Keeyask Infrastructure Project

Terrestrial and Aquatic Monitoring Plan

Avian Monitoring

Annual Report 2014-2015

Keeyask Hydropower Limited Partnership

December 2015

KEEYASK INFRASTRUCTURE PROJECT

TERRESTRIAL AND AQUATIC MONITORING PLAN

Avian Monitoring: Annual Report 2014- 2015

Report for

MANITOBA CONSERVATION AND WATER STEWARDSHIP

Prepared on Behalf of the
Keeyask Hydropower Limited Partnership

By
Stantec Consultants Inc.

December 2015

EXECUTIVE SUMMARY

The Keeyask Hydropower Limited Partnership constructed the Keeyask Infrastructure Project (the Project or KIP) between 2012 to July 2014, after which construction of the Keeyask Generation Project began.

The KIP is located approximately 40 km southwest of Gillam, extending between Provincial Road (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. The start-up camp is located near the intersection of PR 280 and the access road, while the first phase of the main camp is located at the end of the access road on the north side of Gull Rapids.

This report summarizes results from three years (2012 to 2014) of construction-related bird monitoring for the Keeyask Infrastructure Project (KIP). KIP entails the construction of a start-up camp, the first phase of a main camp, and a 25-km all-weather road and associated right-of-way.

As part of the KIP licensing conditions (*Environment Act* Licence No. 2952R), the Keeyask Hydropower Limited Partnership (KHLP) conducted terrestrial effects monitoring during the KIP construction. The monitoring approach focused on verifying construction-related effects on songbirds and owls within the Local Study Area (LSA) predicted in the KIP Environmental Assessment (EA) Report (KHLP 2009). Methods included nocturnal surveys for owls in April and May 2012, 2013 and 2014, breeding bird point counts for songbirds in June and July of 2012, 2013 and 2014, 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 plots 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 plots. As a result, not all of the analyses described in the Avian Monitoring 2012-2013 Annual Report were applied to the 2013 datasets. Data from the 2012 and 2013 breeding bird survey field programs was reanalyzed for this report to provide a better comparison to the 2014 results.

Results of the construction monitoring study indicated that density and richness of breeding birds was lower in close proximity to disturbance in 2012, but there appeared to be no impact from distance to disturbance in 2013 or 2014. It is likely that birds were avoiding loud construction noises associated with the initial site clearing in 2012. Breeding bird density and richness in the LSA and Regional Study Area (RSA) were found to be similar in all years of the study, indicating that habitat within the RSA is suitable for any birds impacted by KIP within the LSA.

Nocturnal owl surveys from 2012 to 2014 revealed the presence of three owl species: boreal owl (*Aegolius funereus*), great horned owl (*Bubo virginianus*) and great gray owl (*Strix nebulosi*).

The 2012 owl survey results show a cluster of owls (all three species identified) within close proximity to a cleared borrow site, likely due to enhanced forage opportunities. Within the RSA, the low detection rate of owls in 2013 (one great horned owl observation, compared to 13 owls detected in 2012) is likely attributable to the late winter conditions extending throughout most of the province. Later that spring, wildfires began to burn throughout the RSA, affecting areas along PR 280 and the KIP access road. By 2014, the KIP access road construction was complete and the road was being utilized by heavy equipment and vehicles involved in construction at the main camp site. A survey of owls in 2014 revealed similar results to those observed in 2012. In both years, the highest density of owls observed occurred along the KIP access road.

Results from the 2012 to 2014 monitoring period indicated the presence of four bird species at risk, protected by federal and/or provincial legislation and/or designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in the KIP RSA: common nighthawk (*Chordeiles minor*; 'threatened' under Schedule 1 of the federal *Species at Risk Act* [SARA], the Committee on the Status of Endangered Wildlife in Canada [COSEWIC] and by the Manitoba Endangered Species and Ecosystems Act [MESEA]); olive-sided flycatcher (*Contopus cooperi*; 'threatened' under Schedule 1 of SARA, COSEWIC and MESEA); rusty blackbird (*Euphagus carolinus*; **'**special concern' under Schedule 1 of SARA and COSEWIC), and horned grebe (*Podiceps auritus*; 'special concern' under COSEWIC). Both breeding bird survey and recording unit data indicate that common nighthawk, olive-sided flycatcher and rusty blackbird were using habitats within close proximity to the KIP access road construction. Additionally, one horned

grebe was observed on a wetland located along the KIP access road. From this data, it does not appear that any of these at risk species are avoiding the access road construction area.

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) for his assistance during the 2014 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

Blair McMahon, M.Sc., P.Biol.	Biologist, Associate
Leane Wyenberg, M.Sc.	Biologist
Angele Watrin-Prodaehl, B.Sc.	Biologist
Jocelyn Hiebert, B.Sc., P.Biol.	Environmental Scientist
Summer Hull, B.Env.Sc.	Environmental Scientist
Dayne Wilkinson	Biologist
Kristin Mozel, MNRM, Adv. Dip. GIS	Terrestrial Ecologist
Cole Moszynski, B.Env.Sc.	Biologist

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF MAPS

Page

LIST OF FIGURES

Page

LIST OF APPENDICES

Page

1.0 INTRODUCTION

1.1 OVERVIEW

The Keeyask Hydropower Limited Partnership constructed the Keeyask Infrastructure Project (the Project or KIP) between 2012 to July 2014, after which construction of the Keeyask Generation Project began.

The KIP is located approximately 40 km southwest of Gillam, extending between Provincial Road (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. The start-up camp is located near the intersection of PR 280 and the access road, while the first phase of the main camp is located at the end of the access road on the north side of Gull Rapids.

As a KIP licensing condition (Environment Act Licence No. 2952R), the Keeyask Hydropower Limited Partnership conducted terrestrial effects monitoring during the KIP construction. This report covers the period between April 1, 2014 and March 31, 2015. The report also provides a synthesis of KIP effects during the entire construction phase.

As described in the KIP Environmental Assessment Report (2009), most of KIP's anticipated construction-related effects were expected to occur within the Local Study Area (LSA; Map 1-1). Avian studies focused on monitoring plots selected in the LSA to monitor construction- related effects and reference plots selected in the greater Regional Study Area to provide a basis for comparison (RSA; Map 1-1). Specific construction-related effects assessment (EA) predictions for birds were:

Songbirds/breeding Birds:

- Loss of breeding, foraging and over-wintering **habitat** due to clearing for Project infrastructure resulting in minimal, local loss of bird habitat.
- Avoidance of Project areas due to construction activities, resulting in reduction of birds in local areas.

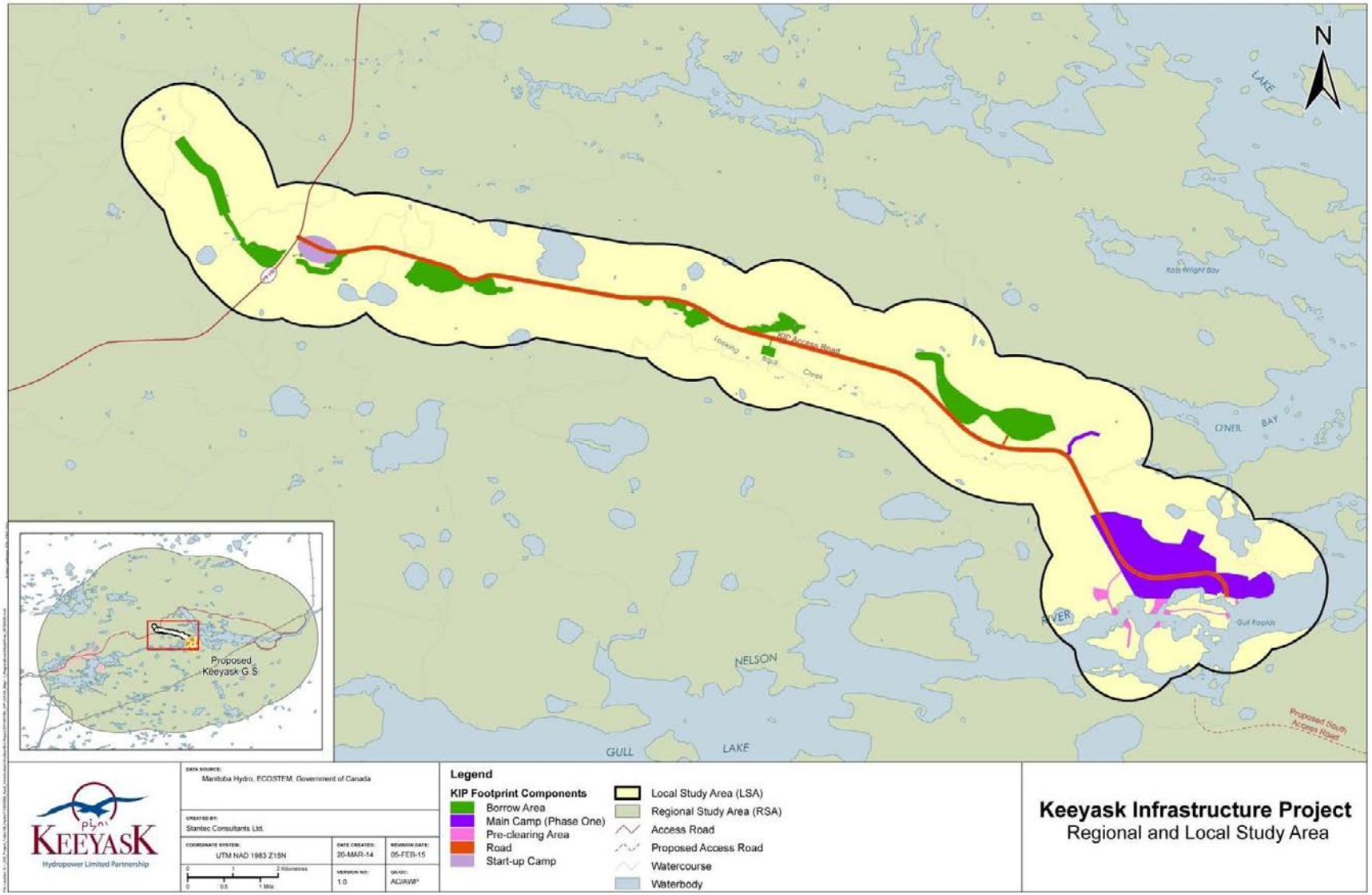
Owls:

- Loss of nesting and over-wintering cover and loss of mature and dead standing trees resulting in a low-magnitude, local loss of habitat.

- Short-term avoidance by owls of Project areas due to construction noise.

Construction of KIP began in January 2012 and was completed in July 2014. Construction activities during the April, 2014 to March 2015 monitoring period included: operation of the Start-Up Camp, construction of the Main Camp (Phase 1) and the installation and commissioning of the wastewater treatment plant.

Spring 2014 marked the third year of construction-phase breeding bird monitoring. Field studies were conducted during the owl breeding period (April/May) and songbird breeding period (June/July) in 2012, 2013 and 2014.



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

This report documents the avian monitoring field studies conducted in 2012, 2013 and 2014, and incorporates information pertinent to KIP from the existing baseline datasets. A glossary of terms is provided in Appendix A. Photographs of some of the representative habitats surveyed are provided in Appendix B. Details of bird survey results, statistical analyses and surveyed vegetation communities are provided in Appendices C, D and E. Appendix F outlines additional observations of wildlife recorded during 2014 surveys, and Appendix G provides weather data recorded during 2014 surveys.

2.0 METHODS

Bird survey methods focused on gathering information on species or bird groups potentially affected by KIP. 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). To test EA predictions, bird surveys were conducted in close proximity and further away from areas under construction in the LSA, as well as reference sites within the RSA that are not affected by construction activities.

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 procedures for conducting surveys using the Point Count Method identified by (Ralph *et al*. 1993 and 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).

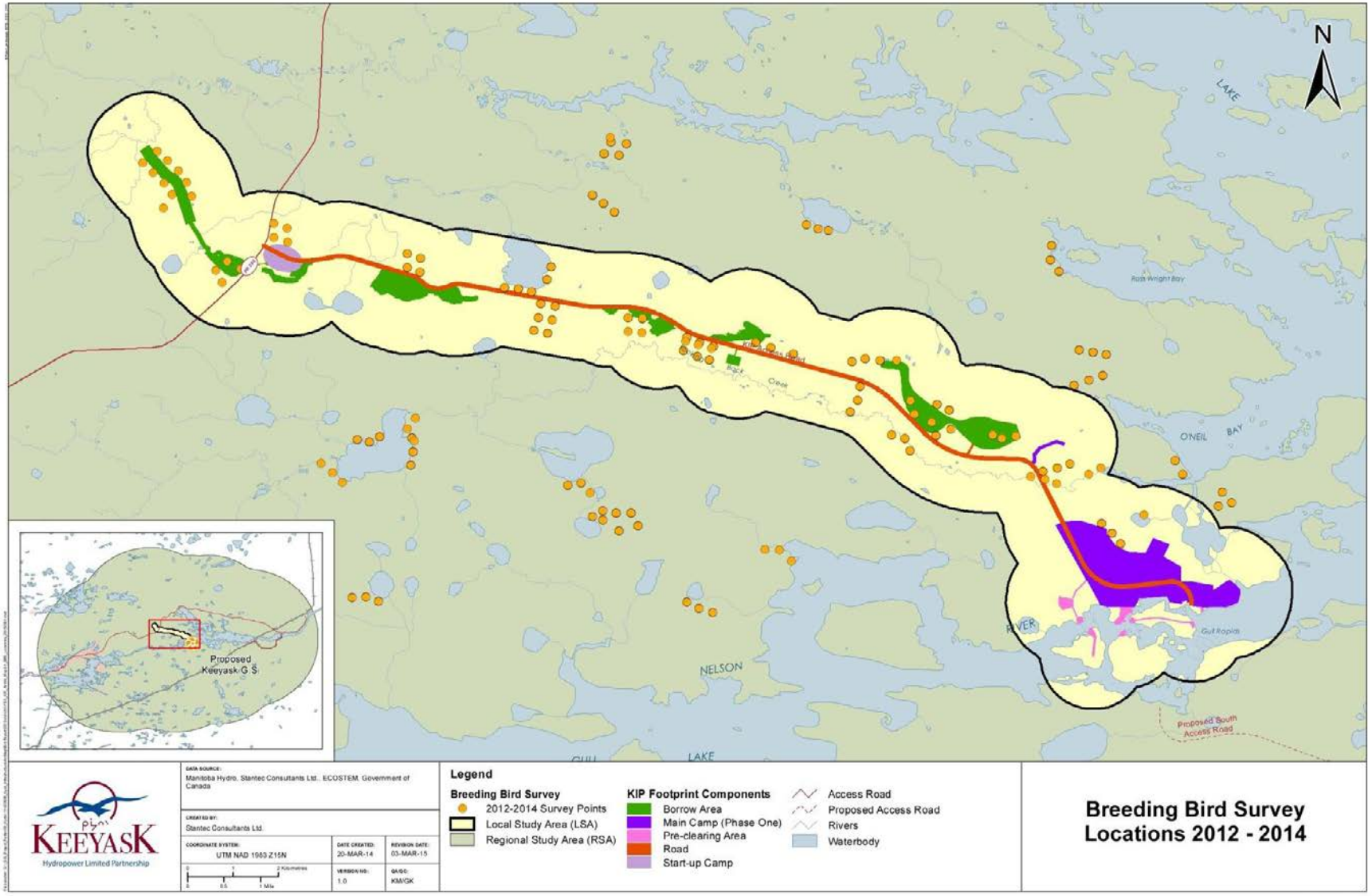
Survey plots were 75 m in radius and located 300 m apart along transects in order to minimize the potential of double-counting birds. Upon arrival at each survey plot, a team of two or three surveyors waited one minute for birds to settle prior to starting the survey. One biologist recorded all birds heard or observed within and just outside of the survey plot. Observations were recorded over a 5-minute listening period. Birds flying over the survey plot were excluded from density calculations if they were not considered to be using the habitat at the survey plot. Birds detected above the highest vegetation, which were flying past the site as part of their flight path, were not considered to be using the survey plot. Conversely, birds that were flying short distances within the plot for foraging purposes were recorded as a regular detection as opposed to a flyover. Surveys were not conducted when winds were greater than approximately 20 km/h, as wind interferes with the intensity or audibility of bird songs. Surveys were also not conducted when it was raining, or fog was present, as this interferes with visibility. Breeding-bird surveys occurred between sunrise and 1000 h. All additional

wildlife observed during surveys was recorded as incidental observations (Appendix E, Table E-1).

All data collected during the construction-phase avian monitoring (*i.e.,* 2012, 2013 and 2014 data sets) were categorized according to distance to disturbance (e.*g.*, under 200 m) and compared.

Construction phase (2012-2014) breeding-bird monitoring surveys were conducted adjacent to construction sites, such as the start-up camp site, the main camp site, borrow pit areas and the KIP access road right-of-way and areas adjacent to the ROW (all located within the LSA), as well as at "control" sites within the RSA (i.e., outside of the LSA). To the extent possible, survey transects sampled in 2012 were resurveyed in subsequent years. In 2013, some transects were not surveyed because of safety issues related to active wildfires. Fires burning along the access road near Provincial Road 280 (PR 280) in June 2013 resulted in the loss of several transects. In other instances, transects were not surveyed in areas that had been recently cleared of trees (*i.e.*, borrow area G-5).

New transects targeting species at risk habitats in the LSA and RSA were added in 2013 using modeled species at risk habitat data (ECOSTEM 2013). Sampling locations were determined based on the preferred breeding habitat of olive-sided flycatcher, rusty blackbird and common nighthawk; in many instances this included forest edge and/or riparian areas. All breeding-bird survey plots were located within representative vegetation communities, and typically occurred in continuous (*i.e.,* homogenous) habitat patches. No new survey plots were selected in 2014. A total of 81 survey plots were surveyed in 2012, 81 in 2013, and 71 in 2014 (Map 2-1).



Map 2-1: Breeding Bird Survey Locations 2012-1014

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; Appendix B, Photo 1); and
- Low vegetation (Appendix B, Photo 2).

Linear models (ANOVA) were developed (using log transformed density and species richness data) to examine how density and richness varied with distance to disturbance and within habitat groups (Appendix D). To assess potential construction-related impacts on bird density and richness, an analysis of distance to disturbance, using ANOVA and/or non-parametric equivalents, was conducted. Based on preliminary graphical exploration of the bird density and richness data, plots within the LSA were grouped into two main distance categories (distance measured from the edge of the access road, borrow area or camp infrastructure): 0 m to 200 m and 201 m to 1,000 m. An ANOVA or non-parametric equivalent was conducted for the distance categories regardless of habitat type. If a significant result was detected, an ANOVA/non-parametric equivalent was conducted on the habitat classes to see if the significant result was related to habitat, rather than distance.

Models (ANOVA and/or non-parametric equivalent) using log-transformed density/richness data were conducted to assess the difference between plots considered "impacted" in the LSA and "control" plots in the RSA. If a significant result was found, models (ANOVA and/or non-parametric equivalent) were run to test if the difference was due to habitat type.

2.2 NOCTURNAL OWL SURVEYS

In April 2012, 38 point-count plots were surveyed for owls within the RSA. Owl surveys were conducted along the western portion of the winter trail adjacent to the KIP access road, along PR 280 and along the Butnau Road. At the time the surveys were conducted, most of the KIP access road was under construction and therefore not accessible to be surveyed by truck. Warm spring conditions did not permit access with snowmobile (no snow cover along trail), therefore surveys were limited to areas along the winter trail that were safely accessible by

truck. As a result, most of the owl survey points in 2012, occurred within the first 10 km of the KIP access road off PR 280. One recording unit was deployed at the Looking Back Creek crossing location via helicopter (Map 2-2).

In April 2013, a total of 51 survey plots were surveyed for owls within the RSA. Point count surveys were conducted along the KIP access road, and at reference sites along PR 280, the Butnau Road and the proposed south access road. Access to the KIP access road had improved by this time, so survey plots extended farther east along the KIP access road, as compared to 2012.

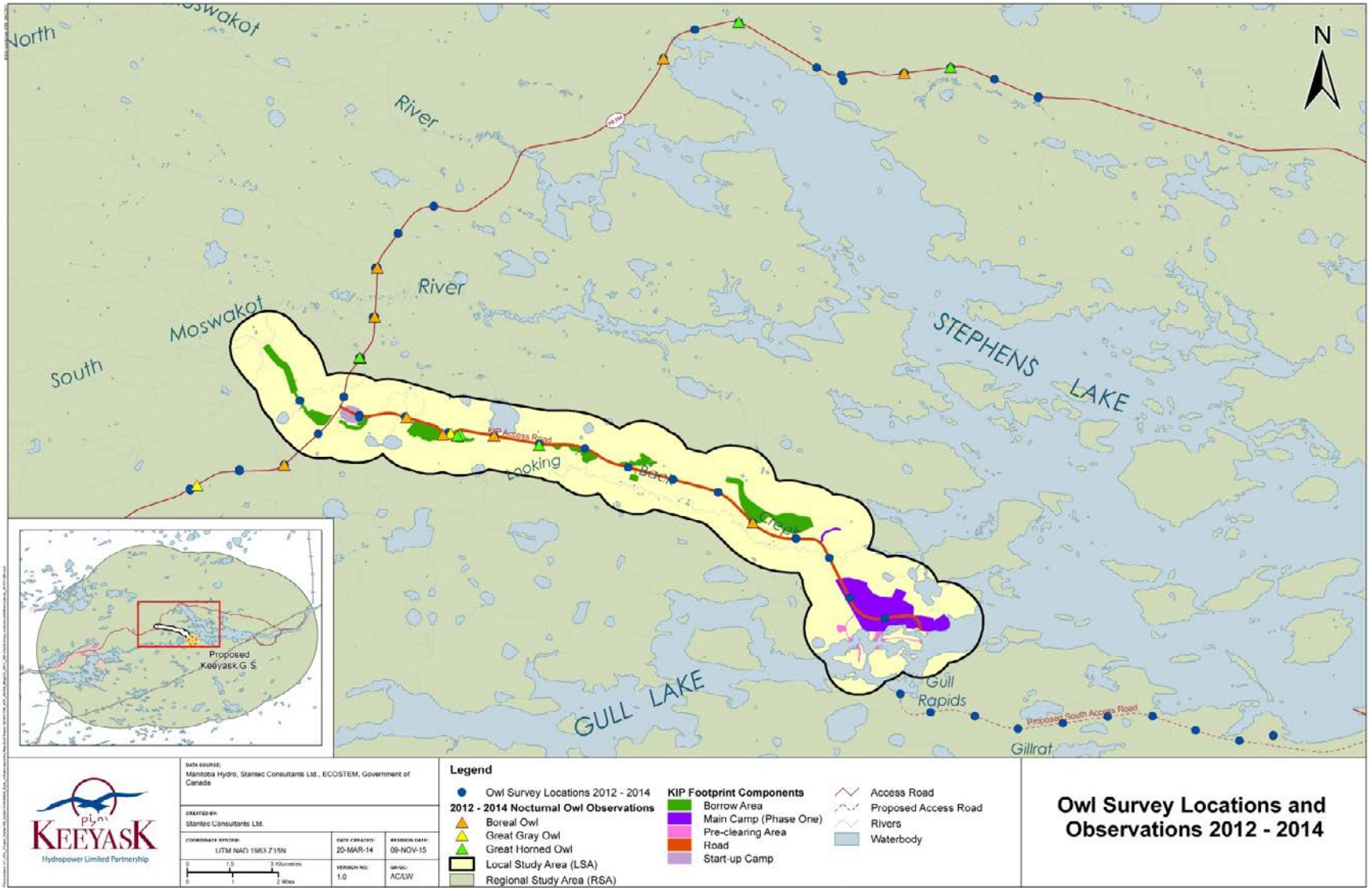
In May 2014, 44 survey plots were surveyed for owls within the RSA, along the KIP access road, along PR 280 (one stop located near cleared borrow site G-5) and along the proposed south access road. In 2014, stops along the KIP access road extended to the main camp.

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 plots were located 1.6 km apart along pre-determined transects, each covering an 800 m radius.

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 2012-2014

2.3 SPECIES AT RISK SURVEYS

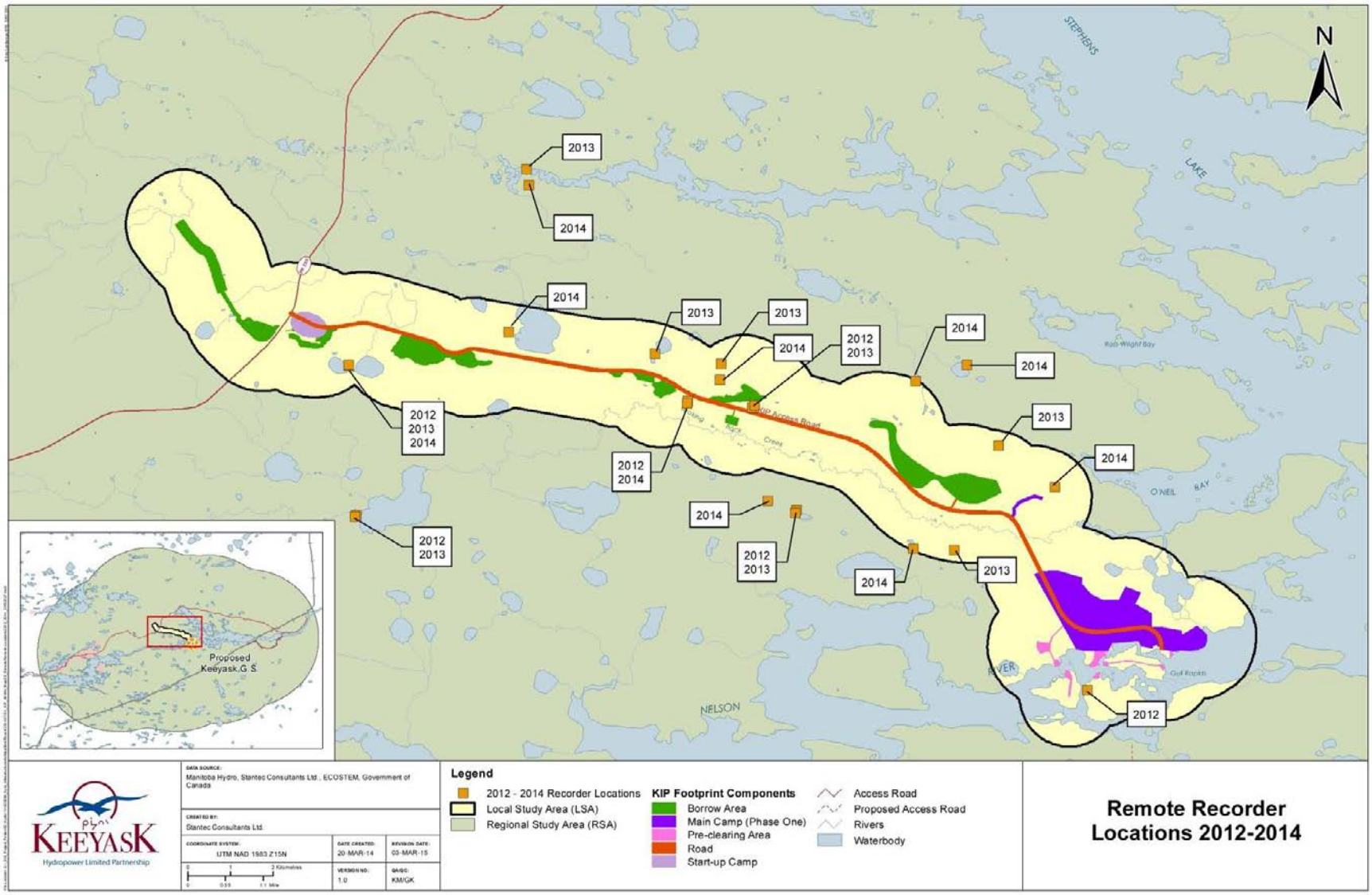
Songmeter acoustic recording units (by Wildlife Acoustics) were primarily used to determine presence of nocturnally active species at risk not typically detected during breeding bird surveys. Species targeted were:

- Common nighthawk (*Chordeiles minor*; '**threatened**' under Schedule 1 of the federal *Species at Risk Act* [SARA; Government of Canada 2014], COSEWIC [COSEWIC 2007a] and by the Manitoba Endangered Species and Ecosystems Act [MESEA; Manitoba Conservation 2014]); and
- Yellow rail (*Coturnicops noveboracensis*; '**special concern**' under Schedule 1 of SARA and COSEWIC [COSEWIC 2009a]).

Units were also used to gather information on other easily detectible species at risk known to breed in the area:

- Olive-sided flycatcher (*Contopus cooperi*; 'threatened' under Schedule 1 of SARA, COSEWIC [COSEWIC 2007b] and by the Manitoba Endangered Species and Ecosystems Act [MESEA; Manitoba Conservation 2014]); and
- Rusty blackbird (*Euphagus carolinus*; 'special concern' under Schedule 1 of SARA and COSEWIC [COSEWIC 2006]).

To gather presence/not-detected information on these species, recording units were set up at eight remote locations spread throughout the RSA in 2012, at ten locations in 2013 and at thirteen locations in 2014 (Map 2-3). Sample locations were identified in common nighthawk and yellow rail preferred breeding habitat, which often included preferred habitats of rusty blackbird and olive-sided flycatcher. Recording units were set to record for 10-minute intervals at 2000 h, 2200 h, 0000 h, 0100 h and 0500 h; units were left at a designated site for a minimum of 24 hours. Recordings were later evaluated to determine the presence of species at risk.



Map 2-3: Remote Recorder Locations 2012-2014

2.4 OTHER WILDLIFE DATA

Incidental observations such as birds heard outside of survey plots, 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 study teams.

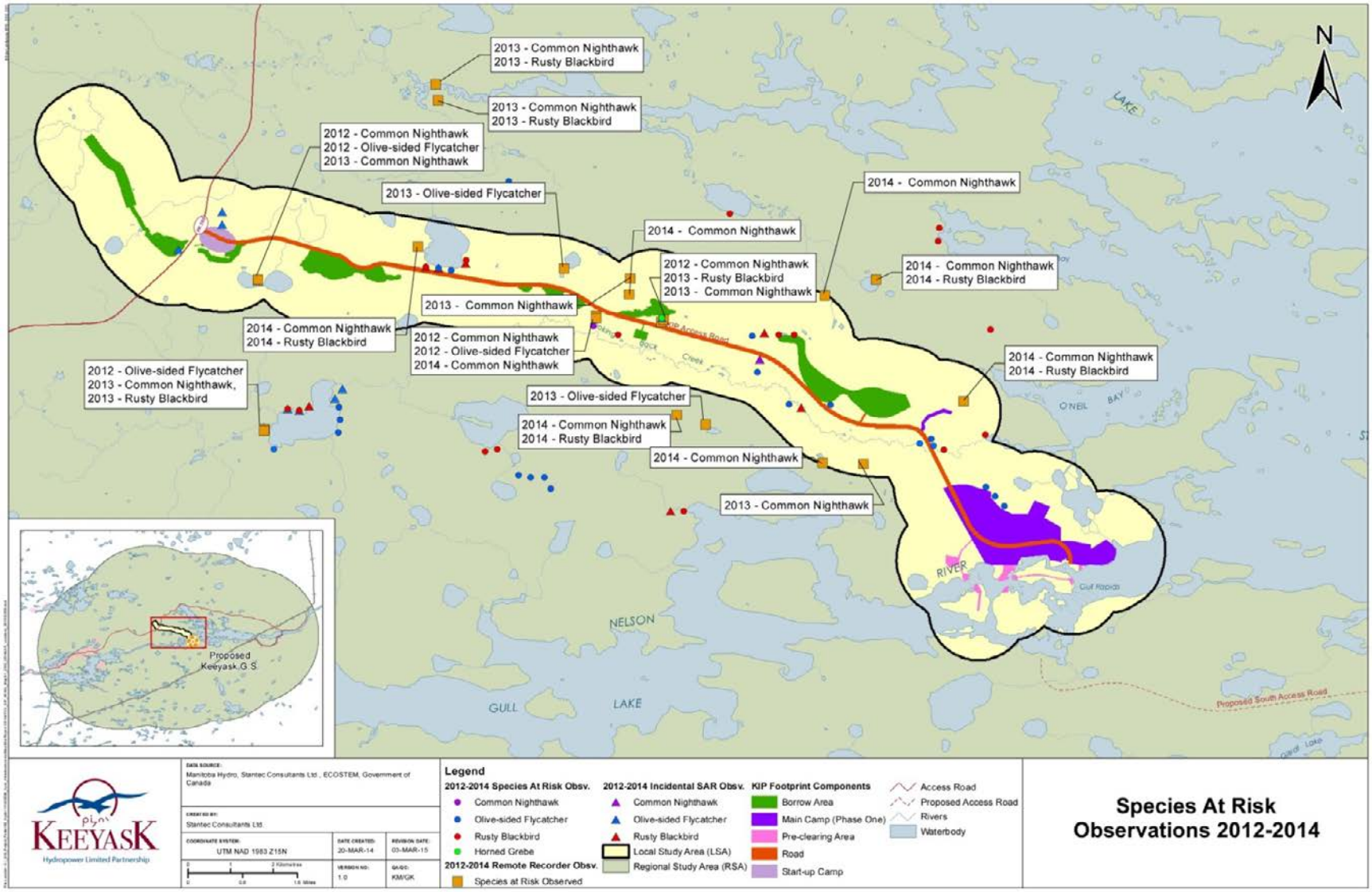
3.0 RESULTS

3.1 BREEDING-BIRD SURVEY RESULTS

Construction-phase breeding-bird monitoring surveys occurred throughout the KIP LSA and RSA between June 25 and July 2, 2012, June 18 and 30, 2013, and June 23 and July 5, 2014 (Map 2-1). Not all previously surveyed plots were re-sampled, as widespread wildfires in 2013, and clearing for the development of borrow sources and camp areas resulted in the loss of some previously surveyed plots. Of the 71 plots surveyed in 2014, 22 of the plots were surveyed in all three years of the study, 41 plots were surveyed in 2013 and 2014 and 8 plots were surveyed in 2012 and 2014. No new plots were established in the 2014 field season.

The 71 survey plots (equaling a total area of 125.7 hectares [ha]) were located within 12 broad vegetation types (ECOSTEM 2013). In 2014, a total of 218 birds representing 36 species were observed in the LSA and 386 birds representing 42 species were observed in the RSA. Passerine birds accounted for 91% of the total birds observed. The RSA has the potential to support up to 178 bird species during the breeding and migration seasons (Appendix C; Table C-1).

Four SAR were identified in the three years of construction monitoring: olive-sided flycatcher, rusty blackbird, common nighthawk and horned grebe (COSEWIC 2009b). During breeding-bird surveys, olive-sided flycatcher and rusty blackbird were recorded in 2014 (Map 3-1; Appendix C, Table C-3), olive-sided flycatcher, rusty blackbird and common nighthawk were recorded in 2013 and olive-sided flycatcher, rusty blackbird and horned grebe were recorded in 2012. All SAR were observed using their preferred breeding habitat; rusty blackbird was detected in areas supporting riparian habitat, olive-sided flycatcher was detected along forest edges where riparian and/or regenerating forest habitat was prevalent, common nighthawk were observed in regenerating forest and a horned grebe was observed flying over a point-count plot and landing in a small lake close to the survey plot (Map 3-1).



Map 3-1: Species at Risk Observations 2014

3.1.1 DENSITY

Overall, approximately 3.1 ± 1.8 birds/ha were observed throughout the LSA and RSA in 2014. This is comparable to densities recorded in 2012 when 2.8 ± 1.5 birds/ha were observed and in 2013 where 2.9 ± 1.5 birds/ha were observed (Table 3-3; Appendix D, Table D-1). In 2014, a density of 3.08 ± 2.03 birds/ha was observed in the LSA, while 3.23 ±1.51 birds/ha were observed in the RSA.

3.1.1.1 Distance to Disturbance

Results of an ANOVA on 2014 bird density indicated no statically significant difference between distance to disturbance categories (Table 3-1; Appendix D – Table D-1, ANOVA, F = 0.303, p = 0.585). Similarly, results from an ANOVA on 2013 data also showed no statically significant difference between distance categories (Table 3-1; Appendix D – Table D-1, ANOVA, F = 0.065, p = 0.8). Results from an ANOVA on 2012 data did indicate a statistically significant difference between distance to disturbance categories (Table 3-1, Appendix D – Table D-1, ANOVA, F = 10.2, p = 0.002).

3.1.1.2 Habitat Classification

When bird distribution among vegetation community types was considered, the highest average bird densities across three years of the study were observed in plant communities dominated by low vegetation, followed by regenerating areas (Table 3-2). Jack pine dominated forest supported lower bird densities than any of the other vegetation community types (Table 3-2). For each vegetation community sampled, average bird densities observed in 2014 were comparable to those observed in other years of the study (Table 3-2).

Table 3-1: Average Bird Densities by Distance to Disturbance Categories in the LSA									
Distance Category	**2012**			**2013**			**2014**		
	Number of Plots	**Total Surveyed Area (ha)**	**Average Density ± Standard Deviation (birds/ha)**	**Number of Plots**	**Total Surveyed Area (ha)**	**Average Density ± Standard Deviation (birds/ha)**	**Number of Plots**	**Total Surveyed Area (ha)**	**Average Density ± Standard Deviation (birds/ha)**
Under 200 m	27	47.79	2.45 ± 1.24	14	24.78	3.06 ± 1.72	26	46.02	2.98 ± 1.35
200 m - 1,000 m	15	26.55	3.99 ± 1.88	25	44.25	3.16 ± 1.78	15	26.55	3.24 ± 2.89

Table 3-2: Average Bird Densities by Habitat Type in the RSA

Vegetation Community Type1	2012			2013			2014		
	Number of Plots	Total Surveyed Area (ha)	Average Density (birds/ha)	Number of Plots	Total Surveyed Area (ha)	Average Density (birds/ha)	Number of Plots	Total Surveyed Area (ha)	Average Density (birds/ha)
Black Spruce (Mixture and Pure stands)	43	76.11	2.7 ± 1.2	28	49.56	2.6 ± 1.1	25	44.25	2.6 ± 1.3
Jack Pine (Mixture and Pure stands)	8	14.16	2.5 ± 1.7	13	23.01	2.1 ± 1.1	14	24.78	2.5 ± 1.7
Low Vegetation	13	23.01	3.6 ± 1.9	24	42.48	5.3 ± 1.5	22	38.94	4.0 ± 2.2
Regenerating (Young Regen and Tall Shrub)	16	28.32	2.5 ± 1.5	16	28.32	3.2 ± 1.6	10	17.7	3.2 ± 1.5
Yearly Average			2.78 ± 1.47			2.91 ± 1.51			3.14 ± 1.81

NOTE: [1]Vegetation community types with three point-count stops or fewer are not included in this table and not utilized in habitat analysis.

3.1.1.3 LSA versus RSA

Average bird densities calculated for plots sampled in 2014 in both the LSA and RSA were similar (Table 3-3). A non-parametric Mann-Whitney Test for 2014 revealed no statistically significant difference in bird density between plots in the LSA and RSA (Appendix D, Table D-2, W=160.5, p-value =0.444). Similarly, no significant difference was found between LSA and RSA plots in 2013 (W=764.5, p=0.763) or 2012 (W=624.5, p=0.292) (Appendix D, Table D-2).

Annual variability in bird populations and loss of survey plots to fire and land clearing activities (and the increased sampling effort in SAR habitats) are factors limiting the ability to make statistical comparisons between monitoring years.

Table 3-3: Average Bird Densities in the Regional Study Area LSA vs. RSA Plots (2012-2014)

Vegetation Community Type[1]	LSA Plots			RSA Plots		
	Average Density ± Standard Deviation (birds/ha)			Average Density ± Standard Deviation (birds/ha)		
	2012	2013	2014	2012	2013	2014
Black Spruce (Mixture and Pure Stands)	2.8 ± 1.2	2.3 ± 1.0	2.1 ± 0.7	2.7 ± 1.3	2.6 ± 1.2	2.9 ± 1.5
Jack Pine (Mixture and Pure Stands)	2.9 ± 1.7	2.2 ± 1.9	2.5 ± 1.8	-	1.9 ± 1.5	2.5 ± 1.5
Low Vegetation	3.6 ± 1.9	3.8 ± 1.6	4.0 ± 2.6	-	3.1 ± 1.2	4.2 ± 1.2
Regenerating	2.4 ± 1.7	3.0 ± 1.6	3.1 ± 2.1	2.5 ± 0.7	3.5 ± 1.7	-
Totals	2.91 ± 1.58	3.1 ± 1.72	3.08 ± 2.03	2.54 ± 1.21	2.75 ± 1.32	3.23 ± 1.51

NOTE:[1]Vegetation community types with three point count plots or fewer are not included in this table and not utilized in habitat analysis.

In 2012, species with the highest densities detected in LSA plots included dark-eyed junco (0.75 ± 0.64 birds/ha), ruby-crowned kinglet (0.49 ± 0.46 birds/ha), northern waterthrush (0.34 ± 0.4 birds/ha) and swamp sparrow (0.34 ± 0.61 birds/ha). These species were also abundant in the

RSA. In the RSA, species with the highest densities included dark-eyed junco (0.35 ± 0.54 birds/ha), fox sparrow (0.33 ± 0.43 birds/ha) and yellow-rumped warbler (0.31 ± 0.41 birds/ha).

Between 2012 and 2013 there was a notable shift in the LSA bird community composition. Species with the highest densities detected in LSA plots included white-throated sparrow (0.37 ± 0.4 birds/ha), hermit thrush (0.24 ± 0.3 birds/ha), orange crowned warbler (0.23± 0.3 birds/ha) and alder flycatcher (0.21 ± 0.3 birds/ha). All of these species occurred at lower densities (<0.12 birds/ha) in the RSA. The most abundant species in the RSA plots were similar to those observed in 2012: yellow-rumped warbler (0.23 ± 0.46 birds/ha), dark-eyed junco (0.22 ± 0.37 birds/ha) and Tennessee warbler (0.19 ± 0.32 birds/ha). Both yellow-rumped warbler and dark-eyed junco were less abundant in the LSA plots (0.03 ± 13 birds/ha and 0.09 ± 0.25 birds/ha respectively).

In 2014, species dominating the LSA plots varied slightly from 2012 and 2013. Dominant species included American robin (0.28 ± 0.3 birds/ha), dark-eyed junco (0.24 ± 0.34 birds/ha), white-crowned sparrow (0.23 ± 0.36 birds/ha) and white-throated sparrow (0.21 ± 0.47 birds/ha) (Appendix C, Table C-3). American Robin had much lower densities in the RSA (0.07 ± 0.19 birds/ha), but the other species with highest densities in the LSA were also abundant in the RSA. In 2014, dark-eyed junco (0.38 ± 0.4 birds/ha), white-crowned sparrow (0.24 ± 0.48 birds/ha) and Lincoln's sparrow (0.24 ± 0.35 birds/ha), typical species of black spruce dominated habitats, were most abundant in the RSA plots.

3.1.2 SPECIES RICHNESS

As breeding bird surveys of the RSA were designed to record terrestrial breeding birds using forested areas, 35 of the 42 bird species observed belonged to the **passerine** group. Of the 42 bird species observed in 2014, 55% of the birds observed belonged to one of ten common species (Table 3-4).

Table 3-4: Common Species Observed in Regional Study Area 2014		
Bird Species	**Percent of Total Birds Observed**	**Number of Plots Species Observed at**
Dark-eyed Junco	9.8	29
White-crowned Sparrow	7.5	21
American Robin	6.2	24
White-throated Sparrow	6.2	15
Lincoln's Sparrow	6.0	18
Swamp Sparrow	4.7	14
Northern Waterthrush	4.2	14
Alder flycatcher	3.6	13
Orange-crowned Warbler	3.6	13
Palm Warbler	3.6	12
Total	**55.4**	

3.1.2.1 Distance to Disturbance

Distance from disturbance did not appear to have any influence on avian species richness in the LSA in 2014, as no statistically significant difference was noted between plots within 200 m of disturbance and those 200 m to 1,000 m from disturbance (Table 3-5; ANOVA $F = 0.391$ $p = 0.535$, $W = 160.5$, $p = 0.4$, Appendix D). No statistically significant difference in richness with distance to disturbance was recorded in 2013 (Table 3-5; ANOVA $F=0.024$, $p=0.877$, Appendix D, Table D-3). In 2012, avian species richness was statistically significantly higher 200 m to 1,000 m away from construction sites (Table 3-5; ANOVA $F=3.65$, $p=0.062$, $W=398.5$, $p=0.023$; Appendix D, Table D-3). In all three years of the study, the only bird species found to occur within 200 m of disturbance, but not further away, was boreal chickadee (Appendix C, Table C-4). All other species were observed within 200 m of disturbance and 200 m to 1,000 m away.

Table 3-5: Average Bird Richness by Distance to Disturbance Categories in the LSA

Distance Category	2012			2013			2014		
	Number of Stops	Total Surveyed Area (ha)	Average Richness ± Standard Deviation (species/ plot)	Number of Stops	Total Surveyed Area (ha)	Average Richness ± Standard Deviation (species/ plot)	Number of Stops	Total Surveyed Area (ha)	Average Richness ± Standard Deviation (species/ plot)
<200 m	38	67.26	2.0 ± 0.87	22	38.94	2.62 ± 1.31	25	44.25	2.58 ± 1.07
200 m-1,000 m	15	26.55	2.7 ± 1.16	15	26.55	2.75 ± 1.43	15	26.55	2.71 ± 2.35

3.1.2.2 Habitat Classification

In 2014, low vegetation supported the most diverse bird community (n=33 species) compared to all other habitat groups. Black spruce-dominated communities supported 29 species, jack pine communities supported 26 species and regenerating forest supported 20 species. Similarly, in 2013, low vegetation supported the most diverse bird community (n=23 species), black spruce- dominated communities supported 20 species, regenerating forest supported 19 species and jack pine 14 species. In 2012, regenerating forest supported 33 species, black spruce communities supported 32 species, low vegetation communities supported 20 species and jack pine supported 14 species. There were few plots in low vegetation communities in 2012 (n = 5), which accounts for the relatively low number of species recorded for this habitat type.

3.1.2.3 LSA versus RSA

In 2014, species richness was not statistically significantly different between LSA and RSA plots (ANOVA F=0.008, P=0.54, W = 650.0, p = 0.725; Appendix D, Table D-4). This result is consistent with other years of the study, where no statistically significant difference in richness was found between LSA and the RSA in 2013 (ANOVA F =0.59, p = 0.45, W = 713, p = 0.42) or 2012 (ANOVA F =0.2, p = 0.62, W = 679, p = 0.615).

From 2012-2014, differences in bird communities observed in the LSA and RSA were evident (Appendix C, Table C-4). Horned grebe (*Podiceps auritus*), red-tailed hawk, spotted sandpiper, common nighthawk, belted kingfisher, hairy woodpecker, Nashville warbler, clay-coloured sparrow and pine grosbeak were recorded in the LSA, but not in the RSA. Species recorded in the RSA, but not in the LSA were bald eagle, red-eyed vireo, golden-crowned kinglet, song sparrow and red-winged blackbird. All of these birds have low densities or were recorded as a single occurrence. Trends for 16 of the most common passerine species in the area were analysed over time and by distance to disturbance. Eight of these species are generalist and edge-dwelling species and eight species associated with wet areas such as marshes, bogs and fens (Figures 3-1 and 3-2). For most of the generalist species, densities within the RSA were higher than in the LSA for all years of the study. However, in 2013 and 2014, the differences in densities between LSA and RSA sites were much smaller (Figure 3-1). Trends from 2012 to 2014 show a slight increase with time of overall densities in areas within 200 m of disturbance,

no notable change for sites 200 m to 1000 m for disturbance and lower densities within the RSA.

Bird species associated with wetland areas also showed higher densities in the RSA than in the LSA in 2012, but not in subsequent years of the study (Figure 3-2). Trends from 2012 to 2014 show a slight increase with time of overall densities in areas within 200 m of disturbance and small decreases in densities for sites 200 m to 1000 m from disturbance and within the RSA.

3.2 NOCTURNAL OWL SURVEY RESULTS

Owls such as northern hawk owl (*Surnia ulula*), boreal owl (*Aegolius funereus*), great horned owl (*Bubo virginianus*), great gray owl (*Strix nebulosa*) and long-eared owl (*Asio otus*) have been observed breeding in the RSA during baseline and monitoring studies. Although short-eared owl (*Asio flammeus*) has been detected during EA surveys, it is not known to breed in the RSA due to the limited availability of suitable breeding habitat. Snowy owl (*Nyctea scandiaca*) is known to pass through the area during migration seasons (Godfrey 1986).

Three owl species were detected along the KIP access road (via the winter trail) during 2012 nocturnal surveys: boreal owl, great horned owl and great gray owl (Table 3-6; Map 2-2). In 2012, the surveyed portion of the KIP access road supported a higher density of nocturnal owls (3.8 owls/10 km^2) than PR 280 (1.5 owls/ 10 km^2).

In 2013, one great horned owl was detected in the 51 point-count locations surveyed for owls (Table 3-6; Map 2-2). Detection occurred west of a PR 280 survey point located in close proximity to a cleared borrow site (G-5).

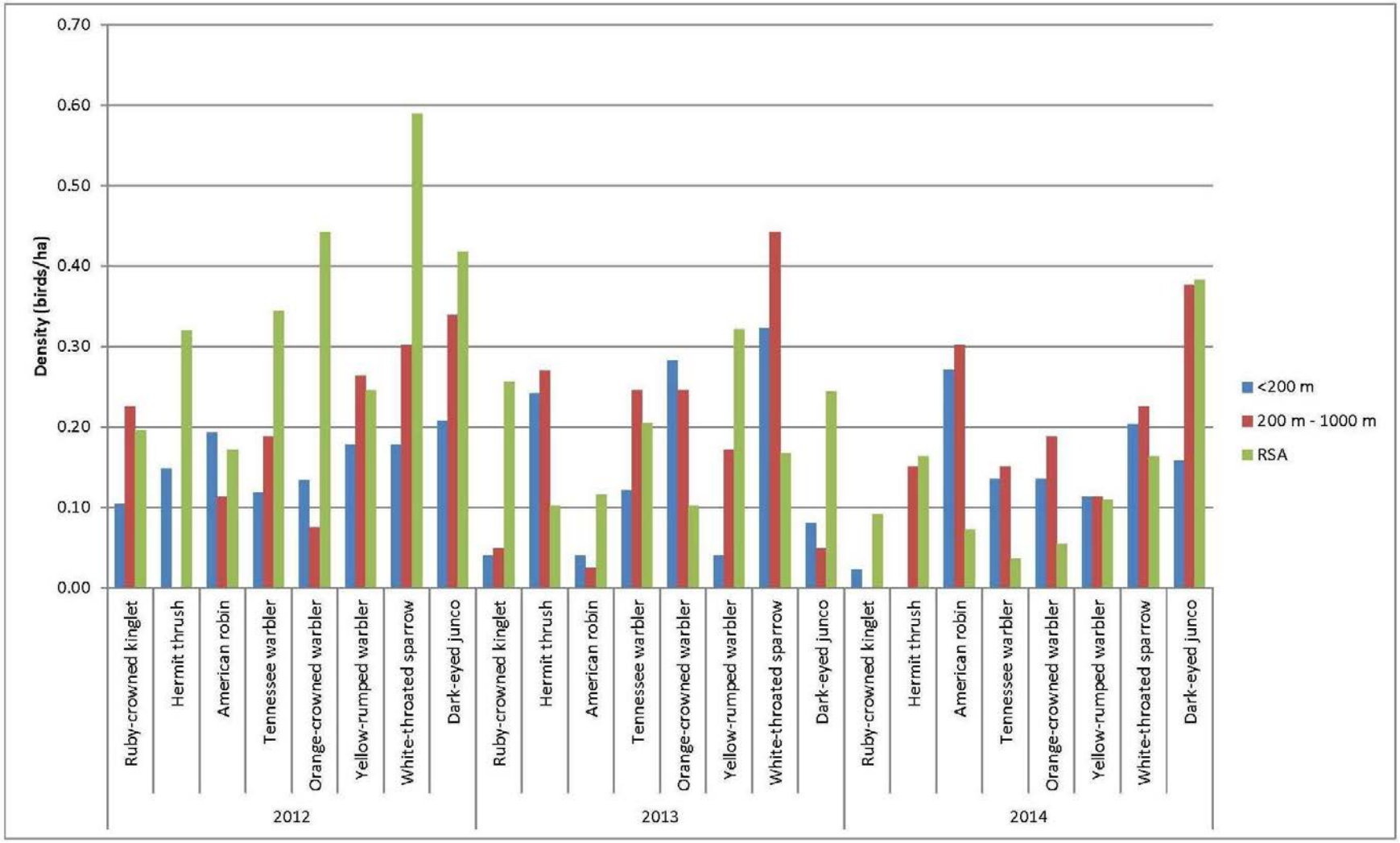


Figure 3-1: Comparison of Generalist Bird Species by Distance to Disturbance in the LSA and in the RSA from 2012-2014

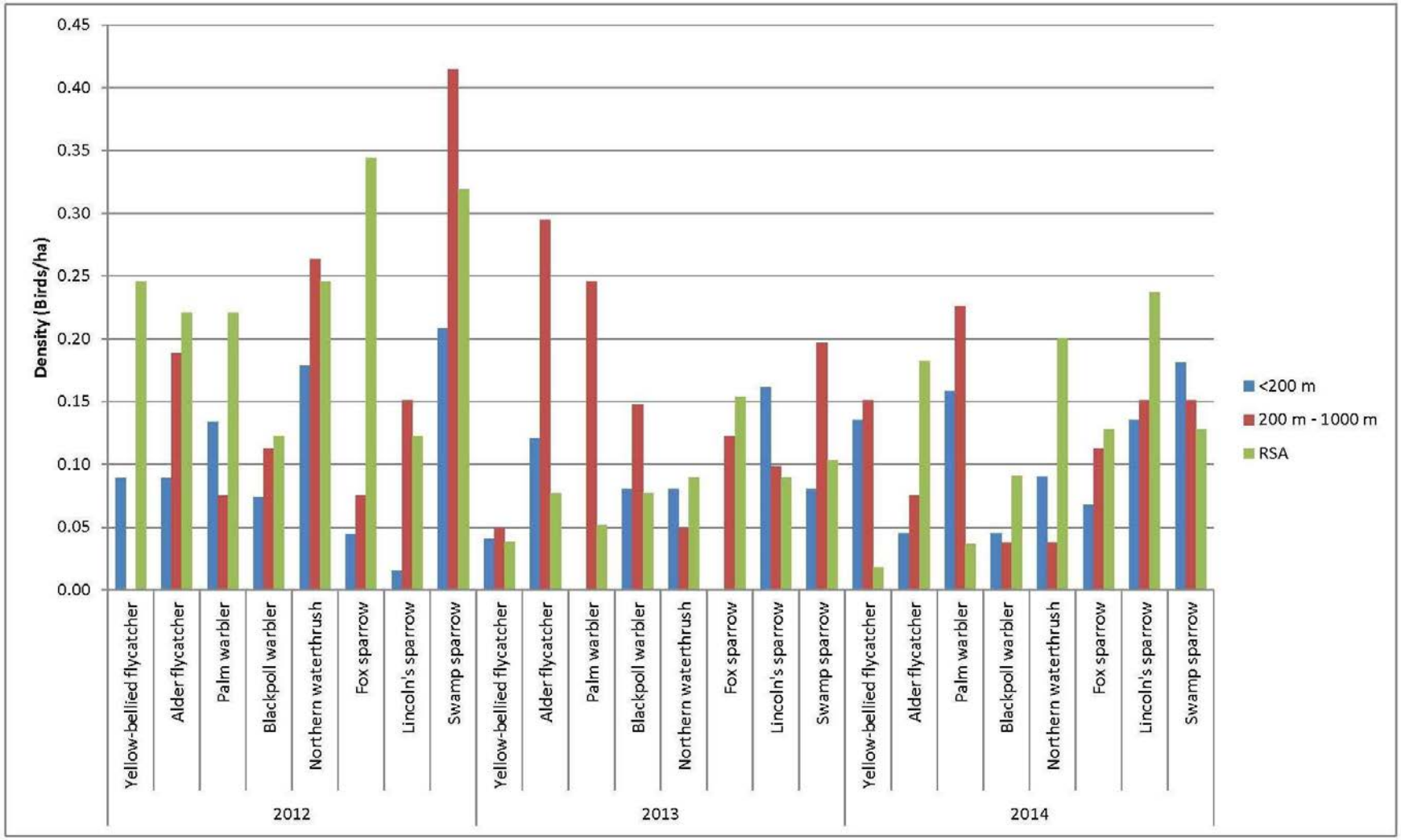


Figure 3-2: Comparison of Wetland-Associated Bird Species by Distance to Disturbance in the LSA and in the RSA from 2012-2014

Two owl species were detected along the KIP access road and PR 280 during the 2014 nocturnal surveys: boreal owl and great horned owl (Table 3-6; Map 2-2). A single boreal owl was detected along the proposed south access road. In 2014, the KIP access road supported a higher density of nocturnal owls (1.1 owls/10 km^2) than PR 280 (0.8 owls/10 km^2) or the proposed south access road (0.5 owls/10 km^2; Table 3-6).

Table 3-6: Densities of Owl Species Observed in KIP RSA 2012-2014

Species	KIP Access Road [1]	PR 280	Proposed South Access Road[2]	Total
2012				
Boreal owl	3	4	n/a	7
Great gray owl	1	1	n/a	2
Great horned owl	2	1	n/a	3
Total Owls	6	6	n/a	12
Number of Plots	8	20	n/a	28
Area Surveyed (km^2)	16	40	n/a	56
Density of Owls (birds/10 km^2)	3.8	1.5	n/a	2.1
2013				
Boreal owl	-	-	-	-
Great gray owl	-	-	-	-
Great horned owl	-	1	-	1
Total Owls	0	1	0	1
Number of Plots	11	21	10	42
Area Surveyed (km^2)	22	42	20	84
Density of Owls (birds/10 km^2)	0.0	0.2	0.0	0.1
2014				
Boreal owl	2	2	1	5
Great horned owl	1	1	-	2
Total Owls	3	3	1	7
Number of Plots	14	20	10	44
Area Surveyed (km^2)	28	40	20	88
Density of Owls (birds/10 km^2)	1.1	0.8	0.5	0.8

1 = KIP Access Road surveyed via the winter trail in 2012

2 = Proposed south access road not surveyed in 2012

3.3 SPECIES AT RISK

In 2012, two SAR were identified on recording units deployed throughout the RSA: olive-sided flycatcher and common nighthawk. Common nighthawk was detected at five of six monitoring locations and olive-sided flycatcher at three locations (Map 3-1; Appendix E, Table E-1).

In 2013, olive-sided flycatcher, common nighthawk and rusty blackbird were identified on recording units deployed throughout the RSA. Common nighthawk was detected most frequently at six of the nine monitoring locations (Map 3-1; Appendix E, Table E-1). Olive-sided flycatcher was detected at two locations and rusty blackbird was detected at two locations.

In 2014, common nighthawk and rusty blackbird were detected on recording units deployed throughout the RSA. Common nighthawk was detected at all ten monitoring locations (Map 3-1; Appendix E, Table E-1). Seven of the ten recording units were positioned within suitable common nighthawk habitat (*e.g.,* sparsely treed vegetation on mineral soil; regenerating forest) and all supported nighthawks (Appendix E, Table E-1). One common nighthawk detection occurred in olive-sided flycatcher primary habitat (*e.g.,* forest edge within 50 m of water) and two occurred in rusty blackbird /yellow rail habitat (*i.e.,* riparian fen).

Rusty blackbird was detected at six of ten monitoring locations, including all of the five rusty blackbird-targeted monitoring locations (located in riparian areas). One additional rusty blackbird detection occurred in common nighthawk primary habitat (Appendix E, Table E-1). Two remote recording units were deployed in olive-sided flycatcher primary habitat but neither supported olive-sided flycatcher.

To understand the impact of KIP access road construction on SAR, recording units were categorized as within 400 m of disturbance or greater than 400 m from disturbance (Appendix E, Table E-1). The distance of 400 m from disturbance was chosen based on the distance that recording units capture and the volume of calls/songs of target species.

In 2012, three recording units were within 400 m of disturbance and three were greater than 400 m away (Map 2-3; Appendix E, Table E-1). Common nighthawk and olive-sided flycatcher were recorded at two of the units within 400 m and three of the units greater than

400 m away. One recording unit was located on an island close to Gull Rapids and did not capture any SAR (Map 2-3). Although suitable habitat may exist on the island, noise levels from the rapids may deter these species.

In 2013, widespread wildfires limited the ability to place recording units close to disturbance. As such, two recording units were placed within 400 m and seven recording units were placed greater than 400 m away from disturbance. Common nighthawk and olive-sided flycatcher were noted at the recording units within 400 m of disturbance, while common nighthawk, rusty blackbird and olive-sided flycatcher were noted at units greater than 400 m away.

In 2014, five recording units were placed within 400 m and five were placed greater than 400 m away from disturbance. Common nighthawks were detected at all 10 recording unit locations. Rusty blackbird were recorded on two recording units located within 400m of disturbance and on four units located 400 m away from disturbance.

3.4 INCIDENTALS

Incidental SAR species observed before starting or after ending a BBS, nocturnal owl and recording unit point-count locations, or observed between point count plots were recorded. In 2014, two SAR - olive-sided flycatcher and rusty blackbird - were noted as incidentals. Six rusty blackbirds and two olive-sided flycatchers were recorded outside of survey points (Map 3-1; Appendix F, Table F-1). Other noteworthy incidentals include a northern goshawk and two spruce grouse. One northern hawk owl was observed north of the KIP access road in April by another consultant conducting surveys in the area.

Between 2012 and 2014, four olive-sided flycatcher incidental observations were recorded inside the LSA, while four were detected near RSA plots. Five rusty blackbirds were incidentally observed within the LSA, and two near a RSA plot. One incidental common nighthawk was detected in the LSA. Habitat use by individuals was difficult to ascertain because the spatial locations of incidental observations, by their nature, are not precise.

4.0 DISCUSSION

4.1 PASSERINES

As predicted in the EA, project clearing resulted in the direct loss of breeding, foraging and overwintering habitat for breeding birds. The EA also predicted that construction activity would cause birds to seek alternate habitat away from disturbance. Habitat avoidance by breeding birds was observed during the first year of monitoring, as survey results showed a short-term reduction in bird density and species richness in areas within 200 m of the disturbance (i.e., low abundance and number of species observed near disturbance compared to areas further away). Although road construction was ongoing in 2013 and 2014, breeding bird density and species richness did not change with distance to disturbance.

The dominant species inhabiting the LSA plots were highly variable between survey years. Changes in the dominant species and their densities may have resulted from a combination of factors including construction disturbance, changes in study design resulting from fire and land clearing, changes in habitat due to widespread forest fires, and annual variability in bird populations.

4.2 OWLS

Most of the owl species known to breed within the RSA forage along forest openings that support a prey base (*e.g.*, mice, voles). The 2012 nocturnal owl survey results show a cluster of owls (three species identified) within close proximity to a cleared borrow site. It was anticipated in the EA (KHLP 2009) that owls would be drawn to some of the areas cleared for Project infrastructure (*e.g.*, borrow areas) due to enhanced forage opportunities. While it is recognized that owl populations fluctuate cyclically relative to rodent population cycles (Hanski *et al.* 2001), this observed change in owl distribution (when compared with 2011 baseline data) along the KIP access road is likely attributable to clearing activities during construction in Year 1.

Only one owl was detected during 2013 nocturnal owl surveys. 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 discrepancy

between survey timing and owl breeding. In April 2013, owl detections throughout many parts of Manitoba were also minimal, suggesting a possible delay in the owl breeding period as a result of the late winter conditions (Duncan 2013, pers. comm.).

By 2014, the KIP access road had been completed and was being utilized by heavy equipment and vehicles involved in construction at the main camp site. The area was affected by forest fires, which occurred following the 2013 owl monitoring program. Two species were identified during nocturnal owl surveys in 2014, and the KIP access road supported a higher density of nocturnal owls than PR 280 or the proposed south access road.

4.3 SPECIES AT RISK

Results from three years of construction monitoring revealed the continued presence of common nighthawk, olive-sided flycatcher and rusty blackbird in habitats adjacent to the KIP access road. One horned grebe was observed on a small wetland located along the north side of the KIP access road in 2013. From this data, it does not appear that species at risk were avoiding areas adjacent to the construction sites.

5.0 CONCLUSIONS

As predicted in the EA, bird habitat availability was fragmented and reduced within the KIP Footprint. An indirect loss in bird habitat also occurred in 2012 following Project clearing and initiation of road construction. In 2012, bird densities and species richness were found to be lower within 200m of active construction sites. Construction noise and activity were likely causing birds to avoid otherwise suitable breeding habitat located adjacent to construction areas. As construction progressed in 2013 and 2014, bird densities and species richness did not change with distance from active construction sites. This result suggests that construction activity was not having an effect on the bird community. However, with the widespread wildfires in 2013 and subsequent changes in study design, it is difficult to make any definitive conclusions regarding construction activity effects on birds in 2013 and 2014.

Several species at risk, including rusty blackbird, olive-sided flycatcher and common nighthawk, were recorded at monitoring plots located within the LSA and RSA. All three species were detected in areas adjacent to construction activities, indicating that it does not appear that KIP construction activities caused these species to avoid areas within 400 m of construction sites.

The EA predicted that owls would be attracted to recently cleared areas of the Project Footprint due to enhanced foraging opportunities (i.e., exposure of prey foods). As expected, there was an increase in owl abundance in the vicinity of the KIP access road and borrow areas following recent clearing activities in the spring of 2012. Owl detections were lower throughout the region in 2013 and 2014. Detections were likely low in 2013 due to late spring conditions, and in 2014 due to changes in habitat resulting from the 2013 forest fires.

6.0 REFERENCES

6.1 LITERATURE CITED

Bayne, E.M., L. Habit and S. Boutin. 2008. Impacts of chronic anthropogenic noise from energy-sector activity on abundance of songbirds in the boreal forest. Conservation Biology 22, 1186– 1193.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2006. COSEWIC Assessment and Status Report on the Rusty Blackbird *Euphagus carolinus* in Canada. From http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_rusty_blackbird_0806_e.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2007a. COSEWIC Assessment and Status Report on the Common Nighthawk *Chordeiles minor* in Canada. From http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_chordeiles_minor_e.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2007b. COSEWIC Assessment and Status Report on the Olive-sided Flycatcher *Contopu cooperi* in Canada. From http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_olivesided_flycatcher_0808_e.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2009b. COSEWIC Assessment and Status Report on the Horned Grebe *Podiceps auritus* Western population, Magdalen Islands population in Canada. From http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_horned_grebe_0809_e.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2009a. COSEWIC Assessment and Status Report on the Yellow Rail *Coturnicops noveboracensis* in Canada. From http://www.registrelep-sararegistry.gc.ca/virtual_sara/files/cosewic/sr_Yellow%20Rail_0810_e.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2014. Search of Database of Wild Species Assessed by COSEWIC. Available at http://www.cosewic.gc.ca/eng/sct0/rpt/csar_fall_2014_e.pdf

ECOSTEM Ltd. 2013. Unpublished preliminary habitat classification mapping provided to Stantec Consulting Ltd. in March 2013.

Francis, C.D., C.P. Ortega, and A. Cruz. 2009. Noise pollution changes avian communities and species interactions. Current Biology 19, 1415–1419.

Godfrey, W. E. 1986. The Birds of Canada, revised edition. National Museum of Natural Sciences, Ottawa. 595 pp.

Government of Canada. 2014. Species at Risk Public Registry. Available at: http://www.sararegistry.gc.ca/species/schedules_e.cfm?id=1.

Keeyask Hydropower Limited Partnership (KHLP). 2009. Keeyask Infrastructure Project Environmental Assessment Report. Report submitted to Environmental Assessment and Licensing Branch, Manitoba Conservation. Available at: http://keeyask.com/wp/wp-content/uploads/2013/06/02-EA-Report-and-Appendices-Part-01.pdf

Manitoba Conservation. 2014. Species Listed Under *The Endangered Species and Ecosystems Act* from Manitoba Conservation and Water Stewardship website: http://www.gov.mb.ca/conservation/wildlife/sar/sarlist.html.

Ralph, C.J., G.R. Guepel, P. Pyle, T.E. Martin and P.F. Desante. 1993. Handbook of field methods for monitoring landbirds. Pacific Southwest Research Station. Albany, California.

Takats, D. L., C. M. Francis, G. L. Holroyd, J. R. Duncan, K. M. Mazur, R. J. Cannings,

W. Harris, D. Holt. 2001. Guidelines for Nocturnal Owl Monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada, Edmonton, Alberta. 32 pp.

Tetr*ES* Consultants Inc. 2004a. Gull (Keeyask) Project Generating Station Avian Field Studies Report 2001. Draft report. Prepared for Manitoba Hydro, Winnipeg, Manitoba.

Tetr*ES* Consultants Inc. 2004b. Gull (Keeyask) Project Generating Station Avian Field Studies Report 2002. Draft report. Prepared for Manitoba Hydro, Winnipeg, Manitoba.

Tetr*ES* Consultants Inc. 2005. Keeyask Project Generating Station Avian Field Studies Report 2003. Draft report. Prepared for Manitoba Hydro, Winnipeg, Manitoba.

Welsh, D.A. 1993. An Overview of the Ontario Forest Bird Monitoring Program. Canadian Wildlife Service Report. Nepean, Ontario.

6.2 PERSONAL COMMUNICATIONS

Duncan, Jim. 2013. Director, Wildlife Branch, Manitoba Conservation and Water Stewardship. Email correspondence with Leane Wyenberg, Stantec Consulting Ltd., Winnipeg, MB, April 16, 2013.

APPENDIX A
GLOSSARY

Density – the number of birds per hectare

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.

Right-of-way (ROW) – 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.

Species Richness – number of different species in an area

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 – Young Regenerating Habitat Type

Photo 2 – Low Vegetation Habitat Type

APPENDIX C
BREEDING-BIRD SURVEY DATA

Table C-1: 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	P
Gavia immer	Common Loon	B	P
Grebes			
Podilymbus podiceps	Pied-billed Grebe	B	P
Podiceps auritus	Horned Grebe	B	P
Podiceps grisegena	Red-necked Grebe	B	P
Pelicans and Cormorants			
Pelecanus erythrorhynchos	American White Pelican	N	P
Phalacrocorax auritus	Double-crested Cormorant	N	P
Herons and Bitterns			
Botaurus lentiginosus	American Bittern	B	P
Ardea herodias	Great Blue Heron	B	P
Vultures			
Cathartes aura	Turkey vulture	N	P
Geese			
Anser albifrons	Greater White-fronted Goose	M	
Anser caerulescens	Snow Goose	M	P
Anser rossii	Ross's Goose	M	
Branta canadensis	Canada Goose	B	P
Swans			
Cygnus columbianus	Tundra Swan	M	P
Ducks			
Anas strepera	Gadwall	B,N	P
Anas americana	American Wigeon	B	P
Anas rubripes	American Black Duck	B	P
Anas platyrhynchos	Mallard	B	P
Anas discors	Blue-winged Teal	B	P
Anas clypeata	Northern Shoveller	B	P
Anas acuta	Northern Pintail	B	P
Anas crecca	Green-winged Teal	B	P

Table C-1: 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 valisinerina	Canvasback	B?,N	
Aythya americana	Redhead	B?,N	
Aythya collaris	Ring-necked Duck	B	P
Aythya marila	Greater Scaup	M	P
Aythya affinis	Lesser Scaup	B	P
Somateria mollissima	Common Eider	M	
Melanitta perspicillata	Surf Scoter	M	P
Melanitta fusca	White-winged Scoter	B	P
Melanitta nigra	Black Scoter	M	P
Bucephala albeola	Bufflehead	B	P
Bucephala clangula	Common Goldeneye	B	P
Lophodytes cucullatus	Hooded Merganser	B	P
Mergus merganser	Common Merganser	B	P
Mergus serrator	Red-breasted Merganser	B	P
Accipters (Hawks and Eagles)			
Pandion haliaetus	Osprey	B	P
Haliaeetus leucocephalus	Bald Eagle	B	P
Circus cyaneus	Northern Harrier	B	P
Accipiter striatus	Sharp-shinned Hawk	B	P
Accipiter gentilis	Northern Goshawk	P	P
Buteo jamaicensis	Red-tailed Hawk	B	P
Buteo lagopus	Rough-legged Hawk	M	P
Aquila chrysaetos	Golden Eagle	M	P
Falcons			
Falco sparverius	American Kestrel	B	P
Falco columbarius	Merlin	B	P
Falco rusticolus	Gyrfalcon	W?	
Falco peregrinus anatum	Peregrine Falcon	M	P
Gulls and Terns			
Stercorarius parasiticus	Parasitic Jaeger	B?	P
Larus philadelphis	Bonaparte's Gull	B	P

Table C-1: 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]**
Larus delawarensis	Ring-billed Gull	B	P
Larus argentatus	Herring Gull	B	P
Sterna caspia	Caspian Tern	B	P
Sterna hirundo	Common Tern	B	P
Sterna paradisaea	Arctic Tern	M	P
Chlidonias niger	Black Tern	?	P
Owls			
Bubo virginianus	Great Horned Owl	P	P
Nyctea scandiaca	Snowy Owl	M,W	P
Surnia ulula	Northern Hawk-Owl	P	P
Strix nebulosa	Great Gray Owl	P	P
Asio otus	Long-eared Owl	B	P
Asio flammeus	Short-eared Owl	B	P
Aegolius funerus	Boreal Owl	P	P
Upland Gamebirds			
Bonasa umbellus	Ruffed Grouse	P	P
Dendragapus canadensis	Spruce Grouse	P	P
Lagopus lagopus	Willow Ptarmigan	W	P
Tympanuchus phasianellus	Sharp-tailed Grouse	P	P
Rails and Cranes			
Coturnicops noveboracensis	Yellow Rail	B	
Porzana carolina	Sora	B	P
Fulica americana	American Coot	B	
Grus canadensis	Sandhill Crane	B	P
Shorebirds			
Pluvialis squatarola	Black-bellied plover	M	P
Pluvialis dominica	Lesser golden-Plover	M	
Charadrius semipalmatus	Semipalmated Plover	M	P
Charadrius vociferus	Killdeer	B	P
Tringa melanoleuca	Greater Yellowlegs	B	P
Tringa flavipes	Lesser Yellowlegs	B	P

Table C-1: 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]**
Tringa solitaria	Solitary Sandpiper	B	P
Actitis macularia	Spotted Sandpiper	B	P
Numenius phaeopus	Whimbrel	M	P
Limosa haemastica	Hudsonian Godwit	M	
Arenaria interpres	Ruddy Turnstone	M	P
Calidris conutus	Red Knot	M	
Calidris alba	Sanderling	M	
Calidris pusilla	Semipalmated Sandpiper	M	P
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?	P
Limnodromus griseus	Short-billed Dowitcher	M	
Gallinago delicate	Wilson’s Snipe	B	P
Phalaropus lobatus	Red-necked Phalarope	M	
Nighthawks			
Chordeiles minor	Common Nighthawk	B	P
Hummingbirds			
Archilochus colubris	Ruby-throated Hummingbird	B,N	
Kingfishers			
Cerlye alcyon	Belted Kingfisher	B	P
Woodpeckers			
Sphyrapicus varius	Yellow-bellied Sapsucker	B,N	P
Picoides pubescens	Downy Woodpecker	P	P
Picoides villosus	Hairy Woodpecker	P	P
Picoides tridactylus	Three-toed Woodpecker	P	P
Picoides arcticus	Black-backed Woodpecker	P	P
Colaptes auratus	Northern Flicker	B	P
Passerines			
Contopus cooperi	Olive-sided Flycatcher	B	P

Table C-1: 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]**
Empidonax flaviventris	Yellow-bellied Flycatcher	B	P
Empidonax alnorum	Alder Flycatcher	B	P
Empidonax minimus	Least Flycatcher	B	P
Lanius excubitor	Northern Shrike	M	P
Vireo solitarius	Blue-headed Vireo	B	P
Vireo philadelphicus	Philadelphia Vireo	B	
Vireo olivaceus	Red-eyed Vireo	B	P
Perisoreus canadensis	Gray Jay	P	P
Pica pica	Black-billed Magpie	P	
Corvus brachyrhynchos	American Crow	P	P
Corvus corax	Common Raven	P	P
Eremophila alpestris	Horned Lark	M,W	
Tachycineta bicolor	Tree Swallow	B	P
Riparia riparia	Bank Swallow	B	P
Hirundo pyrrhonota	Cliff Swallow	B	P
Hirundo rustica	Barn Swallow	B	P
Poecile hudsonicus	Boreal Chickadee	P	P
Sitta canadensis	Red-breasted Nuthatch	P	P
Certhia americana	Brown Creeper	B	P
Troglodytes troglodytes	Winter Wren	B	P
Regulus satrapa	Golden-crowned Kinglet	B	P
Regulus calendula	Ruby-crowned Kinglet	B	P
Catharus minimus	Gray-cheeked Thrush	M	P
Catharus ustulatus	Swainson's Thrush	B	P
Catharus guttatus	Hermit Thrush	B	P
Turdus migratorius	American Robin	B	P
Toxostoma rufum	Brown Thrasher	B?	
Sturnus vulgaris	European Starling	B,I	
Bombycilla garrulus	Bohemian Waxwing	B	
Bombycilla cedrorum	Cedar Waxwing	B	P
Vermivora peregrina	Tennessee Warbler	B	P

Table C-1: 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]**
Vermivora celata	Orange-crowned Warbler	B	P
Vermivora ruficapilla	Nashville Warbler	B?N	P
Dendroica petechia	Yellow Warbler	B	P
Dendroica magnolia	Magnolia Warbler	B	P
Dendroica tigrina	Cape May Warbler	B	P
Dendroica coronata	Yellow-rumped Warbler	B	P
Dendroica fusca	Blackburnian Warbler	B	P
Dendroica palmarum	Palm Warbler	B	P
Dendroica castanea	Bay-breasted Warbler	B	P
Dendroica striata	Blackpoll Warbler	B	P
Mniotilta varia	Black-and-white Warbler	B	P
Seiurus aurocapillus	Ovenbird	B	P
Seiurus noveboracensis	Northern Waterthrush	B	P
Wilsonia pusilla	Wilson's Warbler	B	P
Spizella arborea	American Tree Sparrow	B	P
Spizella passerina	Chipping Sparrow	B	P
Spizella pallida	Clay-colored Sparrow	B?,N	P
Passerculus sandwichensis	Savannah Sparrow	B	P
Ammodramus leconteii	Le Conte's Sparrow	B	P
Passerella iliaca	Fox Sparrow	B	P
Melospiza melodia	Song Sparrow	B	P
Melospiza lincolnii	Lincoln's Sparrow	B	P
Melospiza georgiana	Swamp Sparrow	B	P
Zonotrichia albicollis	White-throated Sparrow	B	P
Zonotrichia leucophrys	White-crowned Sparrow	B	P
Zonotrichia querula	Harris's Sparrow	M	
Junco hyemalis	Dark-eyed Junco	B	P
Calcarius lapponicus	Lapland Longspur	M	
Calcarius pictus	Smith's Longspur	M	
Plectophenax nivalis	Snow Bunting	M	P
Pheucticus ludovicianus	Rose-breasted Grosbeak	B	P

Table C-1: 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]
Agelaius phoeniceus	Red-winged Blackbird	B	P
Euphagus carolinus	Rusty Blackbird	B	P
Quiscalus quiscula	Common Grackle	B	P
Pinicola enucleator	Pine Grosbeak	P	P
Loxia curvirostra	Red Crossbill	P	P
Loxia leucoptera	White-winged Crossbill	P	P
Carduelis flammea	Common Redpoll	P	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**

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 2014

Table C-2: Species' Densities in LSA vs RSA 2014		
Species	**LSA**	**RSA**
	Average Density (birds/ha)	**Average Density (birds/ha)**
Loons		
Common Loon	0.01 ± 0.09	-
Shorebirds		
Killdeer	0.01 ± 0.09	-
Greater Yellowlegs	-	0.09 ± 0.3
Solitary Sandpiper	0.03 ± 0.12	0.02 ± 0.1
Wilson's Snipe	0.04 ± 0.15	0.02 ± 0.1
Woodpeckers		
American Three-toed Woodpecker	0.01 ± 0.09	-
Black-backed Woodpecker	0.01 ± 0.09	0.04 ± 0.14
Northern Flicker	0.04 ± 0.15	0.02 ± 0.1
Passerines		
Yellow-bellied Flycatcher	0.14 ± 0.25	0.02 ± 0.1
Alder flycatcher	0.06 ± 0.17	0.18 ± 0.03
Least Flycatcher	0.01 ± 0.09	-
Blue-headed Vireo	0.01 ± 0.09	-
Gray Jay	0.03 ± 0.12	0.02 ± 0.1
Common raven	0.03 ± 0.18	-
Boreal Chickadee	0.03 ± 0.12	0.02 ± 0.1
Winter Wren	0.01 ± 0.09	-
Golden-crowned Kinglet	-	0.04 ± 0.20
Ruby-crowned Kinglet	0.01 ± 0.09	0.09 ± 0.21
Swainson's Thrush	0.01 ± 0.09	0.07 ± 0.12
Hermit Thrush	0.06 ± 0.21	0.16 ± 0.42
American Robin	0.28 ± 0.29	0.07 ± 0.19
Tennessee Warbler	0.14 ± 0.28	0.04 ± 0.14
Orange-crowned Warbler	0.12 ± 0.29	0.05 ± 0.17
Nashville Warbler	0.04 ± 0.15	-
Yellow Warbler	0.07 ± 0.26	0.04 ± 0.14
Magnolia Warbler	0.01 ± 0.09	-
Yellow-rumped Warbler	0.11 ± 0.23	0.11 ± 0.27
Palm Warbler	0.18 ± 0.32	0.04 ± 0.14
Blackpoll Warbler	0.04 ± 0.15	0.09 ± 0.21
Northern Waterthrush	0.07 ± 0.23	0.20 ± 0.31
Wilson's Warbler	0.01 ± 0.09	0.11 ± 0.27
Chipping Sparrow	0.07 ± 0.19	0.07 ± 0.19
Clay-colored Sparrow	0.03 ± 0.12	-

Table C-3: Spec ies' Densities in LSA vs RSA 2014		
Species	**LSA**	**RSA**
	Average Density (birds/ha)	**Average Density (birds/ha)**
Savannah Sparrow	-	0.04 ± 0.14
Fox Sparrow	0.08 ± 0.2	0.13 ± 0.28
Song Sparrow	-	0.02 ± 0.1
Lincoln's Sparrow	0.14 ± 0.33	0.24 ± 0.35
Swamp Sparrow	0.17 ± 0.37	0.13 ± 0.28
White-throated Sparrow	0.21 ± 0.47	0.16 ± 0.33
White-crowned Sparrow	0.23 ± 0.36	0.24 ± 0.48
Dark-eyed Junco	0.24 ± 0.34	0.38 ± 0.49
Rusty Blackbird	-	0.24 ± 0.56
White-winged Crossbill	0.03 ± 0.18	-

Table C-4: Species Occurrence by Distance from the Access Road in LSA and RSA

Species	LSA						RSA		
	Under 200 m			200 m to 1,000 m			>1,000 m		
	2012	2013	2014	2012	2013	2014	2012	2013	2014
Grebes									
Horned Grebe	✓								
Accipiters (Hawks and Eagles)									
Bald Eagle							✓		
Red-tailed Hawk					✓				
Shorebirds									
Greater Yellowlegs	✓				✓			✓	✓
Lesser Yellowlegs	✓			✓	✓	✓		✓	
Solitary Sandpiper	✓		✓	✓			✓		✓
Spotted Sandpiper				✓					
Wilson's Snipe	✓	✓	✓		✓		✓	✓	✓
Gulls and Terns									
Ring-billed Gull	✓							✓	
Common Tern				✓				✓	
Nighthawks									
Common Nighthawk					✓				
Kingfishers									
Belted Kingfisher				✓					
Woodpeckers									
Hairy Woodpecker	✓								
American Three-toed Woodpecker						✓	✓		✓
Black-backed Woodpecker			✓						✓
Northern Flicker	✓		✓		✓				✓
Passerines									
Olive-sided Flycatcher	✓	✓		✓	✓		✓	✓	✓
Yellow-bellied Flycatcher	✓	✓	✓	✓	✓	✓	✓	✓	✓
Alder Flycatcher	✓	✓	✓	✓	✓	✓	✓	✓	✓
Least Flycatcher		✓			✓	✓	✓	✓	
Blue-headed Vireo		✓		✓	✓	✓	✓	✓	✓
Red-eyed Vireo									✓
Gray Jay	✓	✓		✓	✓	✓	✓	✓	✓
Common Raven			✓						✓
Tree Swallow	✓			✓	✓				✓
Boreal Chickadee	✓	✓	✓						✓
Winter Wren	✓		✓				✓		
Golden-crowned Kinglet									✓
Ruby-crowned Kinglet	✓	✓	✓	✓	✓		✓	✓	✓

Table C-4: Species Occurrence by Distance from the Access Road in LSA and RSA

Species	LSA						RSA		
	Under 200 m			200 m to 1,000 m			>1,000 m		
	2012	2013	2014	2012	2013	2014	2012	2013	2014
Swainson's Thrush	✓	✓		✓	✓	✓	✓	✓	✓
Hermit Thrush	✓	✓		✓	✓	✓	✓	✓	✓
American Robin	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cedar Waxwing	✓			✓			✓		
Tennessee Warbler	✓	✓	✓	✓	✓	✓	✓	✓	✓
Orange-crowned Warbler	✓	✓	✓	✓	✓	✓		✓	✓
Nashville Warbler			✓						
Yellow Warbler	✓	✓	✓	✓		✓		✓	✓
Magnolia Warbler	✓	✓				✓	✓		
Yellow-rumped Warbler	✓	✓	✓	✓	✓	✓	✓	✓	✓
Palm Warbler	✓		✓	✓	✓	✓	✓	✓	✓
Blackpoll Warbler	✓	✓	✓	✓	✓	✓	✓	✓	✓
Black-and-White Warbler	✓								
Northern Waterthrush	✓	✓	✓	✓	✓	✓	✓	✓	✓
Wilson's Warbler	✓	✓	✓	✓	✓		✓		✓
Chipping Sparrow	✓		✓	✓	✓		✓	✓	✓
Clay-colored Sparrow			✓			✓			
Savannah Sparrow	✓			✓					✓
Fox Sparrow	✓		✓	✓	✓	✓	✓	✓	✓
Song Sparrow							✓		✓
Lincoln's Sparrow	✓	✓	✓	✓	✓	✓	✓	✓	✓
Swamp Sparrow	✓	✓	✓	✓	✓	✓	✓	✓	✓
White-throated Sparrow	✓	✓	✓	✓	✓	✓	✓	✓	✓
White-crowned Sparrow			✓			✓		✓	✓
Dark-eyed Junco	✓	✓	✓	✓	✓	✓	✓	✓	✓
Red-winged Blackbird								✓	
Rusty Blackbird	✓	✓		✓	✓		✓	✓	✓
Common Grackle	✓			✓			✓		
Pine Grosbeak	✓								
Red Crossbill	✓							✓	
White-winged Crossbill	✓					✓	✓		
Common Redpoll	✓							✓	

APPENDIX D
DENSITY AND RICHNESS ANALYSES

Introduction

Statistical analyses (e.g., densities, standard deviations, ANOVA, Shapiro-Wilk, etc.), using the 2012, 2013 and 2014 breeding bird point count data were conducted using Microsoft Excel and Mystat V. 12 (Systat 2008).

Data Summaries

Breeding bird surveys were completed at "affected" plots that are within the LSA and "control" plots within the RSA. These plots were categorized by broad vegetation type (ECOSTEM 2013) and distance from disturbance (*i.e.*, road right of way, active borrow pits and camp infrastructure). Due to small sample sizes, the broad vegetation types surveyed were combined into four habitat groups: Black Spruce, Jack Pine, Regenerating, and Low Vegetation. Based on patterns observed in preliminary graphical analysis of the data (Figure D-1), distance from each stop in the LSA to the construction sites was categorized as less than 200 m and 201 m to 1,000 m. The full dataset was assigned 'treatment' categories of Affected (within the LSA – generally less than 1,000 m from the disturbance) and Control (outside of the LSA – generally greater than 1,000 m from the disturbance).

Passerine Density

Passerine Density by Distance from Disturbance within LSA

Exploratory data analysis for plots within the LSA showed that the data was not normally distributed. As such, the data was log-transformed because the untransformed model residuals were not normally distributed. The sample sizes in the two groups are different, which could be affecting the variance of the residuals. While running the ANOVA, a Shapiro-Wilk test for normality was run as an additional approach to examining the normality of the data. If the data was found to be non-normal, a non-parametric test (such as Kruskal-Wallis Rank Sum or Mann-Whitney test) were also used to analyse the data.

Using logged density data there was no significant difference between distance to disturbance categories (table D-1) for 2013 or 2014, but there was a significant difference in 2012, where the densities further from the road (200 m to 1,000 m) were higher.

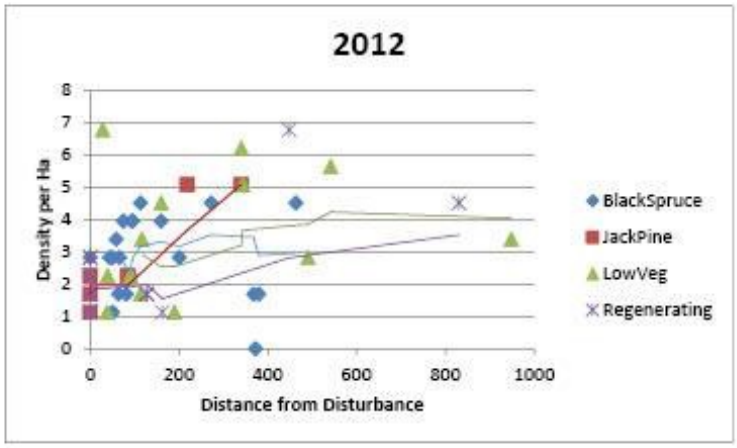
Passerine Density by Habitat classification

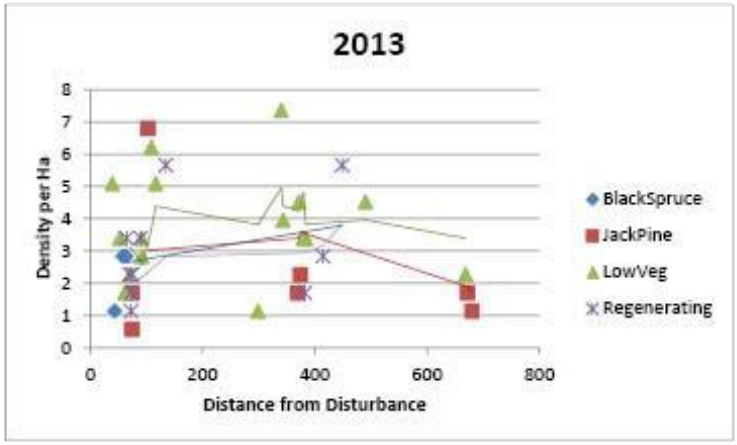
A model testing differences based on habitat type was only run if the ANOVA for distance to disturbance was found to be significant. As for the previous analyses, the linear model based on log transformed data met the model assumptions (equal residual variances between groups, normally distributed residuals) better than the model based on untransformed data. The model showed no significant difference between habitat categories in 2012 (Table D-1), indicating that higher densities observed away from the road (200 m to 1,000 m) were not due to differences in habitat type.

Passerine Density in LSA and RSA

As with the previous models, an ANOVA with log-transformed data was used to test for differences between "affected" plots in the LSA and "control" plots in the RSA (table D-2). A Shapiro-Wilk test for normality was run with the ANOVA. If the data were non-normal, an analogous non-parametric test (e.g. Kruskal-Wallis, Mann-Whitney) was used. In all years of the study, there were no significant differences in density between affected and control plots.

Figure D-1: Exploratory data analysis on Density versus Distance to Disturbance by Habitat Classification





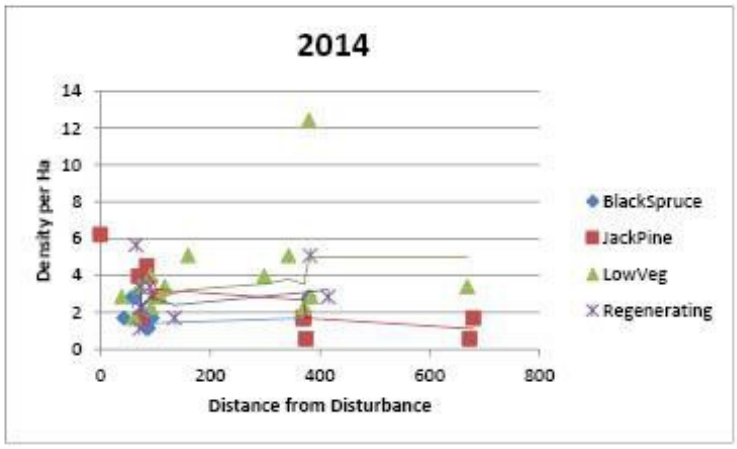


Table D-1: ANOVA Results for Density – Distance to Disturbance Categories 2012-2014								
Year	**Distance**	**Density (birds/ha)**	**Plots**	**Area surveyed (ha)**	**ANOVA***			
					F Statistic	**p- value**		
2012	**<200 m**	**2.45 ± 1.24**	**38**	**67.26**	**10.2**	**0.002**	**Normal**	**ANOVA for habitat categories not**
	200 m- 1,000 m	**3.99 ± 1.88**	**15**	**26.55**				
2013	**<200 m**	**3.06 ± 1.72**	**22**	**38.94**	**0.065**	**0.8**	**Normal**	
	200 m-1,000 m	**3.16 ± 1.78**	**15**	**26.55**				
2014	**<200m**	**2.98 ± 1.35**	**25**	**44.25**	**0.303**	**0.585**	**Normal**	
	200m-1,000m	**3.24 ± 2.89**	**15**	**26.55**				

*If a significant result was noted for distance to disturbance categories, a test was conducted on habitat types

Table D-2: ANOVA Results for Density – Impacted Versus Control Plots 2012-2014								
Year	Location	Density	Plots	Area surveyed (ha)	ANOVA*			
					F Statistic	p- value		
2012	Impacted	2.91 ± 1.58	53	93.81	1.248	0.267	Non-normal	Mann-Whitney U test statistic = 624.5, p = 0.292
	Control	2.54 ± 1.21	28	49.56				
	Yearly Average	2.78 ± 1.47	81	143.37				
2013	Impacted	3.1 ± 1.72	37	65.49	0.241	0.625	Non-normal	Mann-Whitney U test statistic =764.5, p = 0.763
	Control	2.75 ± 1.32	44	77.88				
	Yearly Average	2.91 ± 1.51	81	143.37				
2014	Impacted	3.08 ± 2.03	40	70.8	0.286	0.594	Non-normal	Mann-Whitney U test statistic =702.5, p = 0.335
	Control	3.23 ± 1.51	31	54.87				
	Yearly Average	3.14 ± 1.81	71	125.67				

*If a significant result was noted for distance to disturbance categories, a test was conducted on habitat types

Passerine Richness

Passerine Richness by Distance to Disturbance

As for the density analyses, a linear model (ANOVA) was built to compare richness between distance to disturbance categories using untransformed data. The model residuals were not normally distributed, so the richness data was log-transformed. While running the ANOVA, a Shapiro-Wilk test for normality was run as an additional approach to examining the normality of the data. If the data was found to be non-normal, a non-parametric test (such as Kruskal-Wallis Rank Sum or Mann-Whitney test) was also used to analyse the data.

Using logged density data there was no significant difference between distance to disturbance categories (table D-3) for 2013 or 2014, but there was a significant difference in 2012, where the richness further from the road (200 m to 1,000 m) were higher.

Passerine Richness by Habitat Classification

A model testing differences based on habitat type was only run if the ANOVA for distance to disturbance was found to be significant. As for the previous 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. The model showed no significant difference between habitat categories in 2012 (Table D-3), indicating that higher richness observed away from the road (200 m to 1,000 m) was not due to differences in habitat type.

Passerine Richness in LSA and RSA

As with the previous models, an ANOVA with log-transformed data was used to test for differences between “affected” plots in the LSA and “control” plots in the RSA (table D-4). A Shapiro-Wilk test for normality was run with the ANOVA. If the data were non-normal, an analogous non-parametric test (e.g. Kruskal-Wallis, Mann-Whitney) was used. In all years of the study, there were no significant differences in richness between affected and control plots.

Table D-3: ANOVA Results for Richness - Distance to Disturbance Categories 2012-2014								
Year	**Distance**	**Richness (species/ha)**	**Plots**	**Area surveyed (ha)**	**ANOVA***		**Shapiro-Wilk**	**Notes**
					F Statistic	**p- value**		
2012	<200 m	2.0 ± 0.87	38	67.26	3.646	0.062	Non- normal	Mann-Whitney U test statistic =398.5, p = 0.023; ANOVA for habitat categories not significant (F=0.468, p=0.75)
	200 m-1,000 m	2.7 ± 1.16	15	26.55				
2013	<200 m	2.62 ± 1.31	22	38.94	0.024	0.877	Normal	
	200 m-1,000 m	2.75 ± 1.43	15	26.55				
2014	<200 m	2.58 ± 1.07	25	44.25	0.391	0.535	Non- normal	Mann-Whitney U test statistic = 160.5 p=0.444
	200 m-1,000 m	2.71 ± 2.35	15	26.55				

*If a significant result was noted for distance to disturbance categories, the a test was conducted on habitat types

Table D-4: ANOVA Results for Richness - Impacted Versus Control Plots 2012-2014								
Year	**Location**	**Richness (species/ha)**	**Plots**	**Area surveyed (ha)**	**ANOVA***		**Shapiro-Wilk**	**Notes**
					F Statistic	**p- value**		
2012	LSA	2.21 ± 0.99	53	93.81	0.204	0.623	Non- normal	Mann-Whitney U test statistic =679.0, p = 0.615
	RSA	2.16 ± 0.95	28	49.56				
	Yearly Average	2.2 ± 0.97	81	143.37				
2013	LSA	2.67 ± 1.34	37	65.49	0.585	0.447	Non- normal	Mann-Whitney U test statistic =713.0, p = 0.420
	RSA	2.32 ± 1.11	44	77.88				
	Yearly Average	2.48 ± 1.23	81	143.37				
2014	LSA	2.63 ± 1.64	40	70.8	0.008	0.931	Non- normal	Mann-Whitney U test statistic = 650.0, p = 0.725
	RSA	2.55 ± 1.11	31	54.87				
	Yearly Average	2.59 ± 1.42	71	125.67				

*If a significant result was noted for distance to disturbance categories, the a test was conducted on habitat types

References

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

Systat Software. 2008. Mystat, Free Version of Systat. Cranes Software International Ltd.

APPENDIX E
RECORDING UNIT DATA

Table E-1: KIP Remote Recording Unit Data 2012 - 2014						
Year	**Recorder Site Name**	**UTM Coordinate**		**Target SAR / Habitat**	**SAR Recorded at Site**	**Distance to Disturbance**
		Northing	**Easting**			
2012	R4/A-037A	354308	6253122	Olive-sided flycatcher primary Common nighthawk secondary	Common nighthawk	Within 400 m
2012	R2	352718	6253153	Common nighthawk primary	Common nighthawk Olive-sided flycatcher	Within 400 m
2012	R7	362147	6246419	Common nighthawk primary	None	Within 400 m
2012	R1/B-016	344755	6254069	Rusty blackbird primary Yellow rail secondary	Common nighthawk Olive-sided flycatcher	Outside 400 m
2012	R3/A-019	344903	6250503	Olive-sided flycatcher primary Rusty blackbird primary Rusty blackbird secondary	Common nighthawk Olive-sided flycatcher	Outside 400 m
2012	B-022/R6	355278	6250589	Rusty blackbird primary Common nighthawk secondary	Common nighthawk	Outside 400 m
2013	A-037A	354260	6253064	Olive-sided flycatcher primary Common nighthawk secondary	Common nighthawk	Within 400 m
2013	F-006	351965	6254326	Rusty blackbird primary Olive-sided flycatcher primary Yellow rail secondary	Olive-sided flycatcher	Within 400 m
2013	B-016	344755	6254070	Rusty blackbird primary Yellow rail secondary	Common nighthawk	Outside 400 m
2013	A-019	344925	6250534	Olive-sided flycatcher primary Rusty blackbird primary Rusty blackbird secondary	Common nighthawk Rusty blackbird	Outside 400 m
2013	D-001	353519	6254090	Common nighthawk secondary	Common nighthawk	Outside 400 m

Table E-1: KIP Remote Recording Unit Data 2012 - 2014						
Year	**Recorder Site Name**	**UTM Coordinate**		**Target SAR / Habitat**	**SAR Recorded at Site**	**Distance to Disturbance**
		Northing	**Easting**			
2013	B-022	355303	6250650	Rusty blackbird primary Common nighthawk secondary	Olive-sided flycatcher	Outside 400 m
2013	G-005	360056	6252168	Common nighthawk secondary Rusty blackbird secondary	None	Outside 400 m
2013	F-023A	359016	6249715	Olive-sided flycatcher primary Common nighthawk secondary	Common nighthawk	Outside 400 m
2013	KIPRC4	348940	6258679	Common nighthawk primary	Common nighthawk Rusty blackbird	Outside 400 m
2014	8	361377	6251200	Rusty blackbird primary Common nighthawk secondary Burned in 2013 fire	Common nighthawk Rusty blackbird	Within 400 m
2014	10	354623	6250867	Rusty blackbird primary Yellow rail secondary Burned in 2013 fire	Common nighthawk Rusty blackbird	Within 400 m
2014	D_001	353499	6253714	Common nighthawk secondary Burned in 2013 fire	Common nighthawk	Within 400 m
2014	F_023A	358054	6249750	Olive-sided flycatcher primary Common nighthawk secondary Burned in 2013 fire	Common nighthawk	Within 400 m
2014	R2	352731	6253215	Common nighthawk primary Burned in 2013 fire	Common nighthawk	Within 400 m
2014	6	359311	6254064	Rusty blackbird secondary Common nighthawk secondary Yellow rail secondary	Common nighthawk Rusty blackbird	Outside 400 m

Table E-1: KIP Remote Recording Unit Data 2012 - 2014						
Year	**Recorder Site Name**	**UTM Coordinate**		**Target SAR / Habitat**	**SAR Recorded at Site**	**Distance to Disturbance**
		Northing	**Easting**			
				Burned in 2013 fire		
2014	7	358105	6253689	Common nighthawk secondary Rusty blackbird secondary Burned in 2013 fire	Common nighthawk Rusty blackbird	Outside 400 m
2014	12	348519	6254840	Olive-sided flycatcher primary Burned in 2013 fire	Common nighthawk Rusty blackbird	Outside 400 m
2014	B_016	344759	6254060	Rusty blackbird primary Yellow rail secondary Burned in 2013 fire	Common nighthawk	Outside 400 m
2014	KIPRC_4	348994	6258295	Common nighthawk primary	Common nighthawk Rusty blackbird	Outside 400 m

APPENDIX F
OTHER WILDLIFE DATA

Table F-1: Incidental Observations During 2014 Bird Surveys			
Date	**Easting**	**Northing**	**Wildlife Observed**
23-Jun-2014	349016	6254334	Rusty blackbird (2)
24-Jun-2014	345959	6251081	Rusty blackbird
24-Jun-2014	345728	6250972	Olive-sided flycatcher
24-Jun-2014	345460	6251021	Olive-sided flycatcher
25-Jun-2014	361934	6252433	Rusty blackbird (2)
25-Jun-2014	351064	6257570	Red squirrel
25-Jun-2014	360962	6254720	Boreal chorus frogs (calling)
25-Jun-2014	360777	6254972	Spruce grouse (2)
26-Jun-2014	351148	6256031	Rusty blackbird
27-Jun-2014	353028	6253154	Red squirrel
27-Jun-2014	354274	6253162	Northern goshawk

APPENDIX G
WEATHER CONDITIONS

Table G-1: Weather Observations During 2014 Bird Surveys		
Date	**Survey Type**	**Weather Range During Survey Period**
2-May-14	Nocturnal Owl	2°c; wind northeast Beaufort 2; 30% cloud cover
3-May-14	Nocturnal Owl	-3°c; wind north Beaufort 1; 80% cloud cover; light snow
4-May-14	Nocturnal Owl	-3°c; calm; clear
23-Jun-14	Breeding Bird	5-14°c; wind calm with north/northeasterly gusts to Beaufort 3 by mid-morning; clear
24-Jun-14	Breeding Bird	3-17°c; calm; clear
25-Jun-14	Breeding Bird	12-24°c; calm with northwesterly wind to Beaufort 2 by mid-morning; clear to 40% cloud cover
26-Jun-14	Breeding Bird	14-20°c; calm with westerly wind to Beaufort 2 by mid-morning; 20-60% cloud cover
27-Jun-14	Breeding Bird	14-25°c; calm to wind southwest Beaufort 1; clear
4-Jul-14	Breeding Bird	22-25°c; wind east Beaufort 1; 80% cloud cover
5-Jul-14	Breeding Bird	15-17°c; calm to wind east Beaufort 2; 80-90% cloud cover