MANITOBA–MINNESOTA TRANSMISSION PROJECT

Environmental Monitoring Plan

SHARP-TAILED GROUSE MONITORING REPORT 2021

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Services MB Inc.

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SENSITIVE DATA REDACTED

EXECUTIVE SUMMARY

The sharp-tailed grouse (*Tympanuchus phasianellus*), which typically inhabits grasslands and aspen parkland, can be found in the Manitoba-Minnesota Transmission Project (MMTP) Regional Assessment Area. Like most grassland birds, it has experienced widespread habitat loss through most of the prairies. In spring, sharp-tailed grouse assemble at grassy areas called leks to mate. Males dance, coo, and rattle to attract females. The objectives of sharp-tailed grouse monitoring, outlined in the MMTP Environmental Monitoring Plan, were to evaluate the effects of transmission line installation on grouse at lekking sites and to identify an association between avian and terrestrial predators, sharp-tailed grouse, and transmission lines. Two hypotheses relating to the abundance of grouse and grouse behaviour at lekking sites were tested while controlling for proximity to the Project.

Pre-construction surveys for sharp-tailed grouse conducted in spring 2017 and 2019 were continued in 2020 and 2021, the first and second years after Project construction. With permission from landowners, two trail cameras were set up to photograph sharp-tailed grouse activity at 10 leks. Reconnaissance surveys were then carried out at 63 sites from previous years, where access was not permitted or could not be obtained from landowners. Surveyors scanned for sharp-tailed grouse and listened for indications of mating behaviour or for signs of the species' presence. Observations of ground and avian predators, if any, were recorded including short-eared owl (*Asio flammeus*), which is a species of conservation concern.

Trail camera photos were reviewed and the maximum number of grouse photographed during five-second intervals was recorded, along with the behaviour most often displayed by each. The proportion of time spent engaged in each behaviour was calculated and the maximum number of individuals photographed engaged in reproductive behaviour each day was recorded, with the greatest considered the number of males at each site. Statistical comparisons were made between potentially affected leks (within 1,500 m of the transmission line right-of-way centreline) and reference leks (more than 1,500 m from the centreline) before and after construction to test the effect of the transmission line on the abundance of males at lekking sties, on grouse alert behaviour, and on time spent on-lek.

Of the 74 sites surveyed in spring 2021, 25 were identified as leks and six as potential leks. Four of the leks were new and two were found at sites previously identified only as potential leks. No sharp-tailed grouse were observed at 43 sites. Analyses of sharp-tailed grouse abundance and behaviour from approximately 580,000 trail camera photos indicated that there was no difference in the mean number of male sharp-tailed grouse photographed at potentially affected and reference leks in 2021. There were more males at potentially affected and reference leks after construction than before, but the difference was not significant. There was no difference in the proportion of alert behaviour at potentially affected and reference leks or from the pre- to post-construction period. No difference in the proportion of time grouse were photographed on-lek at potentially affected and reference leks in 2021 was detected, and no change was observed from the pre- to post-construction period. Few predators were observed in 2021; no increase in predator activity at potentially affected leks relative to the pre-construction period was observed.

No significant effects on sharp-tailed grouse near the transmission line have been identified to date, and no unexpected effects have been observed.

STUDY TEAM

Biologists and technicians who designed, participated in, and drafted the survey results included:

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INTRODUCTION

The sharp-tailed grouse (*Tympanuchus phasianellus*), which typically inhabits grasslands and aspen parkland (Taylor 2003), can be found in the Manitoba-Minnesota Transmission Project (the Project) Regional Assessment Area (RAA). Like most grassland birds, it has experienced widespread habitat loss through most of the prairies, as indicated in the *Manitoba–Minnesota Transmission Project Environmental Impact Statement* (EIS). In spring, sharp-tailed grouse assemble at grassy areas called leks to mate (Taylor 2003). Nearby forest or shrubs are important for cover (Taylor 2003). Males dance, coo, and rattle to attract females, which begin to congregate in mid-April, and the mating season ends in June (Taylor 2003).

As outlined in the EIS, anticipated Project effects on sharp-tailed grouse included the temporary loss of some habitat at tower sites and the compaction of vegetation cover along the transmission line right-of-way (ROW). Additionally, grouse are vulnerable to increased rates of predation if birds of prey (raptors) use transmission towers as perches when hunting or nesting near leks (e.g., Dwyer et al. 2020) or if mammalian predators are attracted to the ROW, potentially resulting in in lower populations due to adult mortality and to reduced nest success if incubating females are preyed upon. Alert behaviours by males on-lek may warn incubating females about the presence of predators and displaying males may distract and lure predators away from nests (Phillips 1990). As such, fewer males or less time spent on-lek could result in decreased nest success and a decline in local populations.

As described in Section 4.5.4 of the *Manitoba-Minnesota Transmission Project Environmental Monitoring Plan* (Manitoba Hydro 2019), the primary objectives of sharp-tailed grouse monitoring were to evaluate the effects of transmission line installation on the abundance of males at lekking sties, on sharp-tailed grouse alert behaviour, and on time spent on the lek. A secondary objective was to identify an association between avian and terrestrial predators, sharp-tailed grouse, and transmission lines. General objectives of the Environmental Monitoring Plan were to confirm the nature and magnitude of predicted environmental effects as stated in the EIS, assess the effectiveness of mitigation measures implemented, identify unexpected environmental effects of the Project if they occur, and identify additional mitigation measures to address unanticipated environmental effects if required.

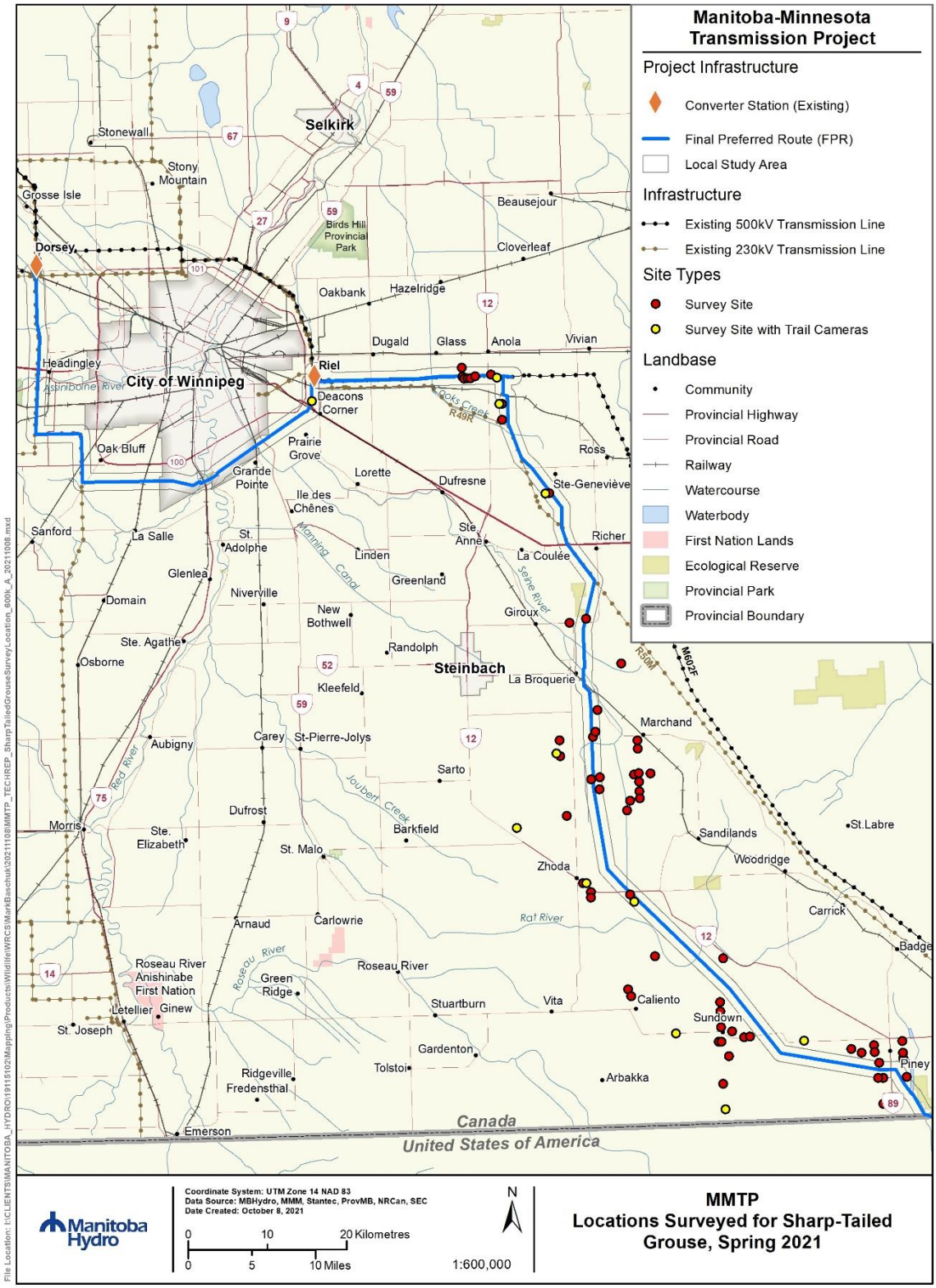
METHODS

Surveys for sharp-tailed grouse conducted in spring 2017, 2019, and 2020 were continued in 2021, the second year after Project construction and the final year of monitoring as described in the Environmental Monitoring Plan. From April 16 to May 4, trail cameras were placed at eight known leks and three new leks after receiving permission from landowners (Map 1). Surveyors walked to the lek, marked its location with a Global Positioning System (GPS) unit, and conducted an active count, where all birds in the area were flushed out and counted. Data were collected in a manner similar to sharp-tailed grouse lek survey protocols previously established by Manitoba

Sustainable Development (B. Kiss 2017, pers. comm.). Two Reconyx™ PM35C31 trail cameras, one facing north and the other west, were set up to photograph sharp-tailed grouse activity (Photo 1). Short metal stakes were driven into the ground, to which trail cameras were fastened with zip ties. Cameras were programmed to take a series of 30 rapid-fire photos every five minutes from 4:00 a.m. until 8:00 a.m.

From April 16 to 29, 2021, reconnaissance surveys were carried out at an additional 63 sites: eight identified as leks in 2020, 38 identified as potential leks in 2020 or as leks or potential leks in 2019 and/or 2017, 15 that were surveyed in 2017 where no grouse were observed, and at two new leks, all where access was not permitted or landowners could not be contacted. Surveys were done from the road between 5:00 a.m. and 8:30 a.m. At each site surveyors scanned for sharp-tailed grouse with binoculars and listened for rattling, cooing, and hooting, which are indicative of mating behaviour, or for clucking, which is only a sign of the species' presence. Each site was surveyed for five minutes and the presence or absence of sharp-tailed grouse, the number heard or observed, their behaviour, and a brief description of the habitat in the area were recorded. Sites where dancing was observed or sounds of mating behaviour were heard were identified as leks, and sites with other indications of sharp-tailed grouse (clucking, observations) were identified as potential leks. Observations of ground and avian predators, if any, were recorded including short-eared owl (*Asio flammeus*), which is a species of conservation concern. Eighteen sites with no sharp-tailed grouse activity that were identified as leks or potential leks in previous survey years were searched two or three times in 2021.

Photo 1: Trail camera at a sharp-tailed grouse lek



Map 1: Locations surveyed for sharp-tailed grouse, spring 2021

Approximately 580,000 trail camera photos were reviewed and the number of grouse and their behaviour were recorded. Cameras at site 464L went missing and were not recovered; no photos from this site were included in the analysis. Photos taken between 5:00 a.m. and 8:00 a.m. at the remaining 10 sites were reviewed in groups, where sharp-tailed grouse behaviours were interpreted, categorized, and summarized for five seconds at a time for the first 15 seconds of each five-minute period, with six to eight photos in each five-second interval. The maximum number of grouse photographed during each five-second interval was recorded, along with the activity most often displayed by each individual (Appendix A). Behaviours were categorized as reproductive (i.e., dancing, rattling, facing off or fighting, copulating), loafing/feeding (resting, feeding, walking, perching), flush (suddenly taking off and flying away from the lek), alert (standing still with head and neck stretched out while looking around), and unknown (behaviour undetermined due to light conditions, obscured camera lens, distant grouse, etc.).

As two cameras were placed at each site, many of the observations of grouse behaviour were duplicated. Data from the camera with the most grouse behaviours each day were included in the analysis (Appendix B). In one instance the same number of behaviours were photographed on both cameras and the west-facing camera was selected. The total number of grouse at each lek could not be definitively determined because grouse entered and left the frame and were not distinguishable from one another. The proportion of time spent engaged in each behaviour was calculated by summing the number of instances of each behaviour at each site and dividing by the sum of all behaviours. The maximum number of individuals photographed engaged in reproductive behaviour each day was recorded, with the greatest considered the number of males at each site. Because the total number of camera operating days was different at the 10 leks, only photos taken over a consistent period (May 11 to 21, 2021) were included in the analyses.

As described in Section 7.3.2.2 of the Environmental Monitoring Plan, the purpose of sharp-tailed grouse lek monitoring was to test two hypotheses:

Hypothesis 1:

- H_0 (null): The installation of the transmission line does not affect the abundance of male sharp-tailed grouse at lekking sites.
- H_1 (alternate): The installation of the transmission line does affect the abundance of male sharp-tailed grouse at lekking sites.

Hypothesis 2:

- H_0 (null): The installation of the transmission line does not increase sharp-tailed grouse alert behaviour or decrease time spent on the lek.
- H_1 (alternate 1): The installation of the transmission line does increase sharp-tailed grouse alert behaviours.
- H_2 (alternate 2): The installation of the transmission line does decrease time spent on the lek by sharp-tailed grouse.

To test the first hypothesis, the number of males at leks within 1,500 m of the ROW centreline (potentially affected) and at leks more than 1,500 m from the ROW centreline (reference) over the 11-day period was compared with statistical *t*-tests. Significance was determined at the $\alpha = 0.05$ level. Results were also compared with those from the pre-construction period.

For the second hypothesis, statistical *t*-tests were performed to compare the mean proportion of each activity to test Project effects on sharp-tailed grouse alert behaviour. The presence or absence of sharp-tailed grouse during the first 15 seconds of each five-minute interval from May 11 to 21, 2021 was noted, and the proportion of time at least one grouse was present was calculated daily. The mean and variance of the daily proportions of time grouse were present on a lek at potentially affected and reference sites were calculated and compared with statistical *t*-tests, to test Project effects on time spent on the lek by sharp-tailed grouse. Comparisons were also made with results from the pre-construction period. Significance was determined at the $\alpha = 0.05$ level.

Trail camera data from Project mammal monitoring studies (Manitoba Hydro unpubl. data) were reviewed for potential predators of sharp-tailed grouse, to relate changes in their numbers to changes in grouse behaviour, if any. Data from 25 trail cameras, 20 within 1,500 m of the ROW (potentially affected) and five further away (reference) were analyzed (Table 1). Because cameras operated for varying periods at different locations, the total number of predators photographed per camera day (number of days the cameras functioned at each site) at potentially affected and reference sites before (2015 to 2019) and after (2020) Project construction was summarized.

Table 1: Trail camera survey effort before (2015 to 2019) and after (2020) Project construction

Period	Site Type	Number of Cameras	Number of Days
Pre-construction	Potentially affected	16	5,852
	Reference	4	1,383
Post-construction	Potentially affected	4	678
	Reference	1	281

RESULTS

Of the 74 sites surveyed in spring 2021, 25 were identified as leks and six were identified as potential leks (Map 2; Appendix C). Four of the leks found in 2021 were new; two were within 1,500 m of the ROW centreline (potentially affected) and two were more than 1,500 m away (reference). Two leks were found at sites previously identified only as potential leks. No sharp-tailed grouse were observed at 43 sites, 20 of which were identified as leks and nine as potential leks in at least one of the three previous survey years (2017, 2019, 2020). No grouse were observed at the remaining 23 sites in any survey year. Up to 25 sharp-tailed grouse were heard or observed at leks and up to three were heard or observed at potential leks (Appendix D).

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Map 2: Sharp-tailed grouse leks and potential leks identified in the study area, spring 2021

A total of 20 potentially affected leks and 38 reference leks were found over the four-year pre-construction (2017 and 2019) and post-construction (2020 and 2021) survey period (Appendix E). Lekking was observed all four years at two reference sites. The greatest number of leks was observed in 2019 (Table 2), including 19 sites where lekking was only observed that year. Leks were identified at three sites in 2017 only; except for the six sites at which lekking was first observed in 2021, the remaining sites were identified as leks during at least two survey years. The same number of leks was found in 2021, the second year after Project construction, as in 2017, before construction began. Five leks were observed both years.

Table 2: Number of sharp-tailed grouse leks identified during reconnaissance surveys, spring 2017, 2019, 2020, and 2021

Period	Year	Number of Sites Surveyed	Number of Leks	Percentage of Sites Where Lekking Observed
Pre-construction	2017	397	25	6
	2019	429	44	10
Post-construction	2020	84	16	19
	2021	74	25	33

During the standardized analysis period of May 11 to 21, 2021, sharp-tailed grouse were photographed at all 10 leks (five potentially affected and five reference) where trail cameras were deployed. Up to 12 individuals were photographed during 15-second intervals (Table 3). Sharp-tailed grouse were photographed each day at all leks during the standardized analysis period.

Table 3: Maximum number of sharp-tailed grouse observed during on-site active counts (April 16–May 4, 2021) and from trail camera photos (May 11–21, 2021)

Site Type	Site	Active Count	Photo Count
Potentially affected	359L	10	7
	369L	31	11
	377L	10	6
	494L	8	10
	495L	8	9
Reference	010L	9	8
	263L	11	12
	461L	8	5
	463L	13	12
	492L	8	4

In 2021, the maximum number of males photographed per day ranged from four to nine at potentially affected sites and from three to eight at reference sites (Table 4). The mean number of males over the standardized analysis period was greatest at potentially affected site 369L. The mean number of male sharp-tailed grouse was greater at potentially affected leks (6.2, standard deviation = 2.3) than reference leks (5.0, standard deviation = 2.1), but the difference was not significant ($t = 2.31$, $p = 0.41$).

Table 4: Number of male sharp-tailed grouse photographed at 10 leks from May 11 to 21, 2021

	Site									
	Potentially Affected					Reference				
Date	359L	369L	377L	494L	495L	010L	263L	461L	463L	492L
May 11	5	6	4	3	4	5	6	2	3	3
May 12	4	9	3	3	8	4	6	2	2	2
May 13	6	8	2	4	4	2	6	2	2	3
May 14	3	3	4	2	8	2	6	2	5	0
May 15	3	5	4	2	6	2	4	2	2	1
May 16	4	5	4	2	4	8	6	1	4	2
May 17	3	7	4	2	6	5	6	2	3	3
May 18	2	8	3	4	8	4	6	3	4	3
May 19	1	4	2	2	0	3	6	3	4	0
May 20	2	4	0	0	3	0	4	0	0	0
May 21	0	6	0	2	5	4	2	1	4	2
Maximum	6	9	4	4	8	8	6	3	5	3
Mean	3.0	5.9	2.7	2.4	5.1	3.5	5.3	1.8	3.0	1.7
Std. dev.	1.7	1.9	1.6	1.1	2.5	2.1	1.3	0.9	1.4	1.3

Trail camera photos were taken at five leks in 2017 and 10 leks in 2019, during the pre-construction period (Wildlife Resource Consulting Services MB Inc. [WRCS] 2018, 2020), and at seven leks in 2020, after construction (WRCS 2021). A total of five leks were at potentially affected sites and nine leks were at reference sites, eight of which surveyed twice over the three-year period (Appendix F). Pre-construction results (2017 and 2019) were combined and compared with combined post-construction (2020 and 2021) results. The mean number of males was greater after construction than before at potentially affected and reference leks, but the differences were not significant (Table 5). No effect of transmission line installation on the abundance of male sharp-tailed grouse at lekking sites was detected.

Table 5: Mean number of male sharp-tailed grouse photographed before (2017 and 2019) and after (2020 and 2021) Project construction

Site Type	2017 & 2019			2020 & 2021				
	Mean	SD	Variance	Mean	SD	Variance	*t*	*p*
Potentially affected	6.60	3.65	13.30	6.75	1.91	3.64	2.20	0.92
Reference	5.00	2.26	5.11	8.22	5.86	31.19	2.23	0.14

In 2021, the greatest proportion of grouse activity photographed was loafing/feeding at nine of 10 leks (Table 6). Reproductive behaviour (Photo 2), which was observed as early as 5:00 a.m. and generally continued until the end of the programmed photo period at 8:00 a.m., was photographed at all 10 leks and was the second-most frequent activity at all but one. Flush and alert behaviours were observed at all leks but there was typically little of each. Flush and alert behaviours were greatest at reference sites 263L and 461L, respectively (Figure 1). When only known behaviours were considered, there was no significant difference between the mean proportion of

reproductive (t = 2.31, p = 0.33), loafing/feeding (t = 2.31, p = 0.17), flush (t = 2.78, p = 0.39), or alert (t = 2.57, p = 0.09) sharp-tailed grouse behaviour at potentially affected vs. reference sites in 2021.

Table 6: Proportion of sharp-tailed grouse behaviours photographed at ten leks from May 11 to 21, 2021

Site Type	Site	Reproductive	Loafing/Feeding	Flush	Alert	Unknown
Potentially affected	359L	0.07	0.34	<0.01	<0.01	0.59
	369L	0.14	0.79	<0.01	0.01	0.05
	377L	0.16	0.82	<0.01	0.01	<0.01
	494L	0.39	0.59	0.01	0.01	<0.01
	495L	0.18	0.82	<0.01	<0.01	0
	Mean	0.19	0.67	<0.01	0.01	0.13
	Std. dev.	0.15	0.21	<0.01	<0.01	0.26
Reference	010L	0.08	0.90	<0.01	0.01	0.01
	263L	0.25	0.65	0.06	<0.01	0.04
	461L	0.07	0.87	0.01	0.04	0.02
	463L	0.03	0.94	<0.01	0.03	<0.01
	492L	0.18	0.80	<0.01	0.02	0.01
	Mean	0.12	0.83	0.02	0.02	0.01
	Std. dev.	0.09	0.11	0.03	0.01	0.01

Photo 2: Dancing sharp-tailed grouse at lek 495L May 14, 2021, with MMTP in background

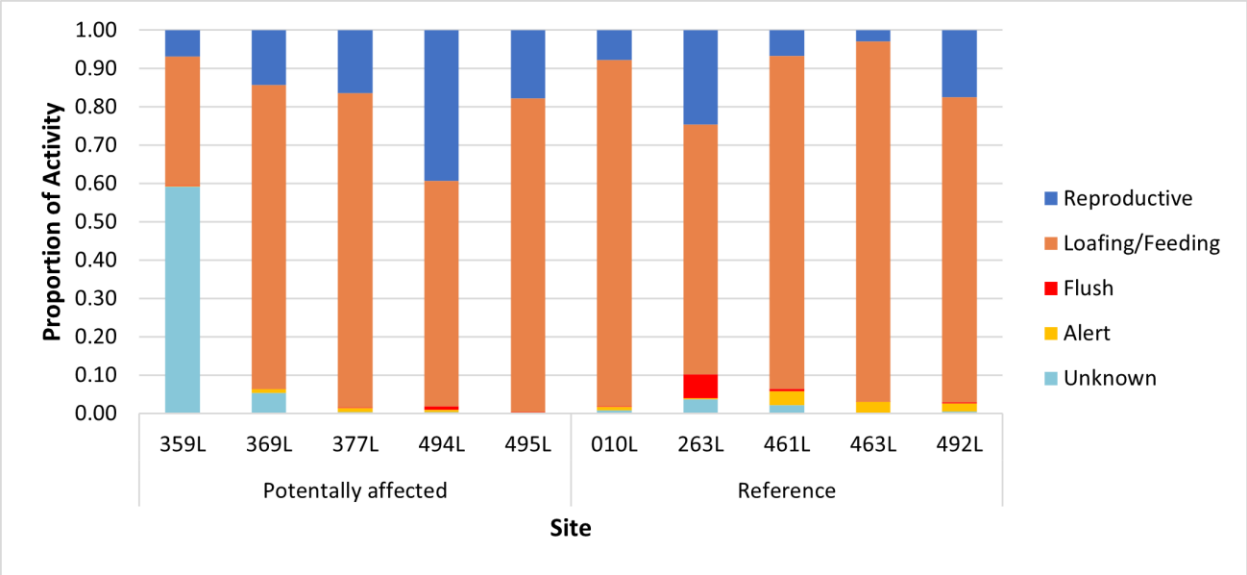

Figure 1: Proportion of sharp-tailed grouse behaviours photographed at 10 leks from May 11 to 21, 2021

There was more reproductive behaviour at potentially affected leks and less reproductive behaviour at reference leks after construction (2020 and 2021) than before (2017 and 2019), but the differences were not significant (Table 7). There was significantly less loafing/feeding behaviour at potentially affected sites after construction than before (t = 2.31, p = 0.02). Reproductive behaviour increased at these sites after construction, but the difference was not significant. There was relatively little flush or alert behaviour at potentially affected and reference sites before and after construction. There was somewhat less alert behaviour at potentially affected sites and somewhat more alert behaviour at reference sites after construction than before. No significant differences were observed, suggesting that the installation of the transmission line did not affect sharp-tailed grouse alert behaviours.

Table 7: Proportion of known sharp-tailed grouse behaviours before (2017 and 2019) and after (2020 and 2021) Project construction

Behaviour	Site Type	2017 & 2019			2020 &2021			t	P^1
		Mean	SD	Variance	Mean	SD	Variance		
Reproductive	Potentially affected	0.13	0.06	<0.01	0.31	0.24	0.06	2.31	0.07
	Reference	0.27	0.12	0.01	0.24	0.19	0.04	2.11	0.69
Loafing/	Potentially affected	0.85	0.04	<0.01	0.60	0.24	0.06	2.31	0.02
Feeding	Reference	0.71	0.13	0.02	0.72	0.18	0.03	2.11	0.88
Flush	Potentially affected	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.20	0.50
	Reference	<0.01	<0.01	<0.01	0.01	0.02	<0.01	2.26	0.49
Alert	Potentially affected	0.02	0.04	<0.01	0.01	<0.01	<0.01	2.78	0.53
	Reference	0.01	0.02	<0.01	0.02	0.03	<0.01	2.10	0.59

On average, sharp-tailed grouse spent the greatest proportion of time on-lek at reference site 010L in 2021 (0.93; Figure 2). The proportion of time on-lek was similar at potentially affected

sites 369L and 377L (0.91 and 0.90, respectively) and at reference site 463L (0.90). Grouse were photographed on-lek at least 59% of the time at all other sites. Grouse were photographed on-lek an average of 84% of the time at potentially affected sites and 79% of the time on-lek at reference sites. The difference was not significant (t = 1.98, p = 0.16).

When compared with the pre-construction (2017 and 2019) period, the mean proportion of time sharp-tailed grouse spent on-lek increased significantly after construction (2020 and 2021) at potentially affected sites and at reference sites (Table 8). There was no difference in mean time spent on-lek at potentially affected vs. reference sites during the pre-construction (t = 1.98, p = 0.06) and post-construction (t = 1.97, p = 0.80) periods. No effect of transmission line installation on time spent on-lek by sharp-tailed grouse was detected.

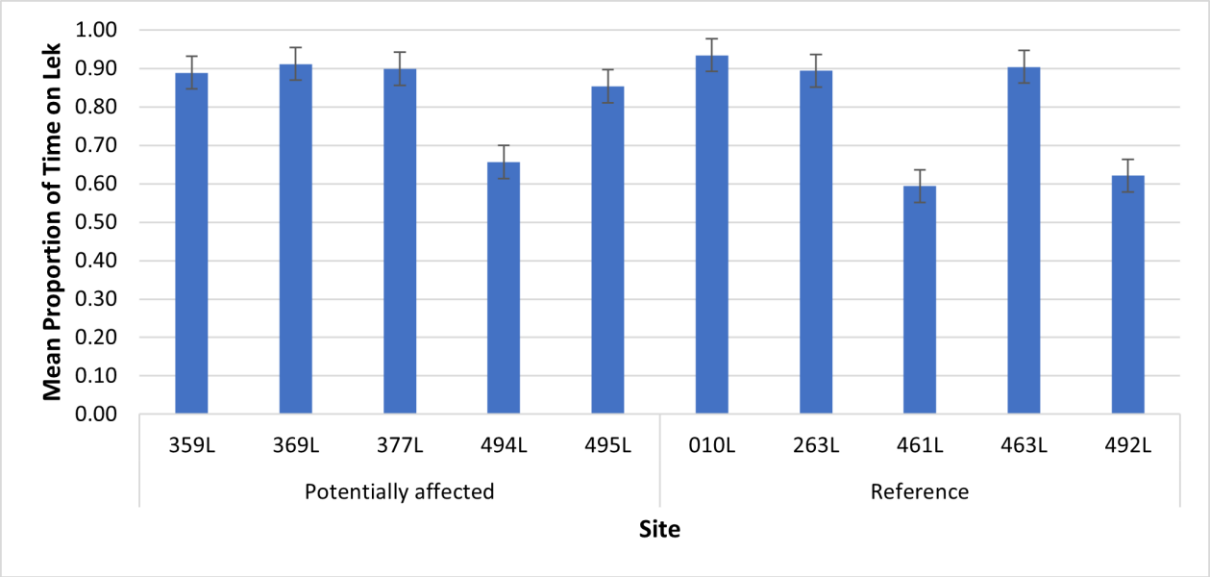

Figure 2: Mean proportion of time sharp-tailed grouse spent on 10 leks from May 11 to 21, 2021

Table 8: Mean proportion of time sharp-tailed grouse spent on-lek before (2017 and 2019) and after (2020 and 2021) Project construction

Site Type	2017 & 2019				2020 & 2021					
	N	Mean	SD	Variance	N	Mean	SD	Variance	*t*	*p*
Potentially affected	5	0.56	0.30	0.09	8	0.68	0.28	0.06	1.98	0.01
Reference	10	0.47	0.25	0.06	9	0.68	0.25	0.08	1.97	<0.01

No avian or ground predators were observed at the leks surveyed in spring 2021. A northern harrier (*Circus cyaneus*) was photographed on a transmission wire at potentially affected site 359L on May 12, outside of the standardized analysis period, but no grouse were photographed that day (Photo 3). At reference site 263L, where the greatest proportion of flush behaviour was observed in 2021, what appeared to be a hawk flew in and perched on a fence post near the lek on April 21, also outside of the standardized analysis period. Two of the seven grouse in the photo

sequence exhibited alert behaviour for a few seconds and then returned to loafing; no grouse were flushed when it appeared. Three males began to dance while the large bird was present (Photo 4). In this single instance where an avian predator was potentially photographed with sharp-tailed grouse in 2021, its presence had no apparent effect on grouse behaviour.

Ground and avian predators were observed at sharp-tailed grouse leks in previous survey years. In 2017, a coyote was photographed at each of two reference leks. No ground or avian predators were detected at potentially affected leks. In 2019, avian predators were observed at one potentially affected lek and two reference leks during the initial survey for sharp-tailed grouse. A northern harrier was photographed at each of two reference leks. No grouse were on-camera at one lek and two grouse were flushed at the other. In 2020, a coyote (*Canis latrans*) was photographed at a potentially affected lek; there was no reaction from the two grouse present. A hawk was photographed at each of two reference leks. Grouse continued dancing at one lek and the birds were absent from the other. A red fox (*Vulpes vulpes)* was also photographed at the latter lek, eliciting alert behaviour from the two grouse present. Where avian and land predators were photographed with grouse, their presence did not appear to affect grouse behaviour that was captured by the camera.

In 2021, white-tailed deer (*Odocoileus virginianus*) were photographed at leks 010L, 263L, 377L, and 463L (Appendix G). American crow (*Corvus brachyrhynchos*), black-billed magpie (*Pica hudsonia*), western meadowlark (*Sturnella neglecta*), Canada goose (*Branta canadensis*), and a gull were also photographed at the lekking sites. No other wildlife or environmental observations were made, including short-eared owl.

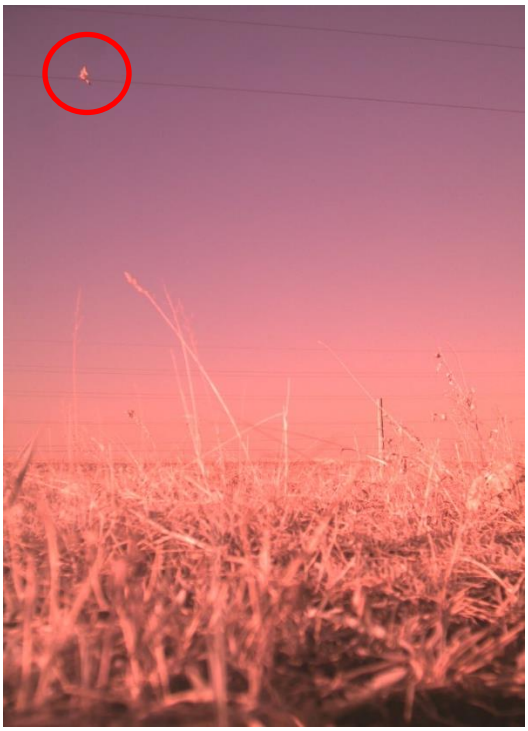

Photo 3: Northern harrier (circled) at lek 359L May 12, 2021

Photo 4: Unknown large bird (circled) perched on fence post near dancing sharp-tailed grouse at lek 263L April 22, 2021

Eleven species of potential predators of sharp-tailed grouse were photographed during mammal monitoring studies from 2015 to 2020 (Manitoba Hydro unpubl. data; Appendix H). The most common in descending order of relative abundance included gray wolf (*Canis lupus*), coyote, and red fox. The number of predators per camera day was considerably greater at potentially affected sites after Project construction than before and was also greater than the number of predators at reference sites (Table 9). At reference sites, the number of predators per camera day was slightly lower after construction than before. In 2019 and 2020, observations of black bear (*Ursus americanus*), gray wolf, and coyote were similar at potentially affected (along the ROW) and reference (>500 m from the ROW) mammal camera sites (Joro Consultants 2021).

Table 9: Predators photographed before (2015 to 2019) and after (2020) Project construction (Manitoba Hydro unpubl. Data)

Period	Site Type	Number of Species	Number Photographed	Number of Predators per Camera Day
Pre-construction	Potentially affected	10	439	0.08
	Reference	8	78	0.06
Post-construction	Potentially affected	8	195	0.29
	Reference	3	12	0.04

DISCUSSION

More sharp-tailed grouse leks were found during the 2021 survey than in 2020, including four that were newly identified and two where only non-reproductive behaviour had been observed in previous survey years (2017, 2019, 2020). In 2021, there was no activity at 20 sites where lekking was observed during at least one of the previous three survey years. Lekking was observed at 14 of these sites during a single year, three in 2017 and 11 in 2019; they were likely temporary satellite leks. The same number of leks (25) was found in 2021, the second year after Project construction, as in 2017, before construction began, including similar numbers of potentially affected leks (11 in 2017 and eight in 2021).

More than 500,000 trail camera photos taken in spring 2021 were analyzed for sharp-tailed grouse behaviour. There was no significant difference in the mean number of male sharp-tailed grouse photographed at potentially affected vs. reference leks during the second year of post-construction monitoring. On average, there were more males at potentially affected and reference leks after construction than before, but the differences were not significant. For Hypothesis 1, the alternative hypothesis was not supported as no effect of transmission line installation on the abundance of male sharp-tailed grouse at lekking sites was detected. The null hypothesis was not rejected.

There was no significant difference in the proportion of alert behaviour at potentially affected vs. reference leks in 2021. When pre-construction and post-construction results were compared, there was no difference in the proportion of alert behaviour at sharp-tailed grouse lekking sites. Alert and flush behaviours comprised a small proportion of sharp-tailed grouse activity at all leks over the four-year survey period. There was no significant difference in the proportion of time grouse were photographed on-lek at potentially affected vs. reference sites in 2021. There was a significant increase in the proportion of time spent on-lek at potentially affected and reference sites between the pre-construction period and the first two years of operation. The installation of the transmission line did not appear to increase sharp-tailed grouse alert behaviour or to decrease time spent on-lek by sharp-tailed grouse. For Hypothesis 2, the alternative hypothesis was not supported and the null hypothesis was not rejected.

Relatively few predators were observed in 2021. A northern harrier and what appeared to be a hawk were each photographed at one lek. No grouse were on-lek when the northern harrier was present, and dancing grouse were not disturbed by the large unidentified bird. No ground predators were photographed in 2021. Avian and/or ground predators were photographed at potentially affected and reference leks in previous survey years. Where predators were photographed with grouse, their presence did not appear to affect grouse behaviour; alert and flush behaviours were each elicited in a single instance. There was no increase in predator activity at potentially affected leks relative to the pre-construction period. No effects of the Project were detected on large predators during mammal monitoring from aerial survey observations; no increase in predator activity was observed in affected areas (Joro Consultants 2021). When trail camera data from mammal studies from 2015 to 2020 (Manitoba Hydro unpubl. data) were summarized, there were considerably more predators at potentially affected sites after Project

construction than before; no increase was observed at reference sites. Analyses of trail camera data from 2019 and 2020 showed that there was little variation in the number of black bear, gray wolf, and coyote observations between potentially affected and reference sites (Joro Consultants 2021). While there was no indication of increased predation on sharp-tailed grouse or effects of predators on their behaviour after construction, an increase in the number of predators near the ROW could affect sharp-tailed grouse in the future.

No significant differences in sharp-tailed grouse abundance or behaviour at potentially affected and reference leks were observed during the first two years of operation monitoring, or at potentially affected leks when compared with the pre-construction period. As such, effects on sharp-tailed grouse near the transmission line were negligible, lower than the EIS prediction of low-magnitude. No mitigation measures have been implemented for sharp-tailed grouse and no unexpected effects have been observed; no additional mitigation measures are required.

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APPENDIX A

Example of spreadsheet used to record sharp-tailed grouse behaviours in trail camera photographs

X18

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Site	Camera	Camera Location	Image Name	Trigger	Date	Time	START	END	NUMBERGROUSE	REPRODUCTIVE	LOAF_FEED	FLUSH	ALERT	UNKNOWNBEHAV	PREDATORS	SCIENTIFIC_NAME	COMMENT
2	010L	N	14 U 709764 5441538	2021-05-12 06-00-00 T 1_30.JPG	T 1/30	5/12/2021	6:00:00 AM	6:00:00 AM	6:00:05 AM	4	3	1	0	0	0	none	na	
3	010L	N	14 U 709764 5441538	2021-05-12 06-00-01 T 2_30.JPG	T 2/30	5/12/2021	6:00:01 AM											
4	010L	N	14 U 709764 5441538	2021-05-12 06-00-01 T 3_30.JPG	T 3/30	5/12/2021	6:00:01 AM											
5	010L	N	14 U 709764 5441538	2021-05-12 06-00-02 T 4_30.JPG	T 4/30	5/12/2021	6:00:02 AM											
6	010L	N	14 U 709764 5441538	2021-05-12 06-00-03 T 5_30.JPG	T 5/30	5/12/2021	6:00:03 AM											
7	010L	N	14 U 709764 5441538	2021-05-12 06-00-03 T 6_30.JPG	T 6/30	5/12/2021	6:00:03 AM											
8	010L	N	14 U 709764 5441538	2021-05-12 06-00-04 T 7_30.JPG	T 7/30	5/12/2021	6:00:04 AM											
9	010L	N	14 U 709764 5441538	2021-05-12 06-00-04 T 8_30.JPG	T 8/30	5/12/2021	6:00:04 AM											
10	010L	N	14 U 709764 5441538	2021-05-12 06-00-05 T 9_30.JPG	T 9/30	5/12/2021	6:00:05 AM											
11	010L	N	14 U 709764 5441538	2021-05-12 06-00-06 T 10_30.JPG	T 10/30	5/12/2021	6:00:06 AM	6:00:06 AM	6:00:10 AM	4	4	0	0	0	0	none	na	
12	010L	N	14 U 709764 5441538	2021-05-12 06-00-06 T 11_30.JPG	T 11/30	5/12/2021	6:00:06 AM											
13	010L	N	14 U 709764 5441538	2021-05-12 06-00-07 T 12_30.JPG	T 12/30	5/12/2021	6:00:07 AM											
14	010L	N	14 U 709764 5441538	2021-05-12 06-00-07 T 13_30.JPG	T 13/30	5/12/2021	6:00:07 AM											
15	010L	N	14 U 709764 5441538	2021-05-12 06-00-08 T 14_30.JPG	T 14/30	5/12/2021	6:00:08 AM											
16	010L	N	14 U 709764 5441538	2021-05-12 06-00-09 T 15_30.JPG	T 15/30	5/12/2021	6:00:09 AM											
17	010L	N	14 U 709764 5441538	2021-05-12 06-00-09 T 16_30.JPG	T 16/30	5/12/2021	6:00:09 AM											
18	010L	N	14 U 709764 5441538	2021-05-12 06-00-10 T 17_30.JPG	T 17/30	5/12/2021	6:00:10 AM											
19	010L	N	14 U 709764 5441538	2021-05-12 06-00-10 T 18_30.JPG	T 18/30	5/12/2021	6:00:10 AM											
20	010L	N	14 U 709764 5441538	2021-05-12 06-00-11 T 19_30.JPG	T 19/30	5/12/2021	6:00:11 AM	6:00:11 AM	6:00:15 AM	4	2	2	0	0	0	none	na	
21	010L	N	14 U 709764 5441538	2021-05-12 06-00-12 T 20_30.JPG	T 20/30	5/12/2021	6:00:12 AM											
22	010L	N	14 U 709764 5441538	2021-05-12 06-00-12 T 21_30.JPG	T 21/30	5/12/2021	6:00:12 AM											
23	010L	N	14 U 709764 5441538	2021-05-12 06-00-13 T 22_30.JPG	T 22/30	5/12/2021	6:00:13 AM											
24	010L	N	14 U 709764 5441538	2021-05-12 06-00-13 T 23_30.JPG	T 23/30	5/12/2021	6:00:13 AM											
25	010L	N	14 U 709764 5441538	2021-05-12 06-00-14 T 24_30.JPG	T 24/30	5/12/2021	6:00:14 AM											
26	010L	N	14 U 709764 5441538	2021-05-12 06-00-15 T 25_30.JPG	T 25/30	5/12/2021	6:00:15 AM											
27	010L	N	14 U 709764 5441538	2021-05-12 06-00-15 T 26_30.JPG	T 26/30	5/12/2021	6:00:15 AM											
28	010L	N	14 U 709764 5441538	2021-05-12 06-00-16 T 27_30.JPG	T 27/30	5/12/2021	6:00:16 AM											
29	010L	N	14 U 709764 5441538	2021-05-12 06-00-16 T 28_30.JPG	T 28/30	5/12/2021	6:00:16 AM											
30	010L	N	14 U 709764 5441538	2021-05-12 06-00-17 T 29_30.JPG	T 29/30	5/12/2021	6:00:17 AM											
31	010L	N	14 U 709764 5441538	2021-05-12 06-00-18 T 30_30.JPG	T 30/30	5/12/2021	6:00:18 AM											
32	010L	N	14 U 709764 5441538	2021-05-12 06-05-00 T 1_30.JPG	T 1/30	5/12/2021	6:05:00 AM	6:05:00 AM	6:05:05 AM	6	2	4	0	0	0	none	na	
33	010L	N	14 U 709764 5441538	2021-05-12 06-05-00 T 2_30.JPG	T 2/30	5/12/2021	6:05:00 AM											
34	010L	N	14 U 709764 5441538	2021-05-12 06-05-01 T 3_30.JPG	T 3/30	5/12/2021	6:05:01 AM											
35	010L	N	14 U 709764 5441538	2021-05-12 06-05-02 T 4_30.JPG	T 4/30	5/12/2021	6:05:02 AM											
36	010L	N	14 U 709764 5441538	2021-05-12 06-05-02 T 5_30.JPG	T 5/30	5/12/2021	6:05:02 AM											
37	010L	N	14 U 709764 5441538	2021-05-12 06-05-03 T 6_30.JPG	T 6/30	5/12/2021	6:05:03 AM											
38	010L	N	14 U 709764 5441538	2021-05-12 06-05-03 T 7_30.JPG	T 7/30	5/12/2021	6:05:03 AM											

APPENDIX B

Camera (north or west facing) used for analysis of grouse behaviour, spring 2021

	Site									
Date	**010L**	**263L**	**359L**	**369L**	**377L**	**461L**	**463L**	**492L**	**494L**	**495L**
May 11	North	West	North	West	North	West	North	West	North	North
May 12	North	West	North	West	North	West	North	West	North	West
May 13	North	West	North	West	West	West	North	North	North	West
May 14	North	West	North	West	North	West	North	West	North	West
May 15	North	West	North	West	West	West	North	West	North	West
May 16	North	West	North	West	West	West	West	North	North	North
May 17	North	West	North	West	West	West	North	West	North	West
May 18	North	North	North	West	North	West	North	West	North	West
May 19	North	West	North	West	North	West	North	West	West	North
May 20	North	North	North	West	North	West	West	West	West	West
May 21	North	West	West	West	West	West	West	North	West	West

APPENDIX C

Locations of sites surveyed in spring 2021

Site Class 2021	Site Type	Site	Approximate Location	Status in 2020	Status in 2019	Status in 2017
Lek	Potentially affected	279L	REDACTED	None	Potential lek	Lek
		359L[1]		Lek	Lek	Potential lek
		367L		Potential lek	Lek	Lek
		369L[1]		Lek	Lek	None
		377L[1]		Lek	Lek	None
		490L		Potential lek	–	–
		494L[1]		–	–	–
		495L[1]		–	–	–
	Reference	006L		None	Lek	Potential lek
		008L		Lek	Lek	Lek
		010L[1]		Lek	Lek	Lek
		012L		–	None	Lek
		093L		None	Lek	None
		117L		Potential lek	Lek	None
		118L		Lek	Potential lek	Potential lek
		167L		Lek	Potential lek	None
		187L		Potential lek	Potential lek	None
		263L[1]		Lek	Lek	None
		461L[1]		Lek	Lek	–
		463L[1]		Lek	Lek	–
		464L[2]		Lek	Lek	–
		475L		Lek	Lek	–
		477L		Potential lek	Lek	–
		492L[1]		–	–	–
		493L		–	–	–

Site Class 2021	Site Type	Site	Approximate Location	Status in 2020	Status in 2019	Status in 2017
Potential lek	Potentially affected	375PL		Potential lek	Lek	Lek
		462PL		Lek	Lek	–
	Reference	112PL		None	Lek	Lek
		146PL		Not surveyed	Not surveyed	None
		406PL		None	Lek	–
		440PL		None	Lek	–
None	Potentially affected	002		Lek	Lek	Lek
		003		Potential lek	Lek	Lek
		042		Lek	Lek	None
		207		None	Lek	None
		208		None	Lek	None
		285		None	Potential lek	None
		349		None	Potential lek	None
		371		Potential lek	Potential lek	None
		473		None	Lek	–
		474		None	Potential lek	Lek
		488		Potential lek	–	–
		489		Potential lek	–	–
	Reference	005		None	Lek	Lek
		007		None	Potential lek	Lek
		090		Potential lek	Lek	Potential lek
		093		None	Lek	None
		158		Lek	Lek	None
		169		Potential lek	Potential lek	None
		179		None	Potential lek	Lek
		182		Potential lek	Potential lek	None
		241		None	Lek	None
		251		None	Lek	Lek
		252		None	Potential lek	Lek

Site Class 2021	Site Type	Site	Approximate Location	Status in 2020	Status in 2019	Status in 2017
None	Reference	299		None	Lek	Potential lek
		301		None	Potential lek	None
		309		None	Lek	None
		362		Potential lek	Lek	None
		476		None	Lek	–
		484		Potential lek	Lek	–
		485		None	Lek	–

1. Trail cameras installed.
2. Trail cameras installed; missing.

APPENDIX D

Number of sharp-tailed grouse at leks and potential leks surveyed in spring 2021

Site Class	Site Type	Site	Number of Birds[1]
Lek	Potentially affected	279L	4
		359L	10
		367L	3
		369L	25
		377L	5
		490L	14
		494L	8
		495L	6
	Reference	006L	5
		008L	5
		010L	9
		012L	9
		093L	11
		117L	7
		118L	5
		167L	1+
		187L	11
		263L	10
		461L	8
		463L	13
		464L	22
		475L	10
		477L	11
		492L	6
		493L	5
Potential lek	Potentially affected	375PL	3
		462PL	1
	Reference	112PL	1
		146PL	3
		406PL	2
		440PL	1

1. "+" indicates minimum number, typically because the number of birds heard was uncertain.

APPENDIX E

Locations of all leks identified in spring 2017, 2019, 2020, and 2021

Site Type	Site	Approximate Location	Status 2017	Status 2019	Status 2020	Status 2021
Potentially affected	002	REDACTED	Lek	Lek	Lek	None
	003		Lek	Lek	Potential lek	None
	042		None	Lek	Lek	None
	114		Lek	Lek	None	–
	130		None	Lek	None	–
	207		None	Lek	None	None
	208		None	Lek	None	None
	268		None	Lek	–	–
	279		Lek	Potential lek	None	Lek
	318		Lek	Lek	–	–
	359		Potential lek	Lek	Lek	Lek
	367		Lek	Lek	Potential lek	Lek
	369		None	Lek	Lek	Lek
	375		Lek	Lek	Potential lek	Potential lek
	377		None	Lek	Lek	Lek
	462		–	Lek	Lek	Potential lek
	473		–	Lek	None	None
	490		–	–	Potential lek	Lek
	494		–	–	–	Lek
	495		–	–	–	Lek
Reference	005		Lek	Lek	None	None
	006		Potential lek	Lek	None	Lek
	007		Lek	Potential lek	None	None
	008		Lek	Lek	Lek	Lek
	010		Lek	Lek	Lek	Lek
	012		Lek	None	–	Lek
	090		Potential lek	Lek	Potential lek	None
	093		None	Lek	None	Lek
	112		Lek	Lek	None	Potential lek
	113		Potential lek	Lek	None	–
	117		None	Lek	Potential lek	Lek
	118		Potential lek	Potential lek	Lek	Lek
	158		None	Lek	Lek	None
	167		None	Potential lek	Lek	Lek
	179		Lek	Potential lek	None	None
	187		None	Potential lek	Potential lek	Lek
	241		None	Lek	None	None
	251		Lek	Lek	None	None

Site Type	Site	Approximate Location	Status 2017	Status 2019	Status 2020	Status 2021
Reference	252		Lek	Potential lek	None	None
	263		None	Lek	Lek	Lek
	269		Potential lek	Lek	None	–
	299		Potential lek	Lek	None	None
	309		None	Lek	None	None
	356		Potential lek	Lek	None	–
	362		None	Lek	Potential lek	None
	406		–	Lek	None	Potential lek
	440		–	Lek	None	Potential lek
	461		–	Lek	Lek	Lek
	463		–	Lek	Lek	Lek
	464		–	Lek	Lek	Lek
	475		–	Lek	Lek	Lek
	476		–	Lek	None	None
	477		–	Lek	Potential lek	Lek
	484		–	Lek	Potential lek	None
	485		–	Lek	None	None
	487		–	Lek	None	–
	492		–	–	–	Lek
	493		–	–	–	Lek

APPENDIX F

Proportion of known sharp-tailed grouse behaviours photographed at 14 leks during pre-construction surveys, 2017, 2019, and 2020

Site Type	Year	Site	Reproductive	Loafing/Feeding	Flush	Alert
Potentially affected	2017	367L	0.14	0.85	<0.01	<0.01
	2019	042L	0.05	0.86	0	0.08
		359L	0.09	0.91	0	<0.01
		369L	0.16	0.84	0	<0.01
		462L	0.20	0.79	0.01	0
	2020	359L	0.43	0.50	<0.01	<0.01
		369L	0.27	0.64	<0.01	<0.01
		462L	0.62	0.14	<0.01	0.01
Reference	2017	010L	0.39	0.59	0.01	<0.01
		112L	0.28	0.72	0	<0.01
		179L	0.13	0.87	0	<0.01
		290L	0.20	0.76	0.01	0.03
	2019	010L	0.47	0.53	<0.01	<0.01
		158L	0.34	0.63	<0.01	0.03
		263L	0.10	0.90	<0.01	<0.01
		461L	0.32	0.62	<0.01	0.06
		463L	0.33	0.65	<0.01	0.02
		464L	0.15	0.84	0.01	0
	2020	158L	0.13	0.69	<0.01	0.07
		263L	0.36	0.60	<0.01	<0.01
		463L	0.50	0.46	0.01	<0.01
		464L	0.52	0.44	<0.01	<0.01

APPENDIX G

Two white-tailed deer with sharp-tailed grouse (red arrow) at lek 377L May 1, 2021

Three white-tailed deer with sharp-tailed grouse (red arrows) at lek 377L May 6, 2021

Two white-tailed deer (circled) with sharp-tailed grouse (red arrows) at lek 377L May 7, 2021

White-tailed deer with dancing sharp-tailed grouse at lek 463L May 11, 2021

APPENDIX H

Potential predators of sharp-tailed grouse photographed during mammal studies 2015 to 2020 (Manitoba Hydro unpubl. data)

Type	Species	Scientific Name	Number of Cameras	Total Number Photographed
Mammal	American black bear	*Ursus amaricanus*	20	541
	American marten	*Martes americana*	4	7
	Canada lynx	*Lynx canadensis*	4	13
	Coyote	*Canis latrans*	13	55
	Fisher	*Pekania pennanti*	3	3
	Gray wolf	*Canis lupus*	12	57
	Raccoon	*Procyon lotor*	1	2
	Red fox	*Vulpes vulpes*	7	28
	Striped skunk	*Mephitis mephitis*	5	15
	Unknown weasel	–	2	2
Bird	Short-eared owl	*Asio flammeus*	1	1

Available in accessible formats upon request