4.0 EVALUATION OF ALTERNATIVE ROUTES AND OTHER INFRASTRUCTURE

4.1.1 Construction Power Transmission Line and Station

Transmission Line rights-of-way contribute to habitat fragmentation in the area, the two route options for the Construction Power Transmission lines were compared to determine habitat use, species composition, diversity and the degree of fragmentation along each route with respect to Project effects on avian communities.

Breeding-bird surveys in the Keeyask Transmission Study Area revealed that pure black spruce vegetation, through which approximately two-thirds of Construction Power Transmission Line Route Option 1 (with a 60-m right-of-way) and over one-half of Construction Power Transmission Line Route Option 2 (with a 60-m right-of-way) bisect (Table 4-1), supported lower bird densities than most other surveyed habitat types. Low vegetation, the second most dominant habitat type along the Construction Power Transmission Line Route Options, supported a higher bird density relative to the pure black spruce vegetation communities (Table 4-1). Areas classified as low vegetation are generally open, sparsely treed habitats with a greater diversity of shrub and understory species than is present in pure black spruce habitats. Due to the diverse vegetative structure, low vegetation habitats are able to support a variety of species, particularly those that nest on the ground or in shrubs (e.g., dark-eyed junco, white-throated sparrow, and blackpoll warbler). The third most abundant habitat type was young regeneration, which supported the lowest abundance of birds of all vegetation types surveyed (Table 4-1). Vegetative communities present in these areas are in relatively early stages of succession as they represent regeneration from recent burns (approximately 20 years ago). As a result, vegetation in these areas lack structural diversity and therefore provide minimal quality bird habitat. As time passes however, these communities will regenerate to mature forest, passing through ecologically productive successional stages in the process.

Table 4-1: Breeding-Bird Mean Density and Diversity in the Keeyask Transmission Area (2009 through 2011)

Broad Vegetation Type	Average Density*	Average Diversity**
Black Spruce Pure	2.7 ± 1.6	4.6 ± 2.4
Low Vegetation	2.9 ± 1.6	4.8 ± 2.4
Tamarack Mixture	3.2 ± 1.2	5.2 ± 2.0
Black Spruce Mixture	2.6 ± 1.4	4.4 ± 2.1

Table 4-1: Breeding-Bird Mean Density and Diversity in the Keeyask Transmission Area (2009 through 2011)

Broad Vegetation Type	Average Density*	Average Diversity**
Young Regeneration	1.8 ± 1.0	3.9 ± 1.3
Jack Pine Mixture	2.6 ± 1.0	4.4 ± 1.8
Jack Pine Mixedwood	2.3	4
Tamarack Pure	3.5 ± 1.3	5.7 ± 1.9
Jack Pine Pure	3.9 ± 1.5	6.0 ± 1.7
Human	4.2 ± 2.9	6.8 ± 4.3
Black Spruce Mixture/Tall Shrub	3.4 ± 2.4	5.5 ± 3.5
Black Spruce Mixedwood	2.3 ± 0.8	4.0 ± 1.4
Total	***2.8 ± 1.6***	***4.9 ± 2.5***

* Density reported as number of birds per hectare ± st.dev.

* Diversity reported as number of species per stop ± st.dev.

4.1.1.1 Passerines

Abrupt habitat edges created by the clearing of forest vegetation associated with transmission line corridor development, have the potential to influence a variety of bird community dynamics including changes to territory boundary establishment and shifts in bird community composition (Kroodsma 1984; Rail *et al.* 1997). Studies have shown that sizeable forest clearings may also affect the movement of birds across newly developed openings as some bird species, especially those characteristic of the forest interior such as yellow-rumped warbler, Swainson's thrush, and red-breasted nuthatch, have a tendency to avoid crossing sizeable habitat gaps (i.e., greater than 50 m; Rail *et al.* 1997; Desrochers and Hannon 1997).

Both proposed Route Options for the Construction Power Transmission Line are similar in length and bisect similar habitat types. As a result, the average number of breeding-bird pairs that could potentially be displaced as a result of habitat clearing along a 60-m right-of-way for the two Route Options is similar, but higher for Route Option 2. Using average bird densities observed in each surveyed vegetation type and assuming complete abandonment of cleared habitat, approximately 300 pairs of breeding birds would be displaced resulting from land clearing along a 60-m right-of-way for Route Option 1 and approximately 331 pairs would be displaced along a 60-m right-of-way for Route Option 2 (Appendix A, Table A-3), making Route Option 1 the preferred option with respect to overall Project impacts to passerine communities.

4.1.1.2 Waterbirds and Shorebirds

Natural riparian edges create diverse vegetative communities that are known to support high bird abundance and diversity (Larue *et al.* 1995, Whitaker and Montevecchi 1997). Breeding-bird surveys in the Project Study Area occasionally revealed a higher diversity of waterbirds at survey stops within or adjacent to riparian edge habitats. Helicopter-based waterbird surveys also confirmed waterbird utilization of inland lakes and creeks in the Project Study Area. Stream or waterbody crossings by the proposed Construction Power Transmission Line Route Options increase the potential for disturbance to riparian edge habitats, and the bird communities they support. A minimum of nine streams/waterbodies are crossed by Construction Power Transmission Line Route Option 1, including one crossing of the Nelson River. Route Option 2 crosses a minimum of 11 streams/waterbodies, including one crossing of the Nelson Riverin which placement of a transmission tower on William Smith Island would be required (Appendix A, Table A-3).

The higher number of stream/waterbody crossings through riparian edge habitat required for Route Option 2, in addition to the potential for displacement of a slightly larger number of birds, suggests this option may have a greater potential impact bird habitat quality and therefore bird populations utilizing these habitats. As a result, the recommended Route Option for the proposed Construction Power Transmission Line, relative to the overall impact to bird habitat quality in the Project Study Area, is Route Option 1.

4.1.1.3 Raptors

As discussed in Section 3.2.7.2, an active great-horned owl nest was identified along Route Option 1 (Map 3-1). Great-horned owls are fairly common residents of Manitoba, occurring almost province-wide (Carey *et al.* 2003). Rarely known to construct or repair their own nest, this owl species generally occupies nests previously used by other large raptors. Most nests are used for only one season, as a lack of nest maintenance, in combination with trampling of nests by owlets, often cause nests to deteriorate (Houston *et.al* 1998). Therefore, it is unlikely that the nest identified along Route Option1 will be reused as nests of other raptor species often are.

While raptors surveys were conducted in the general vicinity of the Keeyask Transmission Study Area, no further raptor species were observed. There is little difference in the two Route Options regarding potential for effects on raptors.

4.1.1.4 Species at Risk

The following three species observed in the Project Study Area are listed as ‘Species at Risk’ by COSEWIC *SARA* and *MESA:* rusty blackbird (special concern), common nighthawk (threatened) and olive-sided flycatcher (threatened).

Olive-sided flycatcher preferential habitat was identified along both Construction Power Transmission Line Route Options. Habitat loss and alteration have been identified as causes in the current decline of olive-sided flycatcher populations, An examination of Olive-sided Flycatcher habitat in the Project Study Area (Map 4-1) showed that there is scattered high quality habitat along both routes. Due to the sparse and scattered availability of the habitat there is no preference for either Construction Power Route Option regarding Olive-sided Flycatcher habitat.

Rusty blackbird favoured habitats of forested riparian edges, such as that along the margins of treed muskeg, swamps and slow moving streams, bogs and marshes. Rusty blackbirds nest along riparian edges, usually in wetland vegetation (e.g., cattails), or shrubs (COSEWIC 2006) which occurs along both Route Options and throughout the Project Study Area. An examination of Rusty Blackbird habitat in the Project Study Area (Map 4-2) showed that there is very little high quality habitat available along either Construction Power Route Option. Although there is slightly more medium quality habitat available along Construction Power Route Option 1, the difference is not substantial. There is no preference for either Construction Power Route Option regarding Rusty Blackbird habitat.

Due to their crepuscular nature, or tendency to be more active at twilight, common nighthawk is rarely encountered during daylight hours (Carey *et al.* 2003). Because no observations of common nighthawk occurred along either Construction Power Transmission Line Route Option during Breeding-bird surveys in the Project Area, common nighthawk use of this portion of the Project Study cannot accurately be determined.

An examination of Common Nighthawk habitat in the Project Study Area (Map 4-3) showed that there is high-quality habitat available along both Construction Power Route Options. There is slightly more high quality habitat along Construction Power Route Option 1, particularly near the Keeyask Switching Station site. For this reason, there is a slight preference for Construction Power Route Option 2 regarding Common Nighthawk habitat, but this would not be a strong preference.

4.1.2 Construction Power Station

Within the Project Study Area, five alternative Construction Power Station sites (CP Sites 2-6) were identified. All five sites, evaluated for the potential of negative effects on birds, were determined to similar in nature and that negative effects on bird communities would be minimal. Technical issues arising from the new access road alignment from PR 280 to the Keeyask Generation Project site determined that four of the five sites (CP Sites 2, 3, 4 and 5) were undesirable leaving Site 6 the preferred siting choice.

4.1.3 Generation Outlet Transmission Lines

Within the Project Study Area, four alternate Generation Outlet Transmission Line Route Options were identified (Map 4-4). All four Route Options were evaluated for line length, number of stream crossings, proximity to wetlands and Stephen's Lake, presence of terrestrial habitat and potential for fragmentation.

Evaluations determined Generation Outlet Transmission Line Route Option A is the best alternative with respect to birds because the potential for line strikes by birds which utilize Stephens, Gillrat, Cache or Joslin lakes is minimized. Generation Outlet Transmission Line Route Option A also places the transmission line in a habitat type that appears to support lower forest bird abundance and diversity.

Generation Outlet Transmission Line Route Option B is in close proximity to Stephen's Lake at its western end and also traverses between two lakes just north of Gillrat Lake. This increases the potential for bird strikes during migration periods. Further east, Route Option B shifts to the south into habitat which is generally less productive for passerine bird communities. It passes in relatively close proximity to Cache Lake, which may result in an additional risk of bird-line collisions.

Generation Outlet Transmission Line Route Option C (the northernmost route) is in closer proximity to Stephen's Lake for a longer length than any other route. Much of this route follows either the existing road extending from Gillam to the Butnau Dam or the proposed South Access Road. Despite riparian habitat being generally more productive for bird communities than any other habitat type, both breeding-bird surveys and aerial reconnaissance flights indicated the southern shores and bays of Stephens Lake tend not to contain large concentrations of birds. Previous Keeyask Generation Project field studies have indicated that the potential for birds nesting on inland lakes such as Cache Lake and Gillrat Lake to collide with transmission lines, guy wires and towers situated close to Stephens Lake exists. More importantly, there is increased potential for transmission line collisions during fall migration, when birds use major waterbodies such as Stephens Lake as both staging areas and as southward flight corridors. With respect to fragmentation, aligning the Generation Outlet Transmission Line alongside the proposed South Access Road has some advantage over developing more contiguous habitat further south.

While Generation Outlet Transmission Line Route Option D traverses very similar habitat to Route Option A and is well removed from the other large lakes mentioned above, it was not chosen as a preferred Route Option. Route Option D line would be routed adjacent to transmission line KN36 for much of its length resulting in a very wide right-of-way which has the potential to be an impediment for utilization by some interior forest bird species.

Evaluations of all Generation Outlet Route Options indicated that based on the potential for avian community effects (particularly with respect to waterbirds), Route Option A is the preferred choice. However, given the potential for fragmentation effects on forest bird communities from the development of Option A, it is not a strong preference.

4.1.3.1 Passerines

Black spruce pure habitats were the dominant vegetation type within the right-of-way of each Generation Outlet Transmission Line, and supported low bird densities relative to other habitat types surveyed (Table 2-2; Appendix A, Table A-4). Low vegetation, the second most abundant vegetation type affected by proposed Route Options A, B, C and D, supported higher bird densities compared to the black spruce vegetated areas (Table 2-2; Appendix A, Table A-4). Parcels of jack pine dominated vegetation along a raised esker between Generation Outlet Transmission Line Route Options B and C were a relatively unique vegetative community within the Project Study Area. Uncommon occurrences and small areas of this vegetative type however, provided limited opportunities to sample sizeable, contiguous stands for breeding birds. Although Project Study Area bird surveys suggest that these areas support a high diversity and density of birds in comparison to other habitats surveyed in the Project Study Area, these results are based on a relatively small sample size (3 stops or less) and are contrary to that observed in similar habitat types in the Region. Survey results, based on larger sample sizes, in similar inland, jack-pine dominated habitats, in the Region between 2001 and 2011 suggest that areas of this vegetation type generally support less abundant and diverse bird communities than other surveyed habitat types.

The four Route Options for the Keeyask Generation Outlet Lines bisect comparable habitat types with respect to use by forest birds. Routes A, B and C are similar in length while Route D is approximately 11% longer. As a result, the average number of breeding-bird pairs that could potentially be displaced from habitat clearing operations along a 230-m right-of-way for each Route Option is comparable, although highest for Route Option D.

Route Option A has experienced minimal fragmentation of bird habitat as a result of infrastructure development, nor is any development other than, potentially, the proposed Generation Outlet Transmission lines, proposed for the area at the time of this report. Transmission Line development along Route Option A would increase fragmentation effects.

In comparison, Route Option B, jointly shared with Route Option C along the western portion of the route, parallels a forested area that is bisected by several existing cutlines which were made during site feasibility studies for the proposed development of the Keeyask Generation Project South Access Road. A longer distance routed alongside existing and proposed infrastructure for Route Option C suggests that the latter route may have a lower potential effect on bird habitat quality and therefore on bird populations utilizing these habitats than Route Option B.

As Route Option D parallels the KN36 transmission line right-of-way for the east-west portion of its route, it is also sited in a previously fragmented landscape. However, as stated previously, the fragmentation effects associated with Route Option D may be greater due to the very wide right-of-way that result from siting the Generation Outlet Transmission lines alongside the KN36 line.

While it is recognized that habitat fragmentation is an issue when considering Route Option A, it is not judged to be as important as some of the factors affecting the more northern options. Route Options B and C pass between two relatively unnamed large lakes just north of Gillrat Lake. The potential for bird collisions in this area by birds transferring back and forth between these lakes exists. In addition to potential bird collisions, Route Options B and C pass in close proximity to Stephens Lake and although Stephens Lake has not been observed to support large numbers of staging waterfowl, there is potential for it to be utilized as a staging area, particularly in the fall.

4.1.3.2 Waterbirds and Shorebirds

Natural riparian edges create diverse vegetative communities that are known to support high bird abundance and diversity (Larue *et al.* 1995, Whitaker and Montevecchi 1997). Breeding-bird surveys in the Project Study Area occasionally revealed a higher diversity of waterbirds at survey stops within or adjacent to riparian edge habitats. Helicopter surveys also confirmed waterbird utilization of inland lakes and creeks in the Project Study Area. Stream crossings by any of the proposed Generation Outlet Transmission Line Route Options increase the potential for disturbance to riparian edge habitats and the bird communities they support. The four proposed Generation Outlet Transmission Line Route Options differ in the number of potential stream crossings required, and therefore, in the potential of each route to affect the quality of bird habitat along riparian edges. A minimum of 10 streams are crossed by Route Option A, Route Option B crosses a minimum of 14, Route Option C crosses at least 17 streams and Route Option D crosses 8 streams (Aquatics Technical Report 2012).

4.1.3.3 Raptors

Generation Outlet Transmission Line Options B and C are located in closer proximity to the Stephens Lake shoreline than Route Options A or D. For this reason, there is increased potential for bald eagles to be in proximity to these lines. However, for most of the route the separation from the lake is sufficient that eagles will likely not utilize the route more frequently than they would Options A or D. All four routes have potential for utilization by foraging raptors and an associated risk of line collisions; however, it is unlikely there will be a measurable difference in level of risk between the options.

4.1.3.4 Species at Risk

Common Nighthawks

Route Option A is located in an area with less fragmented habitat than exists near Options B and C which are located near the Keeyask Generation Project South Access Road and Butnau Road. Route Option D is sited along the KN36 transmission line. As such, clearing land along Option A may have potential to affect common nighthawks more than similar activities at Options B, C or D since Options B, C and D already have more open areas which may be frequented by foraging or nesting common nighthawks. Due to their low densities and broad distribution, effects on common nighthawks are expected to be low for all Route Options.

Olive-sided Flycatcher

Along the Generation Outlet Transmission Line options, olive-sided flycatcher habitat was found in the area to the east of Gillrat Lake, in the Cache Creek/Cache Lake area and along the Kettle River in the Gillam area (Map 4-2). Olive-sided flycatcher preferred habitat evaluations revealed that Route Option C would potentially traverse the most habitat followed by Route Options B and A, respectively. Habitat mapping for Option D was unavailable.

Rusty Blackbird

Along the Generation Outlet Transmission Line Route Options, rusty blackbird habitat was found around Gillrat Lake and just to the east of Gillrat Lake, north of Cache Lake near Stephens Lake, and in the area to the south of the Butnau dam (Map 4-3). Rusty blackbird preferred habitat evaluations revealed that Route Option C would potentially traverse the most habitat and has the potential to affect rusty blackbird habitat followed by Route Options B and A, respectively. Habitat mapping for Option D was unavailable.

Table 4-2 illustrates the ratings of the Generation Outlet Transmission Line Options for the various bird groups.

Table 4-2: Generation Outlet Transmission Line Options Ratings for Bird Groups

Bird Group	Option A	Option B	Option C	Option D
Passerines	p			
Waterbirds/Shorebirds	**P**			
Raptors	n	n	n	n
Common Nighthawk	N	n	n	n
Olive-sided Flycatcher	p			
Rusty Blackbird				

P = preferred route
p = preferred route (slight preference)
n = no preference

4.1.4 Keeyask Switching Station

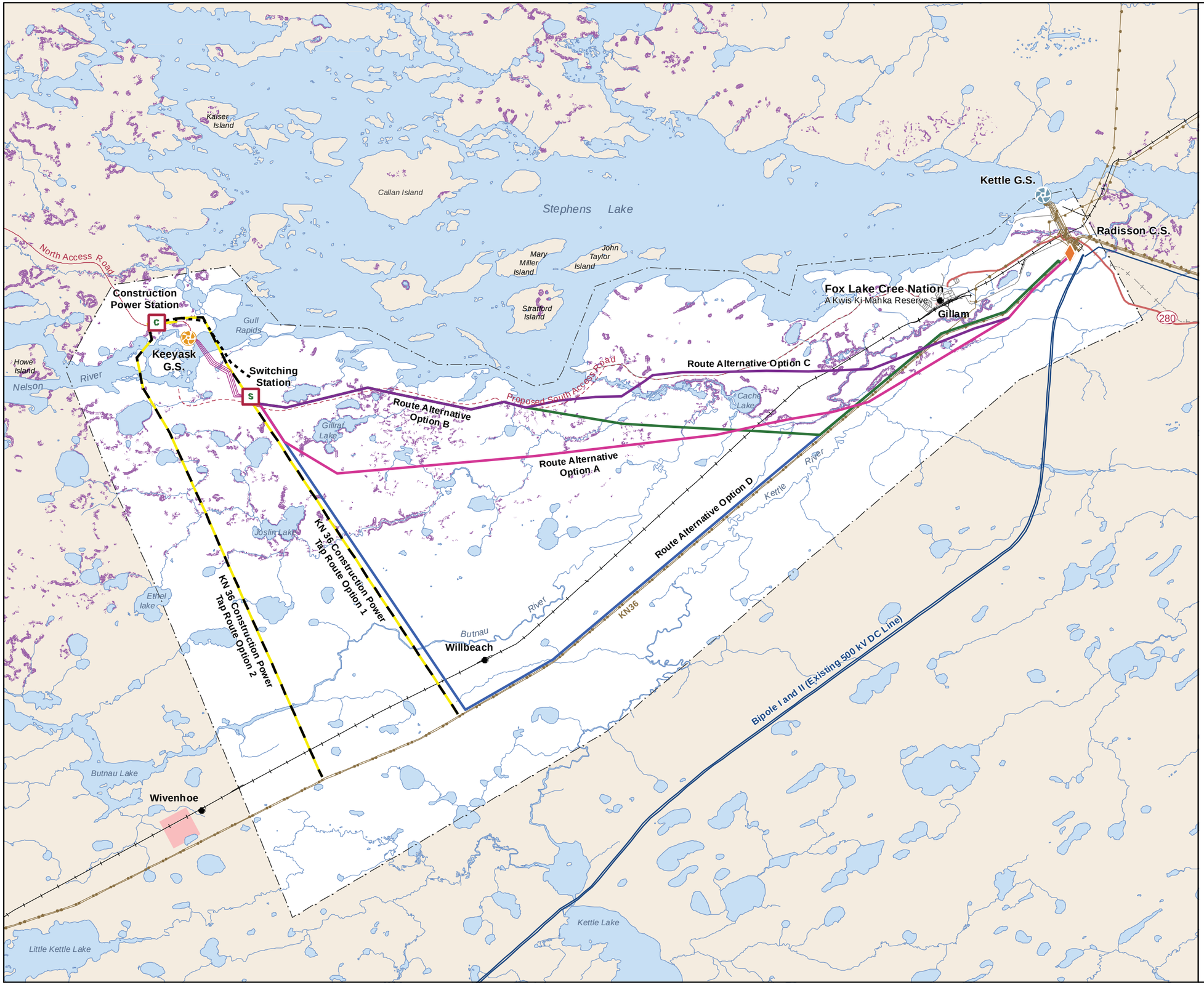
Within the Project Study Area, seven alternative station sites were identified. Three sites (Sites 5, 6 and 7) on the north side and four sites (Sites 1 through 4) on the south side of the Nelson River (Map 4-4). Sites 5 through 7 were ruled out as technically not feasible due to doubling the distance of transmission lines and the need for approximately four to 16 electrical crossovers. Site 1 was ruled out due to its location within the flooded area of the proposed Keeyask Generation Project and Site 2 is located on a rock quarry making construction unfeasible. Technically, Site 3 on the south side of the Nelson River is the preferred site with Site 4 serving as the alternative location.

A desktop photo analysis and examination of data collected for Keeyask Generation Project studies was undertaken to assess Sites 3 and 4 to identify the potential for substantive negative effects on birds. Results from this analysis verified that should any significant constraints be identified with respect to unanticipated negative effects on birds at Site 3, Site 4 would be developed as the alternative (Map 4-4).

4.1.5 Radisson Converter Station Upgrade

Evaluations with respect to birds did not identify any significant environmental effects associated with the proposed changes to the Radisson Converter Station.

Upgrades to the Radisson Converter Station will occur within the existing footprint of the station. These upgrades will not adversely affect bird species in the area as they have been acclimated to the existence of the station for many years.



Manitoba Hydro

Keeyask Transmission Project

Project Infrastructure

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

Infrastructure

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

Olive-sided Flycatcher Habitat

- High
- Moderate

Landbase

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

Coordinate System: UTM Zone 15N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: Monday, September 24, 2012

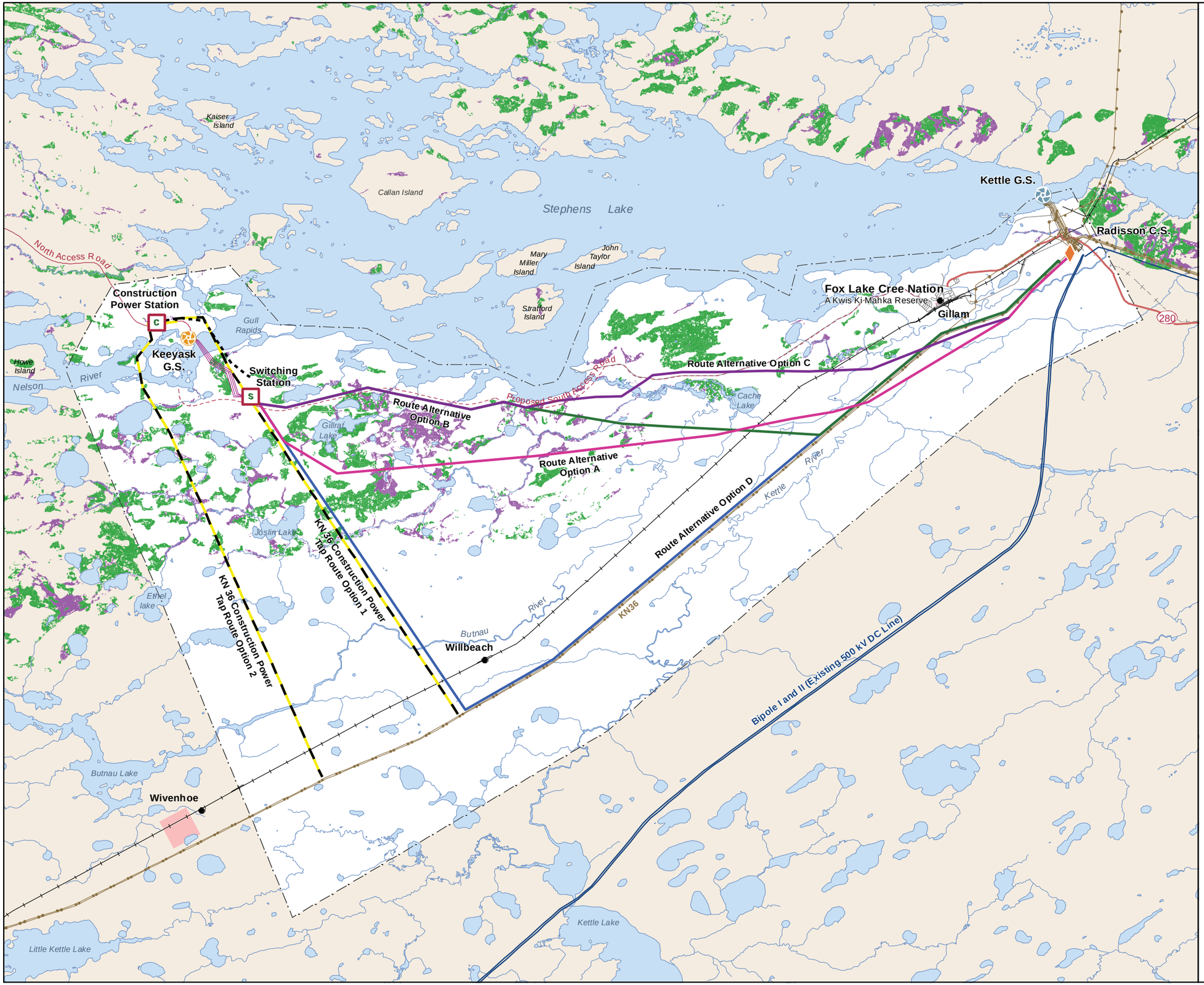
N

0 2 4 Kilometres
0 2 4 Miles

1:150,000

Olive-sided Flycatcher Habitat within the Project Study Area

Map 4-1



Manitoba Hydro

Keeyask Transmission Project

Project Infrastructure

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

Infrastructure

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

Rusty Blackbird Habitat

- High
- Medium

Landbase

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

Coordinate System: UTM Zone 15N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: Monday, September 24, 2012

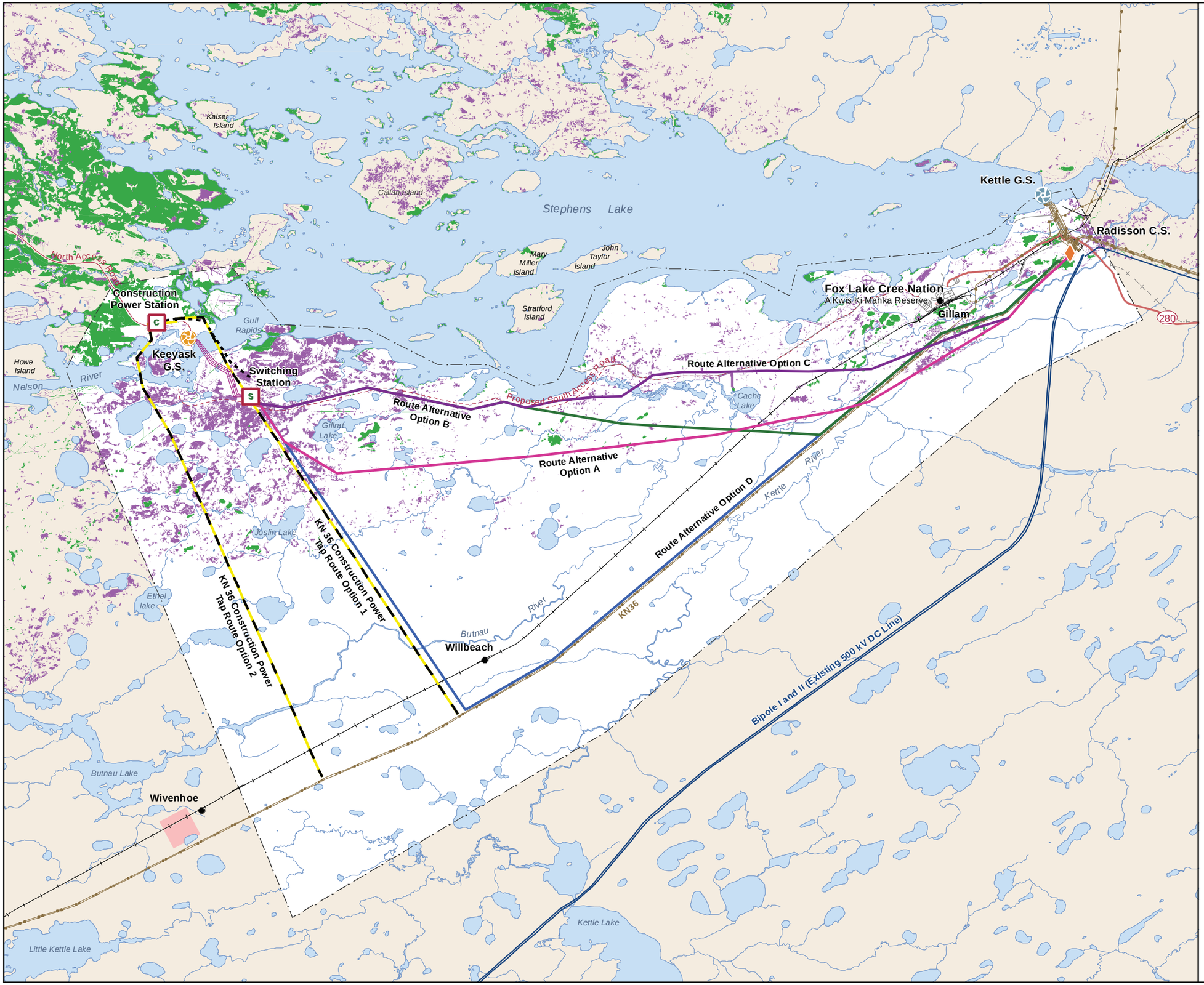
N

0 2 4 Kilometres
0 2 4 Miles

1:150,000

Rusty Blackbird Habitat within the Project Study Area

Map 4-2



Manitoba Hydro

Keeyask Transmission Project

Project Infrastructure

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

Infrastructure

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

Common Nighthawk Habitat

- High
- Moderate

Landbase

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

Coordinate System: UTM Zone 15N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: Monday, September 24, 2012

N

0 2 4 Kilometres
0 2 4 Miles

1:150,000

Common Nighthawk Habitat within the Project Study Area

Map 4-3

Manitoba Hydro

Keeyask Transmission Project

Project Infrastructure

- Alternative Construction Power Station Site
- Alternative Switching Station Site

Infrastructure

- Keeyask Generation Infrastructure (Proposed)
- South Access Road (Proposed)
- North Access Road

Coordinate System: UTM Zone 15N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: September 24, 2012

N

0 250 500 Metres

1:20,000

Alternative Construction Power and Switching Station Sites

Map 4-4

5.0 EFFECTS AND MITIGATION

5.1 BIRD OVERVIEW

Manitoba Hydro is committed to responsible environmental stewardship, which aims to minimize the environmental effects of the Project components on bird species (Manitoba Hydro 2011). By conducting a detailed effects assessment, Manitoba Hydro is committed to developing the Project while mitigating any potential Project effects on migratory and resident bird species where possible.

Potential effects are expected when bird ranges overlap spatially and temporally with the Project. Most species are migratory in Manitoba, generally migrating northward in spring, nesting in suitable habitats in spring and summer, and migrating south in fall to over-winter in the southern United States and in Central and South America. In Manitoba, few bird species are year-round residents (Carey *et al.* 2003).

Clearing, construction, operation, and maintenance of the infrastructure associated with the Project are expected to affect birds and bird communities in several ways. Effects can be positive, negative, or neutral, depending upon the affected species. Potential effects include increased mortality, habitat alteration and fragmentation, sensory disturbance, and disruption of movements.

5.1.1 Potential Effects

The completed effects assessment identifies potential effects of the Project components on bird species during the operation and construction phases of the Project; this includes evaluation of: Construction Power Transmission lines, Unit Transmission lines and Generation Outlet Transmission lines, as well as the Construction Power Station, Keeyask Switching Station and Radisson Converter Station Upgrades. Proposed mitigation measures were derived based on public domain literature and environmental assessments. The potential effects of Project-related construction, operation and maintenance on bird species and communities are as follows:

- Increased Mortality:
    - Due to collisions with vehicles or machinery, and collisions with transmission wires.
    - Of waterfowl, other waterbirds, and upland game birds due to increased hunting.
    - Mortality or nest loss due to construction or maintenance during the spring nesting season.
    - Increased susceptibility to terrestrial predators.

- Habitat Alteration:
    - Loss or alteration of habitat on Project rights-of-way
    - Loss or alteration of habitat in Project infrastructure component footprints.
- Sensory Disturbance:
    - And/or habitat avoidance due to clearing or maintenance activities.
    - Disruption of daily movements due to the physical presence of humans, machinery, or Project structures.

5.1.1.1 Mortality

Increases in bird mortality can occur in a variety of forms, including collisions with transmission wires and vehicles, electrocutions, increased predation and hunting. Bird-wire strikes are one of the most common causes of non-hunter related mortality for birds, particularly birds with short wings and large body masses (Avery *et al.* 1980; Malcolm 1982; Rusz *et al.* 1986; Faanes 1987; Morkill and Anderson 1991; Brown and Drewien 1995; Bevanger 1998; Training Unlimited Inc. 2000). Other factors influencing a bird's likelihood of colliding with a transmission wire include visibility (e.g., weather conditions, time of day), age of the bird (i.e., younger birds are more prone to collisions), location of the wire (e.g., wires crossing migration corridors can cause more collisions), and surrounding environment (Bevanger 1994; Brown and Drewien 1995; Bevanger 1998). While the possibility for any bird species to collide with a vehicle exists, the likelihood of such an event is considered to be remote while travelling on a transmission line right-of-way.

Clearing and maintenance associated with the right-of-way and other Project components may result in the destruction of some nests, consequently decreasing nest success or increasing mortality rates of hatchlings. With the exception of a few irregular nesting species such as gray jay (*Perisoreus canadensis*) that nest in late winter, the risk of nest disturbance from maintenance and clearing is reduced and nearly eliminated by limiting these activities to winter months.

The introduction of new transmission lines on the landscape could contribute to increased predation on some bird species located near the right-of-way, by raptors. Artificial perching and roosting structures such as transmission towers are used by some raptors in habitats with few natural perches; these perches provide an elevated viewpoint to aid in locating prey (Boeker and Nickerson 1975; Knight and Kawashima 1993). Raptors often utilize transmission towers even in habitats containing natural perch sites as the great height of transmission towers offer the highest vantage point (Lammers and Collopy 2007).

In addition, nests located near the forest edge are under greater predatory pressures from small mammals such as chipmunks and red squirrels that may not utilize the central portion of transmission line rights-of-way (Chasko and Gates 1982). In addition to increased predation as the right-of-way is cleared and access trails are created, opportunities for harvest of upland game birds and waterfowl may increase. In some cases, access could be limited by physical barriers (e.g., terrain, water). Provincial harvest management strategies and regulations are an important consideration in ensuring that sustainable upland game bird and waterfowl population goals are met.

5.1.1.2 Habitat Alteration

The loss of individuals and a decline in a species' population is strongly associated with habitat loss (Schmiegelow and Mönkkönen 2002). The vulnerability of bird species to habitat loss is dependent on their degree of habitat specialization; birds with broad-ranging habitat requirements are less likely to be affected (Hockey and Curtis 2008). Conversely, species that are highly specialized for small, rare habitat features are extremely vulnerable to any habitat loss (Hockey and Curtis 2008). Generally, habitat types that occur in the Project Study Area are common in the Region.

Fragmentation of habitat involves the removal of existing habitat that results in smaller isolated patches of remaining habitat where there was previously continuous habitat (Bender *et al.* 1998). Stable species abundance in fragmented landscapes may mask changes in bird communities due to replacement of locally extirpated species by immigration of species that favour fragmented habitats (Schmiegelow *et al.* 1997). Population declines observed in some birds may be attributed to their habitat requirements, as species that favour interior habitat will experience declines as the habitat becomes fragmented into smaller and smaller patches (Bender *et al.* 1998). This high degree of habitat specialization increases bird species' susceptibility to habitat loss and fragmentation. Increasing fragmentation of a landscape may not lead to declines in bird populations when remaining patches of habitat are large enough to provide suitable breeding habitat to allow for stable populations (Schmiegelow *et al.* 1997). It was observed during field studies, that other bird species may be positively affected by the creation of openings in a previously contiguous forest stand. Consequently, fragmentation of habitat has the potential to affect many bird species, both positively and negatively.

The effects of fragmentation on bird groups may be somewhat mitigated by allowing vegetation regrowth to occur; however vegetation management will generally maintain the right-of-way at an early stage of succession, which may be of limited use to species favouring interior forest habitat. The habitat of rights-of-way is expected to benefit edge-favouring species, and potentially shrubland birds.

The effects of habitat alteration due to clearing and maintenance activities, as well as construction activities would be mitigated in part, by limiting these activities to winter months.

Year-round construction disturbances associated with the Project are associated with point-source disturbances at the station sites and borrow areas.

5.1.1.3 Sensory Disturbance

Birds occurring along transmission lines that are affected by sensory disturbance may react by nest or territory abandonment, particularly those birds that rely on songs and calls for communication and territory establishment and defence (Bayne *et al.* 2008; Francis *et al.* 2009). Additionally, noise disturbance (i.e., construction equipment noise) may result in increased and decreased predation rates, as noise interferes with the ability of some birds to pick up on audio cues to the presence of a predator (e.g., warning calls from other birds) while interfering with the ability of predators to pick up on audio cues regarding the presence of prey species (Slabbekoorn and Ripmeester 2007).

The physical presence of humans, towers, and machinery in the Project Study Area during Project construction and operation and during maintenance operations could affect seasonal and daily movements of some species or individuals as they alter their pathways to avoid disturbance. Limited movement can prevent individuals from accessing resources and can hamper their ability to avoid predators (AltaLink Management Ltd. 2006). Daily movements could be altered on a local scale. Most transmission line projects likely have little effect on seasonal movements such as the spring and fall migrations of larger bird species, as most fly considerably higher than the height of transmission lines and any related construction activities on the ground (Gauthreaux 1972). The effects of disruption of movements due to clearing and maintenance activities, as well as construction activities, are mitigated by limiting these activities to winter months.

5.1.2 Summary of Mitigation Measures

The following mitigation measures are proposed to minimize and mitigate effects of the transmission lines during the clearing and construction phase:

- Project activities during bird breeding and brood rearing months will be restricted from April 1 to July 31, to reduce the risk of nest destruction and sensory disturbance;
- Searches for nests will be undertaken prior to spring or summer construction if the timing of construction activity overlaps with sensitive time periods;
- Setback distances will be applied if the timing of construction activity overlaps with sensitive time periods (300 m for olive-sided flycatcher and 100 m for rusty blackbirds).
- Night-time activities will be avoided during the nesting season to minimize disturbance to common nighthawk.

- Shrubby vegetation will be maintained on the rights-of-way where possible.
- Shrubby vegetation will be maintained on the right-of-way where possible as potential olive-sided flycatcher habitat.
- Vegetation management will be limited in areas where common nighthawk could occur from April 1 to July 31 to minimize the risk of nest destruction.
- Bird diverters may be installed if sensitive sites are identified during Project Monitoring. These have been demonstrated to be effective in other locations (Manitoba Hydro 2012).

Although individuals of a population may collide with transmission lines, there is not expected to be a population level effect; however, the use of deflectors on the lines could potentially reduce the collision risk if an area of high occurrence was found.

5.2 VALUED ENVIRONMENTAL COMPONENTS

5.2.1 Bird Valued Environmental Components

Bird Valued Environmental Components (VECs) for the Project consisted of one bird group (raptors) and three Species at Risk (common nighthawk, olive-sided flycatcher and rusty blackbird).

As a group, raptors have several species that may utilize transmission line corridors for hunting, perching or nesting (certain hawks, some owls, bald eagles and osprey). Consequently, they have the potential to be affected by the Project. Effects of Project construction and operation on raptors include: mortality, habitat alternation and sensory disturbance.

The common nighthawk is listed as “threatened” by Schedule 1 of *SARA* and *MESA*. Because common nighthawks lay eggs directly on the ground in open areas and frequently roost on bare patches on the ground they have the potential to be affected by clearing activities related to the Project (Taylor 2003a). Effects of Project construction and operation on common nighthawks include mortality and habitat alteration.

Rusty blackbird and olive-sided flycatcher both nest in the forested area which will be affected by Project development. They have the potential to be affected by habitat loss and alteration along the transmission line right-of-way and at station sites. They could similarly be affected by vegetation management along the right-of-way and at station sites depending on the timing of these activities.

5.2.2 Construction Effects on Raptors

5.2.2.1 Mortality

Few direct causes of mortality of raptors such as bald eagle are expected during clearing and construction phases of the Project. Birds of prey are somewhat susceptible to collisions with vehicles (Harness and Wilson 2001; AltaLink Management Ltd. 2006; Stinson *et al.* 2007). Limited increases in local traffic to and from construction sites, and low vehicle speeds along transmission line rights-of-way are expected to result in very few accidental raptor injuries or mortalities. Ground nesting raptors are at increased potential for nest and egg destruction by machinery during the construction phase.

5.2.2.2 Habitat Alteration

Clearing of the rights-of-way and at the station sites will result in the disruption, alteration, and improvement of some raptor nesting and foraging habitat. Loss of mature and dead standing trees from clearing will have an adverse effect on the local population of raptors that return each year to breed within the Project Study Area (e.g., northern hawk owl, great gray owl, osprey, and red-tailed hawk [*Buteo jamaicensis*]).

With the exception of short-eared owl (*Asio flammeus*) and northern harrier (*Circus cyaneus*), ground-nesting species that use open habitats, loss of tree cover will have long-term adverse effects on all raptor species that utilize the Project Study Area (Holt and Leasure 1993; Marks *et al.* 1994; Houston *et al.* 1998). Species potentially affected include merlin, northern hawk owl (*Surnia ulula*) and long-eared owl.

The removal of forest cover will not only affect breeding and foraging habitat but it will also lower the abundance of thermal cover required by raptor species that overwinter within the Project Study Area (e.g., northern hawk owl and great gray owl [*Strix nebulosa*]).

Some raptor species, including members of the hawk (*Accipteridae*), falcon (*Falconidae*), and owl (*Strigidae*) families, may benefit from the creation of edge habitats associated with forest clearing along rights-of-way and at station sites. For some raptors, foraging efficiency is often greater along forest edges due to the presence of perches (e.g., trees), visibility of prey and abundance of prey (Widen 1994). For other species, fragmentation of contiguous forest will have an adverse effect on their abundance and distribution. Great gray owls can be adversely affected by forest clearing activities through increased competition with great horned owls, which benefit from the creation of edge habitats (Bull and Duncan 1993).

5.2.2.3 Sensory Disturbance

During construction, noise from heavy equipment and human activity may cause short-term disturbance to some raptors breeding and/or overwintering in the Project Study Area. However,

raptors are quite tolerant of disturbance and may acclimate to the noise quite readily (Becker 2002).

5.2.3 Operation Effects on Raptors

5.2.3.1 Mortality

Electrocution can be a significant source of raptor mortality (Lehman *et al.* 2007). As large raptors such as bald eagle are susceptible to electrocution (Harness and Wilson 2001; Millsap *et al.* 2004), mortality could increase where they are attracted to the transmission line and structures. Collisions with wires are a potential source of mortality, and species that fly at high speeds in pursuit of prey, such as northern goshawk, are most prone to collisions (Bevanger 1994). Potential collision occurrences can be minimized in areas of high incidents with the use of deflectors to increase the visibility of these wires. While individual birds may occasionally collide with transmission wires, otherwise healthy populations should not be affected by such incidents. Mortality of a few individuals would result in negligibly reduced local populations of birds of prey.

Northern harriers and short-eared owls which nest on the ground in open areas (Holland and Taylor 2003) could have their nests destroyed or damaged by vegetation management during the spring nesting season.

5.2.4 Construction Effects on Common Nighthawk

5.2.4.1 Mortality

Common nighthawk range extends throughout the Project Study Area. No effects on this migratory species' mortality are anticipated during winter clearing. This species lays eggs directly on the ground in open areas (Taylor 2003b), and eggs or hatchlings could be destroyed during construction machinery in the summer. Common nighthawks frequently roost on bare patches on the ground, and are susceptible to collisions with vehicles (COSEWIC 2007b). Local increases in traffic associated with construction activities may temporarily increase the risk of common nighthawk collisions with vehicles. These collisions are generally infrequent. As all sources of mortality are important to species at risk as they can affect local and regional populations, mitigation measures are required to minimize these potential effects. A common nighthawk was found dead on the roadside during 2010 bird surveys, indicating that collisions with vehicles, while unlikely, are possible in the Project Study Area.

5.2.4.2 Habitat Alteration

COSEWIC (2007b) reports that habitat loss or alteration may contribute to the decline of common nighthawk populations in the Prairie Provinces. In some cases, common nighthawk

nesting and foraging habitat may improve slightly where forest is converted to open habitats where nighthawks nest on the ground and often forage in open habitats. This may be true when clearing of the transmission line rights-of-way and at the station sites.

Common nighthawks may be subject to sensory disturbance from construction equipment noise. Also, lighting at the construction camp and work sites may attract insects which could be preyed upon by nighthawks.

5.2.5 Operation Effects on Common Nighthawk

As common nighthawks lay eggs on the ground in clearings (Taylor 2003b), eggs or hatchlings could be damaged or destroyed during vegetation maintenance in spring. As this species is migratory, no effects on mortality are anticipated during the winter. As well, there is potential for some bird-wire collisions by nighthawks foraging along the right-of-way. Permanent lighting at station sites may attract insects which could be preyed upon by common nighthawks.

5.2.6 Construction Effects on Olive-sided Flycatcher

Mortality

No effects on the olive-sided flycatcher's mortality are anticipated during winter clearing. Olive-sided flycatchers are unlikely to nest on the cleared rights-of-way if shrubs are not established. It is anticipated that olive-sided flycatcher will not experience adverse effects during construction activities as this species is not likely to be subject to vehicle collisions.

Habitat Alteration

COSEWIC (2007a) states that habitat loss and alteration are believed to contribute to olive-sided flycatcher population declines. Minor habitat alterations and losses may affect a few individuals where suitable perch trees are removed, but are not expected to have a measurable effect on local populations or to breeding and nesting habitat availability.

5.2.7 Operation Effects on Olive-sided Flycatcher

Minor Project-related effects on olive-sided flycatcher mortality are anticipated during the operation and maintenance phase. As olive-sided flycatchers are associated with semi-open forests, edges, and clear-cuts (Altman and Sallabanks 2000), nests could be destroyed during vegetation management on the right-of-way in spring.

5.2.8 Construction Effects on Rusty Blackbird

Rusty blackbird range extends throughout Manitoba, including the Project Study Area. As this species is migratory, no effects on mortality are anticipated during winter clearing. Rusty blackbirds mainly nest in northern treed muskeg habitat (Nero and Taylor 2003), and are unlikely to nest on the cleared right-of-way if regenerating vegetation is not established. Collisions with vehicles are not reported in the literature reviewed. No Project-related effects are expected during the clearing and construction phase.

COSEWIC (2006) states that alteration of wintering habitat is the most important threat to rusty blackbird populations, and loss of breeding habitat also contributes to this species' decline. Minor habitat alterations and any potential habitat losses may affect a few individuals at Project footprints but are not expected to have a measurable effect on local populations or on breeding and nesting habitat availability.

5.2.9 Operations Effects on Rusty Blackbird

Minor effects on rusty blackbirds may occur as a result of right-of-way maintenance activities. Once vegetation becomes re-established along the right-of-way there is potential for rusty blackbirds to utilize the right-of-way for nesting and the nesting birds could be disturbed if vegetation control activities occurred during the nesting season

5.3 RESIDUAL EFFECTS

Manitoba Hydro has sought to avoid adverse impacts and to enhance positive benefits during the site-selection process, whenever possible and practical.

After the mitigation measures are implemented, the potential long-term residual effects remaining may include:

- Minor alteration or loss of habitat and its use by birds along the transmission line rights-of-way and at station sites and borrow sites.
- Sensory disturbances which may result in temporary movements into alternate habitats by local birds.
- Small increases in foraging and nesting opportunities for some birds, while other bird species may experience small decreases in foraging and nesting opportunities.
- Small increase in bird mortality from increased hunting pressure due to increased access along the transmission line rights-of-ways.

These effects can be observed during the construction and operations phases of the Project and mainly reversible based on decommissioning activities. Residual effects are expected to only be of small magnitude after applying the Project mitigation measures. As outlined in Section 2.5.1, residual effects on VECs are discussed below.

5.3.1 Residual Effects on Raptors

Residual effects on raptors will include habitat alteration, habitat loss and habitat avoidance due to sensory disturbance. During construction, habitat alteration will occur along the transmission line rights-of-way and at borrow sites. Habitat loss will occur at the tower footprints and at the station sites. Sensory disturbance from construction activities may discourage use of some habitat in the local area.

During operations, habitat alteration will occur as a result of vegetation-management activities along the rights-of-way. Although infrequent, sensory disturbance as a result of maintenance activities may result in temporary avoidance of the area. However, maintenance activities will occur infrequently. Habitat avoidance due to sensory disturbance from mechanical operations or human activity may occur at the station sites.

5.3.2 Residual Effects on Common Nighthawk

Residual effects on common nighthawk may include habitat loss, alteration and avoidance (and sensory disturbance). Construction activities will cause habitat alteration along the transmission lines rights-of-way and at the borrow sites. Habitat loss will occur at station sites and tower footprints. Sensory disturbance, specifically noise from construction equipment activities may discourage use of some habitat in the Project Study Area.

During operations, habitat alteration will result from vegetation management along the transmission line rights-of-way. It is possible short-term avoidance of the area resulting from sensory disturbance from human and mechanical activities during both maintenance and operations activities of the Project may occur. Maintenance activities will only occur once per year or less, while operation activities will occur for the life of the Project. Additional potential for bird collisions along transmission lines also exists.

A summary of residual effects is provided in Table 5-1.

5.3.3 Residual Effects on Olive-sided Flycatcher and Rusty Blackbird

Residual effects on olive-sided flycatcher and rusty blackbird will be potential for bird-wire collisions along the transmission line rights-of-way and very minor habitat loss at station sites and tower footprints. These effects are expected to be small and not significant.

Table 5-1: Summary of Residual Effects on Birds

Potential Effect	Project Phase	Mitigation	Residual Effect	Assessment Characteristics
Bird Habitat				
Minor habitat loss will occur at station sites and transmission tower footprints	Construction and Operation	Land developed at station sites will be kept to the minimum required and land disturbed during tower construction, but not part of the actual tower foundation, will be returned to a natural state	Some bird habitat will be lost	Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Long-term.
Minor habitat alteration will occur along right-of-way	Construction and Operation	Land cleared along the right-of-way will be allowed to regenerate to a height that is considered practical for operations	Some bird habitat will be altered	Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Long-term.
Sensory disturbance from construction activities	Construction	Clearing to occur in winter to avoid effecting migratory species, vehicles will be maintained in good working order to limit noise produced	Some disturbance from construction noise	Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: short-term.
Mortality due to increased hunting	Construction and Operation	Prohibition of firearms in camp Decommissioning of trails used during construction	Some increased harvest of upland gamebirds and waterfowl	Direction: Adverse Magnitude: Small Geographic Extent: Small Duration: Long-term.

Table 5-1: Summary of Residual Effects on Birds

Potential Effect	Project Phase	Mitigation	Residual Effect	Assessment Characteristics
Increase in foraging opportunities for species that frequent forest openings	Construction and Operation	none	Potential positive effect on some species	Direction: Positive Magnitude: Small Geographic Extent: Small Duration: Long-term.

5.4 INTERACTIONS WITH FUTURE PROJECTS

Future projects that were considered in evaluating the effects of the Project included:

- Development of the Keeyask Generation Project.
- Development of the Bipole III Transmission Project.
- Development of the Conawapa Generation Project.
- Town of Gillam Redevelopment (including the potential for development of new housing within the Town of Gillam).

The proposed Project is not particularly large. However, has numerous components including transmission lines, a switching station, a transformer station, a construction camp, and the creation of borrow pit areas. Each Project component may have environmental effects that may act cumulatively with effects from other components along with effects from future projects and activities in the Project Study area.

Maintaining bird species and communities is important for maintaining biodiversity and ecosystem function. Bird species play an important role as seed dispersers, pollinators, game species, and insect predators (Sekercioglu 2006). Worldwide, the rate of bird species extinctions is largely unprecedented and is worsened by human activities including habitat loss and alteration (particularly deforestation), climate change, and introduced species (Butchart *et al.* 2006; Pimm *et al.* 2006).

Many environmental factors may play a role in affecting bird species and communities alongside the development of the the Project. These factors could include various anthropogenic practices, specifically forms of landscape development including road building, land clearing and hydroelectric generating station developments such as the Keeyask Generation Project.

Natural changes to bird communities could alternately take place through environmental drivers including forest fires, flooding, insect outbreaks, and climate change. Due to the uncertainty of climate change, it is difficult to predict its role in cumulative effects on bird species and communities. However a number of potential effects can be identified such as changes in predictable climate patterns may result in earlier breeding and egg laying (Price and Glick 2002, BirdLife International 2004). Additional changes in bird behaviour linked to environmental changes include migratory birds responding to cues in the south indicating the onset of migration season when in fact they are returning to the summering grounds too early (Price and Glick 2002, BirdLife International 2004).

The development of infrastructure such as roads, transmission lines, trails, etc., may lead to increased bird-vehicle (Loos and Kerlinger 1993) and bird-wire collisions (Chasko and Gates 1992; Nobel 1995).The potential for forest fires also exists in the region where large tracts of forests can precipitate forest fires which lead to a level of landscape disturbance and alter the suitability of habitat to avian species (Vierling *et al.* 2008).

Increases in global temperatures are also predicted to result in the northern expansion of bird ranges. A warming climate could result in fewer wetlands holding water, and drought could be more frequent and of longer duration, while in the boreal forest, permafrost thawing could cause wetland drying in some regions (Andrews *et al.* 2008), affecting habitat for waterfowl and other waterbirds, while in other areas permafrost thawing may result in an increase in wetlands. Finally, changes in climate may cause disruption of ecological communities resulting in new predators, competitors, and prey to which a species has not adapted to (Price and Glick 2002, BirdLife International 2004). The following assessment examines how the development of the Keeyask transmission line, considered with other development in the area, could affect avian VECs.

5.4.1 Raptors

There are a number of raptor species inhabiting, breeding or staging in the Region. This assessment focuses on the bald eagle and short-eared owl. Raptors have a range of habitat use characteristics but are similar in typically having relatively large hunting grounds and being largely responsive to changes in prey density (Janes 1984). Foraging areas therefore often includes perching areas as well as open ground where raptors can ambush prey (Kirk and Hyslop 1998; Smith *et al.* 2003). The removal of stands through forestry practices and forest fires can therefore possibly remove perch stands, while increasing open areas, and affect raptor distribution (Kirk and Hyslop 1998; Smith *et al.* 2003). Use of chemical deterrents, (i.e., pesticides and herbicides) which cause declines in the abundance of potential prey (i.e., rodents) can also be linked with limiting raptor distribution, fledgling deformations and decreased eggshell thickness (e.g., the impact of DDT) on bald eagles (Buehler 2000). The use

of pesticides in rights-of-way maintenance may also cause bioaccumulation of harmful substances in animals that raptors prey (Buehler 2000; Koonz 2003).

5.4.1.1 Bald Eagle

The Bald eagle range extends over much of Manitoba and they are abundant in the area near where the Project development will occur. Impacts of development on bald eagles are often associated with the removal of large trees potentially used as nesting areas and as perches overlooking hunting areas (Buehler 2000). Previously, pesticide use, specifically DDT, was linked with population declines and was a primary determinant in this species being listed in the United States under the *Endangered Species Act* (Buehler 2000; Koonz 2003).

Specific developments that could affect bald eagle presence include forestry practices and other development projects that reduce the quantity of usable forest stands. Where the consumption of fish species is prevalent, the bioaccumulation of methylmercury can have adverse effects on bald eagles (Bechard *et al.* 2009). The impact of climate change on bald eagles is likely variable and based on the extent of seasonal climatic extremes where changes in the available prey may affect life-history characteristics. Milder winters may benefit this species, as it may become a more frequent year-round resident in Manitoba.

Residual effects of the Project on bald eagles include habitat alteration, habitat loss and potential habitat avoidance due to sensory disturbance. There is minor potential for wire strikes by this species (Buehler 2000); although bald eagles are generally considered agile flyers, therefore wire strikes will likely not affect overall population numbers. Forest clearing and the periodic maintenance of cleared transmission line rights-of-way should be done with caution and according to those guidelines and thresholds set by Manitoba Conservation (2010) where nests are avoided by 50-200 m based on season.

5.4.1.2 Short-eared Owl

The breeding season range of short-eared owl potentially extends over all of Manitoba. The irruptive nature of short-eared owl populations and where they may nest in Manitoba; however, is difficult to predict. Notable threats to short-eared owl include the development of habitat areas for varied development purposes as well as the absence of potential prey species (Holt and Leasure 1993).

The introduction of varying environmental contaminants, i.e. pesticides, fertilizers, herbicides, etc., likely play a role in altering the availability of prey for short-eared owls.

Residual effects of the Project could affect short-eared owl mortality associated with individual bird-wire collisions.

5.4.2 Common Nighthawk

The breeding range of the common nighthawk extends over much of Manitoba, though it is seldom present above the treeline (Taylor 2003a). Threats to common nighthawk are mainly based on habitat loss and alteration and reductions in insect populations that serve as a primary food source (Behrstock 2001; Savignac 2007).

Foraging by nighthawks generally takes place in areas with water (i.e., lakes, rivers and swamps) as well as forested clearings. The creation of gravel roads can serve to attract nighthawks for nesting purposes and have the adverse consequence of increased mortalities through vehicle strikes (Taylor 2003a). Climate-change effects which may serve to potentially alter common nighthawk distribution include the expansion of the breeding range with the northwards expansion of the treeline.

Residual effects of the Project on common nighthawks are expected to include some mortality associated with a few individual bird-wire collisions. The Project may create some usable habitat through the maintenance of cleared rights-of-way.

5.5 MONITORING

In order to determine long-term effects of the Project on birds, a bird-monitoring program will be implemented. The Bird-Monitoring Program is designed to confirm predictions of effects and to determine whether unexpected effects are occurring. Manitoba Hydro is responsible for ensuring that mitigation measures prescribed are implemented and verified through follow-up inspections, monitoring and reporting. Recommended follow-up activities include monitoring of species at risk populations and assessment of bird-wire collisions.

5.5.1 Monitoring During Construction

Potential construction-related activities that would have the most notable effect on birds are primarily associated with:

- The clearing and grubbing of habitat in the Project footprint.
- The presence and noise associated with construction equipment and personnel, which is expected to have potential effects on bird use in habitat adjacent to the Project footprint.

The effects of these Project construction activities on birds will be monitored to test construction-related impact predictions and to measure the effectiveness of the Environmental Protection Plan developed for the Project and to improve it, where necessary.

Bird-monitoring studies during the construction period will focus on areas where bird habitat will be affected most by construction-related activities, i.e., along the transmission route, and at the work camp and station sites.

5.5.1.1 Objectives

The primary objectives of bird monitoring during the construction phase of the Project are to:

- Assess predictions regarding the effects of construction activities on local bird abundance and distribution.
- Determine if any unexpected impacts are occurring as a result of construction activities.
- Determine the effectiveness of mitigation measures and, if appropriate, propose new mitigation options, should unexpected impacts to birds occur as a result of construction-related activities.

5.5.1.2 Project Design

Bird species abundance and diversity will be monitored at sites adjacent to Project construction sites and at sites located at increasing distances from Project construction sites to determine the effects of construction activities on birds. For example, it is expected that bird abundance and diversity at sites immediately adjacent to construction areas may be lower than at less disturbed sites further away from construction activities.

5.5.1.3 Sampling Frequency and Schedule

The bird-monitoring study schedule presently anticipates bird monitoring during the construction period (and for one or two years during operations). Breeding-bird surveys will be conducted during an approximate three-week period during spring (late May to early June) when most birds are singing. Bird monitoring surveys will commence in the first spring following the start of construction. Bird monitoring studies will occur in all areas where construction has been initiated.

5.5.1.4 Methods

The methods for conducting breeding-bird inventories will be consistent with standard procedures for conducting population surveys using the Point-Count Method (Ralph *et al.* 1993; Welsh 1993).These methods have been utilized in all breeding-bird surveys done for the Project. Field investigators conducting the surveys will be familiar with the songs, calls and visual identification of the species encountered. Pre-field training, including listening to bird calls, will add to the integrity of species identification and resulting data.

Surveys will not be conducted when rain or winds interfere with the intensity or audibility of bird songs, or when fog or rain interferes with visibility. Since surveys occur during morning hours, a few species that are more active and sing more frequently in the evening and at night will likely be under-represented during counts (e.g., common nighthawks, owls).

In addition to breeding-bird surveys, an evaluation of other potential construction-related effects, including nesting areas used by raptors (e.g., hawks and eagles) that may be active prior to Project clearing or construction.

5.5.2 Monitoring During Operations

Breeding-bird surveys will be done for one or two years during operations. If analysis of data collected indicates any potential effect on bird communities, additional mitigation measures, such as the installation of bird deflectors, may be necessary.

6.0 CONCLUSIONS

During the routing and site-selection process for the transmission lines and stations associated with the Project, alternative Route Option and Site locations were assessed based on their potential for Project-related effects on bird species and communities.

The two Construction Power Transmission Line Route Options and four Generation Outlet Transmission Line Routes Options were surveyed and evaluated with regard to their environmental effects on bird species and communities. Evaluations were also conducted on sites for the Construction Power and Switching Stations. As areas for these components are similar regarding their potential for effects on bird species and communities, preferred site selection was based on technical considerations.

The Bird Valued Ecosystem Components selected for the Project included three Species at Risk – common nighthawk, olive-sided flycatcher and rusty blackbird as well as one bird group - raptors. These species were utilized to assess residual effects of the Project.

Sensitive sites identified along alternative Route Options included river crossings and routing between two lakes. These sites were judged to have greater potential for negative effects on birds and were identified as less desirable options when considering the potential for effects on bird species and communities.

Potential negative effects of the Project will be mitigated to the extent feasible by route selection decision making. Where the potential for negative effects have been identified, mitigation measures need to be employed. Mitigation measures include:

- Winter clearing of rights-of-way and station sites to reduce potential for effects on nesting birds.
- Allowing some regrowth of vegetation along the rights-of-way to reduce habitat fragmentation effects.
- Restriction of hunting by Project workers to reduce negative impacts on migratory and upland gamebirds.
- Avoidance and buffering of large stick nests.

Effects of the Project on bird communities will exist for the life of the Project. These effects will include minor habitat loss at station sites and transmission tower footprints, sensory disturbance during construction activities, a potential for increased foraging and/or nesting opportunities for species which prefer open areas, and mortality from increased hunting pressure. However,

these effects are expected to be small, and likely not measurable within the range of natural variation of bird populations.

Other developments may occur in the Project Study Area which may affect bird populations. These may include: building of roads, clearing of land and the development of hydroelectric generating stations. Other naturally occurring factors could cause changes in the bird communities. These include: forest fires, insect outbreak or die-offs and climate change.

Monitoring of project-related effects on bird communities has been proposed to occur during the construction period and one or two years after during project operations. Breeding-bird surveys will be conducted to assess bird species abundance and diversity at sites adjacent to Project construction sites.

7.0 GLOSSARY

Biodiversity: The variability among living organisms from all sources, including, without limiting the generality of the foregoing, terrestrial and marine and other aquatic ecosystems and the ecological complexes of which they form a part and includes the diversity within and between species and of ecosystems (Canadian Environmental Assessment Act).

Boreal: Of or relating to the cold, northern, circumpolar area just south of the tundra, dominated by coniferous trees such as spruce, fir, or pine. Also called taiga.

Crepuscular: Appearing or active in twilight.

Cryoboreal: Refers to species characteristic of the colder parts of the Boreal Zone.

Esker: A narrow ridge of sand or gravel, usually deposited by a stream flowing in or under glacial ice.

Fen: Peatland in which the plants receive nutrients from mineral enriched ground and/or surface water. Water chemistry is neutral to alkaline. Sedges, brown mosses and/or Sphagnum mosses are usually the dominant peat forming vegetation.

Forage(ing)[1]: To locate, capture, and eat food.

Fragmentation: Refers to the extent to which an area is broken up into smaller areas by human features and how easy it is for animals, plant propagules and other ecological flows such as surface water to move from one area to another. Fragmentation can isolate habitat and create edges, which reduces habitat for interior species and may reduce habitat effectiveness for other species. *OR* The breaking up of contiguous blocks of habitat into increasingly smaller blocks as a result of direct loss and/or sensory disturbance (*i.e.*, habitat alienation). Eventually, remaining blocks may be too small to provide usable or effective habitat for a species (Cumulative Effects Assessment).

Indicator Species: A species this is closely correlated with a particular environmental condition or habitat type such that its presence, absence, or state of well-being can be used as indicator of environmental conditions. A species whose population size and trend is assumed to reflect the population size and trend of other species associated with the same geographic area and habitats.

Moraine: A mass of rocks, gravel, sand, clay and other materials deposited directly by a glacier.

Riparian: Along the banks of rivers and streams.

Topography: General configuration of a land surface, including its relief and the position of its natural and manmade features.

Transect: A line located between points and then used to investigate changes in attributes along that line.

Umbrella indicator: An indicator that is thought to represent changes for a broad group of species, several ecological pathways and/or an indicator of one or more other topics.

Valued Environmental Component (VEC): Any part of the environment that is considered important by the proponent, public, scientists or government involved in the assessment process. Importance may be determined based on cultural values or scientific concern.

Wildlife: All undomesticated organisms including invertebrates, amphibians, reptiles, birds, and mammals. Excludes people and plants.

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APPENDIX A

SURVEY DATA

Appendix A, Table A-1: Average Density of Birds Observed Within Surveyed Broad Vegetation Types* in the Keeyask Transmission Project Study Area - 2009 to 2011											
Species	**Scientific Name**	**Black Spruce Mixedwood**	**Black Spruce Mixture**	**Black Spruce Pure**	**Human**	**Jack Pine Mixture**	**Jack Pine Pure**	**Low Vegetation**	**Tamarack Pure Mixture**	**Tamarack Pure**	**Young Regeneration**
Passerine											
Alder Flycatcher	*Empidonax alnorum*		0.10	0.08	0.28	0.17		0.14	0.06		
American Crow	*Corvus brachyrhynchos*			<0.01							
American Robin	*Turdus migratorius*		0.02	0.04		0.04		0.05			0.07
Bay-breasted Warbler	*Dendroica castanea*					0.04	0.09				
Blackpoll Warbler	*Dendroica striata*	0.28	0.34	0.31	0.42	0.13	0.19	0.21	0.60	0.94	0.14
Blue-headed Vireo	*Vireo solitaries*					0.04					
Boreal Chickadee	*Parus hudsonicus*			0.01			0.09	0.01			
Brown Creeper	*Certhia Americana*		0.02	0.01							0.07
Chipping Sparrow	*Spizella passerine*		0.07	0.03				0.02	0.05		0.21
Clay-colored Sparrow	*Spizella pallida*				0.14						
Common Raven	*Corvus corax*			0.01					0.05	0.06	0.07
Common Redpoll	*Carduelis flammea*			<0.01							
Dark-eyed Junco	*Junco hyemalis*		0.17	0.17	0.42	0.17	0.09	0.26	0.09		0.07
Fox Sparrow	*Passerella iliaca*	0.28	0.07	0.19		0.13	0.19	0.17	0.27	0.44	
Gray Jay	*Perisoreus canadensis*		0.05	0.08	0.28	0.09	0.56	0.08	0.05		
Hermit Thrush	*Catharus guttatus*		0.14	0.09	0.14	0.13	0.38	0.11	0.09	0.19	
Least Flycatcher	*Empidonax minimus*			0.01				0.01	0.02		
Lincoln's Sparrow	*Melospiza lincolnii*		0.12	0.08	0.14	0.09	0.19	0.14	0.03		
Magnolia Warbler	*Dendroica magnolia*			0.03		0.13	0.09	0.02	0.09	0.25	
Nashville Warbler	Oreothlypis ruficapilla			<0.01	0.14	0.04		0.01	0.02		
Northern Waterthrush	*Seiurus noveboracensis*		0.21	0.21	0.28	0.17	0.09	0.27	0.19		0.21
Olive-sided Flycatcher	*Contopus borealis*		0.07	0.02	0.28			0.01			
Orange-crowned Warbler	*Vermivora celata*		0.02	0.06	0.14	0.04		0.19	0.03	0.19	0.14
Palm Warbler	*Dendroica palmarum*		0.09	0.11	0.28	0.22	0.09	0.18	0.11	0.25	
Pine Grosbeak	*Pinicola enucleator*				0.14						
Red-breasted Nuthatch	*Sitta Canadensis*							0.01			
Red-winged Blackbird	*Agelaius phoeniceus*			0.02							
Ruby-crowned Kinglet	*Regulus calendula*	0.28	0.15	0.20	0.14	0.09	0.28	0.12	0.27	0.31	0.21
Rusty Blackbird	*Euphagus carolinus*		0.02	0.02			0.19	0.02	0.02		
Savannah Sparrow	*Passerculus sandwichensis*			<0.01				0.02			

Appendix A, Table A-1: Average Density of Birds Observed Within Surveyed Broad Vegetation Types* in the Keeyask Transmission Project Study Area - 2009 to 2011											
Species	**Scientific Name**	**Black Spruce Mixedwood**	**Black Spruce Mixture**	**Black Spruce Pure**	**Human**	**Jack Pine Mixture**	**Jack Pine Pure**	**Low Vegetation**	**Tamarack Pure Mixture**	**Tamarack Pure**	**Young Regeneration**
Song Sparrow	*Melospiza melodia*			<0.01				0.01			
Swainson's Thrush	*Catharus ustulatus*	0.28	0.10	0.05				0.04	0.19	0.06	
Swamp Sparrow	*Melospiza georgiana*			0.03				0.08	0.03		
Tennessee Warbler	*Vermivora peregrina*	0.28	0.07	0.13	0.14	0.26	0.38	0.13	0.19	0.06	0.07
White-crowned Sparrow	*Zonotrichia leucophrys*			0.01				0.04	0.02		
White-throated Sparrow	*Zonotrichia albicollis*		0.14	0.20	0.14	0.09	0.28	0.20	0.11	0.19	0.14
Wilson's Warbler	*Wilsonia pusilla*	0.28	0.09	0.03		0.04		0.07	0.05		0.07
Winter Wren	*Troglodytes troglodytes*		0.03	0.02				0.05	0.05	0.13	0.07
Yellow Warbler	*Dendroica petechia*		0.05	0.02					0.05		
Yellow-bellied Flycatcher	*Empidonax flaviventris*	0.28	0.10	0.15	0.56	0.39	0.28	0.20	0.28	0.25	
Yellow-rumped Warbler	*Dendroica coronata*	0.28	0.22	0.18	0.14	0.04	0.19	0.02	0.14		0.14
Crane											
Sandhill Crane	*Grus canadensis*			0.01							
Rail											
Sora	*Grus canadensis*			0.00							
Gull											
Bonaparte's Gull	*Larus philadelphis*										
Kingfisher											
Belted Kingfisher	*Cerlye alcyon*							0.02		0.00	
Nighthawk											
Common Nighthawk	*Chordeiles minor*						0.09				
Raptor											
Merlin	*Falco columbarius*							0.01			
Bald Eagle	*Haliaeetus leucocephalus*							0.01			
Hawk spp.	undetermined								0.02		
Shorebird											
Common Snipe	*Gallinago gallinago*		0.02	0.02				0.02	0.02		
Greater Yellowlegs	*Tringa melanoleuca*		0.02	<0.01				0.01			
Lesser Yellowlegs	*Tringa flavipes*			<0.01							
Yellowlegs spp.	*Tringa sp.*			<0.01							

Appendix A, Table A-1: Average Density of Birds Observed Within Surveyed Broad Vegetation Types* in the Keeyask Transmission Project Study Area - 2009 to 2011											
Species	**Scientific Name**	**Black Spruce Mixedwood**	**Black Spruce Mixture**	**Black Spruce Pure**	**Human**	**Jack Pine Mixture**	**Jack Pine Pure**	**Low Vegetation**	**Tamarack Pure Mixture**	**Tamarack Pure**	**Young Regeneration**
Woodpecker											
Black-backed Woodpecker	*Picoides arcticus*			<0.01							
Hairy Woodpecker	*Picoides villosus*			<0.01							
Northern Flicker	*Colaptes auratus*										0.07
Woodpecker spp.	undertermined			<0.01					0.02		
Waterfowl											
American Wigeon	*Anas americana*			<0.01							
Upland Game Bird											
Ruffed Grouse	*Bonasa umbellus*		0.02	<0.01							
Spruce Grouse	*Dendragapus canadensis*		0.03	<0.01					0.05		

Descriptions of Vegetation Types and Abbreviations:

Black Spruce Pure – BS Pure	Black spruce dominated and representing >90% of tree species present.
Black Spruce Mixedwood – BS Mixedwood	Black spruce dominated and representing >40% of treed species present; broadleaf tree species >=30% and <=40% of treed species present.
Black Spruce Mixture – BS Mixture	Black spruce dominated and representing >40% of treed species present; broadleaf tree species representing <=20% of treed species present.
Human	Habitat is dominated by human disturbance.
Jack Pine Pure – JP Pure	Jack pine dominated and representing >90% of tree species present.
Jack Pine Mixture – JP Mixture	Jack pine dominated and representing >40% of treed species present; broadleaf tree species representing <=20% of treed species present.
Low Vegetation	Habitat comprised of <10% trees, <25% tall shrubs and >10% ground cover.
Tamarack Pure – TL Pure	Tamarack dominated and representing >90% of tree species present.
Tamarack Mixture – TL Mixture	Tamarack larch dominated and representing >40% of treed species present; broadleaf tree species representing <=20% of treed species present.
Young Regeneration	Area burned between 1993 and 2003, vegetation in regeneration.

Appendix A, Table A-2: Bird Species Observed During Terrestrial Breeding-Bird Surveys in the Keeyask Transmission Study Area, 2009 to 2011																
Species	Total Number of Birds Observed				Density of Birds Observed (birds/ha)[1]				Frequency of Observation (%)				Percent of Total			
	2009-2011 (n=490 stops)	2009 (n=193 stops)	2010 (n=192 stops)	2011 (n=105 stops)	Average Density	2009 (n=193 stops)	2010 (n=192 stops)	2011 (n=105 stops)	Average Frequency of Observa-tion	2009 (n=193 stops)	2010 (n=192 stops)	2011 (n=105 stops)	% of Birds Observed in 2009 to 2011 (n=2406 birds)[2]	% of Birds Observed in 2009 (n=1134 birds)[2]	% of Birds Observed in 2010 (n=837 birds)2	% of Birds Observed in 2011 (n=435 birds)[2]
Passerine																
Blackpoll Warbler	279	143	85	51	0.32	0.42	0.25	0.27	56.94%	58.5	43.8	47.6	11.6	12.6	10.2	11.7
Ruby-crowned Kinglet	162	77	63	22	0.19	0.23	0.19	0.12	33.06%	37.8	32.8	21.0	6.7	6.8	7.5	5.1
Northern Waterthrush	181	90	56	35	0.21	0.26	0.16	0.19	36.94%	39.9	28.6	32.4	7.5	7.9	6.7	8.0
Fox Sparrow	156	84	48	24	0.18	0.25	0.14	0.13	31.84%	38.9	24.5	22.9	6.5	7.4	5.7	5.5
Yellow-bellied Flycatcher	154	69	55	30	0.18	0.20	0.16	0.16	31.43%	34.2	28.6	29.5	6.4	6.1	6.6	6.9
White-throated Sparrow	160	76	49	35	0.18	0.22	0.14	0.19	32.65%	36.3	25.0	32.4	6.7	6.7	5.9	8.0
Dark-eyed Junco	154	64	56	34	0.18	0.19	0.16	0.18	31.43%	29.0	28.1	30.5	6.4	5.6	6.7	7.8
Yellow-rumped Warbler	127	72	36	19	0.15	0.21	0.11	0.10	25.92%	32.6	18.8	18.1	5.3	6.3	4.3	4.4
Tennessee Warbler	117	15	74	28	0.13	0.04	0.22	0.15	23.88%	6.2	37.5	24.8	4.9	1.3	8.8	6.4
Palm Warbler	105	49	42	14	0.12	0.14	0.12	0.08	21.43%	21.8	21.9	13.3	4.4	4.3	5.0	3.2
Hermit Thrush	88	55	16	17	0.10	0.16	0.05	0.09	17.96%	25.9	8.3	15.2	3.7	4.9	1.9	3.9
Gray Jay	70	30	38	2	0.08	0.09	0.11	0.01	14.29%	13.5	16.1	1.9	2.9	2.6	4.5	0.5
Alder Flycatcher	81	37	26	18	0.09	0.11	0.08	0.10	16.53%	15.5	13.5	16.2	3.4	3.3	3.1	4.1
Lincoln's Sparrow	76	34	22	20	0.09	0.10	0.06	0.11	15.51%	15.5	11.5	19.0	3.2	3.0	2.6	4.6
Swainson's Thrush	53	22	31	0	0.06	0.06	0.09	0.00	10.82%	9.8	16.1	0.0	2.2	1.9	3.7	0.0
Orange-crowned Warbler	68	28	24	16	0.08	0.08	0.07	0.09	13.88%	12.4	12.5	14.3	2.8	2.5	2.9	3.7
Wilson's Warbler	38	10	26	2	0.04	0.03	0.08	0.01	7.76%	5.2	13.0	1.9	1.6	0.9	3.1	0.5
American Robin	31	13	10	8	0.04	0.04	0.03	0.04	6.33%	6.7	5.2	7.6	1.3	1.1	1.2	1.8
Winter Wren	28	15	8	5	0.03	0.04	0.02	0.03	5.71%	7.8	4.2	4.8	1.2	1.3	1.0	1.1
Chipping Sparrow	30	7	15	8	0.03	0.02	0.04	0.04	6.12%	3.1	7.3	7.6	1.2	0.6	1.8	1.8
Magnolia Warbler	35	12	8	15	0.04	0.04	0.02	0.08	7.14%	5.7	4.2	13.3	1.5	1.1	1.0	3.4
Swamp Sparrow	27	19	3	5	0.03	0.06	0.01	0.03	5.51%	8.3	1.6	4.8	1.1	1.7	0.4	1.1
Olive-sided Flycatcher	16	9	6	1	0.02	0.03	0.02	0.01	3.27%	4.7	3.1	1.0	0.7	0.8	0.7	0.2
Rusty Blackbird	23	6	13	4	0.03	0.02	0.04	0.02	4.69%	2.1	5.2	2.9	0.8	0.5	1.1	0.9
Yellow Warbler	14	8	3	3	0.02	0.02	0.01	0.02	2.86%	3.6	1.6	2.9	0.6	0.7	0.4	0.7
White-crowned Sparrow	11	8	2	1	0.01	0.02	0.01	0.01	2.24%	4.1	1.0	1.0	0.5	0.7	0.2	0.2
Common Raven	13	11	2	0	0.01	0.02	0.01	0.00	2.65%	4.7	0.5	0.0	0.4	0.6	0.2	0.0
Boreal Chickadee	11	6	3	2	0.01	0.02	0.01	0.01	2.24%	3.1	1.6	1.9	0.5	0.5	0.4	0.5

Appendix A, Table A-2: Bird Species Observed During Terrestrial Breeding-Bird Surveys in the Keeyask Transmission Study Area, 2009 to 2011																
Species	Total Number of Birds Observed				Density of Birds Observed (birds/ha)[1]				Frequency of Observation (%)				Percent of Total			
	2009-2011 (n=490 stops)	2009 (n=193 stops)	2010 (n=192 stops)	2011 (n=105 stops)	Average Density	2009 (n=193 stops)	2010 (n=192 stops)	2011 (n=105 stops)	Average Frequency of Observa-tion	2009 (n=193 stops)	2010 (n=192 stops)	2011 (n=105 stops)	% of Birds Observed in 2009 to 2011 (n=2406 birds)[2]	% of Birds Observed in 2009 (n=1134 birds)[2]	% of Birds Observed in 2010 (n=837 birds)2	% of Birds Observed in 2011 (n=435 birds)[2]
Least Flycatcher	9	9	0	0	0.01	0.03	0.00	0.00	1.84%	4.7	0.0	0.0	0.4	0.8	0.0	0.0
Brown Creeper	9	3	5	1	0.01	0.01	0.01	0.01	1.84%	1.6	2.6	1.0	0.4	0.3	0.6	0.2
Red-winged Blackbird	11	7	3	1	0.01	0.02	0.01	0.01	2.24%	2.6	1.6	1.0	0.4	0.5	0.4	0.2
Nashville Warbler	6	5	0	1	0.01	0.01	0.00	0.01	1.22%	2.6	0.0	1.0	0.2	0.4	0.0	0.2
*Bank Swallow**	*29*	*6*	*23*	*0*	*0.03*	*0.00*	*0.07*	*0.00*	*5.92%*	*1.0*	*1.0*	0.0	-	-	-	-
Common Redpoll	27	26	1	0	<0.01	0.00	0.00	0.00	5.51%	1.6	0.5	0.0	0.0	0.1	0.0	0.0
Song Sparrow	2	0	2	0	<0.01	0.00	0.01	0.00	0.41%	0.0	1.0	0.0	0.1	0.0	0.2	0.0
Bay-breasted Warbler	2	2	0	0	<0.01	0.01	0.00	0.00	0.41%	1.0	0.0	0.0	0.1	0.2	0.0	0.0
Savannah Sparrow	3	3	0	0	<0.01	0.01	0.00	0.00	0.61%	1.0	0.0	0.0	0.1	0.3	0.0	0.0
Pine Grosbeak	1	0	1	0	<0.01	0.00	0.00	0.00	0.20%	0.0	0.5	0.0	0.0	0.0	0.1	0.0
*Red Crossbill**	*2*	*0*	*1*	*1*	*<0.01*	*0.00*	*0.00*	*0.01*	*0.41%*	*0.0*	*0.5*	1.0	-	-	-	-
American Crow	2	1	0	1	<0.01	0.00	0.00	0.01	0.41%	0.5	0.0	1.0	0.1	0.1	0.0	0.2
Clay-colored Sparrow	1	1	0	0	<0.01	0.00	0.00	0.00	0.20%	0.5	0.0	0.0	0.0	0.1	0.0	0.0
Red-breasted Nuthatch	1	1	0	0	<0.01	0.00	0.00	0.00	0.20%	0.5	0.0	0.0	0.0	0.1	0.0	0.0
*White-winged Crossbill**	*45*	*45*	*0*	*0*	*<0.01*	*0.00*	*0.00*	*0.00*	*9.18%*	*0.5*	*0.0*	3.8	-	-	-	-
Blue-headed Vireo	2	0	0	2	<0.01	0.00	0.00	0.01	0.41%	0.5	0.0	1.9	0.1	0.1	0.0	0.5
Crane																
Sandhill Crane	3	3	0	0	<0.01	0.01	0.00	0.00	0.61%	1.6	0.0	0.0	0.1	0.3	0.0	0.0
Rail																
Sora	1	0	0	1	<0.01	0.01	0.00	0.01	0.20%	1.6	0.0	1.0	0.2	0.3	0.0	0.2
Gull																
*Bonaparte's Gull**	*1*	*1*	*0*	*0*	*<0.01*	*0.00*	*0.00*	*0.00*	*0.20%*	*0.5*	*0.0*	*0.0*	-	-	-	0.0
*Gull sp.**	*5*	*4*	*1*	*0*	*<0.01*	*<0.01*	*<0.01*	*0.00*	*1.02%*	*0.5*	*0.5*	*1.0*	-	-	-	0.0
*Ring-billed Gull**	*2*	*1*	*1*	*0*	*<0.01*	*<0.01*	*<0.01*	*0.00*	*0.41%*	*0.5*	*0.5*	*0.0*	-	-	-	0.0
Kingfisher																
Belted Kingfisher	3	2	1	0	<0.01	0.01	0.00	0.00	0.61%	0.5	0.5	0.0	0.1	0.2	0.0	0.0
Loon																
*Common Loon**	*1*	*1*	*0*	*0*	*<0.01*	*0.00*	*0.00*	*0.00*	*0.20%*	*0.5*	*0.0*	*0.0*	-	-	-	0.0

Appendix A, Table A-2: Bird Species Observed During Terrestrial Breeding-Bird Surveys in the Keeyask Transmission Study Area, 2009 to 2011																
Species	**Total Number of Birds Observed**				**Density of Birds Observed (birds/ha)[1]**				**Frequency of Observation (%)**				**Percent of Total**			
	2009-2011 (n=490 stops)	**2009 (n=193 stops)**	**2010 (n=192 stops)**	**2011 (n=105 stops)**	**Average Density**	**2009 (n=193 stops)**	**2010 (n=192 stops)**	**2011 (n=105 stops)**	**Average Frequency of Observa-tion**	**2009 (n=193 stops)**	**2010 (n=192 stops)**	**2011 (n=105 stops)**	**% of Birds Observed in 2009 to 2011 (n=2406 birds)[2]**	**% of Birds Observed in 2009 (n=1134 birds)[2]**	**% of Birds Observed in 2010 (n=837 birds)2**	**% of Birds Observed in 2011 (n=435 birds)[2]**
Nighthawk																
Common Nighthawk	2	0	1	1	<0.01	0.00	0.00	0.01	0.41%	0.0	0.5	1.0	0.1	0.0	0.1	0.2
Raptor																
Bald Eagle	1	0	1	0	<0.01	0.00	0.00	0.00	0.20%	0.0	0.5	0.0	0.0	0.0	0.1	0.0
Hawk sp.	1	0	1	0	<0.01	0.00	0.00	0.00	0.20%	0.0	0.5	0.0	0.0	0.0	0.1	0.0
Merlin	1	1	0	0	<0.01	0.00	0.00	0.00	0.20%	0.5	0.0	0.0	0.0	0.1	0.0	0.0
Shorebird																
Common Snipe	28	20	6	2	0.03	0.04	0.02	0.01	5.71%	9.3	3.1	1.0	0.7	1.1	0.2	0.5
Greater Yellowlegs	9	3	3	3	0.01	0.01	0.00	0.02	1.84%	1.6	1.6	1.0	0.3	0.3	0.1	0.7
Lesser Yellowlegs	1	0	1	0	<0.01	0.00	0.00	0.00	0.20%	0.0	0.5	0.0	0.0	0.0	0.1	0.0
Yellowlegs sp.	2	2	0	0	<0.01	0.01	0.00	0.00	0.41%	1.0	0.0	0.0	0.1	0.2	0.0	0.0
Upland Game Bird																
Ruffed Grouse	1	0	0	1	0.00	0.01	0.00	0.01	0.20%	1.0	1.0	1.0	0.2	0.2	0.2	0.2
Spruce Grouse	6	2	2	2	0.01	0.01	0.01	0.01	1.22%	1.0	1.0	1.9	0.2	0.2	0.2	0.5
Waterfowl																
American Wigeon	1	1	0	0	<0.01	0.00	0.00	0.00	0.20%	0.5	0.0	0.0	0.0	0.1	0.0	0.0
*Canada Goose**	*158*	*48*	*110*	*0*	*0.00*	*0.00*	*0.00*	*0.00*	*32.24%*	*1.6*	*1.6*	*0.0*	-	-	-	-
Mallard*	1	1	0	0	0.00	0.00	0.00	0.00	0.20%	0.5	0.0	0.0	-	-	-	-
Woodpecker																
Black-backed Woodpecker	1	0	1	0	<0.01	0.00	0.00	0.00	0.20%	0.0	0.5	0.0	0.0	0.0	0.1	0.0
Hairy Woodpecker	1	1	0	0	<0.01	0.00	0.00	0.00	0.20%	0.5	0.0	0.0	0.0	0.1	0.0	0.0
Northern Flicker	1	1	0	0	<0.01	0.00	0.00	0.00	0.20%	0.5	0.0	0.0	0.0	0.1	0.0	0.0
Woodpecker sp.	2	2	0	0	<0.01	0.01	0.00	0.00	0.41%	1.0	0.0	0.0	0.1	0.2	0.0	0.0
Total (including flyovers)	**2708**	**1272**	**985**	**451**												
Total (excluding flyovers)	**2449**	**1166**	**848**	**435**									**100.0**	**100.0**	**100.0**	**100.0**
Density[1]					**2.7 ± 1.6**	**3.3 ± 1.9**	**2.5 + 1.3**	**2.3 ± 1.2**								
Diversity[2]					**4.7 ± 2.4**	**5.3 ± 2.7**	**4.5 + 2.1**	**4.1 ± 1.9**								

* observed as fly-over flocks and thus excluded from overall density and diversity calculations
[1] mean bird density/hectare ± standard deviation
[2] percentages based on totals excluding fly-over flocks

Appendix A, Table A-3: Potential Number of Breeding Pairs of Passerines Displaced and Waterbody Crossings Required Along Construction Power Route Options 1 and 2							
Broad Vegetation Type	**Average Bird Density**	**Route 1**			**Route 2**		
		Area (ha) of a 60-m ROW	**% of Total Area**	**Average Number of Breeding Pairs Displaced**	**Area (ha) of a 60-m ROW**	**% of Total Area**	**Average Number of Breeding Pairs Displaced**
Black Spruce Pure	2.7 + 1.6	79.5	68.0%	214.7	66.9	54.0%	180.7
Low Vegetation	2.9 + 1.6	18.0	0.0%	52.3	36.7	29.6%	106.4
Young Regeneration	1.8 ± 1.0	3.5	3.0%	6.3	6.8	5.5%	12.2
Tamarack Mixture	3.2 + 1.2	3.4	2.9%	11.0	3.2	2.5%	10.1
Black Spruce Mixture	2.6 + 1.4	2.6	0.0%	6.8	2.8	2.3%	7.3
Tamarack Pure	3.5 + 1.3	2.3	1.9%	8.1	-	-	8.1
Other Vegetation Types Not Surveyed for Birds	N/A	2.0	1.7%	N/A	1.7	1.4%	N/A
Water (including Nelson River)	N/A	5.6	4.8%	N/A	5.9	4.8%	N/A
Total		**117**	**100%**	**299**	**124**	**100%**	**331**
Number of Stream/Waterbody Crossings (Minimum)		**9**			**11**		

Appendix A, Table A-4: Potential Number of Breeding Pairs of Passerines Displaced Along Collector Line Route Options A, B and C*										
		Route A			Route B			Route C		
Broad Vegetation Types	Average Bird Density	Area (ha) of a 160-m ROW	% of Total Area	Average Number of Breeding Pairs Displaced	Area (ha) of a 160-m ROW	% of Total Area	Average Number of Breeding Pairs Displaced	Area (ha) of a 160-m ROW	% of Total Area	Average Number of Breeding Pairs Displaced
Black Spruce Pure	2.7 + 1.6	380.64	56.7%	1027.7	353.90	54.0%	955.5	433.45	66.8%	1170.3
Low Vegetation	2.9 + 1.6	126.46	18.8%	366.7	128.49	19.6%	372.6	47.90	7.4%	138.9
Tamarack Mixture	3.2 + 1.2	14.55	2.2%	46.6	20.39	3.1%	65.2	19.38	3.0%	62.0
Black Spruce Mixture	2.6 + 1.4	9.78	1.5%	25.4	16.92	2.6%	44.0	17.44	2.7%	*45.3*
Jack Pine Mixture	2.6 + 1.0	8.90	1.3%	23.1	3.58	0.5%	9.3	7.47	1.2%	19.4
Young Regeneration	1.8 ± 1.0	8.64	1.3%	15.5	8.64	1.3%	15.5	8.64	1.3%	15.5
Human	4.2 ± 2.9	4.67	0.7%	19.6	4.40	0.7%	18.5	8.81	1.4%	37.0
Black Spruce Mixedwood	2.3 ± 0.8	0.01	0.0%	0.0	0.95	0.1%	2.2	1.99	0.3%	4.6
Jack Pine Pure	3.9 ± 1.5	1.43	0.2%	5.6	0.99	0.2%	3.9		0.0%	0.0
Tamarack Pure	3.9 + 1.5	2.03	0.3%	7.9	3.26	0.5%	12.7	0.4	0.1%	1.7
Other Vegetation Types Not Surveyed for Birds:	-	14.4	2.1%	N/A	13.4	2.1%	N/A	11.5	1.8%	N/A
Trembling Aspen Mixture	-	2.55	0.4%	N/A	4.06	0.6%	N/A	2.07	0.3%	N/A
Tall Shrub	-	4.58	0.7%	N/A	3.45	0.5%	N/A	2.54	0.4%	N/A
Jackpine Mixedwood	-	3.74	0.6%	N/A	1.77	0.3%	N/A	3.80	0.6%	N/A
Black Spruce Pure/Tall Shrub	-	2.89	0.4%	N/A	3.56	0.5%	N/A	2.46	0.4%	N/A
Trembling Aspen Mixture/Tall Shrub	-	0.62	0.1%	N/A	0.39	0.1%	N/A	0.62	0.1%	N/A

Appendix A, Table A-4: Potential Number of Breeding Pairs of Passerines Displaced Along Collector Line Route Options A, B and C*										
Broad Vegetation Types	**Average Bird Density**	**Route A**			**Route B**			**Route C**		
		Area (ha) of a 160-m ROW	**% of Total Area**	**Average Number of Breeding Pairs Displaced**	**Area (ha) of a 160-m ROW**	**% of Total Area**	**Average Number of Breeding Pairs Displaced**	**Area (ha) of a 160-m ROW**	**% of Total Area**	**Average Number of Breeding Pairs Displaced**
Trembling Aspen Mixedwood	-	-	-	N/A		0.0%	N/A	-	-	N/A
Trembling Aspen Mixture/Tall Shrub	-	-	-	N/A	-	-	N/A	-	-	N/A
Trembling Aspen Pure	-	0.02	0.0%	N/A	0.21	0.0%	N/A	-	-	N/A
Tamarack Mixture/Tall Shrub	-	-	-	N/A	-	-	N/A	-	-	N/A
Water (including Nelson River)	-	2.52	0.4%	N/A	3.15	0.5%	N/A	2.83	0.4%	N/A
Area Not accounted for by Habitat Data	-	97.38	14.5%	N/A	97.10	14.8%	N/A	88.78	13.7%	N/A
Total		**671**	**100.0 %**	**1538**	**655**	**100.0%**	**1499**	**649**	**100.0%**	**1495**
Number of Stream/Waterbody Crossings (Minimum)		**14**			**19**			**11**		
* Estimates not available for Route D as habitat mapping not completed for this option.										