear corridor present during the Pre-construction phase in the Wabowden range, as well for the widened corridor created through Project Construction (Wood 2019).

This pattern of reduced use of habitat adjacent to the ROW has continued into subsequent years of Operations (Figure 15 A & B). For both ranges, caribou locations occurrences were reduced within the first 2 km of the Bipole III alignment relative to areas farther away. The polynomial models calculated for 2019/2020 were significant for both ranges (adjusted R2 = 0.8 with a p-value of << .0001 for both). Modelled relationships and confidence intervals as a function of distance indicate that there is a significantly lower use of areas directly adjacent to the ROW, with almost no caribou found directly along the Project alignment.

For the Wabowden range (Figure 15 B) the intercept was significant and negative, with the modelled relationship intersecting the x-axis at approximately 150-200 m. While this could be a model effect, it may be an actual pattern in the data that may not be entirely the influence of the Bipole III alignment. In the Wabowden range, an existing railway, predating the alignment appears to act as a significant barrier to movement and has been for some time (Figure 16). Although this relationship is not statistically evaluated in this report, it is visually evident. Potential impact of other features within the Wabowden ZOI). There are many telemetry locations occurring up to the railway, and few crossing this feature. This relationship appears in Pre-, During- and Post-construction, although there are more telemetry locations north of the ROW Pre-construction. The large number of locations that occur adjacent to this feature contributes to the steep slope for the polynomial model in the 200 m to 1000 m (1km) distances interval from the alignment.

Woodland caribou are impacted by cumulative disturbance within a range (Environment Canada 2012) and behavioral responses to the Project may be influenced by other disturbances within the range. Previous reports (MMPTR 2016) suggest an influence of highways, in combination with Project disturbances, may be a factor in determining the ZOI. Future studies should include railways and other anthropogenic features. It should be noted also that the current animals that are being tracked using GPS telemetry occur to the south of the alignment in Wabowden and to the north-east of the alignment (along the Long Point moraine) for the P-Bog range. Site fidelity and increased sampling effort on one, but not both sides of the ROW, may in combination reduce the apparent use of habitat close to the alignment.

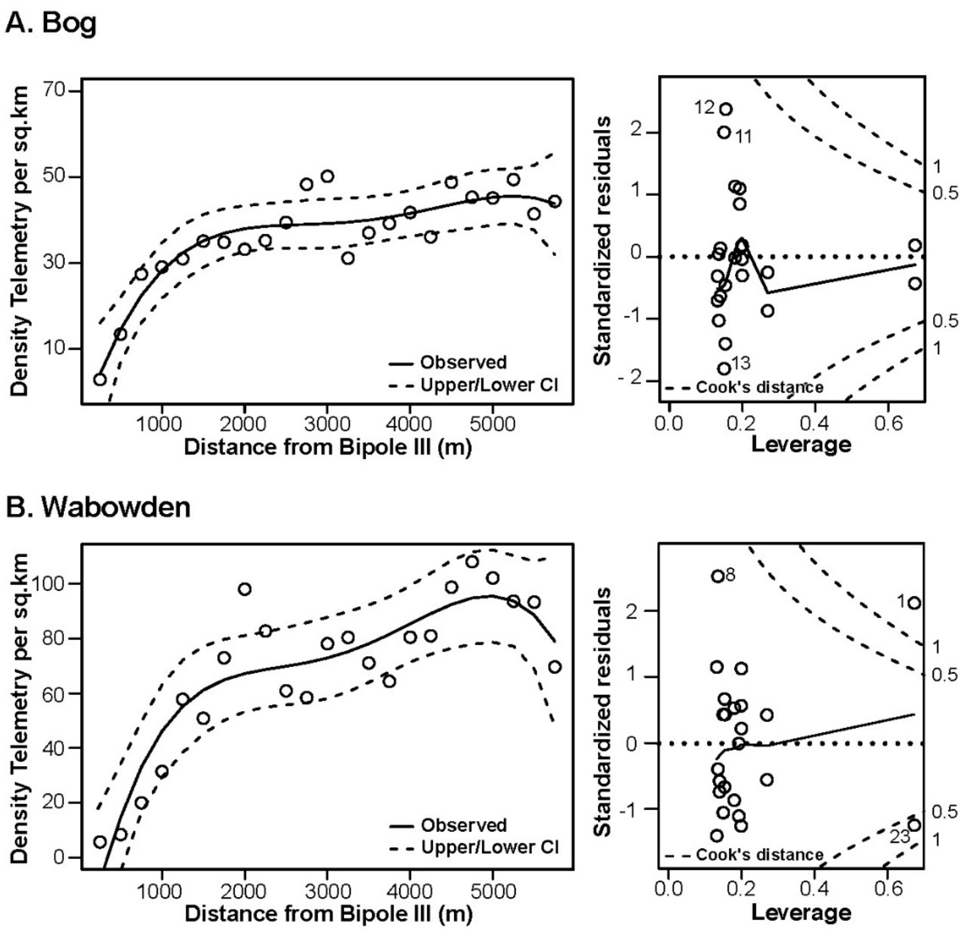

Figure 15: Zone of Influence Results for the Bog (A) and Wabowden (B) Ranges with polynomial regression models (solid line) for density over distance and upper and lower confidence intervals (dashed lines). Residual and leverage plots are provided to identify potential outlier observations. Outliers are those observations with large Cook's distances (a measure of the influence of that point on the regression). For P-Bog no outliers were detected, for Wabowden both the first and final observations are influential. This is expected given the strong decrease in density near the alignment for Wabowden and lower density of the final location relative to the adjacent observations.

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Figure 16: Potential impact of other features within the Wabowden ZOI showing Pre-, During- and Post-Construction. Bipole III is shown in red, the railway using black cross-hatch lines and the highways in white. Vegetation patterns and waterbodies are provided for context.

5.1.1.4 Crossing Analysis

To further explore relationships observed in the ZOI analysis, caribou behavior was assessed by evaluating the extent that the alignment acts as a barrier to movement. Caribou crossing the ROW were assessed based on path trajectories of caribou movement between October 1, 2019 and September 30, 2020. Caribou trajectories for P-Bog are provided below (Figure 17-Figure 18) and additional trajectories for comparison to Charron Lake and Wabowden are found in Appendix 3 (Figure 25-Figure 28). Crossings were significantly more frequent in the P-Bog range, with 95% of caribou crossing the ROW at least once, and a mean crossing rate of 10.3 crossings per animal. In comparison, the Wabowden range population made fewer crossings, with only 35% of animals crossing the ROW, and a mean of 4.7 crossings per animal (9.0 crossings including a single outlier of 35 crossings by one animal) (Table 5).

Table 5: Summary of caribou ROW crossing events, from telemetry data collected between October 2019 and September 2020.

Range	No. of Caribou		Total ROW crossings (2019/20)	Crossings Mean per animal	Max Crossings by one animal
	Total	Crossed ROW (at least once)			
P-Bog	20	19	195	10.3 ±6.7	31
Wabowden	20	7	63	9.0 ±11.8 (*4.7 ±3.1)	35
Total	**40**	**26**	**258**	**9.9**	**35**

*Mean crossings per animal excluding a single outlier of 35 crossings by one animal

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Figure 17: P-Bog Caribou path trajectories 1. Depicting path trajectories of individual collared caribou between October 2019 and September 2020. ROW depicted as dashed line, with red segments indicating vegetation mitigation areas.

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Figure 18: P-Bog Caribou path trajectories 2. Depicting path trajectories of individual collared caribou between October 2019 and September 2020. ROW depicted as dashed line, with red segments indicating vegetation mitigation areas.

A CRW analysis was completed to assess if the rate of ROW crossing by observed animal pathways differed from randomly generated pathways for the same animals. If a barrier effect exists, the proportion of the number of crossings should be lower for actual animals than the random simulations. Simulations were performed in CRAN-R, as described in the methods, and examples from each range are provided as CRW figures (Figure 19). In the P-Bog range, simulations using caribou BOG1908 crossed the least, with 67% of all paths intersecting the ROW at least once (the actual animal did not cross the ROW) and BOG1907 crossed the most often, with 100% of all simulations crossing the ROW (the actual animal crossed the ROW the most of all collared caribou at 31 times). The mean number of simulations where animals crossed at least once was 82.5%, with a standard deviation of 9.3%. This is less than the 95% of actual animals that crossed the ROW at least once. However, the CRW simulations were not constrained by range boundary, or habitat, and thus simulated animals could move into areas not typically utilized by caribou and away from the ROW.

In the P-Bog range, when comparing the actual number of crossings to simulated total crossings for each animal, none of the collared caribou cross or avoid the ROW more or less than expected. When comparing the observed total number of crossing to the per-animal distribution created in the simulations, no animal significantly avoided the ROW. Of the individuals tested against random crossings, BOG1915 was at the lower tail of the distribution (test of avoidance using the exact p-value = 0.329) and BOG1916 the upper tail of the distribution (test that this animal exceeded random expectation had the exact p-value = 0.148), neither of which was significant. The total number of crossings for all other animals were well within the distribution of random crossings observed. At the population-level, the distribution of mean total number of crossings for the P-Bog simulations was compared to the observed mean total crossings for that range, and the test of avoidance was not significant (exact p-value = 0.313). In P-Bog, there is no strong evidence at the individual and population level that caribou are avoiding the ROW. This finding may support mitigation efforts, since many of the observed crossings in this range occur at mitigated sites (see mitigation section below).

Simulation results in the Wabowden range contrast with those of the P-Bog population. In general the number of actual observed crossings was much lower and this must be considered when interpreting the results. In simulation, WAB1912 crossed the ROW at least once in 51% of the simulations, the lowest value observed (the actual animal crossed the ROW as well), and in simulation WAB1904 at 99% crossed the ROW at least once the most frequently (the actual animal crossed as well). Although the minimum and maximum number of simulations of individuals that crossed the ROW at least once was lower for Wabowden compared with P-Bog, at the population level the mean was 88.2% with a standard deviation of 11%. This is far more than the 35% of actual animals that crossed the ROW at least once. The caribou that were collared in 2019 were south-east of the ROW and have core areas on that side of the alignment, this could be avoidance or site fidelity. It should also be noted that the telemetry for these animals does not cross the railway ROW that is to the south-east of the Bipole III alignment. Multiple (cumulative) disturbance avoidance may be a factor.

Because the proportion of actual animals crossing the ROW is low, the exact-p values need to be interpreted carefully. For all animals that in actuality never crossed the ROW, the p-value is identical to the results for animals crossing at least once (one crossing is greater than none). For most of the animals that did not cross, the exact-p was either significant or suggestive of avoidance. For those individuals that in actuality did cross at least once or more, no significant avoidance was detected. One animal with a large number of intersections (35), crossed the ROW more often than most simulations for that animal (exact p-value = 0.06 that the observed crossings exceed random expectation). This animal had core use areas on both sides of the ROW and crossed frequently. At the population-level, the distribution of mean total number of crossings for the Wabowden simulations was compared to the observed mean total crossings for that range and the test of avoidance was significant (exact p-value < .001). In Wabowden range, there is evidence at the individual and population level that caribou are avoiding the ROW, although this may be confounded by collar capture location, habitat selection, site fidelity, and cumulative effects of other ROWs (notably the railway).

The results presented above are based on CRW using random bearings with identical starting locations, and step length sequences as were observed for actual animals. However, we obtained equivalent results for random step lengths using the sequence of observed bearings, and also when both step length and bearing was randomly selected from observed path trajectory data. Choice of CRW method does not effect results, and the overall approach is robust.

While serving as a suitable null model for animals moving across the landscape without the barrier effects of linear features, CRW also do not include important biological constraints on movement imposed by habitat selection and site fidelity. The caribou in these ranges display strong site fidelity as demonstrated in the fidelity analysis. Animals collared on one side of the alignment may not cross because of fidelity to that particular area. This may be an important factor in explaining the pattern of movement observed for the Wabowden range. Habitat selection and fidelity are confounded with barrier effects, and determining which of these three factors best explains the difference between observed and CRW crossings could be examined in the future.

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Figure 19: Example Correlated Random Walk simulations (black lines) for individual animals in the Wabowden (A) and P-Bog (B) ranges with the BPIII ROW indicated in red. For each range a simulation example of a path crossing and not crossing the ROW is provided. For Wabowden a simulation from two different animals is presented and for P-Bog the same animal. For each animal 1000 simulated CRW paths were created, many of these crossed the ROW. There is a similar overall appearance of these simulations to Figure 18 is similar although simulated animals show no preference for habitat or site fidelity.

5.1.2 Mitigation Effectiveness Monitoring

In previous reports: 2016 to 2018, caribou in the P-Bog range crossed the ROW at mitigated areas more frequently than non-mitigated areas, but it was found in the 2018-2019 season that caribou did not choose to use the mitigation areas as often as was predicted and/or as observed in previous years. It was speculated that low sample size, or a reduction in sensory disturbance following Construction phase completion, might explain those results. In 2019 a collar redeployment program ensured that an adequate number of individuals were being tracked, and with additional years of data, sample size is greatly improved. For 2019-2020, we compared the number of crossings at mitigated sites with non-mitigated sites (Table 6). Because the number of crossings was not normally distributed, and each animal could be sampled with replacement, a Wilcoxon signed rank test with continuity correction was performed. The results suggest that mitigated crossings were used significantly more than non-mitigated crossings ($p = 0.0015$). These 2019-2020 results reflect the trends from 2016-2018 with higher crossing rates at mitigated sites. Sample size was the likely cause for non-significant results in the 2018-2019 analysis.

Table 6: Summary of caribou ROW crossing in relation to the Vegetation Mitigation Areas, from telemetry data collected between October 2019 and September 2020.

Range	No. of Caribou		Vegetation Mitigation Areas			
	Total	Crossed ROW (at least once)	On-VMA Crossings	On-VMA Mean Crossings per animal	Off-VMA Crossings	Off-VMA Mean Crossings per animal
P-Bog	20	19	150	7.9 ±5.0	45	2.37 ±3.4
Wabowden	20	7	*100% of Wabowden ROW is considered VMA*			
Total	**40**	**26**				

A statistical comparison of mitigated versus non-mitigated vegetation areas cannot be undertaken in the Wabowden range, where vegetation mitigation was applied along the entire length of the ROW intersecting caribou locations. Most of the animals currently being monitored do not cross the ROW, however one animal with core areas on both sides of the ROW, crossed Bipole III 35 times and is likely benefitting from the mitigation along this section of the ROW.

5.1.2.1 Movement Paths and High Use Areas - Brownian Bridge Movement Models

High use corridors associated with individual movements were quantified using Brownian Bridge Movement Models (BBMM's). As in previous reports, the BBMMs for individual animals were combined. The results were mapped utilizing similar symbology as in those reports, to identify low to high use areas for movement at the population level. For this report, the previous year's data were not re-analyzed as the methods used and maps produced were very similar to those previously published.

In both the P-Bog range (Figure 20) and Wabowden range (Figure 21), the distribution of annual high use has not changed much from the post-construction distributions published previously for 2018-2019. Similarly, the pattern of low and high use areas in the Charron Lake range for 2019-2020 are very similar to those in previous years. This similarity is notable in that during 2019 a major recollaring effort was undertaken, such that many of the animals used in generating the BBMMs are not the same as those previously studied. Despite the high turnover, long distance movement corridors in P-Bog, along the Long Point moraine and in the southwest portion of the range, are apparent. The fact that many of the same movement corridors are present in multiple years of monitoring, suggests that movement between core areas is important. It should be further noted that some of these corridors do cross the ROW (e.g., P-Bog), but their biological importance should be considered, and similar movement corridors included in planning new developments.

Figure 20: Brownian Bridge Movement Results for the Bog Range

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Figure 21: Brownian Bridge Movement Results for Charron Lake Range

5.2 Moose

The data from moose surveys conducted by the Province of Manitoba in 2020 and provided on the ARD website (https://gov.mb.ca/sd/pubs/fish_wildlife/hunting/2020biggame_results.pdf) are summarized in Table 7 and Figure 22. In both the Porcupine Hills (GHA 13/13A) and Duck Mountains (GHA 18/18A/18B/18C) areas, moose populations appear to be at or above their long-term means. In these areas, hunting closures and other management activities have been in effect since 2011. Populations have been increasing slowly following these management prescriptions. As moose populations in GHAs 13/13A and 18/18A/18B/18C have been increasing during the Pre-construction and early Operation phases of Bipole III, there is no evidence of an impact. However, it is hard to determine direct effects of the ROW based on these data. Clearly, reduction of mortality through harvest closures has proved to be an effective management tool, and may continue to be, to mitigate impacts of climate change and other stressors on the moose population.

Table 7: Comparison of Long-term Mean Population Metrics (>2010) Survey Results for Populations Intersected by the Bipole III Transmission Project ROW. Table data from previous reports with updated data provided by ARD for 2020 in (GHA 13/13A) and (GHA 18/18A/18B/18C).

Moose Population	Year	Winter Population (±90% CI)	Winter Density (#/km2)	Adult Sex Ratio (M/100F)	Calf Recruitment (calves/100F)
Monitored / Sensitive Moose Populations					
Tom Lamb WMA (GHA 8)	**Long Term Mean (1971-2018)**	**634**	**0.201**	**61.3**	**58.8**
	January 2012	317 ±32.0%	0.101	84.5	46.6
	January 2016	339 ±18.5%	0.107	57.7	52.1
Moose Meadows (portion of GHA 14)*	**Long Term Mean (1971-2018)**	**79**	**0.423**	**35.7**	**56.0**
	January 2011	7	0.040	72.7	52.3
Pine River (GHA 14A/19A)	**Long Term Mean (1971-2018)**	**526**	**0.169**	**53.4**	**52.0**
	January 2013	104 ±12.8%	0.033	37.5	87.5
	January 2014	100 ±19.0%	0.032	138.5	76.9
Split Lake (Keeyask GS 2015 Survey Area)	**Long Term Mean (1971-2018)**	**1,106**	**0.066**	**90.8**	**52.9**
	January 2010	961 ±21.0%	0.057	118.3	35.5
	January 2015	1,349 ±22.6%	0.080	50.0	51.4
	January 2018	1,159 ±26.9%	0.069	28.8	44.7
Regional Reference Moose Populations in Manitoba					
Upper SK Delta (GHA 6/6A)	**Long Term Mean (1971-2018)**	**354**	**0.191**	**48.2**	**47.4**
	January 2010	255 (100% census)	0.141	---	---
Red Deer Bog (GHA11/12)	**Long Term Mean (1971-2018)**	**493**	**0.103**	**48.3**	**58.5**
	January 2013	199 ±24.6%	0.042	31.6	34.2
	January 2016	100 ±46.7%	0.043	66.7	66.7
Swan-Pelican (GHA14/14A)	**Long Term Mean (1971-2018)**	**1,509**	**0.264**	**40.1**	**54.4**
	January 2011	144 ±12.8%	0.029	72.7	52.3
	February 2014	150 ±18.9%	0.030	---	---
Porcupine Hills (GHA 13/13A)	**Long Term Mean (1971-2018)**	**813**	**0.314**	**47.8**	**42.0**
	February 2011	817 ±17.8%	0.315	32.3	30.5
	February 2017	1,057 ±16.4%	0.408	63.6	48.7
	January 2020	997 ± 16%	0.440	52.0	38.0
Duck Mountains (GHA 18/18A/18B/18C)	**Long Term Mean (1971-2018)**	**2,225**	**0.398**	**65.1**	**45.4**
	February 2011	1,466 ±12.4%	0.257	63.0	45.0
	February 2017	1,958 ±15.1%	0.344	69.3	34.7
	January/February 2020	2,171 ± 15.2%	0.380	83.0	41.0

WMA – Wildlife Management Area. Note: *Estimates for Moose Meadows were Projected (based on proportion of habitat area) from the Swan-Pelican moose population model using GHA 14 data only to calculate relative population size and trend.

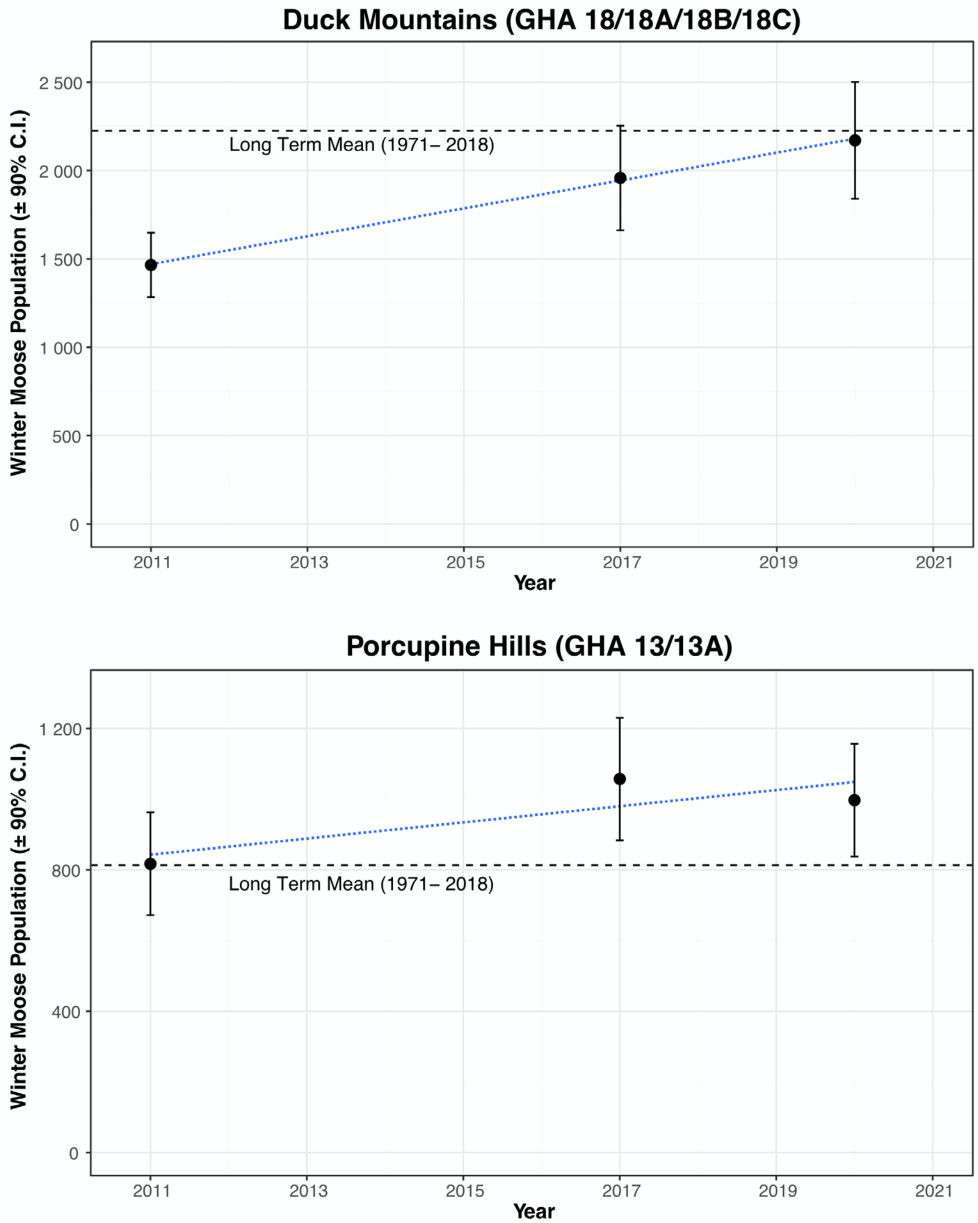

Figure 22: Point estimates of number of moose (± 90% confidence interval) in Porcupine Hills (GHA 13/13A) and Duck Mountains (GHA 18/18A/18B/18C), Manitoba. Reported point estimates do not account for detectability of moose, which can vary from survey to survey due to factors weather, vegetation cover, and observer distance. Point estimates are suited to establishing long-term trends. The dotted line depicts the population trend from 2011 to 2020 while the dashed line represents the long-term mean from 1971 to 2018.

5.3 Trail Camera Analysis

A total of 70 trail cameras (36 on ROW, 34 at 1500m from ROW) deployed in 2019/20 (Table 8) yielded a total of 729 recordings. Of these, 428 wildlife recordings of 12 different species were logged (Table 9). Overall occurrence of wildlife was found to be similar between on-ROW (48.1%) and off-ROW (51.9%). In instances where occurrences were significantly different, the data indicated significantly more on-ROW occurrences in all cases but one. These include coyote (100% on ROW, n=19), fox (96.4%, n=28) and wolf (100%, n=8), and Canada lynx (67%, n=12; p=0.0072) were all observed significantly more on the ROW. Hare observations occurred significantly more frequently off-ROW (91.9%, n=86; p=0.0039). All other species were observed in lower frequencies, with similar on- and off- ROW occurrences.

These results support the results from ground transect surveys described in Part A. Results for the Operational phase were consistent with previous Construction phase monitoring and showed no signifiant relationship with distance to the BPIII ROW with vegetation contributing to distribution and occupation.

In comparison, Construction stage observations from trail cameras found a greater proportion of observations occurring off-ROW (58.3%). With the exception of fox (78.0% on-ROW, n=49) and wolf (71.9% on-ROW, n=57), all species were observed in simlar or higher frequencies off-ROW. With the completion of Construction activities, and a relative decrease in overall activity and disturbance on the ROW, it can be expected that wildlife habitat use on-ROW may increase relative to during the Construction stage.

A total of 107 instances of human activity (individual vehicles or people) were observed over 65 recording events (excluding camera maintenance). The predominant human activity observation was commercial truck activity (n=43) and snowmobile/atv activity (n=31). Construction equipment (n=23) and personal light duty vehicles (n=8) were also noted.

The majority of human activity was observed in line sections N3 (n=59) and N4 (n=40) (Figure 23-24). Recreational vehicle (snowmobile/atv) traffic was observed in smaller numbers per recording, and over a wider range of camera stations across the study area (n = 11 stations). This is likely a reflection, in part, of local recreational vehicle users utilizing the ROW alignment as a corridor for travel. In contrast, observations of larger vehicles and in particular commercial vehicles and construction equipment were largely concentrated to four stations: BPIII_006 and BPIII_010 in section N3, and BPIII_105 and BPIII_119 in section N4 (Figure 23). These stations are positioned at or near major transportation corridors, including PTH 10 (section N4) and PTH 39 (section N3), and the higher instances of human activity are likely associated with laydowns and staging areas positioned near these main highways.

All human activity type and dates of observations are found in Figure 23-24; Table 10.

Table 8: Summary of Camera Trap Deployments for Bipole III, 2014-2020.

Construction Segment	Monitoring Year of Deployment	Number of Active Cameras Deployed			Comments
		Near ROW	1.5km from ROW	Total	
N1	1 (2014/15)	-	-	-	No access/not sampled in 2015
	2 (2015/16)	10	10	20	Cameras deployed on 10 transects
	3 (2016/17)	6	5	11	4 additional cameras deployed but inactive (not serviced in Feb 2017); 3 deployed in 2016 were missing/stolen and not replaced; 2 from 2016 were retrieved for servicing and not replaced
	4 (2017/18)	4	4	8	9 additional cameras deployed but inactive (not accessed/serviced in Feb 2018)
	5 (2018/19)	8	9	17	-
	6 (2019/20)	6	5	11	-
N2	1	8	10	18	Cameras deployed on 10 transects
	2	10	9	19	2 additional cameras deployed; 1 camera deployed in 2015 was stolen and not replaced
	3	9	8	17	2 cameras deployed in 2016 were retrieved for servicing but not replaced
	4	3	3	6	11 additional cameras deployed but inactive (not accessed/serviced in Feb 2018)
	5	8	8	16	-
	6	10	10	20	-
N3	1	10	9	19	Cameras deployed on 10 transects
	2	9	9	18	1 camera deployed in 2015 was missing (trees cleared) and not found/replaced
	3	8	7	15	3 additional cameras deployed but inactive (not serviced in Feb 2017)
	4	10	8	18	-
	5	10	9	19	-
	6	10	9	19	-
N4	1	-	-	-	No access/not sampled in 2015
	2	-	-	-	No access/not sampled in 2016
	3	10	10	20	Cameras deployed on 10 transects
	4	7	7	14	6 additional cameras deployed butinactive (not accessed/serviced in Feb 2018)
	5	10	10	20	-
	6	10	10	20	-
Total	1	18	19	37	-
	2	29	28	57	-
	3	33	30	63	4 additional cameras on N1 and 3 cameras on N3 deployed but not active (for logistical reasons were not accessed for servicing in Year 3)
	4	24	22	46	26 cameras were not accessed or serviced because of line stringing or no helicopter or vehicle access availability
	5	36	36	72	-
	6	36	34	70	-

Table 9: Summary of trail camera trap observations in the 2019-2020 season, including cameras deployed on the ROW, and at 1500m from the ROW. Also showing observations reported in 2015-2018 (Construction stage) for comparison.

Mammal Species	No. of Observations (2019/2020)		No. of Transects Species was Detected (n)	Mean No. of Observations per transect		z-Test Two Sample for Means		Annual Occurrence Relative to ROW	No. of Observations (Feb 2015 - Feb 2018)		No. of Transects Species was Detected (n)
	ROW	1.5 km	---	ROW	1.5 km	z Stat	p (1-tail)	--	ROW	1.5 km	--
Black Bear	37	26	14	2.643	1.857	-0.8539	0.1966	No significant difference	64	79	22
Coyote	**19**	**0**	**6**	**3.167**	**0.000**	**-**	**-**	**Significantly closer (Insufficient data)**	**10**	**16**	**8**
Wolf	**8**	**0**	**2**	**4.000**	**0.000**	**-**	**-**	**Significantly closer (Insufficient data)**	**41**	**16**	**21**
Fox	**27**	**1**	**8**	**3.375**	**0.125**	**-**	**-**	**Significantly closer (Insufficient data)**	**39**	**10**	**15**
Wolverine	0	0	0	-	-	-	-	No records	2	7	4
Marten	6	10	12	0.500	0.833	-0.1562	0.4379	No significant difference	5	20	10
Fisher	0	1	1	0.000	1.000			Insufficient data for analysis	5	7	5
Ermine	0	0	0	-	-	-	-	No records	2	1	3
Canada Lynx	**8**	**4**	**8**	**1.000**	**0.500**	**2.4494**	**0.0072**	**Significantly closer**	**19**	**65**	**18**
Hare	**7**	**79**	**15**	**0.467**	**5.267**	**-2.6588**	**0.0039**	**Significantly further**	**84**	**158**	**17**
Squirrel	0	0	0	-	-	-	-	No records	14	18	6
Beaver	0	0	0	-	-	-	-	No records	0	1	1

Figure 23: Human activity observations from trail camera monitoring over the 2019/2020 season. Data points are scaled by the total number of individual vehicle/person.

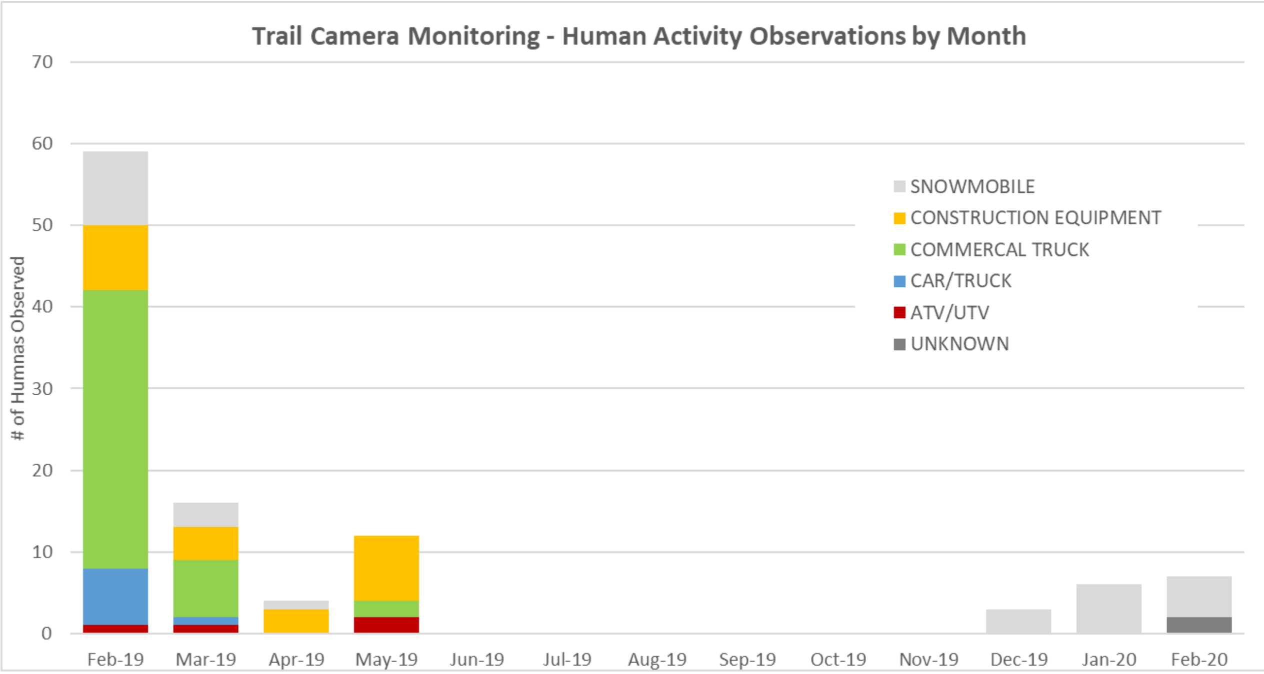

Figure 24: Observed human activity during trail camera monitoring of Bipole III Transmission Line. Showing total number of humans observed by month, grouped by activity type recorded. Data excludes recordings related to camera maintenance.

Table 10: Summary of Human Activity Observations from Bipole III Trail Camera Monitoring, February 2019 – February 2020. Data grouped by activity type observed. Data excludes recordings related to camera maintenance.

Section	Camera Trail ID	Date	Activity Type	No. of Observations
N1	BPIII_N1MULTI_014	Feb. 2019	CAR/TRUCK	1
		Feb. 2020	SNOWMOBILE	2
N2	BPIII_022	Jan. 2020	SNOWMOBILE	4
	BPIII_028	Feb. 2020	N/A	1
N3	BPIII_006	Feb. 2019	CONSTRUCTION EQUIPMENT	2
			CAR/TRUCK	3
			COMMERCIAL TRUCK	8
	BPIII_010	Feb. 2019	CONSTRUCTION EQUIPMENT	5
			CAR/TRUCK	3
			COMMERCIAL TRUCK	20
	BPIII_011	Mar. 2019	SNOWMOBILE	1
	BPIII_013	Feb. 2019	SNOWMOBILE	5
		Mar. 2019	SNOWMOBILE	2
			ATV/UTV	1
		Dec. 2019	SNOWMOBILE	1
	BPIII_016	Feb. 2019	SNOWMOBILE	3
		Jan. 2020	SNOWMOBILE	2
	BPIII_018A	Feb. 2019	SNOWMOBILE	1
	BPIII_019	Feb. 2019	ATV/UTV	1
		Apr. 2019	SNOWMOBILE	1
N4	BPIII_101	May. 2019	ATV/UTV	2
	BPIII_105	Feb. 2019	COMMERCIAL TRUCK	6
		Mar. 2019	CAR/TRUCK	1
			CONSTRUCTION EQUIPMENT	4
			COMMERCIAL TRUCK	3
	BPIII_107	Feb. 2020	N/A	1
	BPIII_109	Feb. 2020	SNOWMOBILE	1
	BPIII_110	Feb. 2019	CONSTRUCTION EQUIPMENT	1
		Dec. 2019	SNOWMOBILE	2
	BPIII_115	Feb. 2020	SNOWMOBILE	2
	BPIII_119	Mar. 2019	COMMERCIAL TRUCK	4
		Apr. 2019	CONSTRUCTION EQUIPMENT	3
		May. 2019	CONSTRUCTION EQUIPMENT	8
			COMMERCIAL TRUCK	2

5.4 Furbearers

An analysis of furbearer trapping harvest reports for the Operation stage of the Project (2018/2019 and 2019/2020) shows a substantial decrease in total harvest for nearly all species assessed, and across all segments of the ROW (Table 10; See Appendix 3). In some cases, the decrease from Construction to Operation phases has been significant; total mean annual Beaver harvest has decreased by 96.2% from Construction (annual mean = 127.5) to Operation (annual mean = 4.9). When compared to Pre-construction harvest reports (annual mean = 688.8), the decrease becomes even more signfiicant, with an 81.5% decrease from Pre-construction to Construction, and a 99.3% drop from Pre-construction to Operation.

For nearly all species and construction segments, similar decreases in total harvest have been noted from Pre-construction to Construction, and again to Operation stages. When taking into account the mean annual number of trapping licenses issues for each time period, similar though less drastic decreases in species harvest exist (Table 11; See Appendix 3). This decrease in both total mean annual harvest and annual harvest per license issue is reflected in the mean number of trapping licenses issued annually, which has similarly decreased from an average of 456 licenses issued per year during the Pre-construction phase, to 246 licenses per year during Construction (46.1% decrease), and 30 licenses issued per year during the Operation phase (93.4% decrease). This decrease is substantial, and likely reflects decreases in market value of pelts noted over the past few years, as the economic sustainability of the trapping industry has severely diminished.

When comparing distribution and abundance of furbearers from trail camera studies during Construction and Operation, there are similar trends in these data. During Operation, coyote, wolf, fox, Canada lynx, and hare were observed closer to the ROW. Compared to the Construction period, wolf and fox showed preference for the ROW. When considering all years of data collection spanning Pre-construction, Construction, and Post-construction, and the results of monitoring from ground transect surveys (Part A Report), camera trap, and trapping records, the Project-effects on furbearers are minor to undetectable. The monitoring program did demonstrate that there was a slight increase in the species abundance along the ROW after Construction, which would be expected as this was a short-term disturbance, and habitat is available for those species in proximity to the ROW.

Note that license sale data may have been corrupted, as provided by ARD from 2014; however, these data are verified for the Year 6 Monitoring period. Harvest data is considered to be accurate and the conclusions described above are sound.

6.0 MONITORING RECOMMENDATIONS

For caribou, attrition of functional collars and reduced sample size will affect the efficacy of future comparisons in Construction and Operation analyses. A review of functional collars is recommended prior to future analyses, and it is possible that winter 2020-2021 data may be adequate for replication in Year 7 reporting.

For moose, continue to include ARD survey results to verify population status through Operation and consider other moose management implications to population response (hunting). Future analysis of Keeyask Generation Station Moose Monitoring is scheduled for 2022, and will further inform ARD on status of moose populations in proximity to the BPIII Project during the Operation phase.

For furbearers, continue with trail camera deployments and consider utility of fur harvest records as an indicator of furbearer abundance.

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APPENDIX 1: MONITORING ACTIVITIES TABLES

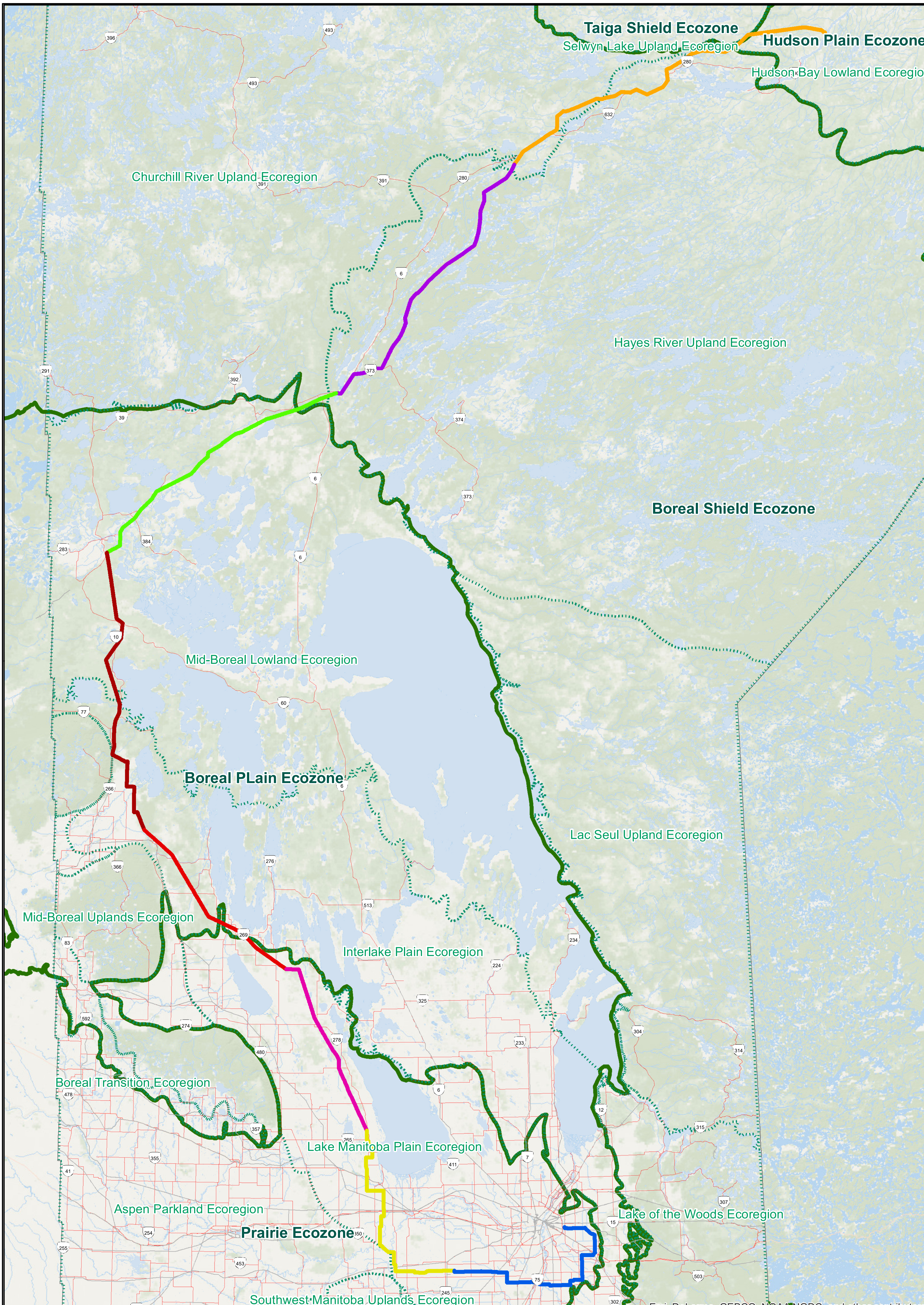
Appendix 1 Table 1: Monitoring Activities for Caribou

Phase	Task	Environmental Indicator	Site Location	Duration	Frequency	Timing	Status	Measurable Parameter
Construction Post-construction	Population monitoring	Change in population state (viability, structure, abundance)	P-Bog, N-Reed, Wabowden, Charron Lake (reference) woodland caribou ranges	≤25 years or until suitable knowledge acquired	3 year intervals	Winter	Ongoing	Significant range (landscape) scale change in population abundance, structure, growth rate and/or viability
Post-construction	Distribution monitoring	Change in distribution (core use areas) or movements (barrier effects)	P-Bog, N-Reed, Wabowden, Charron Lake (reference) woodland caribou ranges	4 years via telemetry study (maintain 20 collars / range)	Annual, continuous via telemetry study	Year round via telemetry study	Completed	Range and local scale Project- related range contraction, barrier effects altered site fidelity levels, altered Project ROW use and zone of influence (ZOI)
Construction Post-construction	Mortality investigation, calf recruitment survey	Change in collared adult female mortality, vehicle collisions, calf recruitment	P-Bog, N-Reed, Wabowden, Charron Lake (reference) woodland caribou ranges	Up to 4 years	Annual via telemetry study and aerial surveys	Year round via telemetry study	Completed	Range and local scale changes in mortality or recruitment rate relative to historical trend
Construction Post-construction	Functional habitat availability monitoring via telemetry studies and systematic surveys	Change in occurrence, prevalence, distribution, movements and/or habitat use	P-Bog, N-Reed, Wabowden, Charron Lake (reference) woodland caribou ranges	3 years via telemetry studies in combination with aerial, surveys	Annual, continuous via telemetry study	Year round via telemetry study	Completed	Detection of a zone of influence affecting occurrence or prevalence
Construction Post-construction	Aerial distribution surveys, IR camera studies, winter ground transects,	Altered predator-prey dynamics	P-Bog, N-Reed, Wabowden, Charron Lake (reference) woodland caribou ranges	Minimum 2 years post construction	Annual	Winter (aerial surveys, ground transects), year-round (IR cameras)	Completed	Change in mortality or mortality risk relative to Project disturbance

Appendix 1 Table 2: Monitoring Activities for Human Access

Phase	Task	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Construction Post-construction	IR Cameras to monitor human use of ROW at major access points along with supplemental human access data collected through multi-species surveys.	Human presence / absence	N1, N2, N3, N4	During construction and 5 years post-construction	Continuous	Year-round	Presence and magnitude of human use of ROW

APPENDIX 2: ADDITIONAL MAPS



LEGEND

Ecoregions

Ecozones

BPIII Transmission Line Route By Section

C1

C2

N1

N2

N3

N4

S1

S2

NOTES:
Data Sources:
ESRI Online Services
Joro, MB Hydro

Manitoba Hydro

Joro Consultants

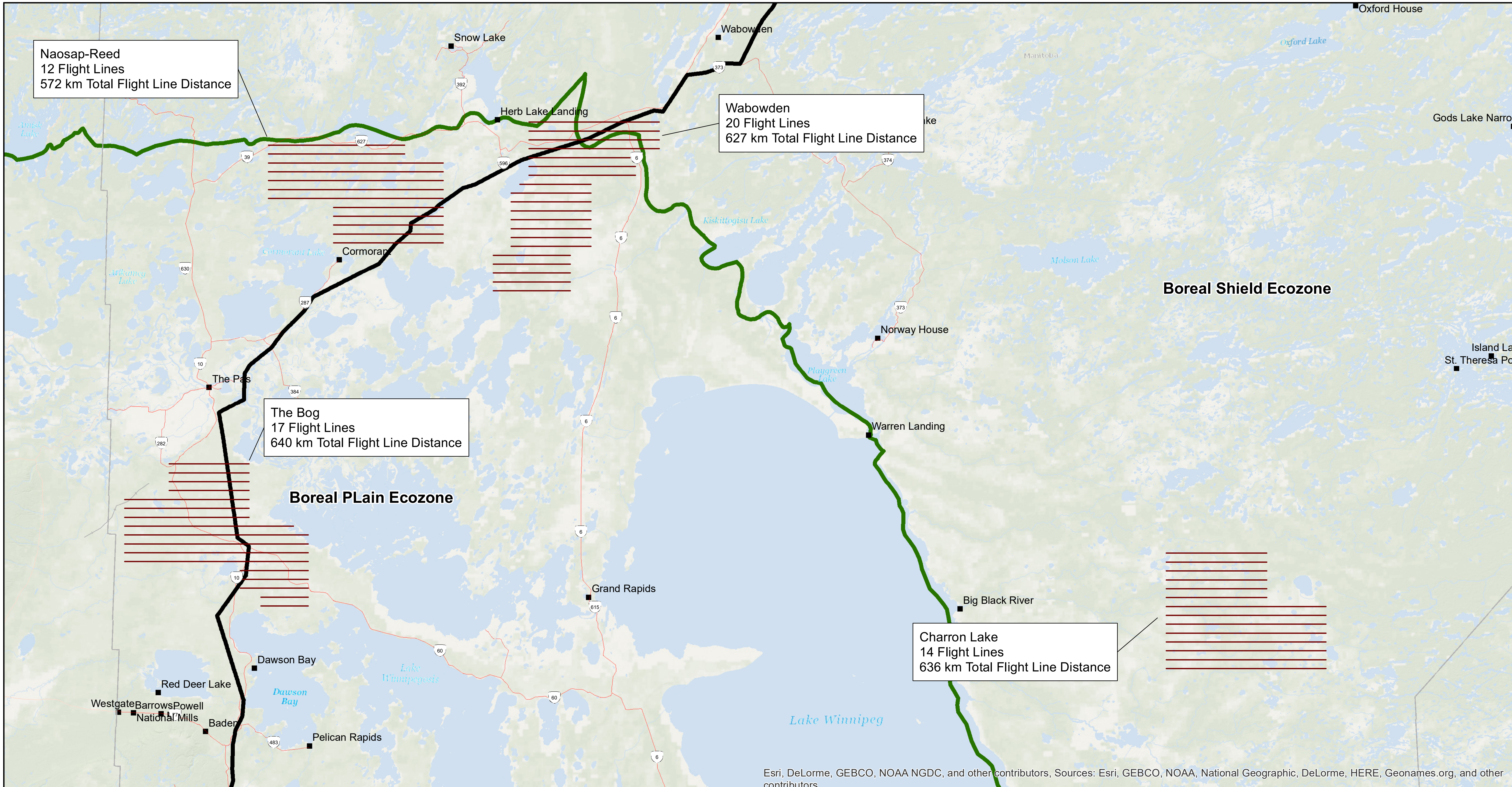
MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Overview

Datum: NAD83
Projection: UTM Zone 14N

0 35 70 140 210 280 350 Kilometers

PROJECT Nº 3008755	**Map 1**
SCALE: 1:2,300,000	DATE: 2020-12-06



LEGEND

Survey Area Flight Lines

BPIII Transmission Line Route

Ecozones

0 30 60 120 180 240 300 Kilometers

NOTES:
Data Sources:
ESRI Online Services
MB Hydro, Wood, Joro

Datum: NAD83
Projection: UTM Zone 14N

Manitoba Hydro | Joro Consultants

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Boreal Woodland Caribou Recruitment Survey Areas

PROJECT Nº 3008755	**Map 2**
SCALE: 1:1,250,000	DATE: 2020-11-22

APPENDIX 3: ADDITIONAL TABLES & FIGURES

Table 11: Comparison of Pre-construction (5-year Mean; 2009/10 – 2013/14) Annual Harvest to Construction (4-year Mean; 2014/15 – 2017/18) and Operation (2-year Mean; 2018/19 – 2019/20), by Construction Segment and Species.

Species	Project Phase	N1 (n = 11 RTLs)	N2 (n = 16 RTLs)	N3 (n = 13 RTLs)	N4 (n = 2 RTLs)	Total (n = 42 RTLs)
Beaver	Pre-construction	42.2 ±25.8	37.4 ±24.7	63.6 ±31.8	545.6 ±211.2	688.8 ±201.5
	Construction	7.3 ±5.3	3.5 ±3.4	4.3 ±3.6	112.5 ±98.0	127.5±95.7
	Operation	0.6 ±1.8	3.9 ±7.5	7.5 ±16.6	19.0 ±17.9	4.9 ±11.2
Coyote	Pre-construction	--NR--	--NR--	11.8 ±12.9	28.2 ±11.8	40.0 ±11.0
	Construction	--NR--	0.3 ±0.5	4.0 ±2.9	26.3 ±30.0	30.5 ±32.1
	Operation	--NR--	0.1 ±0.5	0.5 ±0.8	13.8 ±17.7	1.4 ±6.1
Fisher	Pre-construction	0.4 ±0.8	1.4 ±1.8	18.8 ±12.7	42.2 ±12.9	62.8 ±19.7
	Construction	--NR--	1.8 ±2.0	15.8 ±11.6	26.5 ±17.2	44.0 ±28.7
	Operation	--NR--	0.2 ±0.4	2.1 ±2.5	6.5 ±6.2	1.1 ±2.8
Fox Cross	Pre-construction	3.4 ±0.8	3.2 ±2.1	0.2 ±0.4	0.6 ±0.8	7.4 ±1.6
	Construction	2.3 ±15	0.3 ±0.5	0.3 ±0.5	0.3 ±0.5	3.0 ±2.1
	Operation	0.1 ±0.5	0.4 ±0.8	0.3 ±0.7	0.3 ±0.5	0.3 ±0.6
Fox Red	Pre-construction	6.8 ±2.3	3.0 ±2.1	14.2 ±6.7	5.4 ±2.6	29.4 ±5.8
	Construction	5.5 ±1.9	2.5 ±2.8	6.5 ±2.8	2.5 ±2.6	17.0 ±1.8
	Operation	0.5 ±1.3	0.6 ±1.4	1.1 ±2.3	2.5 ±2.5	0.8 ±1.8
Fox Silver	Pre-construction	1.2 ±1.1	0.6 ±0.8	1.0 ±1.2	--NR--	2.8 ±1.9
	Construction	0.5 ±0.6	--NR--	0.3 ±0.5	--NR--	0.8 ±0.9
	Operation	0.1 ±0.3	--NR--	--NR--	--NR--	0.02 ±0.2
Fox Arctic	Pre-construction	5.4 ±7.3	--NR--	--NR--	--NR--	5.4 ±7.3
	Construction	3.8 ±3.2	1.3 ±1.9	--NR--	--NR--	5.0 ±4.7
	Operation	0.1 ±0.3	--NR--	--NR--	--NR--	0.05 ±0.2
Canada Lynx	Pre-construction	6.8 ±3.6	27.0 ±28.4	23.6±7.9	13.2 ±9.3	70.8 ±34.6
	Construction	5.5 ±2.0	14.3 ±9.5	13.0 ±6.8	7.8 ±5.6	40.5 ±19.1
	Operation	0.8 ±1.5	4.1 ±4.9	2.4 ±3.4	9.0 ±9.8	2.9 ±4.8
Marten	Pre-construction	373.4 ±110.2	140.2 ±104.9	79.2 ±28.0	323.0 ±74.9	915.8 ±156.1
	Construction	110.8 ±75.3	81.3 ±54.0	94.0 ±44.3	131.0 ±69.8	417.0 ±202.0
	Operation	26.9 ±30.8	28.1 ±78.3	14.9 ±11.4	63.3 ±42.3	27.9 ±49.9
Mink	Pre-construction	14.4 ±6.9	36.2 ±19.1	27.8 ±14.5	59.8 ±36.4	138.2 ±48.6
	Construction	9.0 ±14.5	41.5 ±25.9	12.5 ±7.2	33.3 ±29.3	96.3 ±40.6
	Operation	0.6 ±1.5	7.5 ±12.9	3.1 ±4.5	18.5 ±15.6	5.0 ±10.0

Species	Project Phase	N1 (n = 11 RTLs)	N2 (n = 16 RTLs)	N3 (n = 13 RTLs)	N4 (n = 2 RTLs)	Total (n = 42 RTLs)
Muskrat	Pre-construction	8.0 ±11.5	27.2 ±49.9	564.8 ±743.0	434.0 ±276.6	1034.0 ±1013.1
	Construction	5.8 ±6.8	25.3 ±25.0	54.3 ±64.5	97.3 ±137.3	182.5 ±132.0
	Operation	--NR--	5.4 ±17.5	27.7 ±86.9	3.5 ±7.0	8.3 ±42.4
Otter	Pre-construction	4.2 ±2.1	10.0 ±7.1	12.4 ±12.7	27.6 ±14.4	54.2 ±14.9
	Construction	1.8 ±1.7	11.3 ±6.8	8.0 ±2.0	6.0 ±2.9	27.0 ±8.1
	Operation	0.1 ±0.3	2.0 ±3.0	0.7 ±1.3	2.3 ±2.2	1.0 ±2.1
Squirrel	Pre-construction	--NR--	0.4 ±0.5	11.2 ±10.4	126.6 ±53.6	138.2 ±55.4
	Construction	--NR--	--NR--	1.8 ±2.8	42.3 ±51.4	44.0 ±53.6
	Operation	--NR--	--NR--	--NR--	20.5 ±28.8	1.9 ±9.7
Weasel	Pre-construction	0.4 ±0.5	19.2 ±9.7	24.4 ±14.5	133.0 ±42.6	177.0 ±41.7
	Construction	0.8 ±0.9	16.5 ±20.4	9.3 ±7.4	42.5 ±47.6	69.0 ±69.7
	Operation	0.1 ±0.3	1.0 ±2.1	2.3 ±6.9	27.3 ±29.0	3.3 ±11.4
Wolf	Pre-construction	1.0 ±0.9	6.0 ±1.2	1.8 ±1.9	7.0 ±4.0	15.8 ±3.2
	Construction	0.8 ±0.9	2.3 ±3.2	2.5 ±1.3	7.3 ±4.8	12.8 ±5.3
	Operation	0.1 ±0.3	2.0 ±3.5	1.5 ±2.5	3.0 ±2.4	1.3 ±2.5
Wolverine	Pre-construction	1.8 ±1.7	2.8 ±2.0	1.0 ±0.9	--NR--	5.6 ±1.8
	Construction	1.3 ±1.2	2.5 ±1.3	--NR--	--NR--	3.8 ±1.9
	Operation	0.2 ±0.5	1.3 ±2.4	0.1 ±0.3	--NR--	0.5 ±1.5

RTL = Registered Trap Line
--NR-- = no reported harvest for the period assessed

Table 12: Comparison of Pre-construction (5-year Mean; 2009/10 - 2013/14) Annual Harvest Rate (#/license) to Construction (4-year Mean; 2014/15 – 2017/18) and Operation (2-year Mean; 2018/19 – 2019/20), by Construction Segment and Species.

Species	Project Phase	N1 (n = 11 RTLs)	N2 (n = 16 RTLs)	N3 (n = 13 RTLs)	N4 (n = 2 RTLs)	Total (n = 42 RTLs)
Beaver	Pre-construction	0.641 ±0.345	0.642 ±0.244	0.804 ±0.187	2.299 ±0.608	1.515 ±0.352
	Construction	0.127 ±0.107	0.082 ±0.084	0.093 ±0.069	1.068 ±0.517	0.481 ±0.273
	Operation	0.024 ±0.631	0.126 ±1.509	0.429 ±3.344	0.409 ±3.625	0.162 ±0.949
Coyote	Pre-construction	--NR--	--NR--	0.135 ±0.092	0.125 ±0.059	0.087 ±0.017
	Construction	--NR--	0.006 ±0.012	0.075 ±0.049	0.317 ±0.250	0.112 ±0.070
	Operation	--NR--	0.005 ±0.108	0.029±0.172	0.296 ±3.581	0.047 ±0.522
Fisher	Pre-construction	0.003 ±0.006	0.023 ±0.023	0.241 ±0.109	0.189 ±0.072	0.143 ±0.055
	Construction	--NR--	0.037 ±0.042	0.290 ±0.190	0.279 ±0.051	0.169 ±0.031
	Operation	--NR--	0.007 ±0.860	0.120 ±0.499	0.140 ±1.262	0.038 ±0.236
Fox Cross	Pre-construction	0.059 ±0.038	0.062 ±0.025	0.002 ±0.003	0.002 ±0.003	0.016 ±0.004
	Construction	0.050 ±0.028	0.006 ±0.011	0.005 ±0.009	0.003 ±0.006	0.016 ±0.011
	Operation	0.005 ±0.177	0.014 ±0.153	0.017 ±0.136	0.005 ±0.101	0.009 ±0.053
Fox Red	Pre-construction	0.146 ±0.158	0.052 ±0.018	0.181 ±0.069	0.023 ±0.010	0.066 ±0.014
	Construction	0.137 ±0.107	0.060 ±0.067	0.183 ±0.170	0.018 ±0.016	0.084 ±0.036
	Operation	0.019 ±0.465	0.019 ±0.283	0.063 ±0.471	0.054 ±0.508	0.028 ±0.150

Species	Project Phase	N1 (n = 11 RTLs)	N2 (n = 16 RTLs)	N3 (n = 13 RTLs)	N4 (n = 2 RTLs)	Total (n = 42 RTLs)
Fox Silver	Pre-construction	0.024 ±0.024	0.012 ±0.014	0.019 ±0.027	--NR--	0.006 ±0.004
	Construction	0.015 ±0.023	--NR--	0.004 ±0.007	--NR--	0.003 ±0.004
	Operation	0.002 ±0.088	--NR--	--NR--	--NR--	0.001 ±0.013
Fox Arctic	Pre-construction	0.047 ±0.060	--NR--	--NR--	--NR--	0.011 ±0.015
	Construction	0.073 ±0.050	0.029 ±0.046	--NR--	--NR--	0.020 ±0.017
	Operation	0.005 ±0.121	--NR--	--NR--	--NR--	0.002 ±0.018
Canada Lynx	Pre-construction	0.074 ±0.048	0.482 ±0.364	0.334 ±0.128	0.049 ±0.028	0.150 ±0.054
	Construction	0.118 ±0.039	0.332 ±0.206	0.253 ±0.082	0.064 ±0.048	0.179 ±0.069
	Operation	0.029 ±0.540	0.133 ±0.988	0.137 ±0.695	0.194 ±1.986	0.097 ±0.407
Marten	Pre-construction	8.166 ±8.191	2.412 ±1.170	1.120 ±0.449	1.368 ±0.170	2.054 ±0.455
	Construction	2.005 ±0.449	2.155 ±0.762	1.795 ±0.635	1.636 ±0.673	1.729 ±0.211
	Operation	1.036 ±10.893	0.920 ±15.820	0.851 ±2.302	1.360 ±8.540	0.925 ±4.239
Mink	Pre-construction	0.326 ±0.316	0.671 ±0.100	0.363 ±0.168	0.236 ±0.085	0.306 ±0.091
	Construction	0.113 ±0.160	1.112 ±0.476	0.224 ±0.095	0.284 ±0.127	0.445 ±0.212
	Operation	0.022 ±0.532	0.246 ±2.600	0.177 ±0.911	0.398 ±3.149	0.165 ±0.846
Muskrat	Pre-construction	0.104 ±0.154	0.395 ±0.685	5.502 ±6.205	1.748 ±1.077	2.059 ±1.773
	Construction	0.112 ±0.131	0.565 ±0.580	0.902 ±0.865	0.872 ±1.448	0.761 ±0.480
	Operation	--NR--	0.176 ±3.544	1.583 ±17.555	0.075 ±1.414	0.276 ±3.597
Otter	Pre-construction	0.076 ±0.063	0.175 ±0.088	0.141 ±0.120	0.107 ±0.031	0.119 ±0.029
	Construction	0.034 ±0.023	0.296 ±0.086	0.160 ±0.046	0.083 ±0.044	0.129 ±0.060
	Operation	0.002 ±0.088	0.066 ±0.614	0.040 ±0.270	0.048 ±0.448	0.034 ±0.177
Squirrel	Pre-construction	--NR--	0.010 ±0.015	0.125 ±0.080	0.527 ±0.159	0.296 ±0.086
	Construction	--NR--	--NR--	0.027 ±0.039	0.326 ±0.380	0.144 ±0.161
	Operation	--NR--	--NR--	--NR--	0.441 ±5.810	0.062 ±0.820
Weasel	Pre-construction	0.003 ±0.004	0.550 ±0.446	0.315 ±0.120	0.570 ±0.130	0.389 ±0.066
	Construction	0.010 ±0.012	0.339 ±0.389	0.164 ±0.093	0.331 ±0.382	0.251 ±0.164
	Operation	0.002 ±0.088	0.033 ±0.419	0.131 ±1.400	0.586 ±5.859	0.111 ±0.965
Wolf	Pre-construction	0.009 ±0.007	0.142 ±0.072	0.019 ±0.016	0.032 ±0.025	0.036 ±0.010
	Construction	0.012 ±0.017	0.054 ±0.079	0.057 ±0.037	0.077 ±0.031	0.057 ±0.020
	Operation	0.005 ±0.121	0.066 ±0.709	0.857 ±0.506	0.065 ±0.495	0.043 ±0.216
Wolverine	Pre-construction	0.031 ±0.029	0.054 ±0.030	0.015 ±0.017	--NR--	0.012 ±0.003
	Construction	0.026 ±0.021	0.069 ±0.024	--NR--	--NR--	0.018 ±0.013
	Operation	0.007 ±0.192	0.042 ±0.478	0.006 ±0.064	--NR--	0.017 ±0.124
Number of Trappers	Pre-construction	83.8 ±40.9	51.4 ±22.3	78.0 ±31.3	242.6 ±73.4	455.8 ±74.1
	Construction	52.5 ±27.3	37.5 ±16.1	50.8 ±14.7	104.8 ±87.3	245.5±134.6
	Operation	26 ±2.8	30.5 ±4.9	17.5 ±4.9	46.5 ±4.9	30.1 ±11.8

RTL = Registered Trap Line
--NR-- = no reported harvest for the period assessed

Redacted

Figure 25: Charron Lake Caribou path trajectories 1. Depicting path trajectories of individual collared caribou between October 2019 and September 2020. ROW depicted as dashed line, with red segments indicating vegetation mitigation areas.

Redacted

Figure 26: Charron Lake Caribou path trajectories 2. Depicting path trajectories of individual collared caribou between October 2019 and September 2020. ROW depicted as dashed line, with red segments indicating vegetation mitigation areas.

Redacted

Figure 27: Wabowden Caribou path trajectories 1. Depicting path trajectories of individual collared caribou between October 2019 and September 2020. ROW depicted as dashed line, with red segments indicating vegetation mitigation areas.

Redacted

Figure 28: Wabowden Caribou path trajectories 2. Depicting path trajectories of individual collared caribou between October 2019 and September 2020. ROW depicted as dashed line, with red segments indicating vegetation mitigation areas.