Keeyask Infrastructure Project

Terrestrial and Aquatic Monitoring Plan

Avian Monitoring

Annual Report 2013-2014

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KEEYASK
Hydropower Limited Partnership

December 2014

KEEYASK INFRASTRUCTURE PROJECT

TERRESTRIAL AND AQUATIC MONITORING PLAN

Avian Monitoring: Annual Report 2013 - 2014

Report for

MANITOBA CONSERVATION AND WATER STEWARDSHIP

Prepared on Behalf of the
Keeyask Hydropower Limited Partnership

By
Stantec Consultants Inc.

December 2014

TECHNICAL SUMMARY

The Keeyask Hydropower Limited Partnership is constructing the Keeyask Infrastructure Project ("the Project" or "KIP"). The Project is located approximately 180 km northeast of Thompson and 40 km southwest of Gillam, extending between PR 280 and Gull Rapids on the Nelson River. The Project includes a start-up camp and associated infrastructure, a 25 km all weather access road and the first phase of a main camp.

As part of the KIP licensing conditions (Environment Act Licence No. 2952R), the Keeyask Hydropower Limited Partnership is conducting terrestrial effects monitoring during the KIP construction. This annual report covers the period from April 1, 2013, to March 31, 2014. Avian monitoring in 2013 followed the same approach taken in 2012, with the focus on verifying construction-related effects on songbirds and owls within the Local Study Area (LSA). Methods included nocturnal surveys for owls in April 2013, breeding bird point counts for songbirds in June 2013, and the use of remote recording units for nocturnally active Species at Risk (SAR). Sampling occurred within potentially affected areas of the LSA, including areas along the access road and active borrow pits, and at regional reference sites located in areas not affected by the KIP construction activity.

In summer 2013, wildfires burning in the Keeyask region affected the avian sample design by limiting access to all of the proposed survey sites. As a result, not all of the analyses described in the Avian Monitoring 2012 - 2013 Annual Report were applied to the 2013 datasets. However, statistical comparisons were made for bird density and species richness in LSA versus RSA plots, and distance from the KIP Footprint. Results from 2013 songbird monitoring were consistent with 2012 results, with bird density and species richness lower at plots located near the KIP Footprint (<200 m) compared to areas further away (201m-1000m) (ANOVA *[density]* $F=4.4$ $p=0.1$; ANOVA *[species richness]* $F = 4.5$, $p = 0.01$). While a small, local effect on the bird community was observed, regional effects were not detected as bird density and species richness did not differ between the LSA and RSA plots (ANOVA *[density]* $F=2.5$, $p=0.1$; ANOVA *[species richness]* $F=2.7$, $P=0.1$).

Nocturnal owl surveys in 2013 revealed the presence of one great horned owl near borrow site G-5 and PR 280. Within the RSA, the low detection rate of owls in 2013 (compared to the 13 owls detected in 2012) is likely attributed to the late winter conditions extending throughout most of the province (Duncan pers. comm. 2013).

Results from the 2013 monitoring period indicated the presence of three bird species listed under Schedule 1 of the federal *Species at Risk Act* (SARA): rusty blackbird (*Euphagus carolinus* – '**special concern'** under SARA), olive-sided flycatcher (*Contopus cooperi* – '**threatened'** under SARA), and common nighthawk (*Chordeiles minor* – ***'threatened'*** under SARA and a ***'threatened species'*** by MESEA). As in 2012, all three species were detected using their preferred habitats along the access road, despite ongoing construction activity.

ACKNOWLEDGEMENTS

Stantec Consultants Inc. would like to thank Manitoba Hydro for their support throughout these studies, and the local First Nations Partners for permitting these studies within their resource management areas and areas of community interest. We wish to thank Peter Massan (York Factory First Nation) and Lorne Beardy (Fox Lake Cree Nation) for their assistance during the 2013 field studies. We also wish to express our gratitude to the other Keeyask consulting teams that assisted in providing input and logistical support for this project. We appreciate the efforts of Mr. Ron Bretecher, Ms. Mary Lang and Ms. Shari Fournier for their organizational assistance.

STUDY TEAM

Leane Wyenberg, M.Sc.	Biologist
Shirley Bartz, M.Sc., P.Biol.	Biologist
Jocelyn Hiebert, B.Sc., P.Biol.	Environmental Scientist
Summer Hull, B.Env.Sc.	Environmental Scientist
Cristina Ranellucci, M.Sc.	Biologist
Blair McMahon, M.Sc., P.Biol.	Biologist, Associate
Kristin Mozel, M.N.R.M, Adv. Dip. GIS	Terrestrial Ecologist

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1.0 INTRODUCTION

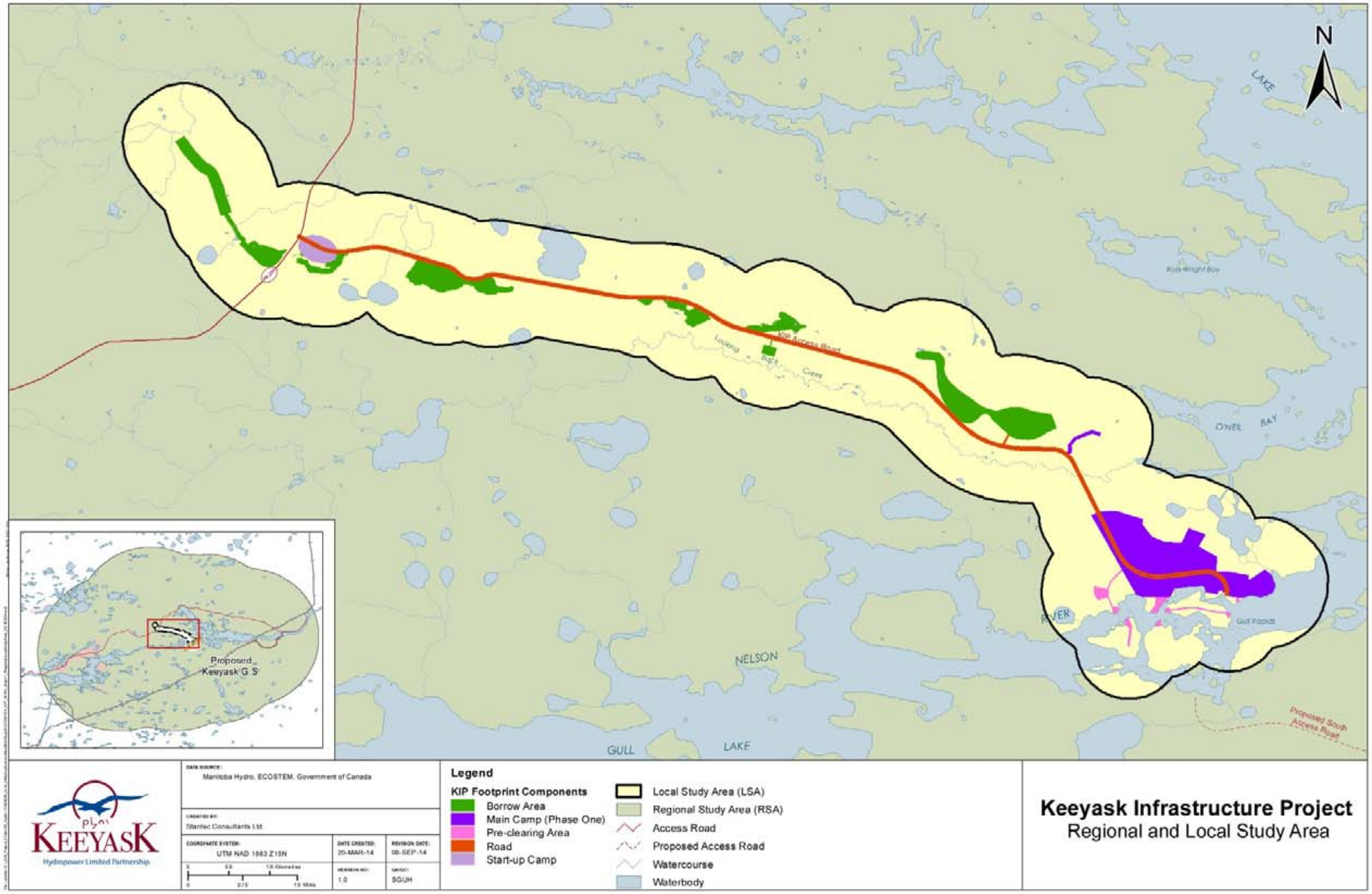
1.1 OVERVIEW

The Keeyask Hydropower Limited Partnership is constructing the Keeyask Infrastructure Project ("the Project" or "KIP"). The Project is located approximately 180 km northeast of Thompson and 40 km southwest of Gillam, extending between PR 280 and Gull Rapids on the Nelson River (Map 1-1). The Project includes a start-up camp and associated infrastructure, a 25 km all weather access road and the first phase of a main camp. This annual report covers the period from April 1, 2013 through to March 31, 2014.

As described in the KIP Environmental Assessment Report (2009), most of the Project's anticipated effects are expected to occur within the Local Study Area (LSA) (Map 1-1). Avian studies were focused within this area although some reference sites were monitored in the greater RSA (Map 1-1). Specific EA effects assessment predictions for birds include:

- Removal of bird **habitat** due to clearing for Project infrastructure resulting in minimal, local loss of bird habitat.
- Bird avoidance of Project areas due to construction activities, resulting in avoidance of some local areas by some birds.
- Increased bird mortality due to vehicle collisions along the road resulting in a minimal increase in bird mortality.

Construction of the access road was initiated in January 2012 and continued through the 2013 spring breeding season. Spring 2013 marked the second year of construction phase breeding bird monitoring. Field studies were conducted during the owl breeding period (April) and songbird breeding period (June) in 2013. In June, wildfires burned throughout the region, producing heavy smoke and hazardous survey conditions. As a result, not all sites surveyed in 2012 were revisited in 2013.



Map 1-1: Keeyask Infrastructure Project Regional and Local Study Area

This annual report documents the avian field studies conducted in 2013 and incorporates information pertinent to the Project from the existing baseline datasets. Photographs of some of the representative **habitats**[1] surveyed are provided in Appendix B. Details of bird survey results and surveyed vegetation communities are provided in Appendices C, D and E. Appendix F outlines additional observations of wildlife recorded during surveys and weather data recorded during 2013 surveys are provided in Appendix G.

[1] Definitions for words appearing in **bold** are provided in Appendix A.

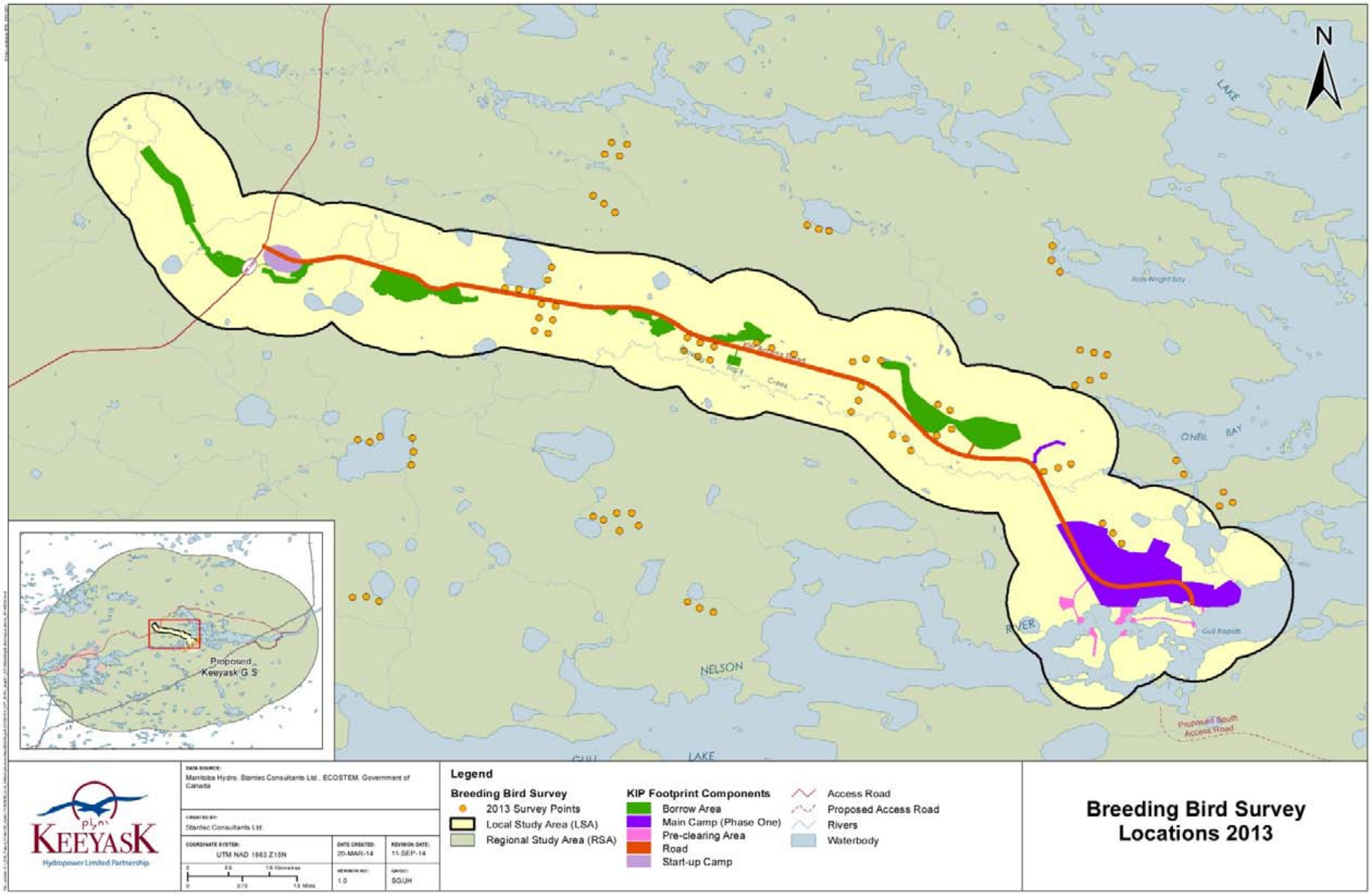
2.0 METHODS

Bird survey methods focused on gathering information on species or bird groups potentially affected by the Project. They included three methods: early morning point count surveys for diurnal species (e.g., songbirds), evening point count surveys for nocturnally active species (e.g., owls), and automated recording units for recording nocturnally active birds in remote areas (e.g. common nighthawk).

2.1 BREEDING BIRD SURVEYS

Point count surveys were used to gather information on breeding birds most active in the early morning hours. Methods used were based on the Canadian and American standard procedures for conducting population surveys using the Point Count Method (USGS 2001; Ralph *et al*. 1993; Welsh 1993). Survey plots were located in black spruce, jack pine, regenerating (post-fire) and low vegetation-dominated plant communities. Some of the plots targeted the preferred habitats of rusty blackbird (**riparian areas**) and olive-sided flycatcher (forest edge habitat).

Survey plots were 75m in radius and located 300 m apart in order to minimize the potential of double counting birds. At each survey plot, a team of three waited one minute for birds to settle prior to the survey. One biologist recorded all birds heard or observed within and just outside of a 75-m radius. Observations were recorded over a 5-minute listening period (only birds recorded in the first three minutes were used in the analysis for comparison to previously collected data). Birds flying over the stop were excluded from the stop density calculation if they were not considered to be using the habitat at the stop being surveyed. Surveys were not conducted when rain or winds greater than ~20 kph interfered with the intensity or audibility of bird songs, or when fog or rain interfered with visibility. Breeding-bird surveys occurred during the peak bird singing hours of 0500-1000 h. All additional wildlife observed during surveys was recorded as reconnaissance observations (Appendix E, Table E-1).



Map 2-1: Breeding Bird Survey Locations 2013

To the extent possible, survey transects sampled in 2012 were resurveyed in 2013. In 2013, some transects were lost as a result of land clearing (i.e., at borrow area G-5) and forest fire. Fires burning along the access road near PR 280 in June resulted in the loss of 3 transects (n=15 plots, 12 of which occurred in black spruce-dominated habitat, 3 in jack pine-dominated habitat).

New transects (consisting of 22 stops) targeting species at risk habitats in the LSA and RSA were added in 2013 (using modeled species at risk habitat data (ECOSTEM 2013)). For species at risk transects, sampling locations were determined based on the preferred breeding habitat of targeted species; in many instances this included forest edge and/or riparian areas. Breeding-bird survey transect sites were located within representative vegetation communities, and typically occurred in continuous (i.e., homogenous) habitat patches. A total of 80 survey plots/sites were surveyed in 2013.

For statistical analysis, the broad vegetation types were grouped into four categories based on the dominant plant community:

- Black spruce dominated (includes black spruce mixture, black spruce pure);
- Jack pine dominated (includes jack pine mixedwood, jack pine mixture, jack pine pure);
- Regenerating forest (includes jack pine mixture/tall shrub, jack pine mixedwood/tall shrub, trembling aspen mixedwood/ tall shrub, tall shrub); and
- Low vegetation.

A linear model (ANOVA) was developed (using log transformed data) to examine how density varied with habitat group. To assess potential construction impacts on bird density, an analysis of distance to disturbance was conducted for all 2013 sites. All plots were grouped into three main distance categories (distance measured from the edge of the access road ROW): 0-200m, 201m-1000m and >1000m. Plots located within 1000m of the road ROW fell within the LSA while plots located >1000m were located in the RSA. Using log transformed density data, an ANOVA was conducted for all plots, regardless of habitat type (Appendix C).

Two tests, a non-parametric Wilcoxon Rank Sum test and an ANOVA (using log transformed data), were conducted on plot data in order to understand if species richness varied between the LSA and RSA plots.

An analysis of distance to disturbance for all 2013 survey plots/sites (Appendix D) was assessed through an ANOVA and a non-parametric Kruskal-Wallis rank sum test. An analysis of species richness by habitat and distance group (two factors) was conducted using ANOVA.

2.2 NOCTURNAL OWL SURVEYS

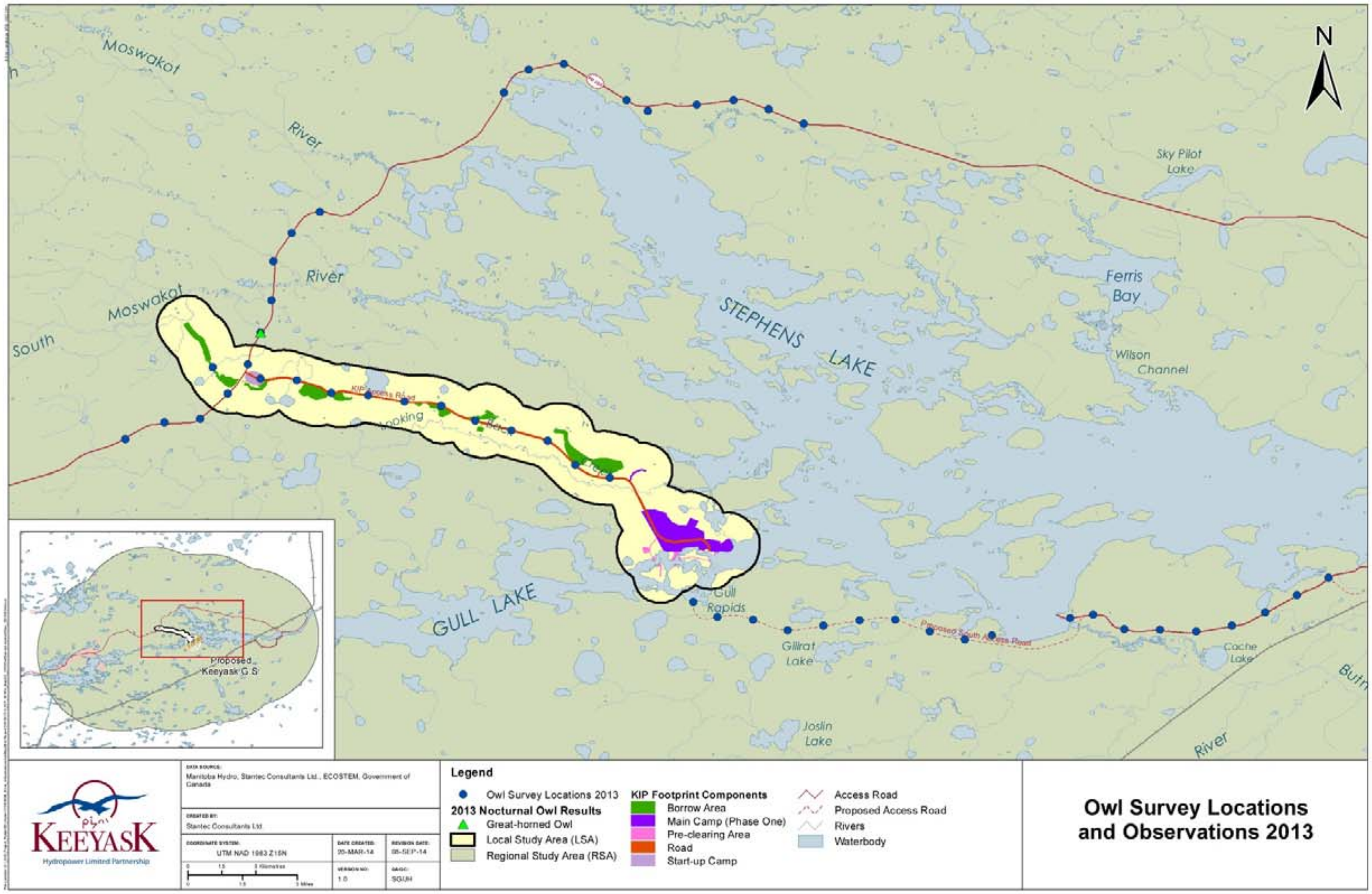
Between April 14 and 17 2013, point count surveys for owls were conducted along the access road (n=11 stops), along PR 280 (n=21 stops), and along the Butnau Road and south access road trail (n=19 stops; Map 2-2).

A total of 51 survey stops were surveyed for owls within the RSA. Surveys were conducted following survey protocols used by Manitoba Conservation and Water Stewardship for their annual Manitoba Nocturnal Owl Surveys (Takats *et al.* 2001). Each survey began within a half hour of sunset and was concluded around midnight. The two-minute listening stops were located 1.6 km apart along pre-determined transects.

During each listening stop, information recorded on data sheets included:

- species (and sex where possible) of each owl heard;
- if the call was repeated;
- direction and distance from which owls called;
- time, temperature, snow cover, cloud cover, wind speed, traffic count (number of cars) and ambient noise levels; and
- any additional wildlife observed or heard

Data collected was utilized to determine owl densities for comparison to previous years' data.



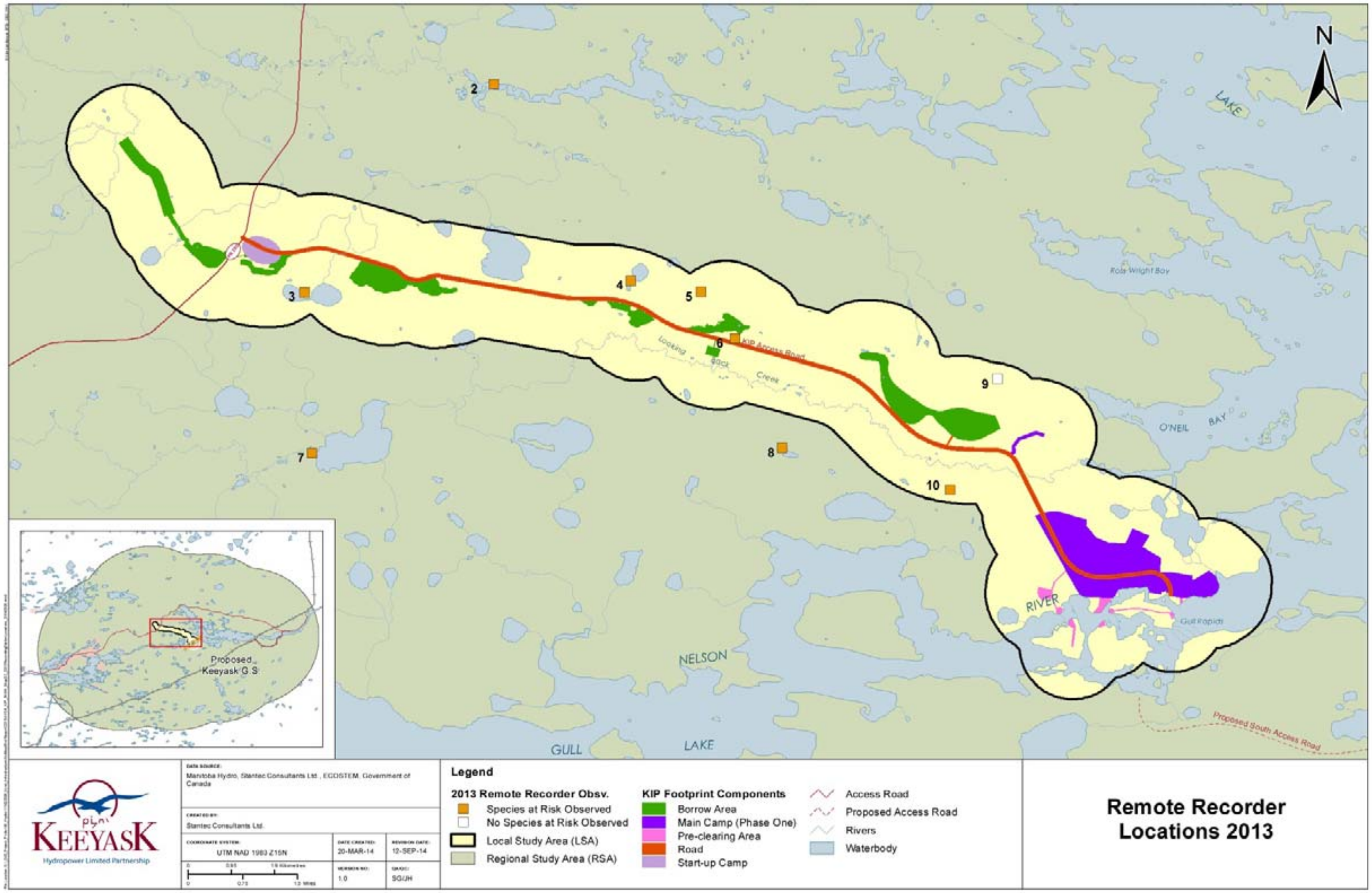
Map 2-2: Owl Survey Locations and Observations 2013

2.3 RECORDING UNITS

Recording units were used to determine presence of species at risk, particularly those which are nocturnally active. Recording units were set up at a total of 10 remote locations spread throughout the RSA (Map 2-3). The following species at risk, protected by federal and/or provincial legislation, are nocturnally active and have the potential to breed within terrestrial habitats potentially affected by the Project:

- common nighthawk (*Chordeiles minor*; listed as 'threatened' under Schedule 1 of SARA and 'threatened' by Manitoba Endangered Species and Ecosystems Act [MESEA]);
- yellow rail (*Coturnicops noveboracensis*; listed as 'special concern' under Schedule 1 of SARA and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) ;
- olive-sided flycatcher (*Contopus cooperi,* listed as 'threatened' under Schedule 1 of SARA); and
- rusty blackbird (*Euphagus carolinus,* listed as 'special concern' under Schedule 1 of SARA).

Point-count surveys during early morning hours capture the daily peak singing period for most terrestrial songbirds, including the SARA-listed rusty blackbird and olive-sided flycatcher. However, in the northern **boreal forest**, common nighthawk is known to be more active at dusk. Similarly, yellow rails call most often at night, usually beginning after dark. In order to gather presence/absence information from these nocturnally active species, recording units were deployed within preferred breeding habitat types of common nighthawk and yellow rail, which often included preferred habitats of rusty blackbird and olive-sided flycatcher. Units were set to record between 2200h and 2400h for common nighthawk and yellow rail, and between 0500h and 0600h for rusty blackbird and olive-sided flycatcher. Recordings were later evaluated to determine the presence of any bird species at risk.



Map 2-3: Remote Recorder Locations 2013

2.4 OTHER WILDLIFE DATA

Incidental observations such as birds heard outside of survey stops, bird nest locations and other wildlife signs were recorded when encountered during avian surveys (Appendix F, Table F-1). When a bird was seen or heard before or after a point count, or en route to another point count, it was recorded as an incidental observation. Any non-avian related observations (e.g. amphibians, mammals) were passed on to other Project study teams.

3.0 RESULTS

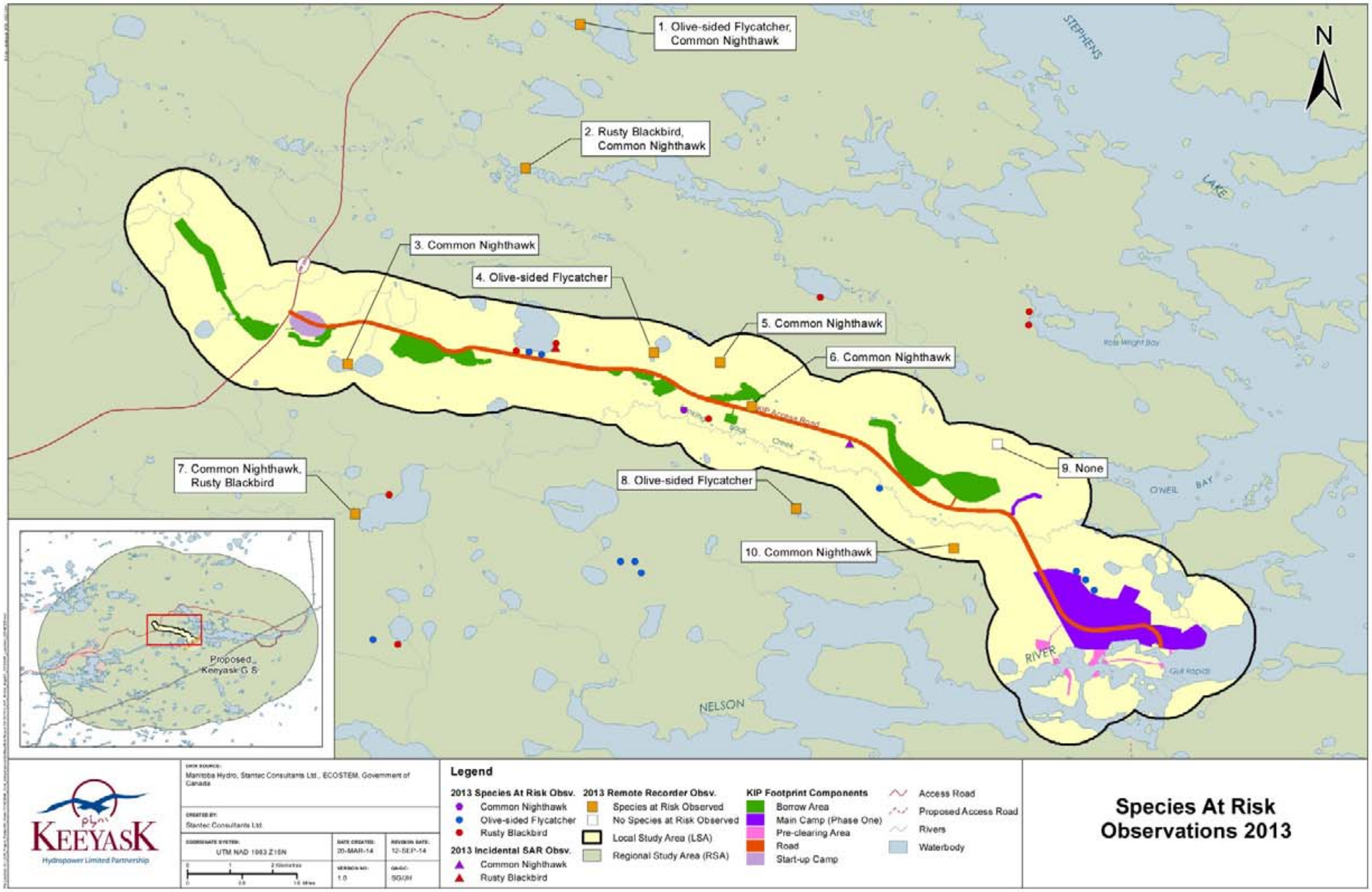
3.1 BREEDING-BIRD SURVEY RESULTS

Between June 18 and 30 2013, construction-phase breeding-bird monitoring surveys occurred throughout the KIP LSA and RSA (Map 2-1). At this time, hazardous conditions produced by the widespread forest fires limited the ability to survey all of the proposed survey plots. Land clearing for the development of borrow sources and camp areas also contributed to the loss of some previously surveyed plots. As a result, a total of 29 plots surveyed in 2012 were not re-surveyed in 2013. However overall sample size in 2013 (n=80) is consistent with 2012 sampling effort (n=81) due to the addition of new plots in 2013.

The 80 survey stops occurred within 10 broad vegetation types (ECOSTEM 2013). A total of 333 birds representing 33 species were observed during breeding-bird surveys in the RSA in 2013 (Appendix C, Table C-1). The RSA has the potential to support up to 178 bird species during the breeding and migration seasons (Appendix C; Table C-2). Three bird species at risk were identified during breeding-bird surveys: olive-sided flycatcher, rusty blackbird and common nighthawk (Map 3-1). Ten rusty blackbirds (detected at eight point count survey stops), six olive-sided flycatchers (detected at six survey stops), and two common nighthawks (detected at one stop) were detected during early morning point count surveys (Appendix C, Table C-3).

All three species were observed using their preferred breeding habitat; rusty blackbirds were detected in areas supporting riparian habitat, olive-sided flycatcher was detected along forest edges where riparian and/or regenerating forest habitat was prevalent and a pair of common nighthawk were observed in regenerating forest on mineral soil (Map 3-1).

Passerine birds accounted for 98% of the total birds observed (333 birds). Other birds included woodpeckers and common nighthawk. A total survey area of 143.4 hectares (ha), comprised of 80 stops was sampled (Map 2-1).



Map 3-1: Bird Species at Risk Observations 2013

3.1.1 Density

Overall, approximately 2.3 ± 1.3 birds/ha were observed throughout the Local and Regional Study Areas in 2013. When bird distribution among vegetation community types was considered, the highest average bird densities in 2013 were observed in young regeneration and low vegetation plant communities (Table 3.1-1). Jack pine dominated forest supported noticeably lower bird densities than any of the other vegetation community types (Table 3.1-1). Results of the ANOVA analysis indicated a significant difference in bird density between habitat groups (ANOVA F=3.33, p=0.02; Appendix D, Section 3.1.1). A Tukey Honest Significant Differences test (*TukeyHSD*) revealed that the significant difference is driven by the difference between the jack pine habitat group (lower density) and the low vegetation and regenerating vegetation group (higher densities) (Appendix D, Section 3.1.1).

For each vegetation community sampled, average bird densities observed in 2013 were lower than observed in 2012, but comparable to densities observed in 2011 (Table 3.1-1). As in 2012, average bird densities per major habitat type were also similar between the LSA and RSA sites sampled in 2013 (Table 3.1-2). An ANOVA on log transformed data showed no significant difference between the LSA (affected) vs. the RSA (reference) sites (F=2.5, p=0.117; Appendix D, Section 3.1.3). A non-parametric Mann-Whitney Test also revealed no significant difference in bird density between the LSA and RSA sites (W=907.5, p-value =0.276). Variation in bird abundance observed between sampling years (2011-2013) is attributed to changes in sampling design in 2013. Annual variability in bird populations and loss of survey plots to fire and land clearing activities (and the increased sampling effort in species at risk habitats) are factors limiting the ability to make statistical comparisons between monitoring years.

Table 3.1-1: Average Bird Densities in the Regional Study Area 2011 to 2013

Vegetation Community Type[1]	# of Birds	# of Stops	Total Surveyed Area (ha)	Average Density (birds/ha +/- Standard Deviation)	# of Birds	#of Stops	Total Surveyed Area (ha)	Average Density (birds/ha +/- Standard Deviation)	# of Birds	# of Stops	Total Surveyed Area (ha)	Average Density (birds/ha +/- Standard Deviation)
	2011				2012				2013			
Black Spruce (Mixture and pure stands)	185	44	77.9	2.4 ± 1.1	364	44	77.9	4.7 ± 1.8	106	29	48.1	2.1±1.1
Jack Pine (Mixture and pure stands	27	9	15.9	1.7 ± 0.7	34	7	12.4	2.7 ± 0.9	38	12	21.2	1.8±1.4
Low Vegetation	-	-	-	-	48	5	8.9	5.4 ± 1.0	110	23	40.7	2.7 ±1.4
Tall Shrub	-	-	-	-	69	5	8.9	7.8 ± 2.7	32	6	10.6	
Young Regeneration	73	18	31.9	2.3 ± 1.6	69	10	17.7	3.9 ± 2.2	47	10	17.7	2.8 ±1.3

NOTE:
[1]Vegetation community types with three point-count stops or fewer are not included in this table and not utilized in habitat analysis. Low vegetation and tall shrub were sampled for species at risk in 2012 and 2013.

Table 3.1-2: Average Bird Densities in the Regional Study Area LSA vs. RSA Sites (2011 and 2012)

Vegetation Community Type[1]	LSA Sites			RSA Sites		
	Average Density (birds/ha +/- standard deviation)			Average Density (birds/ha +/- standard deviation)		
	2011	2012	2013	2011[2]	2012	2013
Black Spruce (Mixture and Pure Stands)	2.1 ± 1.1	4.6 ± 1.8	2.7 ± 2.0	2.5 ± 1.1	4.7 ± 1.8	2.0 ± 1.0
Jack Pine (Mixture and Pure Stands)	1.9 ± 0.6	2.9 ± 1.0	1.8 ± 1.6	-	-	1.4 ± 1.2
Low Vegetation	-	5.6 ± 1.1	2.9 ± 1.5	-	-	2.3 ± 0.9
Young Regeneration	2.3 ± 1.6	3.9 ± 2.2	2.8 ± 1.3	-	4.2 ± 2.3[2]	2.8 ± 1.3

NOTE:
[1]Vegetation community types with three point count stops or fewer are not included in this table and not utilized in habitat analysis.
[2]Based on the Keeyask 2001-2011 BBS dataset.

At the species level, differences in bird density (birds/ha) between the LSA and RSA was largely driven by differences in sampling effort between major habitat groupings. Of the species detected in the LSA sites, orange crowned warbler (0.23± 0.3), alder flycatcher (0.21 ± 0.3), hermit thrush (0.24 ± 0.3) and white-throated sparrow (0.37 ± 0.4) occurred at the highest densities (Appendix C, Table C-5). All of these species occurred at densities <0.12 in the RSA. In 2013, yellow-rumped warbler (0.23 ± 0.46) and dark-eyed junco (0.22 ± 0.37), typical species of black spruce dominated habitats, were most abundant in the RSA sites.

Results of an ANOVA indicated a significant difference between distance to disturbance categories (ANOVA, F = 4.4, $p = 0.01$). Results of a non-parametric test (i.e., Kruskal-Wallis rank sum test) also indicated a significant difference between distance to disturbance categories ($\chi^2=7.3$, p=0.02). The difference between distance to disturbance categories was driven by the 201-1000m category, which had higher densities than the other two categories based on the Tukey HSD test (Appendix D, Section 3.1.2).

3.1.2 Diversity

As breeding bird surveys of the Regional Study Area (RSA) were designed to record terrestrial breeding birds using forested areas, 98% of bird species observed belonged to the **passerine** group. Low vegetation supported the most diverse bird community (n=23 species) compared to all other habitat groups (Appendix B, Photo 1; Appendix C, Table C-3). Black spruce-dominated communities supported 20 species and regenerating forest (Appendix B, Photo 2) supported 19 species (Appendix C, Table C-3). Jack pine communities supported the lowest species richness (n=14 species). Of the 33 bird species observed in 2013, 65% of the birds observed belonged to one of ten common species (Table 3.1-3). The remaining 35% of the total birds observed encompassed the remaining 23 species (Appendix C, Table C-1). Less common passerines included white-crowned sparrow (*Zonotrichia leucophrys*), red-winged blackbird (*Agelaius phoeniceus*), magnolia warbler (*Setophaga magnolia*), and common redpoll (*Acanthis flammea*).

Table 3.1-3: Common Species Observed in Regional Study Area 2013

Bird Species	Percent of Total Birds Observed	Number of Stops Species Observed in
White-throated sparrow	9%	54
Tennessee warbler	8.4%	24
Yellow-rumped warbler	7.2%	17
Hermit thrush	6.6%	20
Orange-crowned warbler	6.3%	19
Alder flycatcher	5.7%	16
Dark-eyed junco	5.7%	15
Ruby-crowned kinglet	5.4%	17
Swamp sparrow	5.1%	15
Fox sparrow	4.8%	16
Total	*333 birds detected*	*80 stops surveyed*

In most cases, a correlation between bird numbers and the percentage of stops in which these birds were observed was evident (i.e., most abundant bird species were also the species that were most widespread throughout the RSA).

Like density, species richness (number of different species) was not significantly different between LSA and RSA sites (ANOVA F=2.7, P=0.1, Appendix D, Section 4.1.3 and W=916, P=0.2, Appendix D, Section 4.1.3). Of the 33 species observed, 30 species were detected at LSA sites and 27 species at RSA sites. Red crossbill, white-crowned sparrow and red-winged blackbird were only found at RSA sites. Boreal chickadee, common nighthawk, magnolia warbler, northern flicker, tree swallow, Wilson's warbler and an unidentified woodpecker were only found in the LSA sites. Densities of all of these species were very low, so no specific conclusions can be made about avoidance or attraction to construction areas.

An analysis of distance to disturbance for all 2013 survey plots/sites (Appendix D, Section 4.1.2) revealed that plots located 201m-1000m from disturbance had significantly higher diversity than those located closer to the disturbance (<200m) and those located further away (>1000m) (ANOVA, F = 4.5, $p = 0.01$ and $\chi^2 = 7.2$, p=0.02). An analysis of species richness by habitat and distance group revealed no significant effect (ANOVA, F=0.9, p=0.5) (Appendix D, Section 4.1.2).

3.2 NOCTURNAL OWL SURVEY RESULTS

From 2004 through 2012, owls observed breeding in the RSA included northern hawk owl (*Surnia ulula*), boreal owl, great-horned owl, great gray owl and long-eared owl (*Asio otus*). Short-eared owl (*Asio flammeus*) has also been detected, however due to limited availability of suitable habitat, they are not expected to breed within the RSA. Snowy owl (*Nyctea scandiaca*) is known to pass through the area during migration seasons (Godfrey 1986).

Of the 51 point-count locations surveyed for owls in 2013, only one great-horned owl (*Bubo virginianus*) was detected (Map 2-2). Detection occurred west from a PR 280 survey point located in close proximity to a cleared borrow site (G-5).

3.3 RECORDING UNIT RESULTS

In 2013, three bird species at risk were identified on recording units deployed throughout the RSA: olive-sided flycatcher, rusty blackbird and common nighthawk (Map 3-1). Common nighthawk was most common, detected at seven of the 10 monitoring locations (Map 3-1). Four of the six recording units located within suitable common nighthawk habitat (e.g., sparsely treed vegetation on mineral soil, regenerating forest) supported nighthawks (Appendix E, Table E-1). Two common nighthawk detections occurred in rusty blackbird and olive-sided flycatcher habitat (e.g., riparian areas) and one occurred in yellow rail/rusty blackbird habitat (i.e., riparian fen).

Two of the five monitoring sites located in olive-sided flycatcher habitat (i.e., forest edge within 50m of water) supported olive-sided flycatcher (Appendix E, Table E-1). One olive-sided flycatcher was detected in rusty blackbird habitat (i.e., riparian habitat; Map 3-1, Location 9). Of the seven rusty blackbird monitoring locations (located in riparian areas), only two supported rusty blackbirds (Appendix E, Table E-1; Map 3-1, Locations 2 and 7).

3.4 INCIDENTALS

Incidental species are those recorded before starting or after ending a point count, or observed between point count plots. In 2013, two species at risk - common nighthawk and rusty blackbird - were noted as incidentals. Four rusty blackbirds (one blackbird ‘family’) and one common nighthawk were the only ‘incidentals’ recorded outside of survey points (Map 3-1).

4.0 DISCUSSION

4.1 PASSERINES

Based on the 2013 monitoring results for passerines, construction disturbance did not appear to have a measureable effect on the local bird community. Bird density and species richness in areas adjacent (<200 m) to the access road ROW was similar to bird density and species richness in areas further from the access road (i.e., >1,000 m). The highest density and species richness of birds occurred in plots located between 200 m and 1,000 m from the access road ROW. Similar results were observed in 2012, as bird density was significantly lower at sites sampled along the access road ROW compared to sites located further away (<500 m). These results were somewhat unexpected as other studies have shown reduced bird density and nesting frequency in areas adjacent to industrial noise (Bayne *et al.* 2008; Francis *et al.* 2009).

In the KIP Avian Monitoring 2012–2013 Annual Report (KHLP 2013), species-specific comparisons between the black-spruce dominated LSA and RSA sites (most common habitat type sampled) indicated a greater density of edge species (e.g., dark-eyed junco and ruby-crowned kinglet) in the LSA sites. In 2013, species composition wasn't analysed due small sample size. Fires limited access to black-spruce dominated sites in the LSA (only six of the proposed 18 black spruce dominated sites were sampled in the LSA compared to the 23 sites in the RSA). While a general comparison of species densities in all habitats indicated a greater density of edge species (e.g., white-throated sparrow, alder flycatcher, and orange-crowned warbler) in the LSA sites verses the RSA sites, this difference is likely attributed to variability in the sampling effort between LSA and RSA habitats, not as a result of road construction activity.

4.2 OWLS

The 2013 owl surveys yielded only one detection of a great-horned owl calling near borrow area G-5. Although surveys occurred at approximately the same time as previous years' surveys (including 2012 which yielded 13 owl detections), the lack of owl observations throughout the RSA suggests a mismatch of survey timing and owl breeding. In April 2013, owl detections throughout many parts of the province were also minimal, suggesting a possible delay in the owl breeding period as a result of the late winter conditions (Duncan pers. comm. 2012).

4.3 SPECIES AT RISK

Three bird species at risk, as defined by COSEWIC, Schedule 1 of the SARA and/or MESEA, were detected during 2013 field studies (common nighthawk, olive-sided flycatcher and rusty blackbird). Although surveys targeted yellow rail habitat, none were observed. Consistent with 2012 observations, all three species were present in habitats located along the access road ROW and in reference sites.

5.0 CONCLUSIONS

Based on the 2013 monitoring results for passerines, the KIP construction activity had no significant effect on the regional bird community. While monitoring revealed significantly lower bird densities and species richness at survey plots located within 200 m of the access road ROW (compared to plots located 201 m – 1,000 m away), they did not differ statistically when compared to sample plots located in areas further away (>1,000 m, i.e., plots located outside of the LSA). These results are consistent with results from 2012 avian monitoring studies, where lower bird densities and diversity occurred in plots located in close proximity to the access road ROW compared to areas further away, but differences at the regional scale (LSA versus RSA sites) were not statistically significant.

Several bird species at risk, including rusty blackbird, olive-sided flycatcher, and common nighthawk were recorded at monitoring sites located within the LSA and RSA. All three species were detected in areas adjacent to construction sites despite ongoing construction in 2013.

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APPENDIX A
GLOSSARY

Boreal Forest – a nearly continuous belt of primarily coniferous trees across northern Canada which overlies formerly glaciated areas.

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

Mixedwood – forests consisting of a mix of coniferous and deciduous tree species.

Passerine – a member of the very large order Passeriformes, usually called 'perching birds'; as their anatomy allows them to perch on branches, unlike a duck or goose.

Riparian area – the area along a watercourse or around a lake or pond.

ROW – a "Right-of-Way," the strip of land through which roadways, railroads, or power lines are built, operated and maintained.

Shorebird – any of a group of wading birds that frequent shorelines of lakes, rivers, ponds or oceans.

Special Concern – a wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

Threatened – a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

APPENDIX B
PHOTOGRAPHS

Photo 1 – Low Vegetation Habitat Type

Photo 2 – Young Regenerating Habitat Type

APPENDIX C
BREEDING-BIRD SURVEY DATA

Table C-1: Species Detected During Breeding Bird Surveys Keeyask Infrastructure Project Regional Study Area - 2013				
Species	**Total Number of Birds**	**Number of Stops**	**Percent (%) of total birds observed**	**Percent (%) of stops observed at**
White-throated Sparrow	33	28	9.9%	34.6%
Tennessee Warbler	28	24	8.4%	29.6%
Yellow-rumped Warbler	24	17	7.2%	21.0%
Hermit Thrush	22	20	6.6%	24.7%
Orange-crowned Warbler	21	19	6.3%	23.5%
Alder Flycatcher	19	16	5.7%	19.8%
Dark-eyed Junco	19	15	5.7%	18.5%
Ruby-crowned Kinglet	18	17	5.4%	21.0%
Swamp Sparrow	17	15	5.1%	18.5%
Fox Sparrow	16	16	4.8%	19.8%
Palm Warbler	14	12	4.2%	14.8%
Blackpoll Warbler	12	11	3.6%	13.6%
Rusty Blackbird	10	8	3.0%	9.9%
Lincoln's Sparrow	9	9	2.7%	11.1%
American Robin	8	8	2.4%	9.9%
Gray Jay	8	7	2.4%	8.6%
Northern Waterthrush	8	7	2.4%	8.6%
Least Flycatcher	7	7	2.1%	8.6%
Olive-sided Flycatcher	6	6	1.8%	7.4%
Swainson's Thrush	5	4	1.5%	4.9%
Yellow-bellied Flycatcher	5	5	1.5%	6.2%
Blue-headed Vireo	4	4	1.2%	4.9%
Chipping Sparrow	3	3	0.9%	3.7%
Wilson's Warbler	3	2	0.9%	2.5%
Common Nighthawk	2	1	0.6%	1.2%

Table C-1: Species Detected During Breeding Bird Surveys Keeyask Infrastructure Project Regional Study Area - 2013				
Species	**Total Number of Birds**	**Number of Stops**	**Percent (%) of total birds observed**	**Percent (%) of stops observed at**
Northern Flicker	2	2	0.6%	2.5%
Tree Swallow	2	1	0.6%	1.2%
Yellow Warbler	2	2	0.6%	2.5%
Boreal Chickadee	1	1	0.3%	1.2%
Magnolia Warbler	1	1	0.3%	1.2%
Red Crossbill	1	1	0.3%	1.2%
Red-winged Blackbird	1	1	0.3%	1.2%
White-crowned Sparrow	1	1	0.3%	1.2%
Woodpecker sp.	1	1	0.3%	1.2%
Total	**333**	**81**	**100.0%**	**100.0%**

Table C-2: Bird Species Known or Expected to Utilize the Keeyask Infrastructure Project Regional Study Area			
Scientific Name	**Common Name**	**Status**[1]	**Observed Using the Study Area**[2]
Loons			
Gavia pacifica	Pacific Loon	M	✓
Gavia immer	Common Loon	B	✓
Grebes			
Podilymbus podiceps	Pied-billed Grebe	B	✓
Podiceps auritus	Horned Grebe	B	✓
Podiceps grisegena	Red-necked Grebe	B	✓
Pelicans and Cormorants			
Pelecanus erythrorhynchos	American White Pelican	N	✓
Phalacrocorax auritus	Double-crested Cormorant	N	✓
Herons and Bitterns			
Botaurus lentiginosus	American Bittern	B	✓
Ardea herodias	Great Blue Heron	B	✓
Swans			
Cygnus columbianus	Tundra Swan	M	✓
Geese			
Anser albifrons	Greater White-fronted Goose	M	□
Anser caerulescens	Snow Goose	M	✓
Anser rossii	Ross's Goose	M	□
Branta canadensis	Canada Goose	B	✓
Ducks			
Anas crecca	Green-winged Teal	B	✓
Anas rubripes	American Black Duck	B	✓
Anas platyrhynchos	Mallard	B	✓
Anas acuta	Northern Pintail	B	✓
Anas discors	Blue-winged Teal	B	✓
Anas clypeata	Northern Shoveller	B	✓
Anas strepera	Gadwall	B,N	✓
Anas americana	American Wigeon	B	✓
Aythya valisinerina	Canvasback	B?,N	□
Aythya americana	Redhead	B?,N	□
Aythya collaris	Ring-necked Duck	B	✓
Aythya marila	Greater Scaup	M	✓

Table C-2: Bird Species Known or Expected to Utilize the Keeyask Infrastructure Project Regional Study Area

Scientific Name	Common Name	Status[1]	Observed Using the Study Area[2]
Aythya affinis	Lesser Scaup	B	✓
Somateria mollissima	Common Eider	M	□
Melanitta nigra	Black Scoter	M	✓
Melanitta perspicillata	Surf Scoter	M	✓
Melanitta fusca	White-winged Scoter	B	✓
Bucephala clangula	Common Goldeneye	B	✓
Bucephala albeola	Bufflehead	B	✓
Lophodytes cucullatus	Hooded Merganser	B	✓
Mergus merganser	Common Merganser	B	✓
Mergus serrator	Red-breasted Merganser	B	✓
Gulls and Terns			
Stercorarius parasiticus	Parasitic Jaeger	B?	✓
Larus philadelphis	Bonaparte's Gull	B	✓
Larus delawarensis	Ring-billed Gull	B	✓
Larus argentatus	Herring Gull	B	✓
Sterna caspia	Caspian Tern	B	✓
Sterna hirundo	Common Tern	B	✓
Sterna paradisaea	Arctic Tern	M	✓
Chlidonias niger	Black Tern	?	✓
Accipters (Hawks and Eagles)			
Pandion haliaetus	Osprey	B	✓
Haliaeetus leucocephalus	Bald Eagle	B	✓
Circus cyaneus	Northern Harrier	B	✓
Accipiter striatus	Sharp-shinned Hawk	B	✓
Accipiter gentilis	Northern Goshawk	P	✓
Buteo jamaicensis	Red-tailed Hawk	B	✓
Buteo lagopus	Rough-legged Hawk	M	✓
Aquila chrysaetos	Golden Eagle	M	✓
Falcons			
Falco sparverius	American Kestrel	B	✓
Falco columbarius	Merlin	B	✓
Falco peregrinus anatum	Peregrine Falcon	M	✓
Falco rusticolus	Gyrfalcon	W?	□

Table C-2: Bird Species Known or Expected to Utilize the Keeyask Infrastructure Project Regional Study Area

Scientific Name	Common Name	Status[1]	Observed Using the Study Area[2]
Owls			
Bubo virginianus	Great Horned Owl	P	✓
Nyctea scandiaca	Snowy Owl	M,W	✓
Surnia ulula	Northern Hawk-Owl	P	✓
Strix nebulosa	Great Gray Owl	P	✓
Asio otus	Long-eared Owl	B	✓
Asio flammeus	Short-eared Owl	B	✓
Aegolius funerus	Boreal Owl	P	✓
Vultures			
Cathartes aura	Turkey vulture	N	✓
Upland Gamebirds			
Dendragapus canadensis	Spruce Grouse	P	✓
Lagopus lagopus	Willow Ptarmigan	W	✓
Bonasa umbellus	Ruffed Grouse	P	✓
Tympanuchus phasianellus	Sharp-tailed Grouse	P	✓
Rails and Cranes			
Coturnicops noveboracensis	Yellow Rail	B	□
Porzana carolina	Sora	B	✓
Fulica americana	American Coot	B	□
Grus canadensis	Sandhill Crane	B	✓
Shorebirds			
Pluvialis squatarola	Black-bellied plover	M	✓
Pluvialis dominica	Lesser golden-Plover	M	□
Charadrius semipalmatus	Semipalmated Plover	M	✓
Charadrius vociferus	Killdeer	B	✓
Tringa melanoleuca	Greater Yellowlegs	B	✓
Tringa flavipes	Lesser Yellowlegs	B	✓
Tringa solitaria	Solitary Sandpiper	B	✓
Actitis macularia	Spotted Sandpiper	B	✓
Numenius phaeopus	Whimbrel	M	✓
Limosa haemastica	Hudsonian Godwit	M	□
Arenaria interpres	Ruddy Turnstone	M	✓
Calidris conutus	Red Knot	M	□

Table C-2: Bird Species Known or Expected to Utilize the Keeyask Infrastructure Project Regional Study Area			
Scientific Name	**Common Name**	**Status[1]**	**Observed Using the Study Area[2]**
Calidris alba	Sanderling	M	□
Calidris pusilla	Semipalmated Sandpiper	M	✓
Calidris minutilla	Least Sandpiper	M	□
Calidris fuscicollis	White-rumped Sandpiper	M	□
Calidris bairdii	Baird's Sandpiper	M	□
Calidris melanotos	Pectoral Sandpiper	M	□
Calidris alpina	Dunlin	M?	✓
Limnodromus griseus	Short-billed Dowitcher	M	□
Gallinago delicate	Wilson’s Snipe	B	✓
Phalaropus lobatus	Red-necked Phalarope	M	□
Nighthawks			
Chordeiles minor	Common Nighthawk	B	✓
Hummingbirds			
Archilochus colubris	Ruby-throated Hummingbird	B,N	□
Kingfishers			
Cerlye alcyon	Belted Kingfisher	B	✓
Woodpeckers			
Picoides pubescens	Downy Woodpecker	P	✓
Picoides villosus	Hairy Woodpecker	P	✓
Picoides tridactylus	Three-toed Woodpecker	P	✓
Picoides arcticus	Black-backed Woodpecker	P	✓
Colaptes auratus	Northern Flicker	B	✓
Sphyrapicus varius	Yellow-bellied Sapsucker	B,N	✓
Passerines			
Contopus borealis	Olive-sided Flycatcher	B	✓
Empidonax flaviventris	Yellow-bellied Flycatcher	B	✓
Empidonax alnorum	Alder Flycatcher	B	✓
Empidonax minimus	Least Flycatcher	B	✓
Eremophila alpestris	Horned Lark	M,W	□
Tachycineta bicolor	Tree Swallow	B	✓
Riparia riparia	Bank Swallow	B	✓
Hirundo pyrrhonota	Cliff Swallow	B	✓
Hirundo rustica	Barn Swallow	B	✓

Table C-2: Bird Species Known or Expected to Utilize the Keeyask Infrastructure Project Regional Study Area			
Scientific Name	**Common Name**	**Status[1]**	**Observed Using the Study Area[2]**
Perisoreus canadensis	Gray Jay	P	✓
Pica pica	Black-billed Magpie	P	□
Corvus brachyrhynchos	American Crow	P	✓
Corvus corax	Common Raven	P	✓
Parus hudsonicus	Boreal Chickadee	P	✓
Sitta canadensis	Red-breasted Nuthatch	P	✓
Troglodytes troglodytes	Winter Wren	B	✓
Regulus satrapa	Golden-crowned Kinglet	B	✓
Regulus calendula	Ruby-crowned Kinglet	B	✓
Catharus minimus	Gray-cheeked Thrush	M	✓
Catharus ustulatus	Swainson's Thrush	B	✓
Catharus guttatus	Hermit Thrush	B	✓
Turdus migratorius	American Robin	B	✓
Bombycilla garrulus	Bohemian Waxwing	B	□
Bombycilla cedrorum	Cedar Waxwing	B	✓
Lanius excubitor	Northern Shrike	M	✓
Moqueur roux	Brown Thrasher	B?	□
Certhia americana	Brown Creeper	B	✓
Sturnus vulgaris	European Starling	B,I	□
Vireo solitarius	Blue-headed Vireo	B	✓
Vireo philadelphicus	Philadelphia Vireo	B	□
Vireo olivaceus	Red-eyed Vireo	B	✓
Vermivora peregrina	Tennessee Warbler	B	✓
Vermivora celata	Orange-crowned Warbler	B	✓
Dendroica petechia	Yellow Warbler	B	✓
Dendroica magnolia	Magnolia Warbler	B	✓
Dendroica tigrina	Cape May Warbler	B	✓
Dendroica coronata	Yellow-rumped Warbler	B	✓
Dendroica fusca	Blackburnian Warbler	B	✓
Dendroica palmarum	Palm Warbler	B	✓
Dendroica castanea	Bay-breasted Warbler	B	✓
Dendroica striata	Blackpoll Warbler	B	✓
Mniotilta varia	Black-and-white Warbler	B	✓

Table C-2: Bird Species Known or Expected to Utilize the Keeyask Infrastructure Project Regional Study Area

Scientific Name	Common Name	Status[1]	Observed Using the Study Area[2]
Seiurus aurocapillus	Ovenbird	B	✓
Seiurus noveboracensis	Northern Waterthrush	B	✓
Wilsonia pusilla	Wilson's Warbler	B	✓
Pheucticus ludovicianus	Rose-breasted Grosbeak	B	✓
Spizella arborea	American Tree Sparrow	B	✓
Spizella passerina	Chipping Sparrow	B	✓
Spizella pallida	Clay-colored Sparrow	B?,N	✓
Passerculus sandwichensis	Savannah Sparrow	B	✓
Ammodramus leconteii	Le Conte's Sparrow	B	✓
Passerella iliaca	Fox Sparrow	B	✓
Melospiza melodia	Song Sparrow	B	✓
Melospiza lincolnii	Lincoln's Sparrow	B	✓
Melospiza georgiana	Swamp Sparrow	B	✓
Zonotrichia albicollis	White-throated Sparrow	B	✓
Zonotrichia leucophrys	White-crowned Sparrow	B	✓
Zonotrichia querula	Harris's Sparrow	M	□
Junco hyemalis	Dark-eyed Junco	B	✓
Calcarius lapponicus	Lapland Longspur	M	□
Calcarius pictus	Smith's Longspur	M	□
Plectophenax nivalis	Snow Bunting	M	✓
Agelaius phoeniceus	Red-winged Blackbird	B	✓
Euphagus carolinus	Rusty Blackbird	B	✓
Quiscalus quiscula	Common Grackle	B	✓
Pinicola enucleator	Pine Grosbeak	P	✓
Loxia curvirostra	Red Crossbill	P	✓
Loxia leucoptera	White-winged Crossbill	P	✓
Carduelis flammea	Common Redpoll	P	✓
Carduelis hornemanni	Hoary Redpoll	M,W	□
Carduelis pinus	Pine Siskin	B?,N	□
Passer domesticus	House Sparrow	B,I	□
TOTAL SPECIES OBSERVED IN REGIONAL STUDY AREA			**144**

Table C-2: Bird Species Known or Expected to Utilize the Keeyask Infrastructure Project Regional Study Area			
Scientific Name	**Common Name**	**Status[1]**	**Observed Using the Study Area[2]**

Source: Godfrey 1986; Manitoba Naturalists Society 2003
[1] B = breeding, M = migrant; P = permanent resident; N = northern extent of range; W = winter range; I = introduced;
? = appropriate habitat uncertain
[2] Bird Surveys from 2001 to 2013

Table C-3: Presence of Bird Species in Keeyask Infrastructure Project Regional Study Area - 2013

Species	Vegetation Community Type											Grand Total (n=80)
	Black Spruce Dominated (n=29)		Jack Pine Dominated (n=12)			Regenerating Forest (n=16)					Low Vegetation (n=23)	
	BS Mix-ture (n=1)	BS Pure (n=28)	JP Mixed-wood (n=3)	JP Mix-ture (n=7)	JP Pure (n=2)	JP Mixed-wood/ Tall Shrub (n=4)	JP Mixture/ Tall Shrub (n=2)	JP Pure/Tall Shrub (n=1)	TA Mixed-wood/ Tall Shrub (n=3)	Tall Shrub (n=6)		
Alder Flycatcher		2		1			1		2	3	10	19
American Robin		4								2	2	8
Blackpoll Warbler		3				2			1	3	3	12
Blue-headed Vireo				3		1						4
Boreal Chickadee		1										1
Chipping Sparrow		2				1						3
Common Nighthawk							2					2
Dark-eyed Junco		17		1							1	19
Fox Sparrow		6		1				1	2	2	4	16
Gray Jay		4		2							2	8
Hermit Thrush		4		2		4	1	1	3		7	22
Least Flycatcher		1	1	2		1	1				1	7
Lincoln's Sparrow		2						1		2	4	9
Magnolia Warbler											1	1
Northern Flicker		1		1								2
Northern Waterthrush		3								4	1	8
Olive-sided Flycatcher		3								1	2	6
Orange-crowned Warbler		1	1	4	1				2		12	21

Table C-3: Presence of Bird Species in Keeyask Infrastructure Project Regional Study Area - 2013

Species	Vegetation Community Type											Grand Total (n=80)
	Black Spruce Dominated (n=29)		Jack Pine Dominated (n=12)			Regenerating Forest (n=16)					Low Vegetation (n=23)	
	BS Mix-ture (n=1)	BS Pure (n=28)	JP Mixed-wood (n=3)	JP Mix-ture (n=7)	JP Pure (n=2)	JP Mixed-wood/ Tall Shrub (n=4)	JP Mixture/ Tall Shrub (n=2)	JP Pure/Tall Shrub (n=1)	TA Mixed-wood/ Tall Shrub (n=3)	Tall Shrub (n=6)		
Palm Warbler		4		1					1	1	7	14
Red Crossbill		1										1
Red-winged Blackbird											1	1
Ruby-crowned Kinglet	1	11		1						2	3	18
Rusty Blackbird	1	5								1	3	10
Swainson's Thrush		2	2	1								5
Swamp Sparrow		2					1		2		12	17
Tennessee Warbler		13	3	4					1	2	5	28
Tree Swallow											2	2
White-crowned Sparrow											1	1
White-throated Sparrow		2		2		1	2	1	4	5	16	33
Wilson's Warbler						1					2	3
Woodpecker sp.							1					1
Yellow Warbler				1							1	2
Yellow-bellied Flycatcher		2					1			1	1	5
Yellow-rumped Warbler		8		2	1	1			3	3	6	24

Table C-3: Presence of Bird Species in Keeyask Infrastructure Project Regional Study Area - 2013												
Species	**Vegetation Community Type**											**Grand Total (n=80)**
	Black Spruce Dominated (n=29)		**Jack Pine Dominated (n=12)**			**Regenerating Forest (n=16)**					**Low Vegetation (n=23)**	
	BS Mix-ture (n=1)	**BS Pure (n=28)**	**JP Mixed-wood (n=3)**	**JP Mix-ture (n=7)**	**JP Pure (n=2)**	**JP Mixed-wood/ Tall Shrub (n=4)**	**JP Mixture/ Tall Shrub (n=2)**	**JP Pure/Tall Shrub (n=1)**	**TA Mixed-wood/ Tall Shrub (n=3)**	**Tall Shrub (n=6)**		
Total Number of Birds	**2**	**104**	**7**	**29**	**2**	**12**	**10**	**4**	**21**	**32**	**110**	**333**
Average Density (per hectare)	**1.13**	**2.10± 1.15**	**1.31± 32**	**2.05± 1.65**	**1.13**	**1.69±0.46**	**2.82±0.80**	**2.26**	**3.95±1.49**	**3.01± 1.32**	**2.70± 1.36**	**2.32± 1.32**
Average Diversity (per stop)	**2**	**3.64± 2.04**	**2.33+ 0.58**	**3.63± 2.92**	**2**	**3.00±0.82**	**4.50±0.71**	**4**	**7.00±2.64**	**5.33± 2.34**	**4.78± 2.41**	**4.13± 2.31**
Number of Species	**2**	**20**	**4**	**14**	**2**	**5**	**7**	**4**	**8**	**11**	**23**	**28**

Table C-4: Comparison of Density and Diversity Among Study Areas and Study Years				
Study Area	**Year**	**Sample Size**	**Overall Bird Density (Birds/ha)**	**Overall Bird Diversity (Species/ stop)**
KIP (Access road)	2013	80	2.3 ± 1.3	4.1 ± 2.3
KIP (Access road)	2012	81	4.6 ± 2.1	8.2 ± 3.7
KIP (Access road)	2011	79	2.1 ± 1.3	3.5 ± 2.0
Gull Lake	2007	65	4.9 ± 3.2	6.2 ± 2.1
North Arm Stephens Lake	2007	61	3.7 ± 2.7	5.0 ± 2.0
Keeyask South Access Road	2006	69	6.3 ± 1.8	8.0 ± 1.7
KIP (Access road)	2005	73	2.1 ± 2.2	3.3 ± 1.8
Keeyask South Access Road	2005	62	5.8 ± 3.5	8.1 ± 2.5
KIP (Access road)	2004	58	3.2 ± 1.4	4.5 ± 1.8
Wuskwatim Access Road	2002	66	3.6 ± 1.8	3.6 ± 1.9
North Arm Stephens Lake	2006	49	3.7 ± 1.0	5.6 ± 1.6
Keeyask GS*	2003	337	4.9 ± 2.0	6.6 ± 2.6
Keeyask GS*	2002	226	5.8 ± 2.3	7.0 ± 2.4
Wuskwatim GS*	2002	236	4.7 ± 2.1	4.5 ± 2.7

NOTE:

* Data for all transects sampled, which were primarily within riparian areas.

Source: Tetr*ES* 2004a, Tetr*ES* 2004b, Tetr*ES* 2005

Table C-5: Species' Densities by Vegetation Community Type in the Regional Study Area LSA vs RSA Sites				
Species	**LSA Sites (n=37)**		**RSA Sites (n=43)**	
	Average Density	**STDEV**	**Average Density**	**STDEV**
Alder Flycatcher	0.21	0.34	0.06	0.22
American Robin	0.03	0.13	0.08	0.20
Blackpoll Warbler	0.11	0.26	0.06	0.18
Blue-headed Vireo	0.03	0.13	0.03	0.12
Boreal Chickadee	0.02	0.09	-	-
Chipping Sparrow	0.02	0.09	0.03	0.12
Common Nighthawk	0.03	0.19	-	-
Dark-eyed Junco	0.03	0.13	0.22	0.37
Fox Sparrow	0.08	0.20	0.14	0.25
Gray Jay	0.08	0.24	0.04	0.14
Hermit Thrush	0.24	0.34	0.08	0.20
Least Flycatcher	0.09	0.21	0.01	0.09
Lincoln's Sparrow	0.06	0.18	0.06	0.18
Magnolia Warbler	0.02	0.09	-	-
Northern Flicker	0.03	0.13	-	-
Northern Waterthrush	0.03	0.13	0.08	0.23
Olive-sided Flycatcher	0.06	0.18	0.03	0.12
Orange-crowned Warbler	0.23	0.34	0.08	0.20
Palm Warbler	0.15	0.32	0.05	0.16
Red Crossbill	-	-	0.01	0.09
Red-winged Blackbird	-	-	0.01	0.09
Ruby-crowned Kinglet	0.05	0.16	0.19	0.30
Rusty Blackbird	0.03	0.13	0.10	0.31
Swainson's Thrush	0.06	0.22	0.01	0.09

Table C-5: Species' Densities by Vegetation Community Type in the Regional Study Area LSA vs RSA Sites				
Species	**LSA Sites (n=37)**		**RSA Sites (n=43)**	
	Average Density	**STDEV**	**Average Density**	**STDEV**
Swamp Sparrow	0.14	0.28	0.10	0.25
Tennessee Warbler	0.20	0.33	0.19	0.32
Tree Swallow	0.03	0.19	-	-
White-crowned Sparrow	-	-	0.01	0.09
White-throated Sparrow	0.37	0.40	0.12	0.23
Wilson's Warbler	0.05	0.21	-	-
Woodpecker sp.	0.02	0.09	-	-
Yellow Warbler	0.02	0.09	0.01	0.09
Yellow-bellied Flycatcher	0.05	0.16	0.03	0.12
Yellow-rumped Warbler	0.09	0.25	0.23	0.46

APPENDIX D
DENSITY AND RICHNESS ANALYSES

Introduction

All analyses were completed using R 3.0.1. The analytical functions used are identified in the text the first time that they are mentioned, in italics and followed by parentheses, e.g.: *example()*. All figures were constructed using the *ggplot()* function in the ggplot2 package.

Data Summaries

Breeding bird surveys were completed at 80 stops (replicates). These stops are categorized by habitat type and distance from the road right of way. There were 10 habitat types. Sample sizes in some of the habitat types were small, so the habitat types were combined into four habitat groups: Black Spruce, Jack Pine, Regenerating, and Low Vegetation. The distance from each stop to the disturbed area was categorized as less than 200 m, 201 m to 1000 m, and greater than 1000 m. The distances were also grouped into 'treatment' categories of Affected (generally less than 1000 m from the disturbance) and Control (generally greater than 1000 m from the disturbance).

Simple summaries of the data follow, generated using the *ddply()* function in the plyr package:

```
   HabitatGroup  n dens_avg  dens_sd rich_avg  rich_sd
1   BlackSpruce 29 2.065069 1.142743 3.586207 2.026913
2      JackPine 12 1.789077 1.380393 3.166667 2.443296
3 LowVegetation 23 2.702039 1.362300 4.782609 2.411271
4  Regenerating 16 2.789548 1.262789 4.875000 2.217356
  Distance.to.Disturbance  n dens_avg   dens_sd rich_avg  rich_sd
1           201m to 1000m 25 3.050847 1.6390673 5.360000 2.899425
2      Greater than 1000m 41 2.066970 1.0154552 3.609756 1.801084
3              Up to 200m 14 1.937046 0.9059703 3.428571 1.603567
  Treatment  n dens_avg  dens_sd rich_avg  rich_sd
1  Affected 37 2.626355 1.542741 4.621622 2.721839
2   Control 43 2.115359 1.017345 3.697674 1.806534
```

Passerine Density

Passerine Density by Habitat Group

A linear model (ANOVA) was constructed to examine how density varied with habitat group, using the *lm()* function. See the following summary (*summary()*)and ANOVA (*anova()*) tables.

```
Call:
lm(formula = density ~ HabitatGroup, data = data)
Residuals:
    Min      1Q  Median      3Q     Max
```

```
-2.2246 -0.9351 -0.2322  0.6878  4.6426
Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)                 2.0651     0.2355   8.767 3.72e-13 ***
HabitatGroupJackPine       -0.2760     0.4354  -0.634   0.5280
HabitatGroupLowVegetation   0.6370     0.3542   1.799   0.0761 .
HabitatGroupRegenerating    0.7245     0.3950   1.834   0.0706 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 1.268 on 76 degrees of freedom
Multiple R-squared:  0.08985, Adjusted R-squared:  0.05393
F-statistic: 2.501 on 3 and 76 DF,  p-value: 0.06573
Analysis of Variance Table
Response: density
             Df  Sum Sq Mean Sq F value  Pr(>F)
HabitatGroup  3  12.071  4.0238   2.501 0.06573 .
Residuals    76 122.273  1.6089
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The model residuals had similar variances, based on a visual examination of the residuals versus fitted values plot. The model residuals were not normally distributed based on a Shapiro-Wilk Normality test (*shapiro.test()*).

```
Shapiro-Wilk normality test
data:  resid(dens_hab)
W = 0.9083, p-value = 2.784e-05
```

To address the non-normal model residuals the analysis was run using logged (*log10()*) response variable (density). See the following summary and ANOVA tables.

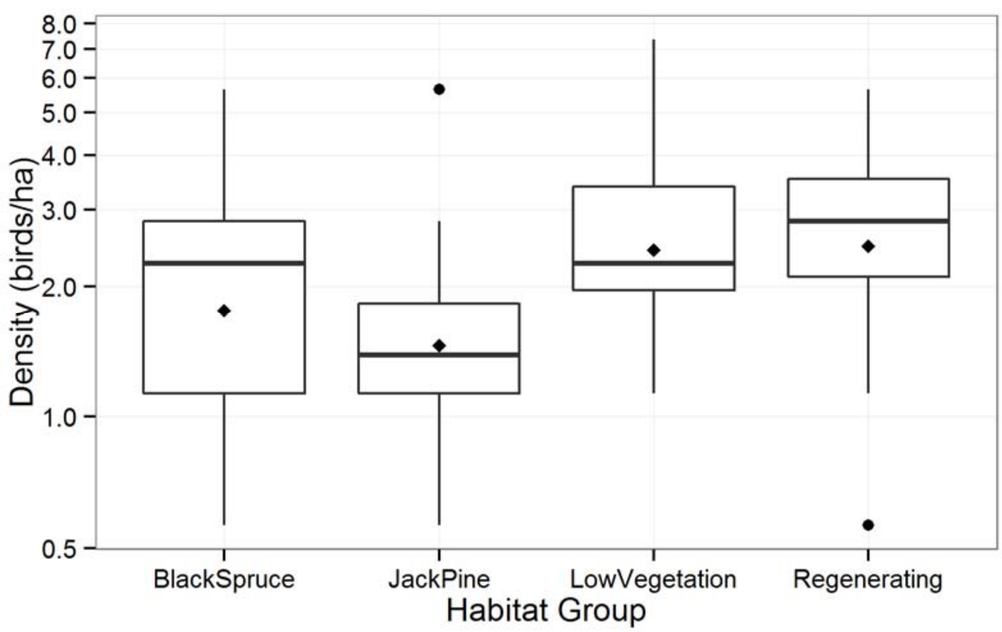
```
Call:
lm(formula = log10(density) ~ HabitatGroup, data = data)
Residuals:
     Min       1Q   Median       3Q      Max
-0.64062 -0.15526  0.02114  0.14577  0.58862
Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)                0.24521    0.04595   5.336 9.49e-07 ***
HabitatGroupJackPine      -0.08181    0.08494  -0.963   0.3385
HabitatGroupLowVegetation  0.13919    0.06910   2.014   0.0475 *
HabitatGroupRegenerating   0.14743    0.07707   1.913   0.0595 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.2475 on 76 degrees of freedom
Multiple R-squared:  0.1162,  Adjusted R-squared:  0.08127
F-statistic: 3.329 on 3 and 76 DF,  p-value: 0.02393
Analysis of Variance Table
Response: log10(density)
             Df Sum Sq  Mean Sq F value  Pr(>F)
HabitatGroup  3 0.6117 0.203894  3.3293 0.02393 *
Residuals    76 4.6544 0.061242
```

The model residuals had similar variances between groups based on a visual examination of the residuals vs. fitted plot. The model residuals were normally distributed based on a Shapiro-Wilk Normality test.

```
Shapiro-Wilk normality test
data:  resid(dens_hab_log)
W = 0.9713, p-value = 0.06896
```

A Tukey Honest Significant Differences (HSD) test (*TukeyHSD()*) revealed that the significant difference is driven by the difference between the Jack Pine habitat group (lower density) and the Low Vegetation and Regenerating habitat groups (higher densities).

```
  Tukey multiple comparisons of means
    95% family-wise confidence level
    factor levels have been ordered
Fit: aov(formula = log10(density) ~ HabitatGroup, data = data)
$HabitatGroup
                                   diff         lwr       upr     p adj
BlackSpruce-JackPine        0.081812019 -0.14131625 0.3049403 0.7706821
LowVegetation-JackPine      0.221006436 -0.01048332 0.4524962 0.0667070
Regenerating-JackPine       0.229246299 -0.01899881 0.4774914 0.0807925
LowVegetation-BlackSpruce   0.139194418 -0.04231161 0.3207004 0.1917650
Regenerating-BlackSpruce    0.147434281 -0.05500723 0.3498758 0.2312583
Regenerating-LowVegetation  0.008239863 -0.20338207 0.2198618 0.9996135
```



Passerine Density by Distance from Disturbance

The same iterative methodology used for the previous analysis was used to assess passerine density by distance from disturbance. The data was log-transformed because the untransformed model residuals were not normally distributed. The transformation actually made the residuals' normality worse, but did make the residuals' variances more equal between groups. The sample sizes in the three groups are different, which could be affecting the variance of the residuals. Finally, I ran a Kruskal-Wallis Rank Sum test as an additional approach to examining the data.

ANOVAs are more sensitive to problems with residual variances than problems with normality. For this reason, model results presented below are based on transformed data, despite its normality problem.

```
Call:
lm(formula = log10(density) ~ Distance.to.Disturbance, data = data)
Residuals:
    Min      1Q  Median      3Q     Max
-0.4971 -0.1952  0.1049  0.1281  0.4416
Coefficients:
                                          Estimate Std. Error t value
Pr(>|t|)
(Intercept)                                0.42433    0.04954   8.565 8.29e-
13 ***
Distance.to.DisturbanceGreater than 1000m -0.17515    0.06286  -2.786
0.00671 **
Distance.to.DisturbanceUp to 200m         -0.18351    0.08269  -2.219
0.02942 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.2477 on 77 degrees of freedom
Multiple R-squared:  0.1027,   Adjusted R-squared:  0.07941
F-statistic: 4.407 on 2 and 77 DF,  p-value: 0.01541
Analysis of Variance Table
Response: log10(density)
                        Df Sum Sq  Mean Sq F value  Pr(>F)
Distance.to.Disturbance  2 0.5409 0.270444   4.407 0.01541 *
Residuals               77 4.7252 0.061366
Shapiro-Wilk normality test
data:  resid(dens_dist_log)
W = 0.9331, p-value = 0.0004204
```

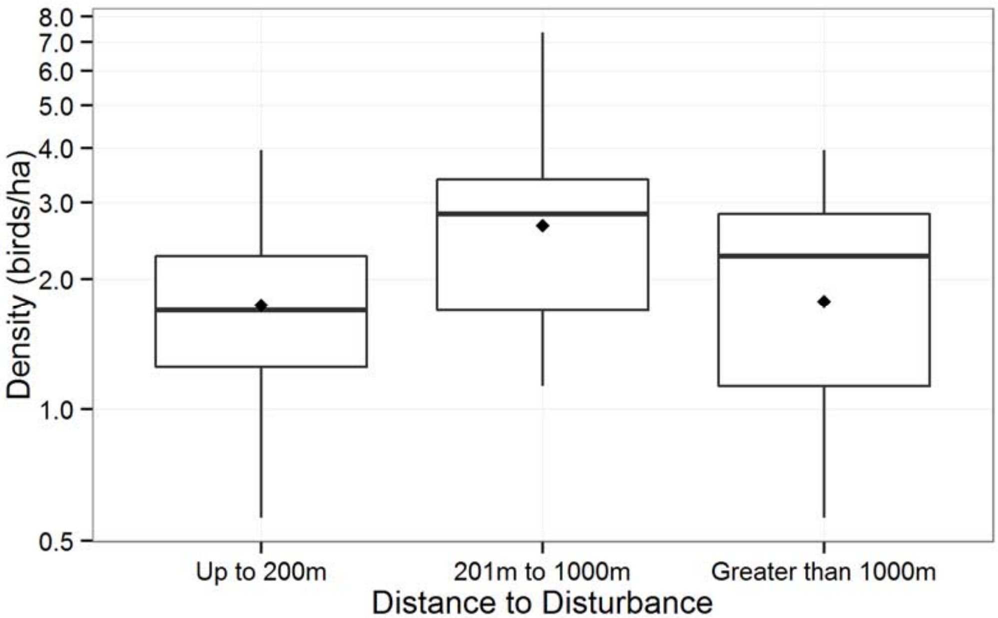
Using logged density data there is a significant difference between distance to disturbance categories. The linear model residual variances were approximately equal between groups, based on a visual examination of the residuals vs. fitted plot. The Kruskal-Wallis Rank Sum test (*kruskal.test()*) also found a significant difference between distance to disturbance categories.

```
Kruskal-Wallis rank sum test
data:  density by Distance.to.Disturbance
Kruskal-Wallis chi-squared = 7.3068, df = 2, p-value = 0.0259
```

The difference between distance to disturbance categories was driven by the difference between the 201 to 1000 m category (higher) and the other two categories (lower), based on the Tukey's Honest Significant Differences test.

```
  Tukey multiple comparisons of means
```

```
    95% family-wise confidence level
    factor levels have been ordered
Fit: aov(formula = log10(density) ~ Distance.to.Disturbance, data = data)
$Distance.to.Disturbance
                                        diff         lwr       upr     p adj
Greater than 1000m-Up to 200m    0.008360038 -0.17489819 0.1916183 0.9934691
201m to 1000m-Up to 200m         0.183509723 -0.01411277 0.3811322 0.0742757
201m to 1000m-Greater than 1000m 0.175149685  0.02492264 0.3253767 0.0182110
```



Passerine Density by Treatment

As for the previous two analyses, the linear model based on log transformed data met the model assumptions (equal residual variances between groups, normally distributed residuals) better than the model based on untransformed data.

```
Call:
lm(formula = log10(density) ~ Treatment, data = data)
Residuals:
     Min       1Q   Median       3Q      Max
-0.59928 -0.20735  0.09368  0.19059  0.51466
Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)       0.35131    0.04204   8.356 1.92e-12 ***
TreatmentControl -0.09090    0.05735  -1.585    0.117
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.2557 on 78 degrees of freedom
Multiple R-squared:  0.03121, Adjusted R-squared:  0.01879
F-statistic: 2.513 on 1 and 78 DF,  p-value: 0.117
Analysis of Variance Table
Response: log10(density)
          Df Sum Sq  Mean Sq F value Pr(>F)
Treatment  1 0.1643 0.164339  2.5126  0.117
```

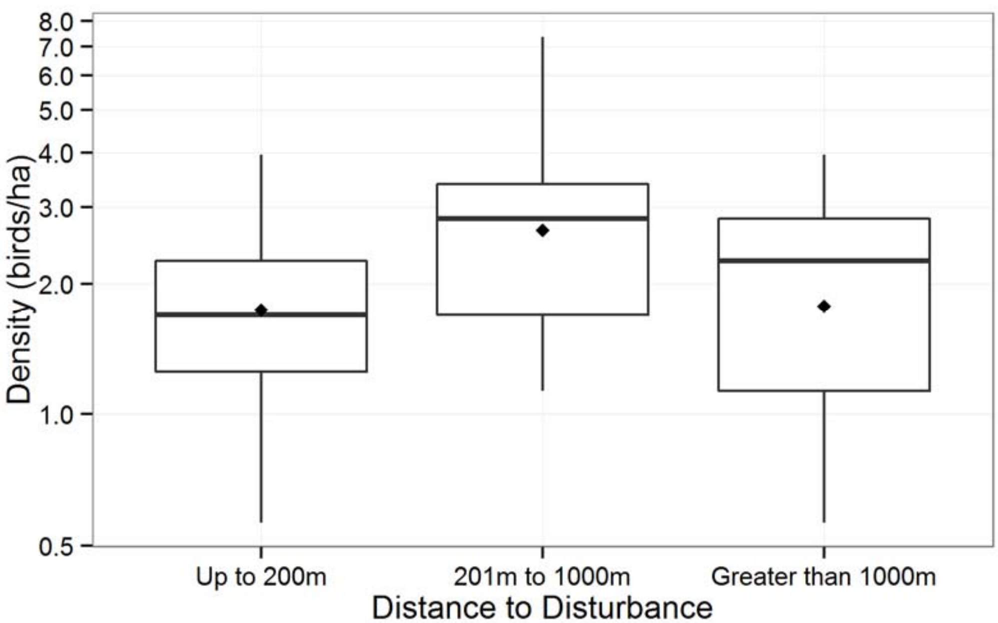
```
Residuals 78 5.1018 0.065407
```

The model showed no significant treatment (affected versus control) effect. Residual variances were approximately equal between groups based on a visual examination of the residuals vs. fitted plot. The model residuals were not normally distributed based on a Shapiro-Wilk Normality test.

```
Shapiro-Wilk normality test
data:  resid(dens_tr_log)
W = 0.959, p-value = 0.01175
```

The non-parameteric Wilcoxon Rank Sum test (also known as the Mann-Whitney test, w*ilcox.test()*) also did not find a significant difference between treatment types.

```
        Wilcoxon rank sum test with continuity correction
data:  log10(density) by Treatment
W = 907.5, p-value = 0.276
```



The treatment categories had no significant effect on passerine density.

Passerine Density by Habitat and Distance

A linear model was developed to examine the effects of habitat group and distance together (two-factor ANOVA with an interaction term) on passerine density. Data was log-transformed. See the model ANOVA table below.

```
Analysis of Variance Table
Response: log10(density)
                                     Df Sum Sq  Mean Sq F value  Pr(>F)
```

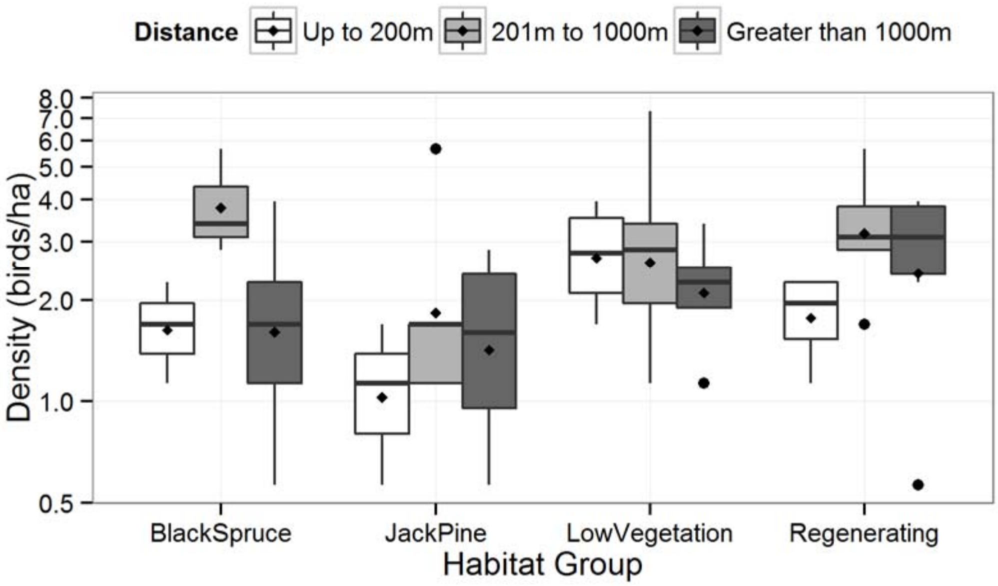
```
HabitatGroup                             3 0.6117 0.203894  3.5002 0.02002 *
Distance.to.Disturbance                  2 0.4068 0.203408  3.4919 0.03601 *
HabitatGroup:Distance.to.Disturbance  6 0.2865 0.047748  0.8197 0.55853
Residuals                               68 3.9611 0.058252
```

The results indicate that Habitat Group and Distance to Disturbance both have significant effects, and that there is no interaction between these two factors.

```
    HabitatGroup Distance.to.Disturbance  n dens_avg   dens_sd rich_avg
rich_sd
1    BlackSpruce            Up to 200m  3 1.694915 0.5649718 3.000000
1.0000000
2    BlackSpruce         201m to 1000m  3 3.954802 1.4947748 7.000000
2.6457513
3    BlackSpruce     Greater than 1000m 23 1.866863 0.9397568 3.217391
1.6502485
4       JackPine            Up to 200m  3 1.129944 0.5649718 2.000000
1.0000000
5       JackPine         201m to 1000m  5 2.259887 1.9159124 4.000000
3.3911650
6       JackPine     Greater than 1000m  4 1.694915 1.0314926 3.000000
1.8257419
7  LowVegetation            Up to 200m  4 2.824859 1.0314926 5.000000
1.8257419
8  LowVegetation         201m to 1000m 11 2.978942 1.7338450 5.272727
3.0689056
9  LowVegetation     Greater than 1000m  8 2.259887 0.8541570 4.000000
1.5118579
10  Regenerating            Up to 200m  4 1.836158 0.5409193 3.250000
0.9574271
11  Regenerating         201m to 1000m  6 3.389831 1.3369672 5.833333
2.4013885
12  Regenerating     Greater than 1000m  6 2.824859 1.2883338 5.000000
2.2803509
```

There did not appear to be a correlation between the residual variance in any given group and the groups' means, based on a visual examination of the residuals vs. fitted plot. The model residuals were normally distributed.

```
Shapiro-Wilk normality test
data:  resid(dens_hab_dist_log)
W = 0.9733, p-value = 0.09169
```



Passerine Richness

Passerine Richness by Habitat Group

As for the density analyses, a linear model (ANOVA) was built to compare richness between habitat groups using untransformed data. The model residuals were not normally distributed, so the richness data was log-transformed. The transformed data model met the assumptions of ANOVA, which indicates that habitat group has a significant effect on species richness.

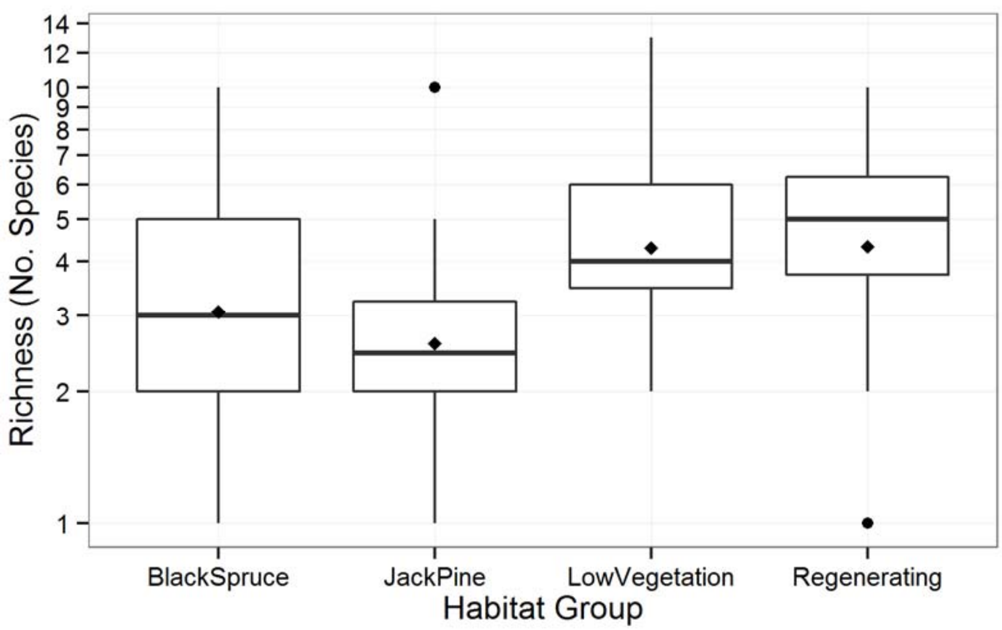
```
Call:
lm(formula = log10(richness) ~ HabitatGroup, data = data)
Residuals:
     Min       1Q   Median       3Q      Max
-0.63567 -0.15526 -0.00745  0.14577  0.58862
Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)                0.48457    0.04575  10.592   <2e-16 ***
HabitatGroupJackPine      -0.07320    0.08457  -0.866   0.3895
HabitatGroupLowVegetation  0.14781    0.06879   2.149   0.0348 *
HabitatGroupRegenerating   0.15110    0.07673   1.969   0.0526 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.2464 on 76 degrees of freedom
Multiple R-squared:  0.1197,   Adjusted R-squared:  0.08494
F-statistic: 3.444 on 3 and 76 DF,  p-value: 0.02081
Analysis of Variance Table
Response: log10(richness)
             Df Sum Sq Mean Sq F value  Pr(>F)
HabitatGroup  3 0.6272 0.20906  3.4442 0.02081 *
Residuals    76 4.6132 0.06070
```

The model residuals had similar variances, based on a visual examination of the residuals versus fitted values plot. The model residuals were normally distributed based on a Shapiro-Wilk Normality test.

```
       Shapiro-Wilk normality test
data:  resid(rich_hab_log)
W = 0.974, p-value = 0.1029
```

A Tukey HSD test revealed that the significant difference between habitat groups was driven by the difference between the Jack Pine habitat group (lower richness) and the Low Vegetation and Regenerating habitat groups (higher richnesses).

```
  Tukey multiple comparisons of means
    95% family-wise confidence level
    factor levels have been ordered
Fit: aov(formula = log10(richness) ~ HabitatGroup, data = data)
$HabitatGroup
                                  diff          lwr       upr     p adj
BlackSpruce-JackPine       0.073195554 -0.148941906 0.2953330 0.8225472
LowVegetation-JackPine     0.221006436 -0.009455378 0.4514683 0.0649575
Regenerating-JackPine      0.224297471 -0.022845291 0.4714402 0.0888586
LowVegetation-BlackSpruce  0.147810882 -0.032889158 0.3285109 0.1472703
Regenerating-BlackSpruce   0.151101918 -0.050440638 0.3526445 0.2086830
Regenerating-LowVegetation 0.003291035 -0.207391186 0.2139733 0.9999750
```



Passerine Richness by Distance from Disturbance

A model was initially developed using untransformed data. The untransformed model variances were not equal between groups based on visual examination of the residuals vs. fitted plot, and the model residuals were not normally distributed. Logging the richness variable improved the variances but made the residuals' normality worse. Because the homogeneity of variances is a more critical assumption of ANOVA than normality (Quinn and Keough, 2002), the summary and ANOVA tables for the logged model are presented below.

```
Call:
lm(formula = log10(richness) ~ Distance.to.Disturbance, data = data)
Residuals:
     Min       1Q   Median       3Q      Max
-0.49106 -0.19003  0.02984  0.12894  0.44481
Coefficients:
                                          Estimate Std. Error t value
Pr(>|t|)
(Intercept)                               0.488790   0.065972   7.409 1.38e-
10 ***
Distance.to.Disturbance201m to 1000m      0.180342   0.082399   2.189
0.0317 *
Distance.to.DisturbanceGreater than 1000m 0.002265   0.076409   0.030
0.9764
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.2468 on 77 degrees of freedom
Multiple R-squared:  0.1047,  Adjusted R-squared:  0.08144
F-statistic: 4.502 on 2 and 77 DF,  p-value: 0.01416
Analysis of Variance Table
Response: log10(richness)
                        Df Sum Sq  Mean Sq F value  Pr(>F)
Distance.to.Disturbance  2 0.5486 0.274315   4.502 0.01416 *
Residuals               77 4.6917 0.060932
Shapiro-Wilk normality test
data:  resid(rich_dist_log)
W = 0.9396, p-value = 0.0009128
```

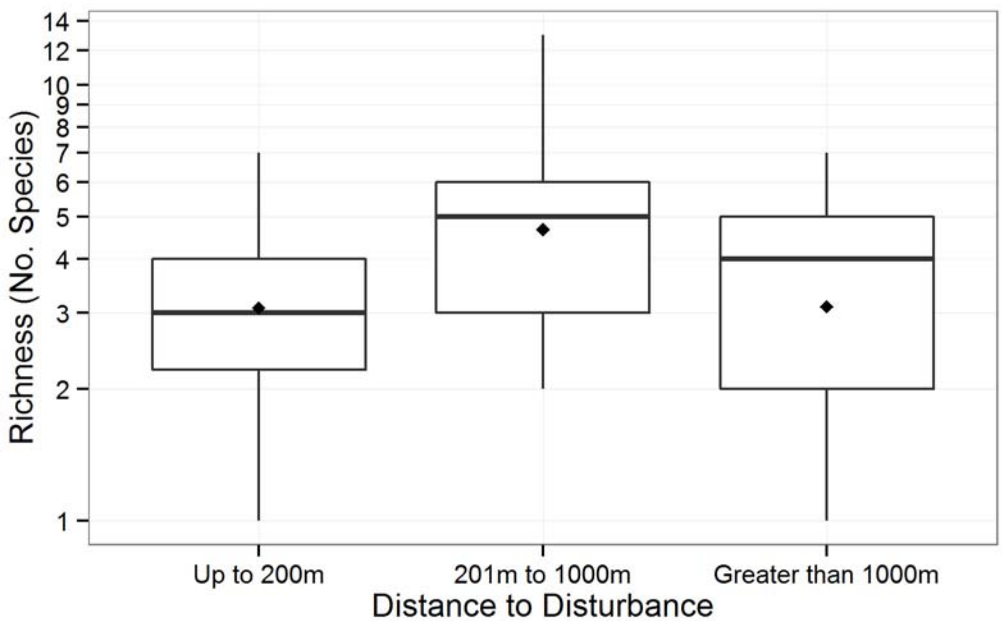
Using logged richness data there is a significant difference between distance to disturbance categories. The linear model residual variances were approximately equal between groups, based on a visual examination of the residuals vs. fitted plot. Because the ANOVA assumptions were not all met I also ran a Kruskal-Wallis Rank Sum test, which also found a significant difference between distance to disturbance categories.

```
Kruskal-Wallis rank sum test
data:  richness by Distance.to.Disturbance
Kruskal-Wallis chi-squared = 7.2513, df = 2, p-value = 0.02663
```

The difference between distance to disturbance categories was driven by the difference between the 201 to 1000 m category (higher richness) and the other two categories (lower), based on the Tukey's HSD test.

```
  Tukey multiple comparisons of means
    95% family-wise confidence level
    factor levels have been ordered
Fit: aov(formula = log10(richness) ~ Distance.to.Disturbance, data = data)
$Distance.to.Disturbance
                                        diff         lwr        upr     p adj
```

```
Greater than 1000m-Up to 200m    0.002265465 -0.18034245 0.1848734 0.9995155
201m to 1000m-Up to 200m         0.180342473 -0.01657873 0.3772637 0.0795194
201m to 1000m-Greater than 1000m 0.178077008  0.02838306 0.3277710 0.0156092
```



Passerine Richness by Treatment

As for the previous richness analyses, the linear model based on log transformed data met the assumptions of ANOVA better than the model based on untransformed data.

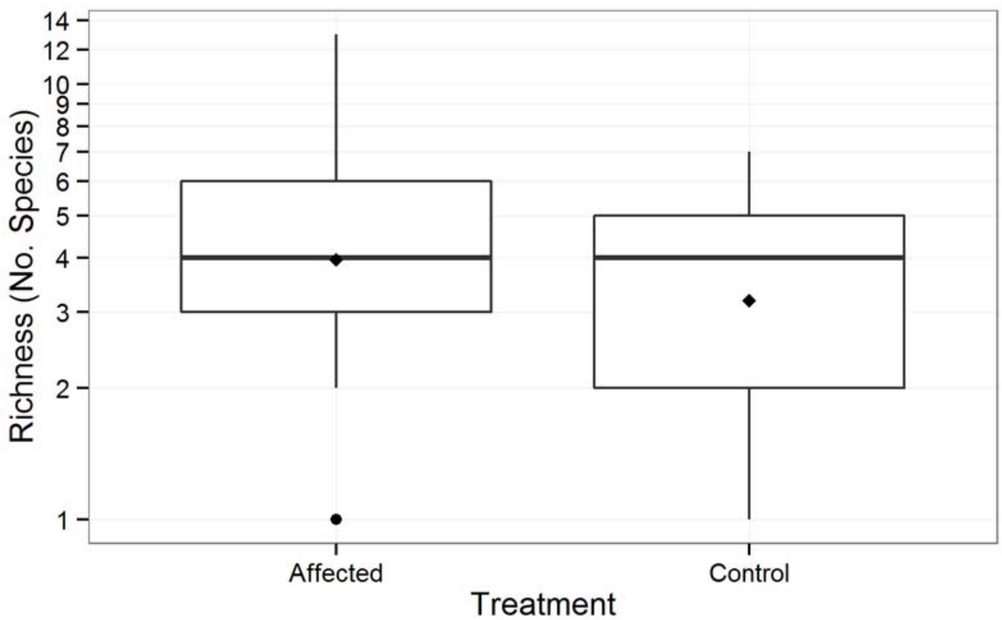
```
Call:
lm(formula = log10(richness) ~ Treatment, data = data)
Residuals:
     Min       1Q   Median       3Q      Max
-0.59714 -0.20154  0.00492  0.19640  0.51680
Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)       0.59714    0.04188  14.258   <2e-16 ***
TreatmentControl -0.09457    0.05713  -1.656    0.102
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.2548 on 78 degrees of freedom
Multiple R-squared:  0.03394, Adjusted R-squared:  0.02156
F-statistic: 2.741 on 1 and 78 DF,  p-value: 0.1018
Analysis of Variance Table
Response: log10(richness)
          Df Sum Sq  Mean Sq F value Pr(>F)
Treatment  1 0.1779 0.177881  2.7407 0.1018
Residuals 78 5.0625 0.064904
```

The model did not show a significant difference between treatments (affected versus control). Residual variances were approximately equal between groups based on a visual examination of the residuals vs. fitted plot. The model residuals were not normally distributed based on a Shapiro-Wilk Normality test.

```
        Shapiro-Wilk normality test
data:  resid(rich_tr_log)
W = 0.964, p-value = 0.02374
```

The non-parametric Wilcoxon Rank Sum test also found no significant difference in richness between treatment types.

```
        Wilcoxon rank sum test with continuity correction
data:  log10(richness) by Treatment
W = 916, p-value = 0.2414
```



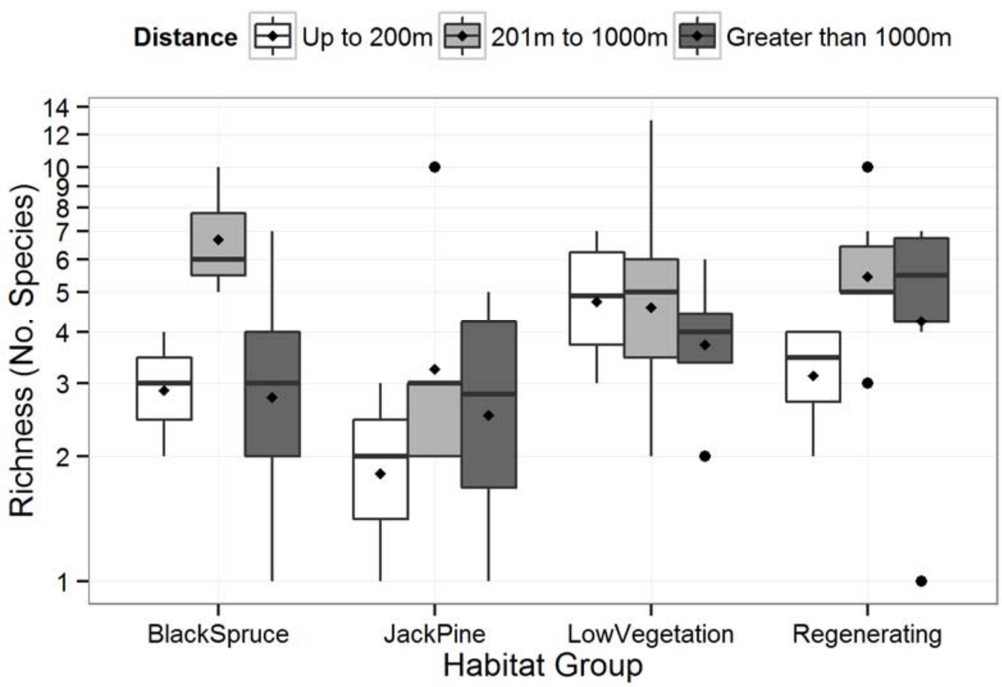
Passerine Richness by Habitat and Distance

A linear model (two-factor ANOVA with an interaction term) was developed to examine the effects of habitat group and distance together on passerine richness. See the model ANOVA table below.

```
Analysis of Variance Table
Response: log10(richness)
                                     Df Sum Sq  Mean Sq F value  Pr(>F)
HabitatGroup                          3 0.6272 0.209064  3.6299 0.01714 *
Distance.to.Disturbance               2 0.3981 0.199046  3.4560 0.03720 *
HabitatGroup:Distance.to.Disturbance  6 0.2987 0.049778  0.8643 0.52571
Residuals                            68 3.9164 0.057594
```

The model showed significant Habitat Group and Distance to Disturbance effects on passerine richness, and no interaction between habitat and distance. The model residuals had roughly equal variances between groups based on a visual examination of the residuals vs. fitted plot. The model residuals were normally distributed based on a Shapiro-Wilk Normality test.

```
        Shapiro-Wilk normality test
data:  resid(rich_hab_dist_log)
W = 0.9775, p-value = 0.1708
```



References

Quinn, G.P., M.J. Keough. 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press. Cambridge, UK.

APPENDIX E
RECORDING UNIT DATA

Table E1: Recording Unit Data							
Date Monitoring Began	**Target Species/ Habitat**	**Easting**	**Northing**	**Common Nighthawk**	**Yellow Rail**	**Olive-sided Flycatcher**	**Rusty Blackbird**
28-Jun-13	Common nighthawk habitat	353519	6254092	2			
27-Jun-13	Common nighthawk & olive-sided flycatcher habitat	359016	6249715	1 (foraging)			
27-Jun-13	Common nighthawk & olive-sided flycatcher habitat	359016	6249715	1 (foraging)			
23-Jun-13	Common nighthawk & rusty blackbird habitat	348940	6258679	1 (foraging)			2
27-Jun-13	Common nighthawk & rusty blackbird habitat	355303	6250650			1	
27-Jun-13	Common nighthawk & rusty blackbird habitat	360056	6252168				
23-Jun-13	Rusty blackbird & olive-sided flycatcher habitat	350220	6262059	1		1	
23-Jun-13	Rusty blackbird & olive-sided flycatcher habitat	344925	6250534	1			1
28-Jun-13	Yellow rail & rusty blackbird habitat	344755	6254070	2			
27-Jun-13	Yellow rail, rusty blackbird & olive-sided flycatcher habitat	351965	6254326			1	

APPENDIX F
OTHER WILDLIFE DATA

Table F-1: Other Wildlife Observations During 2013 Bird Surveys			
Date	**Easting**	**Northing**	**Wildlife Observed**
16-Apr-13	389838	6245447	Spruce grouse (1)
26-Jun -13	349647	6254445	Rusty blackbird (family of 4)
27-Jun-13	356567	6252187	Common nighthawk (1)
27-Jun-13	352750	6253269	Boreal Chorus Frog (calling in distance)

APPENDIX G
WEATHER CONDITIONS

Table G-1: Weather Observations During 2013 Bird Surveys		
Date	**Survey Type**	**Weather Range During Survey Period**
14-Apr-13	Nocturnal Owl	-5°c; 30 km/hr west wind; 20% cloud cover
15-Apr-13	Nocturnal Owl	-10°c; 20 km/hr north wind; 10% cloud cover
16-Apr-13	Nocturnal Owl	-6°c; 10-15 km/hr northeasterly wind; 40% cloud cover
17-Apr-13	Nocturnal Owl	-5; 30 km/hr westerly wind; 60% cloud cover
18-Jun-13	Breeding Bird	6°c; calm; clear
22-Jun-13	Breeding Bird	15°c; calm; clear
26-Jun-13	Breeding Bird	5-20°c; calm-30 km/hr northwesterly winds by mid-morning; 100% cloud cover
27-Jun-13	Breeding Bird	10-15°c; calm-30km/hr west winds by mid-morning; 15% cloud cover
28-Jun-13	Breeding Bird	10-20°c; calm - 10 km/hr northwesterly wind; 10 - 30% cloud cover
29-Jun-13	Breeding Bird	16 - 18°c; calm - 10 km/hr northwesterly wind; 20% cloud cover
30-Jun-13	Breeding Bird	9°c; 10 km/hr northeasterly wind; 40% cloud cover