APPENDIX C

+

MANITOBA MINNESOTA TRANSMISSION PROJECT

AMPHIBIAN MONITORING PROGRAM 2020

TECHNICAL REPORT

March 2021

Prepared for:

Manitoba Hydro

By:

North/South Consultants Inc.
Aquatic Environment Specialists
83 Scurfield Blvd.
Winnipeg, Manitoba, R3Y 1G4
Website: www.nscons.ca
Tel.: (204) 284-3366
Fax: (204) 477-4173
E-mail: nscons@nscons.ca

SENSITIVE DATA REDACTED

EXECUTIVE SUMMARY

As part of Manitoba Hydro's Manitoba-Minnesota Transmission Project (MMTP), North/South Consultants Inc. directed studies on the amphibians within the MMTP Study Area in an effort to provide a post-construction description of Northern Leopard Frog and Tiger Salamander populations on and adjacent to the Project Development Area (PDA). Wetland mitigation compliance monitoring was also conducted, as outlined in Sections 4.5.1 of the MMTP Environmental Monitoring Plan (EMP).

Wetlands and streams known to support Northern Leopard Frogs and/or Eastern Tiger Salamanders were prioritized for visits during summer and fall amphibian and water quality surveys. This included wetlands and waterbodies previously surveyed and found to support Northern Leopard Frogs, and any additional wetlands observed to be good habitat. Surveys included amphibian visual encounter surveys (VES) and water quality surveys in the summer and fall, and summer salamander surveys. Spring site visits focusing on anuran call surveys could not be undertaken during the 2020 survey period as construction was not yet complete at the time. The Least Bittern (*Ixobrychus exilis*) was also surveyed incidentally throughout the course of amphibian wetland surveys.

Overall, there did not appear to be any unanticipated project effects on Northern Leopard Frogs, Eastern Tiger Salamanders, or water quality at surveyed amphibian wetland sites within or adjacent to the PDA. Least Bittern was not identified incidentally during the course of amphibian wetland surveys.

During summer VES, Northern Leopard Frogs were observed at two of the 17 sites. Northern Leopard Frogs were also observed incidentally at these sites, outside of the VES, as well as at a third site. Northern Leopard Frog tadpoles were also captured incidentally in funnel traps during salamander surveys at four additional sites. Site 17.5 had both the greatest amphibian species richness and the greatest number of Northern Leopard Frogs observed. During fall VES, Northern Leopard Frogs were observed at nine of the 15 surveyed sites and incidentally at one additional site.

Of the 17 summer sites examined in 2020, seven were also examined during pre-construction surveys in 2017. Northern Leopard Frogs were observed in equal or greater abundance at all seven of the summer sites that were also examined during 2017 pre-construction surveys. Of the 15 fall sites examined in 2020, 12 were also examined during pre-construction surveys in 2014 or 2017. Northern Leopard Frog abundance was variable at fall survey sites, with six sites having greater abundances of Northern Leopard Frogs during pre-construction surveys, and five sites having greater abundance of Northern Leopard Frogs during post-construction surveys. Generally, the river sites had fewer frogs in 2020, while the shallow creek sites had a greater abundance of frogs, suggesting that Northern Leopard Frogs might not have yet migrated to their overwintering sites.

Summer salamander surveys were conducted at 11 wetland ponds. Larval Eastern Tiger Salamanders were caught at REDACTED. Larvae were similar in length and head width, suggesting they are all from the same larval cohort.

Water quality parameters were variable at sites dependent on the size, depth and flow pattern of the waterbodies. During fall surveys, Northern Leopard Frogs were consistently observed at all sites where DO was relatively high. Overall, water quality at sites was similar during pre-construction and post-construction fall surveys.

Construction was compliant with prescribed mitigation and considered to be effective at 23 of the 26 wetlands and water courses assessed in 2020. The wetland buffer was less than 30 m at Sites 17.5 and 19; rutting, erosion, sedimentation were not observed however, and water quality and amphibian abundance did not appear to be affected. It is recommended that a follow up survey be conducted at these sites to monitor for the re-establishment of vegetation. In consideration of the presence of Eastern Tiger Salamanders at Site 19, it is also recommended that a 30 m riparian buffer be established around the wetlands at Site 19 for any future Right of Way maintenance work. Although water quality readings were similar in pre- and post-construction surveys, subsequent water quality measurements are recommended at Site 19 for continued monitoring of turbidity levels. Large woody debris from riparian clearing remained in the channel at Site 27 (Aqua-130). Removal of the debris was recommended and has since been removed. There is no longer a mitigation concern with the watercourse crossing at Site 27.

ACKNOWLEDGEMENTS

Manitoba Hydro is thanked for the opportunity to conduct this project, as well as support with land access, and logistics.

The collection of amphibian samples was authorized by Manitoba Agriculture and Resource Development under terms of wildlife scientific permit # WB24553.

NORTH/SOUTH CONSULTANTS INC. STUDY TEAM

Data Collection

Katarzyna Dyszy

Kim Mandzy

Data Analysis, Report Preparation, and Report Review

Duncan Burnett

Katarzyna Dyszy

Kim Mandzy

Kurt Mazur

Candace Parker

TABLE OF CONTENTS

page

LIST OF TABLES

LIST OF MAPS

LIST OF PHOTOS

LIST OF APPENDICES

1.0 INTRODUCTION

In September 2015, Manitoba Hydro filed an Environmental Impact Statement (EIS) in support of the Manitoba-Minnesota Transmission Project (MMTP), a 500 kilovolt (kV) alternating current (AC) international transmission line in southeastern Manitoba (Map 1). The transmission line originates at the Dorsey Converter Station, located near Rosser, Manitoba, northwest of Winnipeg, and continues south-east to the Manitoba-Minnesota border near Piney, Manitoba, where it connects to Minnesota Power's Great Northern Transmission Line. MMTP also includes additions and upgrades to three associated transmission stations at Dorsey, Riel and Glenboro South.

As outlined in MMTP's Environmental Impact Statement (EIS, Chapter 9) and supporting materials, the MMTP Environmental Protection Plan (EPP) and supporting Environment Monitoring Plan (EMP), amphibians favoring wetland habitat for part or all of their life cycle may be vulnerable to changes in habitat availability as a result of Project activity. The prairie population of the Eastern Tiger Salamander (*Ambystoma tigrinum*) that overlaps MMTP's Local Assessment Area (LAA) (COSEWIC 2013) is listed under the *Species at Risk Act* (SARA) as Endangered. Similarly, the Northern Leopard Frog (*Lithobates pipiens*) is listed SARA as a species of Special Concern within portions of Manitoba (COSEWIC 2009). This species is found in wetlands within the MMTP Development Area (PDA) and surrounding LAA.

In 2014, as part of a multi-disciplinary study, existing conditions were described for amphibians and their habitat in the general region that would support the project (Stantec 2015). Additional pre-construction amphibian surveys were conducted on wetlands and waterbodies within the LAA in 2017 (Dyszy 2018). As outlined in Section 4.2.1 of the EMP, North/South Consultants Inc. (NSC) directed studies in 2020 on amphibians within the MMTP LAA in an effort to provide a post-construction description of Northern Leopard Frog and Eastern Tiger Salamander populations on and adjacent to the MMTP footprint. Sites were also examined to assess mitigation compliance, as outlined in the EMP. This report presents the findings from summer and fall 2020 field surveys conducted on the amphibian communities and associated waterbodies within the MMTP Assessment Area.

2.0 STUDY AREA

MMTP lies within the transitional zone of 3 Ecozones: Boreal Shield, Boreal Plains and Prairie Ecozones. Within the Regional Assessment Area (RAA), ecoregions are represented predominately by Lake Manitoba Plain, Interlake Plain, and Lake of the Woods, with additional smaller representation by Aspen Parkland and Southwest Manitoba Uplands. Within the MMTP LAA, all ecoregions but the Southwest Manitoba Uplands are represented.

The Study Area is primarily restricted to the area overlapping the transmission line and 30m right-of-way corridor, from the Dorsey Converter Station near Rosser Manitoba, west and south of Winnipeg, and south-east of Winnipeg to the Manitoba-Minnesota border near Piney, Manitoba (Map 1). The Study Area also includes some wetlands within the LAA, which extends 1 km on either side of the MMTP centreline. In particular, field studies focused on wetland areas and waterbodies within the LAA.

3.0 METHODS

Amphibian Surveys

As outlined in Sections 4.2.1 and 7.3.1.1 of the EMP, wetlands and streams surveyed for Northern Leopard Frogs and/or Eastern Tiger Salamanders during pre-construction surveys (2014 and 2017) were prioritized for visit during the 2020 summer and fall amphibian and water quality surveys. Spring site visits focusing on anuran call surveys could not be undertaken during the 2020 survey period as construction was not yet complete at the time.

Northern Leopard Frog Surveys

Visual encounter surveys (VES) were completed at accessible sites, where landowner permission had been granted, to identify the presence of Northern Leopard Frogs and their habitat. The VES were conducted during two time periods coincident with important Northern Leopard Frog life history stages: (1) in mid-summer during the post-breeding season when larvae (tadpoles) and emerging young of year are abundant (July 6-11, 2020); and (2) in fall during the pre-hibernation period (September 8-10, 2020).

VES were conducted during daylight hours between 09:00 and 18:15 hrs. Before walking commenced, a start location was established. At this start location a number of attributes were recorded, including: ambient air temperature (°C), water temperature (°C), wind speed (km/hr) and direction, cloud cover (%), and precipitation (%). Ideal survey conditions include water and air temperatures greater than 10°C, calm winds, and precipitation not exceeding light to intermittent rains (Kendell 2002). The VES commenced with two field biologists walking the perimeter of the wetland for a maximum of 20 min, or until the field crew encircled the entire circumference of the wetland, whichever came first. The path walked approximately followed the 2017 VES track and was mapped using a Garmin GPSMAP® 78s handheld GPS. The two field biologists walked side-by-side along the wetland edge, with one individual disturbing the vegetation along the wetland edge and monitoring for amphibians while the other individual monitored and recorded all amphibians observed. Where possible, all amphibians observed during the VES were identified to species and photographed. Observation locations were recorded using a Garmin GPSMAP® 78s handheld GPS. Survey start and end time, start and end location, and shoreline photographs were recorded.

Incidental Sightings

Incidental observations of amphibians were defined as all auditory and visual observations made outside of intended surveys. These included individuals observed before or after VES, during water quality measurements, and those caught incidentally during salamander surveys. All incidental amphibian observations, where possible, were enumerated and identified to species, photographed using a Nikon Coolpix GPS-linked digital camera, and location recorded using a Garmin GPSMAP® 78s handheld GPS.

As outlined in Section 4.5.1 of the EMP, the Least Bittern (*Ixobrychus exilis*) was also surveyed for incidentally throughout the course of amphibian wetland surveys.

Eastern Tiger Salamander Surveys

Larval amphibian surveys were conducted in summer (July 6-11, 2020) at wetland ponds previously surveyed in 2017 as well as additional sites identified as being potentially suitable for salamanders (i.e. no fish, not marshy). At each wetland, a number of physical parameters were collected, including: ambient air temperature (°C), water temperature (°C), wind speed (km/hr) and direction, cloud cover (%), and precipitation (%). Pictures of the wetland, including the location and direction, were taken using a Nikon Coolpix GPS-linked digital camera.

At each wetland, five funnel traps were set along the shoreline. Funnel traps were set in the evening partially submerged in approximately 15-25 cm deep water, baited with 2 glow sticks (Grayson and Roe 2007), left overnight, and checked the following morning. In addition to funnel traps, where conditions permitted, one wetland site was also sampled for larval salamanders (and other amphibians) using a dipnet. Each funnel trap location and dipnet track was recorded using a Garmin GPSMAP® 78s handheld GPS. Where possible, larval amphibians captured were measured for snout-length and total length. Tissue samples were collected from all individuals captured for DNA analysis by the Manitoba Conservation Data Centre. All amphibian larvae captured were identified to species and released.

Water Quality

Water quality parameters were measured at summer and fall VES sites where water was of sufficient depth (i.e., >0.3 m). *In situ* measurements were recorded at three subsample locations spaced along the shore at each VES site. Measurements were made at the interface between emergent and submergent vegetation at 0.30 m from the surface (Archer et al. 2010). *In situ* parameters were measured using an Analite NEP-160 (Turbidity) and the YSI-Pro Plus (pH, Specific Conductance, Water Temperature, and Dissolved Oxygen). During the summer surveys, a water sample was collected at one of the subsample locations at each VES site for laboratory analysis of pH, Turbidity and Total Suspended Solids (TSS). Samples were analyzed at ALS Laboratories in Winnipeg, MB.

Mitigation Compliance Monitoring

Mitigation compliance and effectiveness at amphibian sites was evaluated using a combination of Manitoba Hydro's Daily Inspection Reports, visual on-site inspections during amphibian surveys, and aerial photographs taken at sites during a helicopter fly-over on June 29, 2020. Mitigation measures included both general mitigation prescribed for wetlands in the Construction Environmental Protection Plan (CEnvPP) as well as site specific mitigation prescribed for Environmentally Sensitive Sites (ESS).

Stability of banks and floodplain were visually evaluated, and rutting, slumping, or other damage to the ground noted. The presence of slash/instream debris or disturbed sediment within the buffer was noted, as well as any evidence of erosion. Buffer widths were evaluated and compared to the width prescribed, as well as the amount of vegetation left in the buffer. Water quality results (i.e. turbidity) aided in the evaluation of erosion and sedimentation. Recommendations for further reclamation to meet the prescribed mitigation were made as required. Specific wetland mitigation measures outlined in the CEnvPP are presented in Appendix Table A1-5.

4.0 RESULTS

Amphibian Surveys

Amphibians were observed during VES, as incidental observations during water quality sampling, and during summer salamander surveys. Amphibians recorded included American Toad (*Anaxyrus americanus*; Photo 1), Cope's/Gray Treefrog (*Hyla chrysoscelis/versicolor*; Photo 2), Spring Peeper (*Pseudacris crucifer*), and Wood Frog (*Lithobates sylvaticus*; Photo 3) Observations of the above mentioned species are included in Map 2 and 3 and presented in Table 1 and 2. For the purpose of this report the following results primarily focus on the Northern Leopard Frog (Photo 4) and Eastern Tiger Salamander (larvae; Photo 5) as representatives of the amphibian community.

Northern Leopard Frog Surveys

Visual encounter surveys occurred at 17 sites in the summer and 15 sites in the fall (Map 2 and 3; Photos 6-47). Seven of these sites had suitable summering and overwintering habitat, and were surveyed in both summer and fall. Site 11 was surveyed by both VES and dipnet during summer surveys, and 7US was not surveyed in the fall due to lack of water. Five species of anurans were detected during VES including Northern Leopard Frogs (Table 1).

Northern Leopard Frogs were detected at both summer and fall VES sites. During summer VES, Northern Leopard Frogs were observed at two of the 17 sites (12%; Sites 17.5 and 19); this was similar to 2017 summer VES, where Northern Leopard Frogs were observed at 14% of sites surveyed. Northern Leopard Frog observations represented 22.5% of all anuran observations.

The greatest number of Northern Leopard Frogs observed was at Site 17.5 (n = 13), predominantly young of year, suggesting this site is a Northern Leopard Frog breeding site. Species richness was also highest at Site 17.5 with five anuran species seen during the course of summer surveys, indicating it is a highly productive wetland with suitable habitat for Northern Leopard Frogs and other anuran species. Three Northern Leopard Frogs were observed at Site 19 during VES.

During fall VES, Northern Leopard Frogs were observed at nine of the 15 sites (60%) visited; during 2017 surveys, Northern Leopard Frogs were observed at 40% of sites surveyed. Northern Leopard Frog observations represented 73.5% of all anuran observations during 2020 fall VES. Four or more individuals were observed at Site 6 (n = 6), Site 26 (n = 6), and Site 27 (n = 4), and one or two individuals were observed at Sites 1, 3, 7DS, 9b, 21, and 28 (Table 1).

Of the 17 summer sites examined in 2020, seven were also examined during pre-construction surveys in 2017 (Table 3). Northern Leopard Frogs were found in equal or greater abundance (CPUE) at all seven sites surveyed in 2020 when compared with the pre-construction surveys. Pre-construction surveys focused on spring call surveys as an indicator of Northern Leopard Frog breeding activity, augmented by summer VES; therefore, a more detailed comparison of breeding activity from post-construction will be made in 2021.

Of the 15 fall sites examined in 2020, 12 were also examined during pre-construction surveys in 2014 or 2017 (Table 3). Northern Leopard Frog CPUE was variable at fall survey sites, with six sites having greater abundances of Northern Leopard Frogs during pre-construction surveys, and five sites having greater abundance of Northern Leopard Frogs during post-construction surveys. Generally, the river sites (i.e., Sites 1, 4, 7DS, and 13) had lower VES CPUE in 2020, while the shallow creek sites of Pine Creek (Sites 26, 27, and 28) all had greater CPUE in 2020. This suggests that although dates and water temperatures of pre- and post- construction surveys were comparable between pre- and post-construction surveys, Northern Leopard Frogs might not have yet migrated to their overwintering sites (river sites) and were mostly still present at summering or staging sites in 2020 (shallow creeks).

Incidental Sightings

Incidental observations of amphibians before or after wetland surveys (i.e., VES or water quality measurements), or as caught incidentally during salamander surveys are presented in Table 2.

During summer surveys, Northern Leopard Frogs were observed incidentally at Sites 17.5 and 19, outside of the VES, as well as adjacent to Site 23. Northern Leopard Frog tadpoles were also captured incidentally in funnel traps during salamander surveys (Photo 48) at Sites 10 (n = 1) and 21 (n = 9), 27 (n = 3) and 28 (n = 2); Northern Leopard Frogs were not observed at Site 10 during summer VES.

During fall surveys, Northern Leopard Frogs were observed incidentally at Sites 9a (n = 9), 9b (n = 3), and 27 (n = 1). Northern Leopard Frogs were not observed at Site 9a during fall VES.

Least Bittern was not identified during incidental surveys during the course of amphibian wetland surveys.

Eastern Tiger Salamander Surveys

Summer salamander surveys were conducted at 11 wetland ponds (Map 4 and 5). Thirteen larval salamanders were caught at REDACTED (Table 4). Larvae were similar in length and head width, suggesting they are all from the same larval cohort. Total lengths ranged from 41.5 to 56.5 mm (avg = 49.7 mm), snout-vent length ranged from 22.0 to 30.0 mm (avg = 27.0 mm), and head width ranged from 7.0 to 12.0 mm (avg = 7.4 mm). Identification of Eastern Tiger Salamanders was based on in-field identification, photo confirmation (D. Collicutt, C. Murray pers. comm.) and size at time of year. Mudpuppy larvae (*Necturus maculosus*) are found in permanent waterbodies such as lakes, streams, and rivers, and have 4 digits on their hindfeet as compared to the 5 digits of tiger salamanders. Blue Spotted Salamander larvae (*Ambystoma laterale*) tend to be smaller and thinner than Eastern Tiger Salamander larvae. Tissue samples were collected from all captured individuals and are currently awaiting DNA sequencing by the Manitoba Conservation Data Centre which would confirm the species identification. REDACTED falls within the range of the Eastern Tiger Salamander and is in close proximity to individuals found in the Sandilands and Tolstoi regions (Manitoba Herp Atlas Project 2021). During the MMTP EIS surveys in 2014, one Eastern Tiger Salamander was observed at EIS Site 22 (Stantec 2015). This site is relatively close to REDACTED. Eastern Tiger Salamanders were not found in wetlands sampled on the PDA pre-construction (i.e., in 2017), including at REDACTED.

Water Quality

In situ water quality was measured at 14 of the 17 VES sites in summer and 15 of the 16 fall VES sites (Table 5). Three of the summer VES sites (Sites 14, 15, and 22) were too shallow for water quality measurements during summer surveys. During fall surveys, Site 7US was too shallow for water quality measurements. While all sites were sampled at three locations and measurements represent averages of the three subsamples, Sites 27 and 28 could only be measured at one sub-sample location where water was deep enough for a meter reading. Overall, water quality parameters were variable at sites dependent on the size, depth and flow pattern of the waterbodies and did not appear to differ post-construction when compared to pre-construction.

During summer surveys, water temperatures ranged from 16.7 to 30.6 °C. Dissolved Oxygen (DO) ranged from 0.75 to 16.34 mg/L (avg = 5.74 mg/L; Table 5) of which five sites were above minimum acceptable concentration guidelines set out in the Manitoba Water Quality Standards, Objectives and Guidelines (MWQSOG) for the protection of early life stages of cool-water species (i.e., 6.0 mg/L; MWS 2011). In general, DO can vary in daily and seasonal patterns and decreases with higher temperatures. DO and associated oxygen saturation was exceptionally high at Site WA9 (16.34 mg/L, 212.4%). These measurements were outliers, likely due to unusually high phytoplankton production at the site and were not included when listing the range at sites above. Visual inspection confirmed green water, and lab TSS results are high at this site supporting the idea that DO measurements were high due to phytoplankton production. Specific conductance at sites ranged from 284-920 µS/cm. The pH was circum-neutral to alkaline (6.8-8.6) at sites and was within MWQSOG (i.e., 6.5-9.0, MWS 2011). *In situ* turbidity was generally low (usually <10 NTU) with the exception of Site WA9 (359.7 NTU) and Site WA10 (25.7 NTU).

During fall surveys, average water temperatures ranged from 8.4 to 17.1 °C. The range for fall DO was similar to summer, from 2.89-12.77 mg/L but with a higher relative average than in summer (avg = 7.89 mg/L). This can be attributed to more river sites being sampled during fall surveys, as surveys focused more on overwintering sites. Overall, DO remained above MWQSOG (i.e., 6.0 mg/L; MWS 2011) at 10 of the 15 sites. Specific conductance ranged from 295-1405 µS/cm across all sites, except for Site 2 (the wastewater pond) where specific conductance averaged 2333 µS/cm. The pH was again circum-neutral to alkaline (7.0-8.4) across sites and was within MWQSOG. *In situ* turbidity was highest at the Site 2 (163.4 NTU) and river sites (Sites 1, 3, 4, and 6; Table 5).

Northern Leopard Frogs are known to overwinter in well oxygenated waters that do not freeze to the bottom (Kendell 2002; Russell and Bauer 2000; Alberta Northern Leopard Frog Recovery Team 2005; Hine et al. 1981). During fall surveys, Northern Leopard Frogs were consistently observed during VES at all sites where DO averaged greater than 9.5 mg/L (Sites 1, 3, 6, 7DS, and 27; Table 5). Three of these sites (Sites 1, 3 and 6) had water depths greater than 1 m suggesting Northern Leopard Frogs may be overwintering at these sites. Where water depth at sites was less than 1 m (Sites 7DS and 27), locations further upstream or downstream of the sample site may be deeper and thus suitable as overwintering sites. Northern Leopard Frogs were also observed at some sites with lower DO concentrations (Sites 9b, 21, 26, and 28). Sites 26 and 28 are shallow creeks, but may be connected to deeper more oxygenated sections further upstream or downstream of the sites. Sites 9a and 21 are deep, interconnecting wetlands suitable for overwintering, and low DO readings might be a product of shoreline sampling where fall plant senescence is high.

At REDACTED, where Eastern Tiger Salamander larvae were observed, summer turbidity and TSS was low. Summer DO was low at REDACTED. Little is currently known about the water quality requirements of Eastern Tiger Salamanders but it is presumed the larvae can tolerate a wide range of DO levels, including anoxic conditions, as they have developing lungs and are able to supplement their oxygen uptake by gulping air (Wassersug and Seibert 1975, Heath 2003, Kokesh 2015).

Overall, water quality at sites was similar during pre-construction and post-construction fall surveys (Table 6), with the exception of turbidity at site 7-DS which was considerably higher pre-construction compared to post-construction (194.4 NTU vs 6.6 NTU, respectively); such a high reading could be a result of any number of short-term influences and is considered an outlier. Pre-construction water quality measurements were collected during 2017 spring and fall sampling pre-construction surveys, but spring water quality measurements were not collected during 2020 post-construction surveys as construction was not yet complete at the time. Following spring sampling in 2021, a more detailed comparison of pre- and post-construction water quality will be made. Pre-construction spring and post- construction summer water quality cannot be compared due to variability in water quality related to differences in seasonal water temperatures.

Mitigation Compliance Monitoring

At the time of monitoring, MMTP was fully constructed with all towers and conductors in place. Construction was compliant with prescribed mitigation and considered to be effective at 23 of the 26 wetlands and water courses assessed in 2020. A summary of mitigation compliance for all sites is presented in Table 7 and a list of mitigation measures outlined in the CEnvPP are presented in Appendix Table A1-5.

Site 17.5

The wetland buffer was less than 30 m at the northern corners of Site 17.5 (Photo 31). According to the CEnvPP (Manitoba Hydro 2019; Appendix Table A1-5), natural vegetated buffer areas of 30 m will be established around wetlands and riparian zones will be maintained to the extent possible (EC-8.03). It is recommended that a follow up survey be conducted at the site to monitor for the re-establishment of vegetation. It should be noted that despite the absence of a vegetated buffer, other mitigation measures such as winter construction appear to have maintained the integrity of the wetland; rutting, erosion, and sedimentation were not observed, and water quality and amphibian abundance did not appear to be affected.

Site 19

The wetland buffer was less than 30 m at Site 19 (Photo 35). According to the CEnvPP (Manitoba Hydro 2019; Table A1-5), natural vegetated buffer areas of 30 m will be established around wetlands and riparian zones will be maintained to the extent possible (EC-8.03). It is recommended that a follow up survey be conducted at this site to monitor for the re-establishment of vegetation. In consideration of the presence of Northern Leopard Frogs and Tiger Salamanders, it is also recommended that a 30 m riparian buffer be established around the wetlands at Site 19 for any future Right of Way (RoW) maintenance work. Despite the absence of a vegetated buffer, other mitigation measures such as winter construction appear to have maintained the integrity of the wetland; rutting, erosion, and sedimentation were not observed, and water quality and amphibian abundance did not appear to be affected. Although water quality readings were similar in pre- and post- construction surveys, subsequent water quality measurements are recommended for continued monitoring of turbidity levels.

Site 27 – Aqua-130 Pine Creek

Large woody debris from riparian clearing remained in the channel at Site 27 (Pine Creek, Aqua-130; Photo 49). According to the CEnvPP (Manitoba Hydro 2019) cleared trees and woody debris should not be pushed into (or adjacent) to standing timber, or within the high-water mark of wetlands or waterbodies (EC-8.05, Table A1-5). It was recommended the woody debris be removed from the channel in order to prevent blockage of the watercourse and potentially affecting amphibian staging and overwintering habitat. Based on the above recommendations, the MMTP contractor at the request of Manitoba Hydro removed the woody debris from Aqua-130. Removal of the woody debris from the channel was confirmed by a Manitoba Hydro inspector on August 25, 2020 (Photo 50). There is no longer a mitigation concern with the watercourse crossing at Aqua-130.

Additional Observations

Large woody debris was observed in the channel at Site 3 (Aqua-108; La Salle River; Photo 9). Woody debris was likely the result of natural processes and was not deemed construction related therefore was not considered a non-compliance issue. Minor rutting along the PDA RoW was also noted at three sites but was likely due to local land owner use and was not considered to pose a threat to the nearby amphibian wetland sites and therefore was not considered a mitigation non-compliance issue.

Oily surface sheens were seen within the PDA on the way to sites 9a and 9b (Aqua-312), WA10 (Aqua-334, Photo 51), 22 (Aqua-349), and 23 (Aqua-350), but are likely the result of iron bacteria naturally occurring at the survey sites.

Refuse was present along the PDA RoW around Site 19 (Photo 52). Environmental Requirements require all project areas to be maintained clean and free of rubbish and debris, disposed of at approved facilities (Manitoba Hydro 2019). It is recommended that the refuse be cleared from the area around Site 19.

5.0 REFERENCES

Alberta Northern Leopard Frog Recovery Team. 2005. Alberta Northern Leopard Frog Recovery Plan, 2005-2010. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No.7. Edmonton, AB. 26 pp.

Archer, R.W., P. Christopher, J. Lorenz, and K.E. Jones. 2010. Monitoring and Assessing Marsh Health in the Niagara River Area of Concern. Final Project Report. Prepared for

Environment Canada – Great Lakes Sustainability Fund by Bird Studies Canada, Port Rowan, ON. 47 pp.

COSEWIC. 2013. COSEWIC assessment and status report on the Eastern Tiger Salamander *Ambystoma tigrinum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiii + 53 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

COSEWIC. 2009. COSEWIC assessment and update status report on the Northern Leopard Frog *Lithobates pipiens*, Rocky Mountain population, Western Boreal/Prairie populations and Eastern populations, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 69 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Dyszy, K. 2018. Manitoba-Minnesota Transmission Project. Amphibian and reptile monitoring program 2017. Draft Technical Report. North/South Consultants Inc. vii + 55 pp.

Environment Canada. 2009. Petroleum industry activity guidelines for wildlife species at risk in the prairie and northern region. Canadian Wildlife Service, Environment Canada, Prairie and Northern Region, Edmonton Alberta. 64 pp.

Government of Manitoba. 2018. Species listed under The Endangered Species and Ecosystems Act.Wildlife Branch. Available at: https://www.gov.mb.ca/sd/environment_and_biodiversity/cdc/index.html [accessed February 8, 2021].

Government of Canada. 2020. Species at risk public registry. Available at: https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html [accessed February 8, 2021].

Grayson, K.L. and A.W. Roe. 2007. Glow sticks as effective bait for capturing aquatic amphibians in funnel traps. Herpetological Review. 38 (2): 168-170.

Heath, A. 2003. Cardiac responses of larval and adult tiger salamanders to submergence and emergence. Comparative Biochemistry and Physiology Part A: Physiology. 65(4): 439-444.

Hine, L. L., B. L. Les, and B. F. Hellmich. 1981. Leopard Frog Populations and Mortality in Wisconsin, 1974-76. Department of Natural Resources, Madison, Wisconsin.

Kendell, K. 2002. Survey protocol for the Northern Leopard Frog. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No.43, Edmonton, AB. 30 pp.

Kokesh, B. 2015. The effects of water quality on habitat use of Tiger Salamanders in prairie wetlands. Poster presentation, Undergraduate Research Symposium 2015, Book 7. University of Minnesota.

Manitoba Herp Atlas Project. 2021. Nature North. Species distribution map. Available at: http://www.naturenorth.com/Herps/MHA_Final_Maps.html [accessed February 11, 2021].

Manitoba Hydro. 2019. Manitoba-Minnesota Transmission Project. Construction Environmental Protection Plan. 262 pp.

Manitoba Water Stewardship (MWS). 2011. Manitoba Water Quality Standards, Objectives, and Guidelines. Water Science and Management Branch. Manitoba Water Stewardship. Report 2011-01.

Russell, A.P., and A.M. Bauer. 2000. The amphibians and reptiles of Alberta. A field guide and primer of boreal herpetology, 2nd Edition. University of Calgary Press and University of Alberta Press, Calgary and Edmonton, AB. 279 pp.

Stantec. 2015. Manitoba-Minnesota transmission project. Wildlife and wildlife habitat- technical data report. Prepared for Manitoba Hydro. Report no. 111420050. Winnipeg, Manitoba. 274 pp.

Wassersug, R.J. and E.A. Seibert. 1975. Behavioral responses of amphibian larvae to variation in dissolved oxygen. Copeia. 1975(1): 86-103.

6.0 PERSONAL COMMUNICATIONS

Collicutt, Doug. NatureNorth. Winnipeg, Manitoba. July 2, 2020.

Murray, Colin. Manitoba Conservation Data Centre, Wildlife and Fisheries Branch, Agriculture and Resource Development. Winnipeg, Manitoba. July 21, 2020.

7.0 TABLES

Table 1. Summary of anurans observed (i.e., seen or heard) during Manitoba-Minnesota Transmission Project visual encounter surveys conducted in summer and fall 2020.

Season	Site	Survey Length (mins)	AMTO	C/GRTF	NLFR	SPPE	WOFR	Unid
Summer	8	21	0	0	0	0	0	0
	9a	7	0	0	0	0	0	0
	9b	10	0	0	0	0	0	0
	10	21	0	0	0	0	0	0
	11	20	0	1	0	0	1	0
	14	23	0	0	0	0	0	0
	15	20	0	0	0	0	0	0
	WA9	3	0	0	0	0	0	0
	17.5	20	6	4	13	1	8	0
	18	20	18	0	0	0	0	0
	WA10	20	0	0	0	0	1	0
	19	21	0	0	3	0	0	0
	21	20	1	0	0	0	4	0
	22	20	0	0	0	0	0	0
	23	20	0	0	0	0	1	0
	27	20	0	0	0	0	8	0
	28	20	0	0	0	0	1	0
		Total	**25**	**5**	**16**	**1**	**24**	**0**
Fall	1	20	0	0	1	0	0	0
	2	20	0	0	0	0	0	0
	3	21	0	0	2	0	0	0
	4	20	0	0	0	0	0	0
	6	20	0	0	4	0	0	0
	7DS	21	0	0	2	0	0	0
	7US	N/A	-	-	-	-	-	-
	9a	7	0	0	0	0	0	0
	9b	20	0	0	2	0	0	0
	10	20	0	0	0	0	0	0
	11	20	0	0	0	0	0	0
	13	20	0	0	0	0	1	0
	21	20	0	0	2	0	1	0
	26	20	0	0	6	0	0	0
	27	20	0	0	4	0	2	1
	28	15	0	0	2	0	1	3
		Total	**0**	**0**	**25**	**0**	**5**	**4**
		Grand Total	**25**	**5**	**41**	**1**	**29**	**4**

AMTO: American Toad; C/CGRTF: Cope's/Gray Treefrog; NLFR: Northern Leopard Frog; SPPE: Spring Peeper; WOFR: Wood Frog; Unid: unidentified frog species

Table 2. Summary of anurans observed incidentally during Manitoba-Minnesota Transmission Project wetland surveys (i.e., visual encounter and water quality surveys), and salamander surveys (FN), 2020.

Season	Site	AMTO	C/GRTF	NLFR	SPPE	WOFR	Unid
Summer	8	0	0	0	0	0	0
	9a	0	0	0	0	1	0
	9b	0	0	0	0	2	2
	10	0	0	FN(1)	0	0	0
	11	0	0	0	0	0	0
	14	0	0	0	0	1	0
	15	0	0	0	0	0	0
	WA9	0	0	0	0	0	0
	17.5	0	25, FN(1)	1	0	0	FN(1)
	18	0	0	0	0	0	FN(1)
	WA10	30	0	0	0	0	0
	19	FN(1)	FN(1)	4	0	1	0
	21	0	0	FN(9)	0	0	0
	22	0	0	0	0	0	0
	23	1	0	1	0	1	0
	27	1	0	FN(3)	0	0	0
	28	0	0	FN(2)	0	0	0
	Total	**33**	**27**	**21**	**0**	**6**	**4**
Fall	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	6	0	0	0	0	0	0
	7DS	0	0	0	0	0	0
	7US	0	0	0	0	0	0
	9a	0	0	9	0	0	0
	9b	0	0	3	0	0	0
	10	0	0	0	0	0	0
	11	0	0	0	0	0	0
	13	0	0	0	0	0	0
	21	0	0	0	0	0	0
	26	0	0	0	0	0	0
	27	0	0	1	0	0	0
	28	0	0	0	0	0	0
	Total	**0**	**0**	**13**	**0**	**0**	**0**
Grand Total		**33**	**27**	**34**	**0**	**6**	**4**

AMTO: American Toad; C/CGRTF: Cope's/Gray Treefrog; NLFR: northern leopard frog; SPPE: spring peeper; WOFR: wood frog; Unid: unidentified frog species

Table 3. Summary of catch per unit effort (CPUE[1]) for Northern Leopard Frogs heard and seen within the Manitoba-Minnesota Transmission Project Local Assessment Area, during pre-construction (2014 and 2017) and post-construction (2020) visual encounter surveys.

Survey Period	Site	Pre-Construction		Post-Construction
		2014[2]	2017[3]	2020
Spring	1	0	-	-
	4	0	-	-
	6	0	-	-
	10	N/A	3.5	-
	16	-	0	-
	17.5	-	0	-
	18	-	0	-
	19	-	0	-
	21	-	6.0	-
	22	3.0	0	-
	23	-	0	-
	27	-	0	-
	28	-	0	-
Summer	8	-	-	0
	9a	-	0	0
	9b	-	-	0
	10	N/A	0	0
	11	-	0	0
	14	-	-	0
	15	-	-	0
	WA9	-	-	0
	17.5	-	2.2	39.0
	18	-	0	0
	WA10	-	-	0
	19	-	0	8.6
	21	-	0	0
	22	-	-	0
	23	-	-	0
	27	-	-	0
	28	-	-	0

Table 3. Continued.

Survey Period	Site	Pre-Construction		Post-Construction
		2014[2]	2017[3]	2020
Fall	1	30.0	-	3.0
	2	-	-	0
	3	-	-	5.7
	4	39.0	-	0
	6	3.0	-	12.0
	7DS	-	21.8	5.7
	7US	-	0	-
	9a	-	4.3	0
	9b	-	-	6.0
	10	N/A	0	0
	11	-	3.0	0
	13	-	30.0	0
	21	-	0	6.0
	26	-	0	18.0
	27	-	0	12.0
	28	-	0	8.0

1 - CPUE is defined as the number of NLFRs observed per hour of survey effort; dashes indicate a survey was not conducted
2 - From Stantec 2015; Results from Site 10 were not presented in Stantec 2015
3 - North/South Consultants Inc (Dyszy 2018)

Table 4. Summary of salamander larvae caught in funnel traps at REDACTED, Manitoba-Minnesota Transmission Project, summer 2020.

ID	Total Length (mm)	Snout-Vent Length (mm)	Head Width (mm)
REDACTED	54	30	7
	56.5	30	12
	42	24	7
	52	27.5	7
	48.5	27.5	7
	44	28.5	7
	51.5	30	7
	52.5	26	7
	51	22.5	7
	48	22	7
	54.5	29.5	7
	41.5	28.5	7.2
	50.5	25.5	7

Table 5. Water quality results from *in situ* measurements and laboratory analysis from samples collected in the field during Manitoba-Minnesota Transmission Project amphibian studies in the summer and fall, 2020.

			In-situ measurements (average)						Lab sample results		
Site ID	Sample Date	Sampling Time	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	pH	Turbidity (NTU)	Turbidity (NTU)	TSS (mg/L)	pH
Summer											
8	06-Jul-20	11:13	23.6	3.64	42.9	691	7.66	0.3	0.37	<1.0	8
9a	06-Jul-20	14:30	25.1	2.34	28.4	444	6.8	1.2	0.88	2.5	7.65
9b	06-Jul-20	16:13	26.6	4.34	54.9	503	7.1	1.6	0.89	1.7	7.81
10	07-Jul-20	12:17	27.3	8.31	97.0	920	7.7	1.4	-	-	-
11	07-Jul-20	15:08	28.7	10.39	135.1	288	8.5	8.2	0.9	1.2	8.49
14	07-Jul-20	-	-	-	-	-	-	-	-	-	-
15	08-Jul-20	-	-	-	-	-	-	-	-	-	-
WA9	08-Jul-20	13:31	28.2	16.34	212.4	792	8.6	359.7	123	104	8.35
17.5	08-Jul-20	14:49	29.5	5.84	76.4	284	7.7	1.1	0.97	1.3	8.28
18	08-Jul-20	15:59	30.6	9.32	125.0	569	7.9	4.7	26.4	82.4	8.37
WA10	09-Jul-20	12:43	19.8	1.83	20.2	730	7.3	25.7	5.5	13.5	7.77
19	09-Jul-20	14:10	21.3	0.75	8.5	415	7.3	1.5	1.11	4.8	7.75
21	09-Jul-20	15:55	26.1	3.65	45.0	287	7.4	0.9	0.73	<1.0	7.76
22	10-Jul-20	-	-	-	-	-	-	-	-	-	-
23	11-Jul-20	9:57	16.7	3.70	37.9	359	7.0	1.5	0.5	<1.0	8
27	11-Jul-20	12:43	20.4	7.39	82.1	334	7.4	2.3	1.69	<1.0	8.01
28	11-Jul-20	13:41	19.1	2.48	26.8	416	7.1	0.7	0.83	1.4	7.87
Fall											
1	8-Sep-20	10:32	13.2	11.58	110.4	858	8.3	65.3	-	-	-
2	8-Sep-20	12:43	12.8	6.79	64.8	2333	8.1	163.4	-	-	-
3	8-Sep-20	14:12	14.1	9.65	94.2	1405	8.4	35.3	-	-	-
4	8-Sep-20	15:25	17.1	8.22	85.4	852	8.2	106.8	-	-	-
6	8-Sep-20	17:06	14.4	11.30	110.9	458	8.4	46.7	-	-	-
7DS	8-Sep-20	18:18	14.6	12.77	126.2	709	8.3	6.6	-	-	-
7US	8-Sep-20	N/A	-	-	-	-	-	-	-	-	-

Table 5. Continued.

In-situ measurements									Lab sample results		
Site ID	Sample Date	Sampling Time	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	pH	Turbidity (NTU)	Turbidity (NTU)	TSS (mg/L)	pH
9a	9-Sep-20	11:17	11.2	4.69	42.3	549	7.3	1.3	-	-	-
9b	9-Sep-20	12:16	11.1	3.20	29.3	564	7.0	2.7	-	-	-
10	9-Sep-20	10:05	13.8	5.36	51.9	944	7.7	0.9	-	-	-
11	9-Sep-20	14:26	13.7	9.14	87.9	330	8.0	18.0	-	-	-
13	9-Sep-20	15:32	13.3	9.21	88.2	442	8.1	4.6	-	-	-
21	10-Sep-20	10:22	11.9	7.69	71.0	295	7.4	1.8	-	-	-
26	10-Sep-20	12:14	8.4	2.89	24.6	337	7.1	19.4	-	-	-
27	10-Sep-20	13:36	15.4	11.72	118.2	465	7.6	5.3	-	-	-
28	10-Sep-20	14:03	14.8	4.16	41.4	441	7.3	11.8	-	-	-

Table 6. Pre- and Post-construction fall water quality results from *in situ* measurements during Manitoba-Minnesota Transmission Project amphibian studies.

Site ID	2017						2020					
	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	pH	Turbidity (NTU)	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	pH	Turbidity (NTU)
7-DS	10.9	6.32	56	574	7.36	194.4	14.6	12.77	126.2	709	8.29	6.64
7-US	-	9.57	87.1	545	-	-	-	-	-	-	-	-
9	14.9	3.3	33.4	546	7.11	0.85	11.2	3.95	35.8	557	7.14	2.00
10	15.2	8.49	87.3	854	7.56	0.69	13.8	5.36	51.9	944	7.70	0.94
11	16	7.15	71.2	335.7	6.96	1.09	13.7	9.14	87.9	330	7.98	18.02
13	14.5	9.12	90	441.5	7.73	4.5	13.3	9.21	88.2	442	8.11	4.62
21	14.6	5.65	56.2	375.8	7.33	2.71	11.9	7.69	71.0	295	7.39	1.76
26	14.7	6.95	67.2	357	6.83	6.38	8.4	2.89	24.6	337	7.08	19.41
27	15.1	4.53	44.9	412.5	7.21	7.9	7.6	11.72	118.2	465	7.64	5.32
28	13.1	1.67	15.1	292.7	6.64	3.9	14.8	4.16	41.4	441	7.33	11.76

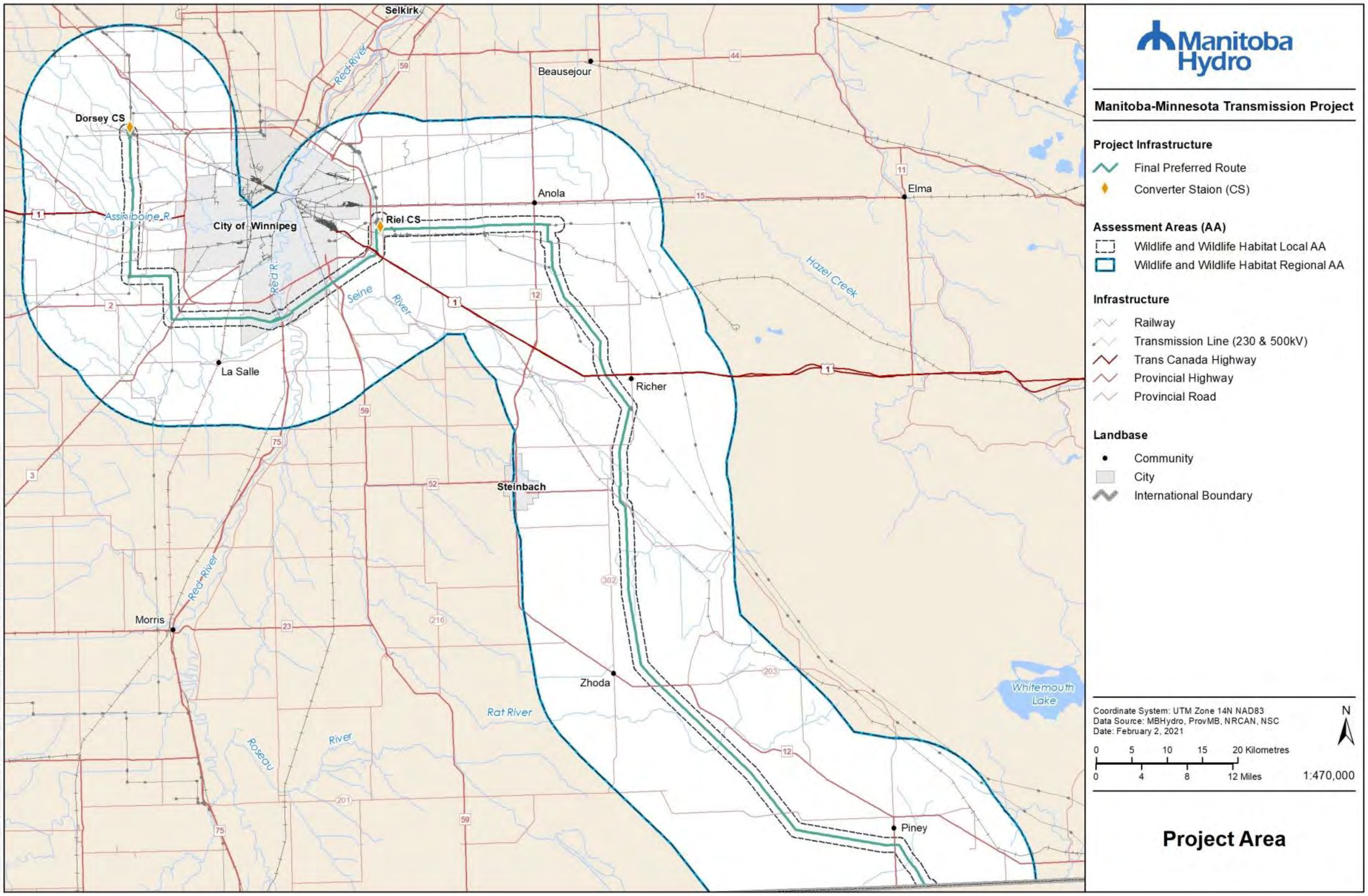
Table 7. Mitigation compliance monitoring at amphibian wetland sites within the Manitoba-Minnesota Transmission Project Development Area, 2020.

Site	ESS ID	Name/Description	Buffer	Rutting	Erosion	Instream Debris	Comments
1	Aqua-103	Assiniboine River	YES	NO	NO	NO	Minor rutting seen along RoW, undetermined whether from construction or from recreational use
2	N/A	wastewater pond	N/A	NO	NO	NO	N/A
3	Aqua-108	La Salle River	YES	NO	NO	NO	Large woody debris present instream at RoW; likely from natural sources
4	Aqua-109	Red River	YES	NO	NO	NO	N/A
6	Aqua-111	Seine River Siphon/Bypass	YES	NO	NO	NO	N/A
7DS	Aqua-112	Seine River Diversion (Old Prairie Grove Drain)	YES	NO	NO	NO	N/A
7US	Aqua-112	Seine River Diversion (Old Prairie Grove Drain)	YES	NO	NO	NO	N/A
8	Aqua-115	Edie Creek	YES	NO	NO	NO	N/A
9a	Aqua-312	Medium Wetlands	YES	NO	NO	NO	Oily sheen seen on way to site, possibly result of naturally produced iron bacteria
9b	Aqua-312	Medium Wetlands	YES	NO	NO	NO	Oily sheen seen on way to site, possibly result of naturally produced iron bacteria
10	N/A	Large Wetland	N/A	NO	NO	N/A	Site is just outside PDA
11	N/A	Large Wetland Lake	N/A	N/A	N/A	N/A	Site is outside the PDA
13	Aqua-123	Seine River at golf course	YES	NO	NO	NO	N/A
14	Aqua-202	Small Wetland/Fen/Aquifer	YES	NO	NO	NO	N/A
15	Aqua-329	Small Wetland	YES	NO	NO	NO	N/A
WA9	N/A	Cattle Dugout	YES	NO	NO	NO	N/A
17.5	N/A	Wetland	**NO**	NO	NO	NO	Buffer on the NE & NW corners <30m
18	Aqua-333A	Small wetland	YES	NO	NO	N/A	Site is just outside of RoW
WA10	N/A	Shallow Wetland	YES	NO	NO	NO	Oily sheen at site, possibly result of naturally produced iron bacteria
19	N/A	Small Shallow Wetland	**NO**	NO	NO	NO	No buffer observed around wetlands; refuse observed at site

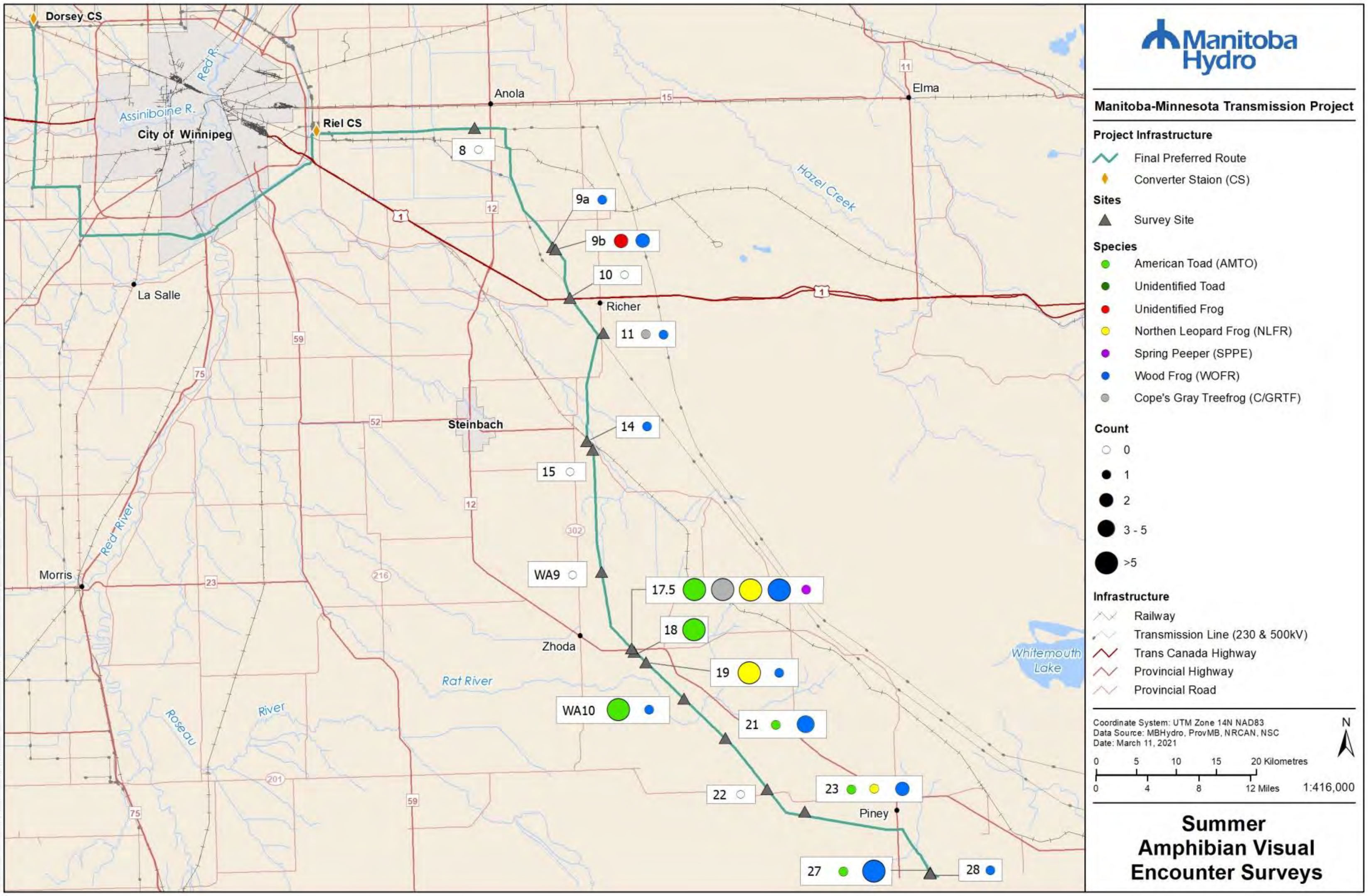
Table 7. Continued.

Site	ESS ID	Name/Description	Buffer	Rutting	Erosion	Instream Debris	Comments
21	Aqua-344	Large Wetland (Sundown Bog)	YES	NO	NO	N/A	Wetland is just outside PDA
22	Aqua-349 & Aqua-127	Large Shallow Wetland (Sundown Bog) & Drain	YES	NO	NO	NO	Oily sheen at site, possibly result of naturally produced iron bacteria
23	Aqua-350	Medium Wetland (Sundown Bog)	YES	NO	NO	NO	Oily sheen at site, possibly result of naturally produced iron bacteria
26	N/A	Pine Creek	N/A	N/A	N/A	N/A	Site is outside PDA
27	Aqua-130	Pine Creek	YES	NO	NO	**YES**	Large woody debris was present instream, removed Aug 2020; compliance issue has been resolved.
28	Aqua-131	Pine Creek	YES	NO	NO	NO	N/A

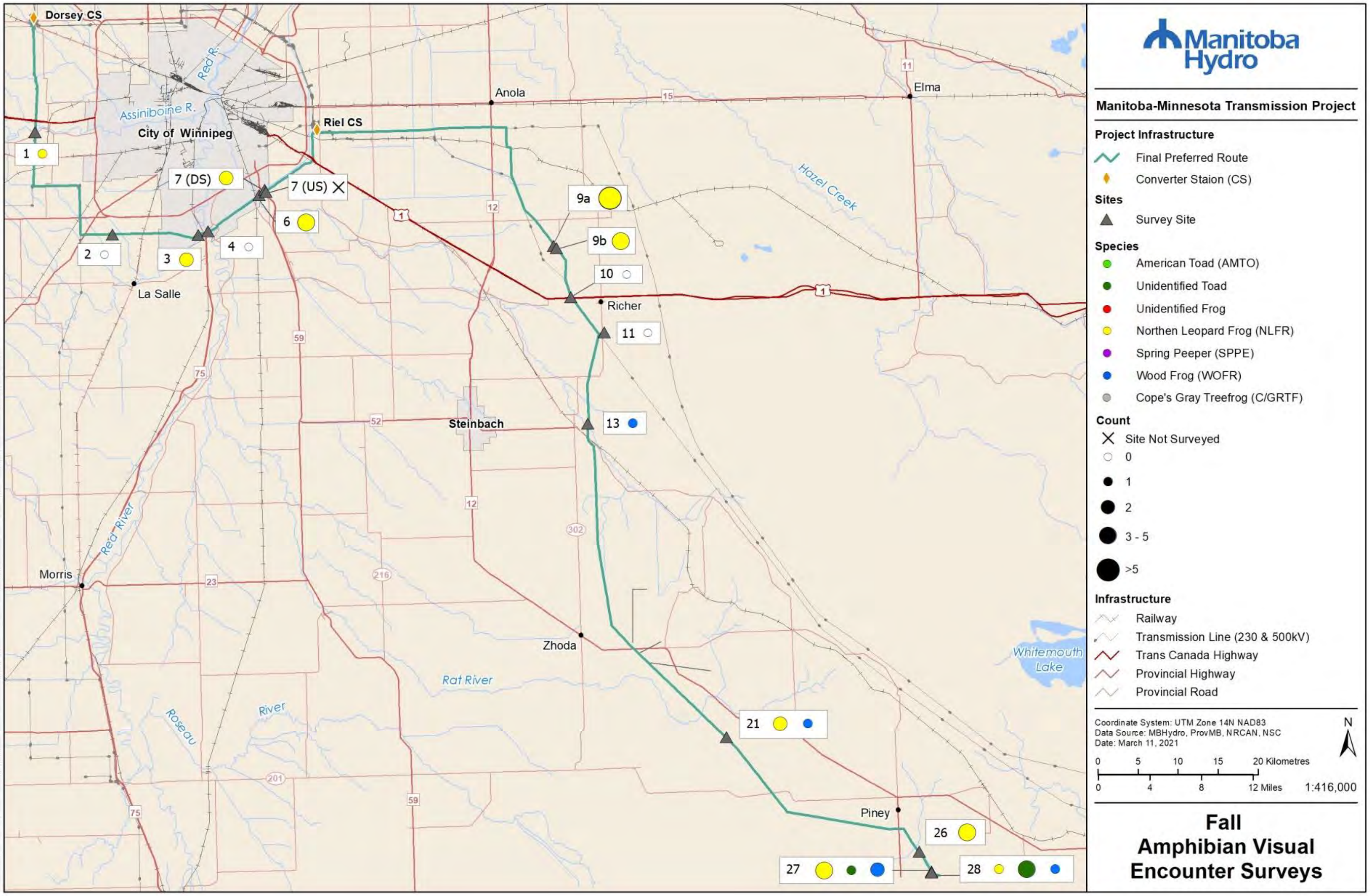
8.0 MAPS



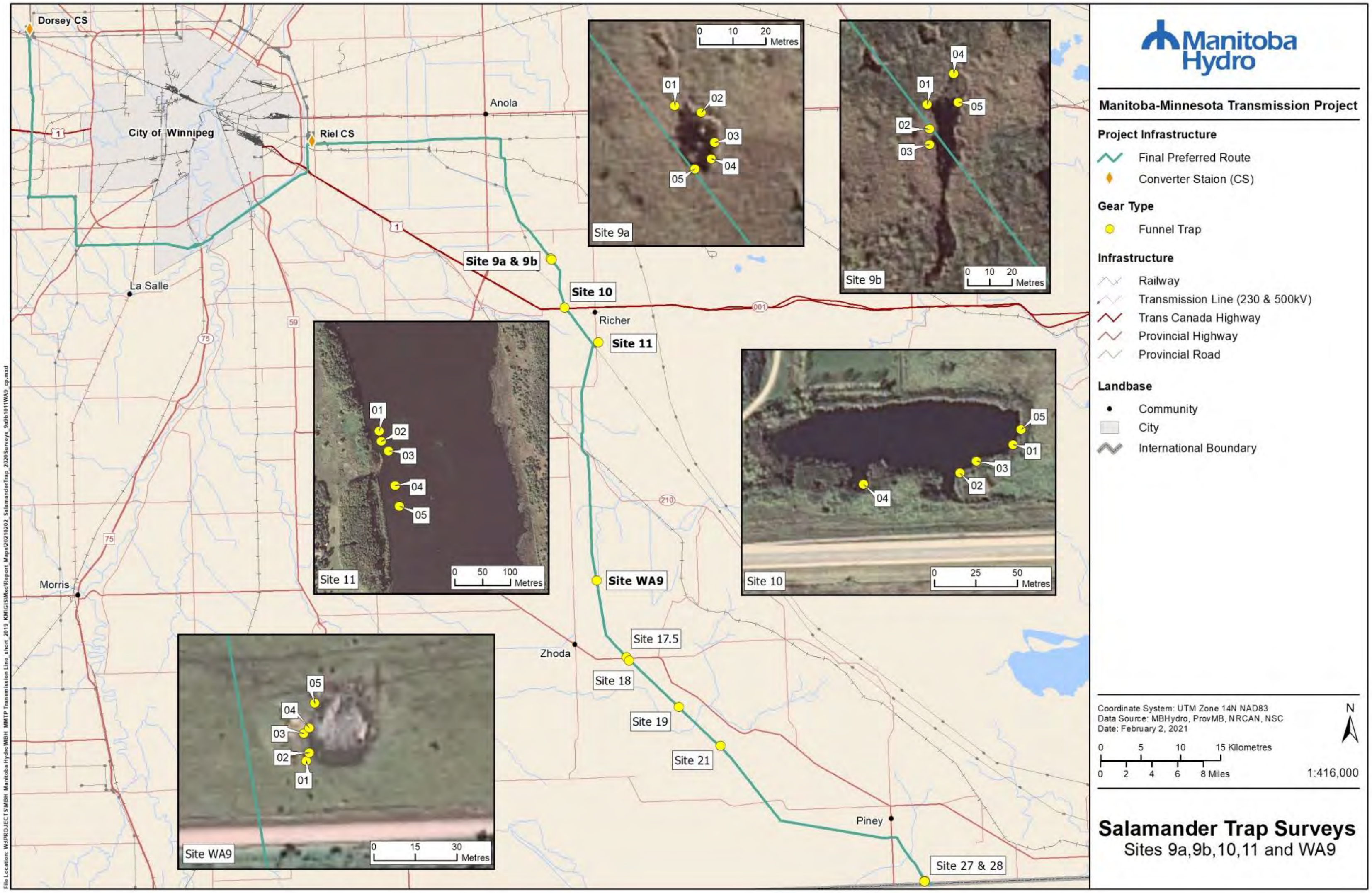
Map 1. The Manitoba-Minnesota Transmission Project Study Area.



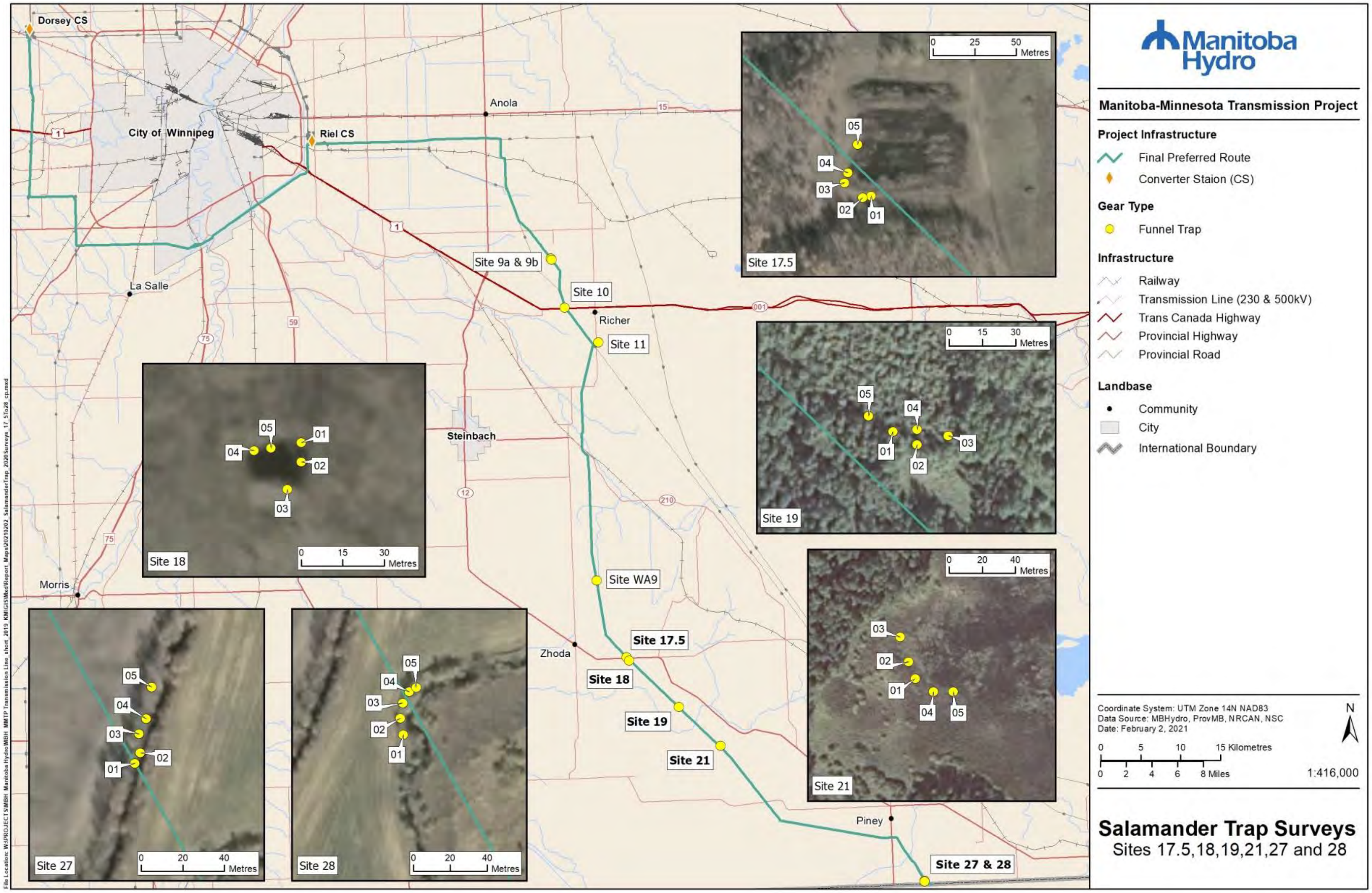
Map 2. Post-construction amphibian survey results for the Manitoba-Minnesota Transmission Project, showing total number of individuals observed during summer 2020 surveys.



Map 3. Post-construction amphibian survey results for the Manitoba-Minnesota Transmission Project, showing total number of individuals observed during fall 2020 surveys.



Map 4. Post-construction salamander survey trap locations Site 9 through WA9, Manitoba-Minnesota Transmission Project, summer, 2020.



Map 5. Post-construction salamander survey trap locations Site 17.5 through 28, Manitoba-Minnesota Transmission Project, summer, 2020.

9.0 PHOTOS

Photo 1. American Toad (*Anaxyrus americanus*) seen during summer Visual Encounter Surveys at Site 18, July 10, 2020.

Photo 2. A newly metamorphosed Cope's/Gray Treefrog (*Hyla chrysoscelis/versicolor*) seen at Site 17.5 during summer Visual Encounter Surveys, July 9, 2020.

Photo 3. Wood Frog (*Lithobates sylvaticus*) seen during summer Visual Encounter Surveys at Site 21, July 10, 2020.

Photo 4. Northern Leopard Frog (*Lithobates pipiens*) adult seen at Site 19 during summer Visual Encounter Surveys, July 10, 2020.

Photo 5. Eastern Tiger Salamander larvae (*Ambystoma tigrinum*) caught in funnel trap FN03 at REDACTED during summer surveys, July 10, 2020.

Photo 6. Aerial view of Site 1 (Assiniboine River) during fly over surveys June 29, 2020.

Photo 7. Overview of Site 1 (Assiniboine River) during fall survey, looking upstream from the south bank, September 8, 2020.

Photo 8. Aerial view of Site 3 (La Salle River) during fly over surveys June 29, 2020.

Photo 9. Overview of Site 3 (La Salle River) during fall survey, at water quality site 3-1, September 8, 2020.

Photo 10. Aerial view of Site 4 (Red River) during fly over surveys June 29, 2020.

Photo 11. Downstream view of Site 4 (Red River) at water quality site 4-2 during fall surveys, September 8, 2020.

Photo 12. Aerial view of Site 6 (Seine River Siphon) during fly over surveys June 29, 2020.

Photo 13. Overview of Site 6 (Seine River Siphon) during fall surveys, September 8, 2020.

Photo 14. Aerial view of Site 7DS and 7US (Seine River Diversion) during fly over surveys June 29, 2020.

Photo 15. Site 7DS (Seine River Diversion) during fall surveys, September 8, 2020.

Photo 16. Site 7US (Seine River Diversion) during fall surveys, September 8, 2020.

Photo 17. Aerial view of Site 8 (Edie Creek) during fly over surveys June 29, 2020.

Photo 18. Water quality site 8-2 at Site 8 (Edie Creek) during summer surveys, July 6, 2020.

Photo 19. Aerial view of Sites 9a and 9b during fly over surveys June 29, 2020.

Photo 20. Looking north at Site 9a during summer surveys, July 6, 2020 with funnel trap in foreground.

Photo 21. Overview of Site 9b looking south from water quality site 9b-1 during summer survey, July 6, 2020.

Photo 22. Aerial view of Site 10 during fly over surveys June 29, 2020.

Photo 23. Overview of Site 11 from funnel trap location FN01 during summer surveys, July 7, 2020.

Photo 24. Aerial view of Site 13 during fly over surveys June 29, 2020.

Photo 25. Overview of Site 13 (Seine River) during fall surveys, September 9, 2020.

Photo 26. Aerial view of Site 14 during fly over surveys June 29, 2020.

Photo 27. Overview of Site 14, showing shallow water covered with duckweed, July 7, 2020.

Photo 28. Aerial view of Site 15 during fly over surveys June 29, 2020.

Photo 29. Overview of Site 15 during summer surveys, showing shallow cattail wetland, July 8, 2020.

Photo 30. Overview of Site WA9 (a cattle dugout) during summer surveys, July 8, 2020.

Photo 31. Aerial view of Site 17.5 during fly over surveys June 29, 2020.

Photo 32. Overview of site 17.5 showing funnel trap FN01 during summer surveys, July 8, 2020.

Photo 33. Aerial view of Site 18 during fly over surveys June 29, 2020.

Photo 34. Overview of Site 18 during summer surveys, July 8, 2020.

Photo 35. Aerial view of Site 19 during fly over surveys June 29, 2020.

Photo 36. Overview of Site 19 during summer surveys, July 9, 2020.

Photo 37. Aerial view of Site 21 on the left of the RoW, during fly over surveys June 29, 2020.

Photo 38. Overview of Site 21 during summer surveys, July 9, 2020.

Photo 39. Aerial view of Site 22 during fly over surveys June 29, 2020.

Photo 40. Overview of Site 22 during summer surveys, showing a shallow dry wetland, July 10, 2020.

Photo 41. Aerial view of Site 23 during fly over surveys June 29, 2020.

Photo 42. Overview of Site 23 during summer surveys, July 11, 2020.

Photo 43. Aerial view of Site 26 during fly over surveys June 29, 2020.

Photo 44. Overview of Site 26 during fall surveys, September 10, 2020.

Photo 45. Aerial view of Sites 27 and 28 during fly over surveys June 29, 2020.

Photo 46. Overview of Site 27 looking upstream during summer surveys, July 11, 2020.

Photo 47. Overview of Site 28 during summer surveys, July 11, 2020.

Photo 48. Northern Leopard Frog (*Lithobate pipiens*) tadpole from funnel trap FN04 at Site 10, caught during summer surveys July 8, 2020.

Photo 49. Woody debris observed in the channel at Site 27 (Aqua-130; Pine Creek) July 11, 2020.

Photo 50. Woody debris removed from Site 27 (Aqua-130) by contractor, confirmed by Manitoba Hydro Project inspector on August 25, 2020.

Photo 51. Oily sheen seen on water surface at Site WA10 during summer surveys, July 9, 2020, likely the result of iron bacteria naturally occurring at the survey site.

Photo 52. Refuse found along the RoW at Site 19 during summer surveys, July 9, 2020.

APPENDIX

Table A-1. Summary of amphibian species that have been observed or have the potential to occur in the Manitoba-Minnesota Transmission Project Local Assessment Area and if they were detected during surveys.

Common Name	Scientific Name	Status Listings			Observed in the LAA[3]					
					2014	2017			2020	
		COSEWIC[1]	SARA[1]	MESEA[2]		Spring	Summer	Fall	Summer	Fall
Mudpuppy	*Necturus maculosus*	Not at Risk	No Status	No Status	N	N	N	N	N	N
Blue-spotted Salamander	*Ambystoma laterale*	No Status	No Status	No Status	N	N	N	N	N	N
Eastern Tiger Salamander	*Ambystoma tigrinum tigrinum*	Endangered	Endangered	No Status	Y	N	N	N	Probable	N
American Toad	*Anaxyrus americanus*	No Status	No Status	No Status	N	Y	N	N	Y	N
Canadian Toad	*Anaxyrus hemiophrys*	No Status	No Status	No Status	Y	N	N	N	N	N
Boreal Chorus Frog	*Pseudacris maculata*	No Status	No Status	No Status	Y	Y	N	N	N	N
Gray Tree Frog	*Hyla versicolor*	No Status	No Status	No Status	Y	N	N	N	Y	N
Cope's Gray Tree Frog	*Hyla chrysoscelis*	Not at Risk	No Status	No Status	Y	N	N	N		
Spring Peeper	*Pseudacris crucifer*	No Status	No Status	No Status	Y	Y	N	N	Y	N
Wood Frog	*Lithobates sylvaticus*	No Status	No Status	No Status	Y	Y	Y	Y	Y	Y
Northern Leopard Frog	*Lithobates pipiens*	Special Concern	Special Concern	No Status	Y	Y	Y	Y	Y	Y
Mink Frog	*Lithobates septentrionalis*	No Status	No Status	No Status	N	N	Y	N	N	N

[1]Government of Canada, 2020
[2]Government of Manitoba, 2018
[3]2014: Stantec 2015; 2017: Dyszy 2018

Table A-2. Amphibian observations at wetland and stream sites within the Manitoba-Minnesota Transmission Project Local Assessment Area, 2020. Bolded species denote priority species.

Site	Species[1]	Survey Types[2]	≥5 NLFR	Description	Surrounding Habitat Type
1	**NLFR**	FallVES, WQ		Assiniboine River	forest/urban
2	none	FallVES, WQ		Ditch and wastewater pond	agriculture
3	**NLFR**	FallVES, WQ		La Salle River	forest/agriculture/golf course
4	none	FallVES, WQ		Red River	agriculture/urban
6	**NLFR**	FallVES, WQ		Seine River Siphon	agriculture
7DS	**NLFR**	FallVES, WQ		Seine R Diversion/ Old Prairie Grove Drain	agriculture/grassland
7US	none	FallVES, WQ		Seine R Diversion/ Old Prairie Grove Drain	agriculture/grassland
8	none	SummVES, WQ		Edie Creek	forest/agriculture
9a	**NLFR**, WOFR	FallVES, FN, SummVES, WQ		Medium Wetlands	forest
9b	**NLFR**, WOFR	FallVES, FN, SummVES, WQ	YES	Medium Wetlands	forest
10	**NLFR**	FallVES, FN, SummVES, WQ		Large Wetland	forest/grassland
11	C/GRTF, WOFR	FallVES, FN, SummVES, WQ		Large Wetland Lake	forest/pasture
13	WOFR	FallVES, WQ		Seine River	treed grassland
14	WOFR	SummVES, WQ		Small Wetland/Fen	agriculture
15	none	SummVES, WQ		Small Wetland	agriculture
WA9	none	FN, SummVES, WQ		Cattle Dugout	pasture
17.5	AMTO, C/GRTF, **NLFR**, SPPE, WOFR	FN, SummVES, WQ	YES	Wetland	forest/pasture/
18	AMTO	FN, SummVES, WQ		Small Wetland	pasture/dugout
WA10	AMTO, WOFR	SummVES, WQ		Shallow Wetland	forest
19	AMTO, C/GRTF, **NLFR**, WOFR	FN, SummVES, WQ	YES	Small Shallow Wetland	forest
21	AMTO, **NLFR**, WOFR	FallVES, FN, SummVES, WQ		Large Wetland (Sundown Bog)	forest
22	none	SummVES, WQ		Large Shallow Wetland (Sundown Bog)	forest
23	AMTO, **NLFR**, WOFR	SummVES, WQ		Medium Wetland (Sundown Bog)	forest
26	**NLFR**	FallVES, WQ	YES	Pine Creek	treed grassland/agriculture
27	AMTO, **NLFR**, Toad, WOFR	FallVES, FN, SummVES, WQ	YES	Pine Creek	agriculture
28	**NLFR**, Toad, WOFR	FallVES, FN, SummVES, WQ		Pine Creek	agriculture

1 - AMTO: American Toad; C/GRTF: (Cope's) Gray Treefrog; EATS: Eastern Tiger Salamander; NLFR: Northern Leopard Frog; SPPE: Spring Peeper; WOFR: Wood Frog
2 - FN: salamander funnel trap surveys; SumVES: summer frog visual encounter survey; FallVES: fall frog visual encounter survey; WQ: water quality

Table A-3. Summary of Manitoba-Minnesota Transmission Project visual encounter survey sites visited in 2020.

Site[1]	Date	Zone	Start Easting	Start Northing	Survey Time (min)	Water Temp (̊C)	Air Temp (̊C)	Avg Wind (km/hr)	Depth (m)	Habitat Type	NLFR	Anurans
Summer												
8	6-Jul-20	14U	667538	5525485	0:21	23.6	28.3	1.6	<1	Creek	NO	NO
9a	6-Jul-20	14U	677976	5510407	0:07	25.1	30.0	6.2	1-2	Wetland	NO	YES
9b	6-Jul-20	14U	678089	5510213	0:10	26.6	27.9	9.9	1-2	Wetland	NO	YES
10	7-Jul-20	14U	679771	5504267	0:21	27.3	27.2	1.7	>2	Wetland	NO	NO
11	8-Jul-20	14U	683985	5499760	0:20	28.7	23.3	2.0	1-2	Wetland	NO	YES
11	8-Jul-20	14U	683996	5499842	0:15	28.7	23.3	2.0	1-2	Wetland	NO	NO
14	7-Jul-20	14U	681906	5486375	0:23	23	27.8	2	<1	Wetland/Fen	NO	YES
15	8-Jul-20	14U	682645	5485310	0:20	25	23.8	11	<1	Wetland	NO	NO
WA9	8-Jul-20	14U	683725	5470059	0:03	28.2	25.9	5.4	<1	Dugout	NO	NO
17.5	9-Jul-20	14U	687579	5460430	0:20	29.5	21.3	3.3	<1	Wetland	YES	YES
18	8-Jul-20	14U	687834	5460054	0:20	30.7	26.8	5.0	<1	Wetland	NO	YES
WA10	9-Jul-20	14U	689570	5458503	0:20	19.8	19.3	9.6	<1	Wetland	NO	YES
19	10-Jul-20	14U	693986	5454290	0:21	21.3	20.4	5.0	<1	Wetland	YES	YES
21	10-Jul-20	14U	699228	5449272	0:20	26.1	27.6	0.0	1-2	Wetland	NO	YES
22	10-Jul-20	14U	704462	5442959	0:20	24.0	25.6	8.8	N/A	Wetland	NO	NO
23	11-Jul-20	14U	709372	5439511	0:20	16.7	25.7	0.0	<1	Wetland	YES	YES
27	11-Jul-20	15U	286060	5432040	0:20	20.4	26.0	5.3	<1	Creek	NO	YES
28	11-Jul-20	15U	286085	5431957	0:20	19.1	25.4	8.5	<1	Creek	NO	YES
Fall												
1	08-Sep-20	14U	612868	5524843	0:20	13.1	9.3	10.6	>2	River	YES	YES
2	08-Sep-20	14U	622519	5512042	0:20	12.8	10.4	10.5	1-2	Pond (Wastewater)	NO	NO
3	08-Sep-20	14U	633254	5512069	0:21	14.1	11.0	5.6	1-2	River	YES	YES
4	08-Sep-20	14U	634442	5512509	0:20	17.1	13.1	2.5	>2	River	NO	NO
6	08-Sep-20	14U	640839	5517024	0:20	14.4	12.3	4.1	1-2	River Siphon	YES	YES
7DS	08-Sep-20	14U	641620	551740	0:21	14.6	10.6	7.9	<1	River Diversion	YES	YES
7US	08-Sep-20	N/A	641695	5517426	N/A	N/A	10.6	7.9	<1	River Diversion	N/A	N/A
9a	09-Sep-20	14U	677972	5510407	0:07	11.2	12.9	9.6	1-2	Wetland	YES	YES
9b	09-Sep-20	14U	678081	5510261	0:20	11.1	12.8	11.8	1-2	Wetland	YES	YES
10	09-Sep-20	14U	679812	5504199	0:20	13.8	9.7	4.2	1-2	Wetland	NO	NO

Table A-3. Continued.

Site[1]	Date	Zone	Start Easting	Start Northing	Survey Time (min)	Water Temp (̊C)	Air Temp (̊C)	Avg Wind (km/hr)	Depth (m)	Habitat Type	NLFR	Anurans
11	09-Sep-20	14U	683969	5499833	0:20	13.7	17.8	1.9	1-2	Wetland	NO	NO
13	09-Sep-20	14U	681932	5488447	0:20	13.3	14.6	11.6	1-2	River	NO	YES
21	10-Sep-20	14U	699243	5449305	0:20	11.9	13.0	4.3	1-2	Wetland	YES	YES
26	10-Sep-20	15U	284734	5434650	0:20	8.4	18.5	5.8	<1	Creek	YES	YES
27	10-Sep-20	15U	286001	5431951	0:20	15.4	19.4	2.9	<1	Creek	YES	YES
28	10-Sep-20	15U	286069	5431941	0:15	14.8	19.4	2.9	<1	Creek	YES	YES

[1]Site 11 was surveyed by VES and dipnet

Table A-4. Summary of Manitoba-Minnesota Transmission Project funnel trap catch, summer 2020.

Site	Trap ID	Zone	Easting	Northing	Set Date	Set Time	Pull Date	Pull Time	Anurans	Salam
9a	1	14U	677977	5510409	6-Jul-20	14:36	7-Jul-20	9:47	No	No
	2	14U	677985	5510407	6-Jul-20	14:46	7-Jul-20	9:52	No	No
	3	14U	677989	5510398	6-Jul-20	14:56	7-Jul-20	9:55	No	No
	4	14U	677988	5510393	6-Jul-20	15:06	7-Jul-20	9:57	No	No
	5	14U	677983	5510390	6-Jul-20	15:17	7-Jul-20	10:00	No	No
9b	1	14U	678087	5510261	6-Jul-20	16:20	7-Jul-20	10:16	No	No
	2	14U	678088	5510250	6-Jul-20	16:27	7-Jul-20	10:28	No	No
	3	14U	678088	5510243	6-Jul-20	16:35	7-Jul-20	10:33	No	No
	4	14U	678099	5510275	6-Jul-20	16:45	7-Jul-20	10:20	No	No
	5	14U	678101	5510262	6-Jul-20	16:57	7-Jul-20	10:24	No	No
10	1	14U	679762	5504239	6-Jul-20	18:18	7-Jul-20	13:22	No	No
	2	14U	679730	5504222	6-Jul-20	18:29	7-Jul-20	13:09	No	No
	3	14U	679740	5504229	6-Jul-20	18:26	7-Jul-20	13:18	No	No
	4	14U	679672	5504215	6-Jul-20	18:37	7-Jul-20	13:44	Yes	No
	5	14U	679767	5504248	6-Jul-20	18:19	7-Jul-20	13:02	No	No
11	1	14U	683976	5499905	7-Jul-20	15:22	8-Jul-20	9:36	No	No
	2	14U	683980	5499887	7-Jul-20	15:30	8-Jul-20	9:43	No	No
	3	14U	683993	5499869	7-Jul-20	15:45	8-Jul-20	9:48	No	No
	4	14U	684005	5499807	7-Jul-20	15:56	8-Jul-20	10:03	No	No
	5	14U	684013	5499769	7-Jul-20	16:14	8-Jul-20	10:12	No	No
WA9	1	14U	683733	5470069	8-Jul-20	13:28	9-Jul-20	9:43	No	No
	2	14U	683734	5470072	8-Jul-20	13:30	9-Jul-20	9:45	No	No
	3	14U	683732	5470079	8-Jul-20	13:34	9-Jul-20	9:46	No	No
	4	14U	683734	5470081	8-Jul-20	13:37	9-Jul-20	9:47	No	No
	5	14U	683736	5470090	8-Jul-20	13:40	9-Jul-20	9:48	No	No
17.5	1	14U	687532	5460434	8-Jul-20	14:41	9-Jul-20	10:50	Yes	No
	2	14U	687527	5460433	8-Jul-20	14:43	9-Jul-20	10:49	Yes	No
	3	14U	687516	5460442	8-Jul-20	14:55	9-Jul-20	10:47	No	No
	4	14U	687518	5460448	8-Jul-20	15:00	9-Jul-20	10:46	No	No
	5	14U	687524	5460465	8-Jul-20	15:03	9-Jul-20	10:44	No	No
18	1	14U	687843	5460053	8-Jul-20	15:52	9-Jul-20	11:19	No	No
	2	14U	687843	5460046	8-Jul-20	16:02	9-Jul-20	11:18	No	No
	3	14U	687838	5460036	8-Jul-20	16:08	9-Jul-20	11:14	Yes	No
	4	14U	687826	5460050	8-Jul-20	16:11	9-Jul-20	11:11	No	No
	5	14U	687832	5460051	8-Jul-20	16:15	9-Jul-20	11:09	No	No
19	1	14U	694058	5454200	9-Jul-20	14:13	10-Jul-20	9:28	No	No
	2	14U	694069	5454194	9-Jul-20	14:17	10-Jul-20	9:31	No	No
	3	14U	694083	5454198	9-Jul-20	14:20	10-Jul-20	9:37	Yes	Yes
	4	14U	694069	5454201	9-Jul-20	14:23	10-Jul-20	9:35	No	No
	5	14U	694047	5454207	9-Jul-20	14:25	10-Jul-20	9:21	Yes	No

Table A-4. Continued.

Site	Trap ID	Zone	Easting	Northing	Set Date	Set Time	Pull Date	Pull Time	Anurans	Salam
21	1	14U	699297	5449343	9-Jul-20	15:48	10-Jul-20	12:47	No	No
	2	14U	699293	5449353	9-Jul-20	15:57	10-Jul-20	12:44	Yes	No
	3	14U	699288	5449368	9-Jul-20	16:09	10-Jul-20	12:41	Yes	No
	4	14U	699308	5449335	9-Jul-20	16:14	10-Jul-20	12:50	Yes	No
	5	14U	699320	5449335	9-Jul-20	16:20	10-Jul-20	12:56	No	No
27	1	15U	286048	5432007	10-Jul-20	16:29	11-Jul-20	14:59	No	No
	2	15U	286051	5432012	10-Jul-20	16:32	11-Jul-20	15:00	Yes	No
	3	15U	286051	5432021	10-Jul-20	16:33	11-Jul-20	15:05	Yes	No
	4	15U	286055	5432028	10-Jul-20	16:34	11-Jul-20	15:11	No	No
	5	15U	286059	5432043	10-Jul-20	16:36	11-Jul-20	15:13	No	No
28	1	15U	286072	5431929	10-Jul-20	16:46	11-Jul-20	14:49	No	No
	2	15U	286071	5431938	10-Jul-20	16:48	11-Jul-20	14:40	Yes	No
	3	15U	286073	5431946	10-Jul-20	16:50	11-Jul-20	14:37	No	No
	4	15U	286077	5431952	10-Jul-20	16:51	11-Jul-20	14:36	No	No
	5	15U	286081	5431954	10-Jul-20	16:52	11-Jul-20	14:23	Yes	No

Table A-5. General wetland mitigation measures for sites overlapping potential amphibian habitat within the Manitoba-Minnesota Transmission Project PDA. (Source: Manitoba-Minnesota Transmission Project Construction Environmental protection Plan, August 2019).

ID	Mitigation
EC-8.01	Clearing wastes and other construction debris or waste will not be placed in wetland areas. Existing logs, snags and wood debris will be left in place.
EC-8.02	Wetland areas will be prescribed riparian buffers in site specific mitigation tables in which understory low-growth vegetation will be maintained where possible. Environmental protection measures for working in and around wetlands will be reviewed with the contractor and employees prior to commencement of any construction activities.
EC-8.03	Natural vegetated buffer areas of 30 m will be established around wetlands and riparian zones will be maintained to the extent possible.
EC-8.04	Disturbance of wetlands will only be carried out under frozen ground conditions. If frozen ground conditions don't exist alternate mitigation measures such as construction matting may be used to minimize surface damage, rutting and erosion if approved by MH Environmental Officer/Inspector.
EC-8.05	Cleared trees and woody debris will not be pushed into (or adjacent) to standing timber, or within the high-water mark of wetlands or waterbodies

APPENDIX D

MANITOBA-MINNESOTA TRANSMISSION PROJECT

BIRD-WIRE COLLISION MONITORING 2020

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Services MB Inc.

May 2021

SUMMARY

As part of the Environmental Monitoring Plan for the Manitoba-Minnesota Transmission Project, studies were conducted to monitor avian mortality caused by transmission line infrastructure using a control-impact study design and determine the effectiveness of mitigation measures and, if appropriate, propose revisions to the existing plans or develop new mitigation options should high levels of avian mortality occur as a result of the transmission line. Bird-wire collision mortality monitoring, using standardized methods, occurred at 18 sites along the transmission line in the fall of 2020. Eleven of the sites were Environmentally Sensitive Sites that had been fitted with bird diverters and seven sites located nearby, without bird diverters, were selected to act as control sites. Each survey site was visited twice from September 10 – 21, 2020, with each survey separated by five to seven days. Evidence of 16 bird collisions were observed at nine sites during the surveys. Ten bird collisions were observed at sites with bird diverters and six bird collisions were observed at sites without bird diverters. No collision evidence from species listed as Threatened or Endangered by the federal *Species at Risk Act* or the provincial *The Endangered Species and Ecosystems Act* were observed during the surveys. Bird carcasses were planted at survey sites to allow the calculation of searcher bias and scavenger bias in the study. These values were used to estimate the collision mortality rates and compare the values between sites with and without bird diverters present. The estimated collision mortality during the six-week fall migration period was 99.9 mortalities/km at sites with bird diverters and 109.6 mortalities/km at sites without bird diverters. These values are higher than the range of other collision mortality studies that have occurred within the Province and may be due to low searcher efficiency and relatively small sample sizes.

Table of Contents

List of Tables

List of Maps

List of Appendices

1.0 INTRODUCTION

The Manitoba-Minnesota Transmission Project (MMTP) is a 500 kilovolt, alternating current transmission line that originates at the Dorsey Converter Station on the northwest side of Winnipeg, and ends at the United States border near Piney, Manitoba (Map 1). During the environmental assessment process, a potential increase of bird mortalities was identified due to bird-wire collisions. Section 4.5.3 in the MMTP Environmental Monitoring Plan outlined the monitoring approach for bird-wire collisions (Manitoba Hydro 2019).

Transmission lines pose a collision risk to birds and can cause fatalities or injuries that can be a significant source of mortality for some species (APLIC 2012; Loss *et al.* 2014). Birds that are most vulnerable to wire collisions often include long-distance migrants, nocturnal migrants, and species with high wing-loading (small wings relative to body size) (Bevanger 1994; Rioux *et al.* 2013). Other factors that also can affect bird collision risk, include the local habitat, environmental conditions, and the design of the transmission line (Bevanger 1994; Bevanger and Broseth 2001). Generally, birds are able to avoid colliding with transmission lines if they are able to see the obstacle early enough (APLIC 2012). Commercially available products can be installed on transmission lines to increase their visibility to birds and have been proven to reduce bird collisions (Barrientos *et al.* 2012; Brown and Drewien 1995; Morkill and Anderson 1991).

To mitigate some risk of bird-wire collisions posed by the MMTP, Environmentally Sensitive Sites (ESS's) were identified during pre-construction surveys and fitted with bird diverters during construction. Bird diverters were installed on the ground conductor wires, including an alternating sequence of Swan-Flight™ Bird Diverters and Bird Flight Diverters, and in some areas additional aircraft cone line markers, that also served to make the transmission line visible to aircraft (Photo 1; Photo 2).

Several studies were conducted during the pre-construction period to identify ESS's where there was a potential for a high number of bird-wire collisions, including bird migration studies, bird movement studies, and bird collision monitoring at nearby, proxy transmission lines.

Bird migration studies were conducted in the spring and fall of 2014 to provide and understanding of bird use near the MMTP and identify important stopover or staging sites in the region (Stantec 2015; Manitoba Hydro 2015). The data collected was used to help identify ESS's and determine the placement of bird diverters.

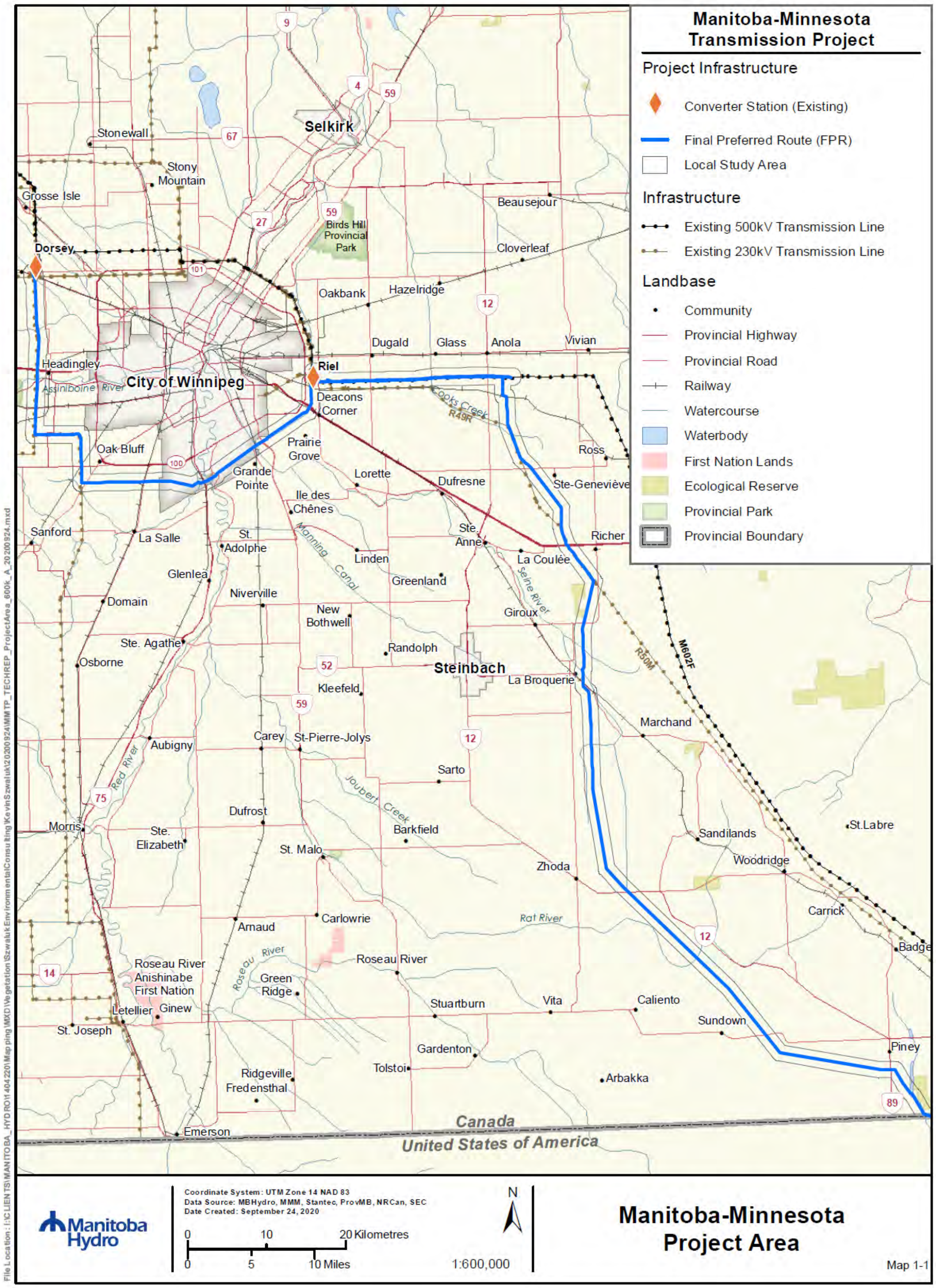
Bird movement studies were conducted at major waterbodies near the MMTP route in the spring and fall of 2014. The objectives of this study were to gather data on the number, distribution, and flight patterns of birds near major waterbodies, including Richer Lake, Lonesand Lake, Sundown Lake, Red River, Assiniboine River, and Deacons Reservoir (Stantec 2015; Manitoba Hydro 2015) (Map 1). The data collected was also used to help identify ESS's and determine the placement of bird diverters.

Additionally, bird-wire collision monitoring was conducted in the fall of 2014 along the existing M602F transmission line and other transmission lines that crossed the Assiniboine River to act as a proxy for the MMTP (Stantec 2015; Manitoba Hydro 2015). Survey sites were classified into collision risk categories based on landcover types. High risk sites were adjacent to a permanent waterbody (*e.g.,* Assiniboine River, Deacon Reservoir), moderate risk sites were adjacent to a wetland or riparian area (*e.g.,* stream, marsh), and low risk sites were located in upland habitat (Stantec 2015). The observed mortalities along with habitat bias, searcher bias, and scavenger bias were used to calculate the estimated collision mortality for each collision risk category. The estimated collision mortality in the study was found to be 120.8 mortalities/km/year at high risk sites, which was based on the number of collisions observed at a single site adjacent to the Assiniboine River (Stantec 2015). Moderate risk sites were found to have 69.3 mortalities/km/year, and low-risk sites had 16.5 mortalities/km/year (Stantec 2015).

These mortality estimations were used to help identify ESS's and the placement of bird diverters on the MMTP. The mortality estimations identified in 2015 can also be compared to the numbers observed in 2020 to help determine the effectiveness of bird diverters and examine if further mitigation may be required.

Specifically, the objectives of this study are to 1) monitor avian mortality caused by transmission line infrastructure using a control-impact study design; and 2) determine the effectiveness of mitigation measures and, if appropriate, propose revisions to the existing plans or develop new mitigation options should high levels of avian mortality occur as a result of the transmission line (Manitoba Hydro 2019).

This report examines the results of bird-wire collision surveys conducted in the fall of 2020.



Map 1. Manitoba-Minnesota Transmission Project

Photo 1. Swan-Flight Bird Diverter (top) and Bird Flight Diverter (bottom) (Linestar Utility Supply 2021; Preformed Line Products 2021)

Photo 2. Alternating Swan-Flight Bird Diverters and Bird Flight Bird Diverters (top), and additional aircraft cone markers (bottom) on the Manitoba-Minnesota Transmission Project

2.0 METHODS

Bird-wire collision monitoring was designed to test the hypothesis that bird diverters are sufficient in reducing mortality of birds due to collisions with the transmission line to a level that is negligible in areas determined to have a high risk of a collision. As such, the null and alternate hypotheses state:

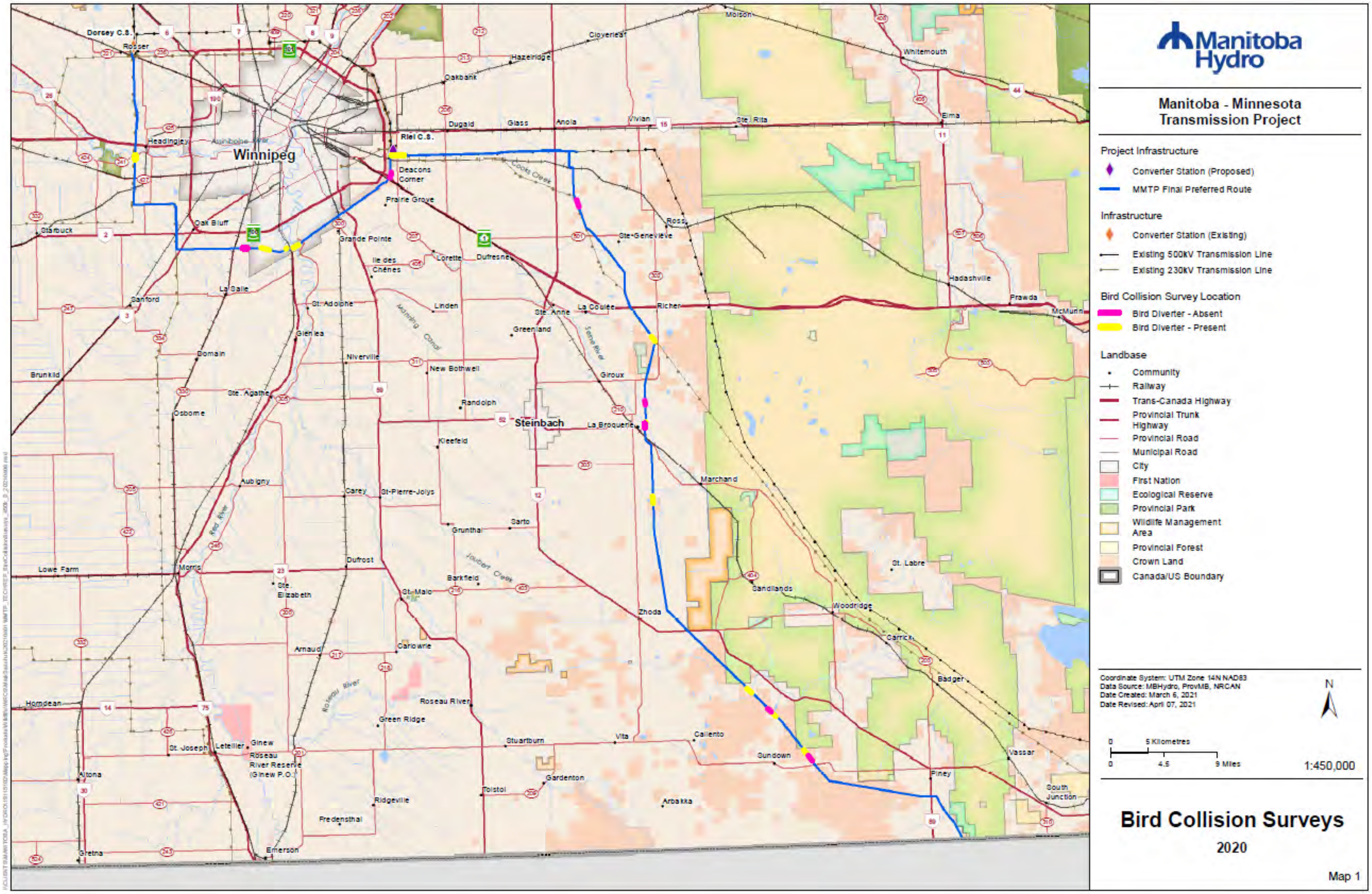
• H_0 (null): The mortality of birds at high-risk areas with bird diverters will not be different than the mortality of birds at low-risk areas without bird diverters.

• H_1 (alternate): The mortality of birds at high-risk areas with bird diverters will be greater than the mortality of birds at low-risk areas without bird diverters.

As outlined in the Section 4.5.3 and 7.3.2 of the MMTP Environmental Monitoring Plan, 18 sites were selected for bird-wire collision mortality monitoring along the Manitoba-Minnesota Transmission Project in a control-impact study design (Map 2). Eleven of the sites were identified as ESS's that were fitted with bird diverters. Seven control sites, that were not fitted with bird diverters, but were expected to have above average bird activity due to waterbody crossings or were nearby ESS's were also selected. Sites ranged in length from 136 to 1,501 m in length (Table 1).

Each site was surveyed twice during the 2020 fall migration season with each survey separated by five to seven days (Table 1). Surveys for bird-wire collisions were conducted at each site by four personnel that walked parallel lines spaced 5-10 m apart, for the entire length of the site, below the cleared right-of-way (ROW) (CWSEC 2007; Photo 3). The spacing of personnel varied slightly depending on depending on the relative density of vegetation and terrain. Personnel visually inspected the search area for signs of bird collisions (*i.e.,* carcasses and clusters of feathers). Collisions were recorded when the remains found consisted of more than five feathers in a square meter (Barrientos *et al.* 2012). The location of the collision was recorded using a handheld global positioning system (GPS), collision evidence was identified to species where possible and photographed.

Bird flight activity surveys were not conducted in 2020 due to study practicalities and statistical design concerns. Study methods such as the frequency of passage studies are being reconsidered as bird movements reported in other studies in Manitoba (Wood 2019), which had a high monitoring effort, still resulted in high variability. Data with high variability rarely result in a statistically meaningful measurable difference.



Map 2. Location of Bird-collision Survey Sites Along the Manitoba-Minnesota Transmission Project

Table 1. Survey Dates and Site Characteristics for Bird-wire Collision Monitoring, September 2020

Site ID	UTM Start	UTM End	Bird Diverters	Environmentally Sensitive Site	Site Length (m)	Visit 1 Date (2020)	Visit 2 Date (2020)
Wild-100	14N 612852 5524260	14N 612874 5524824	Present	Assiniboine River	565	Sep-10	Sep-15
Wild-103	14N 631009 5511990	14N 629896 5512242	Present	Brady Landfill	1141	Sep-10	Sep-16
Wild-104	14N 633256 5512083	14N 633375 5512151	Present	La Salle River	136	Sep-10	Sep-16
Wild-105	14N 634221 5512238	14N 634926 5512641	Present	Red River	647	Sep-10	Sep-16
Wild-106	14N 647686 5524747	14N 647892 5524753	Present	Deacon Reservoir	1501	Sep-11	Sep-16
Wild-118	14N 682799 5500258	14N 683261 5499642	Present	Richer Lake (Waterfowl Sensitivity Area)	770	Sep-11	Sep-17
Wild-123	14N 682009 5488650	14N 681841 5488433	Present	Seine River	275	Sep-14	Sep-21
Wild-126	14N 682967 5478612	14N 682999 5477647	Present	Breeding Habitat Sensitive Area	965	Sep-14	Sep-21
Wild-131	14N 696364 5451953	14N 695776 5452518	Present	Rat River	816	Sep-15	Sep-21
Wild-132	14N 699047 5449373	14N 699635 5448809	Present	Lonesand Lake (Waterfowl Sensitivity Area)	814	Sep-15	Sep-21
Wild-133	14N 703436 5444197	14N 704026 5443449	Present	Sundown Lake and Wetland Sensitive Area	952	Sep-11	Sep-17
Ctrl-103	14N 627981 5512213	14N 627408 5512198	Absent	Brady Landfill	573	Sep-10	Sep-16
Ctrl-106	14N 647519 5522464	14N 647351 5521749	Absent	Deacon Reservoir	761	Sep-10	Sep-16
Ctrl-123	14N 681842 5488432	14N 681863 5487958	Absent	Seine River	388	Sep-14	Sep-21
Ctrl-132	14N 698589 5449814	14N 699047 5449373	Absent	Lonesand Lake (Waterfowl Sensitivity Area)	636	Sep-15	Sep-21
Ctrl-133	14N 704027 5443448	14N 704580 5442747	Absent	Sundown Lake and Wetland Sensitive Area	893	Sep-11	Sep-17
Ctrl-243	14N 672961 5517848	14N 672621 5518744	Absent	Cook's Creek	959	Sep-11	Sep-16
Ctrl-313	14N 681909 5491500	14N 681923 5491016	Absent	Unnamed Creek	485	Sep-14	Sep-21

Photo 3. Personnel Conducting a Bird-mortality Collision Survey along the MMTP right-of-way, September 2020. Note: the R49R transmission line in the background.

Sources of bias, including searcher efficiency bias and scavenger bias, can influence the estimations of bird collisions. Searcher efficiency bias is important to include in mortality estimates as dead or injured birds may be overlooked during a survey, particularly when vegetation is present. Additionally, scavenger bias is important to include as both mammalian and avian scavengers may remove carcasses before they are located. By placing (planting) dead birds on the survey sites, these sources of biases can be considered, and a more accurate estimate of bird mortality can be produced.

Searcher efficiency bias was estimated by planting one quail (*Coturnix sp.*) carcass, sourced from a commercial supplier, within search areas in locations unknown to the searchers prior to searches commencing (California Energy Commission 2003; APLIC 2012). Fourteen quail were planted at fourteen sites in 2020 for the searcher efficiency trials. The proportion of the planted birds found is then used in the estimation of total collision mortality.

Searcher efficiency was calculated as:

$$\text{Seacher Efficiency} = \frac{\text{Number of planted birds found}}{\text{Number of birds planted}}$$

The planted birds used in the searcher efficiency trials were also used to estimate the scavenger removal bias. Search periods were separated by five to seven days to allow time for potential scavengers to locate planted bird carcasses. Carcasses were considered scavenged if they were missing, or partially consumed. The proportion of planted birds remaining after the specified time period was used to determine the scavenger bias.

Scavenger bias was calculated as:

$$\text{Scavenger Bias} = \frac{\text{Number of planted birds remaining}}{\text{Number of birds planted}}$$

Habitat bias effects were also calculated to account for unsearchable portions of the formal search areas (*i.e.,* marshes, ponds, thick standing crops). Unsearchable areas were delineated in the field with a handheld GPS and its size was subtracted from the formal search area.

Habitat bias was calculated as:

$$\text{Habitat Bias} = \frac{\text{Actual area searched}}{\text{Formal search area}}$$

Estimated collision mortality (collisions/site/week) was calculated using searcher efficiency, scavenger, and habitat bias at all surveyed sites. The following assumptions were made during calculations:

- Due to logistical restraints, weather conditions, etc., site revisits were conducted from five to seven days after the initial visit. Despite these differences in duration, it was assumed that collision mortalities and scavenging results are representative of a seven-day period.
- The observed level of mortality was consistent throughout the six-week spring and six-week fall migration periods.
- Bird mortality is negligible outside these six-week migration periods.
- The sites surveyed have representative levels of mortality in comparison to other areas of the transmission line.

Estimated weekly mortality was calculated as:

$$\text{Estimated Weekly Mortality} = \frac{\text{Number of bird carcasses found}}{\text{Searcher Efficiency} * \text{Scavenger Bias} * \text{Habitat Bias}}$$

The estimated weekly mortality was then standardized per kilometer of transmission line searched to obtain the estimated weekly mortality/km. To estimate seasonal collision mortality (spring or fall), weekly collision mortality estimates were multiplied by a factor of six weeks (42 days). Annual collision mortality can be calculated by adding the spring and fall collision mortality estimates together.

To examine the effectiveness of bird diverters, the average estimated weekly mortality per km from was compared between sites with diverters to those without diverters using a two-tailed t-test was conducted (α= 0.05).

3.0 RESULTS

Evidence of 16 bird collisions were found during the 2020 surveys. Ten bird collisions were located at seven sites with bird diverters present and six bird collisions were located at two sites without bird diverters (Table 2). The average estimated weekly mortality per km was not significantly different between sites with bird diverters and without ($p = 0.58$). No species listed under the federal *Species at Risk Act* or the provincial *Endangered Species and Ecosystems Act* were found during the surveys. One injured or exhausted Vesper sparrow (*Pooecetes gramineus*), that was unable to fly, was observed at the base of a tower at site Wild-103 and was included as a collision.

Several of the sites had evidence of multiple collisions. One site, Ctrl-103, had evidence of four collisions. The site Wild-103 had evidence of three collisions, and three other sites, Ctrl-123, Wild-106, and Wild-106, had evidence of two collisions.

Table 2. Bird Collision Evidence Observed Along the MMTP in Fall 2020

Site	Bird Diverters	Date	Visit No.	Species	UTM Coordinate
Wild-100	Present	Sep 15 2020	2	Nashville warbler	14 U 612875 5524591
Wild-103	Present	Sep 10 2020	1	Mallard	14 U 631000 5511988
Wild-103	Present	Sep 16 2020	2	Vesper sparrow	14 U 629994 5512220
Wild-103	Present	Sep 16 2020	2	Unknown waterfowl species	14 U 630780 5512069
Wild-106	Present	Sep 16 2020	2	Unknown species	14 U 649178 5524784
Wild-106	Present	Sep 16 2020	2	Gull species	14 U 648329 5524766
Wild-118	Present	Sep 17 2020	2	Black and white warbler	14 U 682886 5500146
Wild-123	Present	Sep 21 2020	2	Vesper sparrow	14 U 682001 5488644
Wild-126	Present	Sep 14 2020	1	Sora	14 U 682987 5478433
Wild-132	Present	Sep 15 2020	1	Unknown species	14 U 699563 5448878
Ctrl-103	Absent	Sep 10 2020	1	Canada goose	14 U 627907 5512177
Ctrl-103	Absent	Sep 10 2020	1	Gull species	14 U 627896 5512231
Ctrl-103	Absent	Sep 10 2020	1	Mallard	14 U 627684 5512220
Ctrl-103	Absent	Sep 16 2020	2	Canada goose	14 U 627629 5512197
Ctrl-123	Absent	Sep 21 2020	2	Sora	14 U 681865 5488312
Ctrl-123	Absent	Sep 21 2020	2	Magnolia warbler	14 U 681846 5488031

Searcher efficiency was estimated to be 14%, with only two of 14 planted carcasses being found by search personnel (Table 3). Half of the planted carcasses were predated by the second search, resulting in a scavenger bias of 50% (Table 3).

Estimated weekly mortality ranged from 0 to 52.0 mortalities/km at sites with bird diverters present (Appendix 1). Only two sites without bird diverters (control sites) had evidence of bird collisions, Ctrl-103, near the Brady Landfill and Ctrl-123 at the Seine River; the estimated weekly mortality at these two sites was 99.7 mortalities/km and 73.7 mortalities/km, respectively (Appendix 1).

The estimated weekly mortality per km was 16.6 mortalities/km at sites with bird diverters, and 18.3 mortalities/km at sites without bird diverters (Table 3). During the six-week fall migration period, this corresponds to 99.9 mortalities/km at sites with bird diverters and 109.6 mortalities/km at sites without bird diverters (Table 3).

Table 3. Bird Collision Survey Results and Estimated Mortalities along the Manitoba-Minnesota Transmission Project in Fall 2020

Site Type	Total Length (km)	No. Collisions	No. Birds Planted	No. Birds Scavenged	No. Planted Birds Found	Searcher Efficiency (%)	Scavenger Bias (%)	Habitat Bias	Est. Weekly Mortality	Est. Weekly Mortality/km	Est. Seasonal Mortality/km*
Bird Diverters Present	8.58	10	8	5	0	14	50	1.0	142.9	16.6	99.9
Bird Diverters Absent (Control)	4.69	6	6	2	2			1.0	85.7	18.3	109.6
All Sites	13.28	16	14	7	2			1.0	228.6	17.2	103.3

*Multiplied by a factor of six weeks

4.0 DISCUSSION

Bird diverters appear to be effective at reducing the number of collisions along the MMTP and the null hypothesis of no mortality difference between sites with and without bird diverters appears to be supported. There appears to be a lower number of bird mortalities at sites with bird diverters present than at sites without bird diverters, even though the difference is not significant. The lack of a significant difference may be due to bird diverter sites supporting greater numbers of birds. These sites were chosen systematically based on bird observations and movements and would presumably have greater numbers of mortalities if bird diverters were not present. The estimated collision mortalities for sites near the Brady Landfill (Ctrl-103 and Wild-103), as well as sites near the Seine River (Ctrl-123 and Wild-123) support this conclusion as the control sites with no bird diverters have higher collision mortalities. However, sites near the Deacon Reservoir (Ctrl-106 and Wild-106) and sites near Lonesand Lake (Ctrl-132 and Wild-132) show the opposite pattern, with bird diverter sites having higher collision mortalities than those without. These estimates are based on relatively small numbers of observed mortalities, two collisions at site Wild-106 and one at site Wild-132, which may not reflect the effectiveness of bird diverters. Additional data from future surveys will help distinguish and support patterns of bird collision mortalities along the MMTP and the effectiveness of bird diverters.

Sites near the Brady Landfill had some of the highest mortality estimates out of all the sites. The Brady Landfill was not anticipated to be an issue for gulls due to being sufficiently far away from the MMTP and not intersecting with gull flight paths (Manitoba Hydro 2015). However, during the surveys in 2020, large numbers of Canada geese (*Branta canadensis*) and ring-billed gulls (*Larus delawarensis*) were observed crossing directly overhead of the MMTP. Habitat differences, such as agricultural crop locations around the Brady Landfill may have influenced bird movements in 2020 in comparison to those observed in 2014. Presumably, the number of bird collisions near the Brady Landfill would be higher if sections of the MMTP nearby were not fitted with bird diverters, which is supported by the greater number of collisions observed at the control site (Ctrl-103) compared to the bird diverter site (Wild-103).

Sites near Sundown Lake (Ctrl-133 and Wild-133) were predicted to have a moderate collision risk for sandhill cranes (*Grus canadensis*) (Manitoba Hydro 2015). During surveys in September 2020, numerous sandhill cranes were observed, but no bird mortalities were found at either site.

The estimated collision mortality rates observed in the fall of 2020 are higher than those observed during the pre-construction studies conducted along the proxy transmission lines in 2014, and those observed at other transmission lines in the province (Table 4). At proxy sites in 2014, high risk sites were estimated to have 120.8 mortalities/km annually. In 2020, estimated collision mortalities were only calculated for the fall period but can be multiplied by two to provide an estimate of annual mortality. In fall 2020, seasonal estimated collision mortalities at sites with bird diverters were 99.9 mortalities/km, or 199.8 mortalities/km annually. At sites without bird diverters, estimated collision mortality was 109.6 mortalities/km in the fall, or 219.2 mortalities/km annually. Both annual estimates of collision mortality for sites with and without bird diverters are much higher than those for the high risk sites observed during the pre-construction surveys.

The bird mortality rates observed in this study are also higher in comparison to the rates observed in other published studies. Faanes (1987) estimated bird collision mortality rate of 69 birds/km and Rioux *et al.* (2013) found average mortality rates of 42.3 ± 17.1 birds/km/year. However, comparisons of mortality rates between studies may be misleading as sources of bias (searcher efficiency, scavenger bias, habitat bias) can vary substantially between study locations (Morrison 2002; APLIC 2006).

Table 4. Estimated Seasonal Collision Mortality (mortalities/km/6 weeks) from Other Studies Conducted in Manitoba (WRCS 2017; WRCS 2018a; WRCS 2018b; WRCS 2018c; WRCS 2021).

Study and Year(s)	Estimated Collision Mortality (mortalities/km/6 weeks)					
	Spring Migration Diverters Present	Spring Migration Diverters Absent	Breeding Bird Diverters Present	Breeding Bird Diverters Absent	Fall Migration Diverters Present	Fall Migration Diverters Absent
Keeyask Transmission Project 2016	NA	NA	10.8	0	10.32	0
Keeyask Transmission Project 2017	469.09*	1130.88*	0	54.91	14.54	27.49
Lake Winnipeg East 2018	NA	NA	NA	NA	5.98	NA
Wuskwatim Outlet Transmission Line 2014, 2016-2018	NA	NA	NA	27.34	NA	27.34
Bipole III Transmission Line 2018-2020	35.10	29.64	NA	NA	19.68	19.38

* The estimated collision mortality was inflated due to efficient scavengers.

The reason estimated collision mortalities in 2020 along the MMTP were higher than in 2014 at the proxy transmission lines and in other studies may be due to several reasons. Bird movements and numbers can be highly variable and may account for some of the differences observed. The timing of migration, species presence, and local weather conditions can affect bird movements, which will influence the number of bird collisions at sites. Additional data collected along the MMTP will help distinguish and support patterns of bird collision mortalities along the MMTP.

Differences in estimated mortality may also be attributed to the relatively low searcher efficiency of personnel in 2020, which amplifies the number of potential collisions. Searcher efficiency is related to vegetation density (Philibert *et al.* 1993) and searcher efficiency was likely reduced at sites where dense vegetation was present. Site selection is limited to sections of the transmission line with bird diverters and vegetation density cannot be controlled for. As shown, two sites Ctrl-103 and Wild-103 were found to have relatively high numbers of collisions, three and four, respectively. It should be noted that both these sites consisted of tilled agriculture where observability of collision evidence was greater than other sites that may have had relatively dense vegetation.

The use of quail, with their cryptic colouration may also affect observability of planted birds, but are a good representation of many wild bird species. In 2020, a variety sizes, from smaller than a typical songbird, to robin-sized quail were used as planted birds. The use of very small quail will try to be avoided as they may not accurately reflect wild birds species and may inflate observer bias. Future surveys may incorporate a greater number of observers, or a larger sample size of planted birds to increase searcher efficiency and accurately determine bias.

Future surveys conducted during the spring, summer, and fall of 2021 will help to distinguish and support patterns of bird collision mortalities along the MMTP. If these surveys consistently identify high number of bird-wire collision mortalities further mitigation may be required at select sites. At this time no further mitigation is recommended along the MMTP.

5.0 CONCLUSIONS

Bird-wire diverters along the MMTP appear to be effective at reducing the number of bird-wire collision mortalities. No Threatened or Endangered species were observed during the fall 2020 survey. Estimated collision mortality rates appear to be higher in comparison to other studies but may be a result of vegetation conditions and relatively low searcher efficiency in 2020. Future surveys will help to discern collision patterns and identify problematic areas if they occur. At this time, no further mitigative measures are recommended. Additional bird-wire collision mortality surveys will be conducted in the spring, summer, and fall of 2021 as part of operation monitoring.

6.0 LITERATURE CITED

APLIC (Avian Power Line Interaction Committee). 2006. Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, and Sacramento, CA.

APLIC (Avian Power Line Interaction Committee). 2012. Reducing Avian Collisions with Power lines: The State of the Art in 2012. Edison Electric Institute and APLIC. Washington, D.C., 159 pp.

Barrientos, R., Ponce, C., Palacin, C., Martin, C.A., Martin, B., and J.C. Alonso. 2012. Wire Marking Results in a Small but Significant Reduction in Avian Mortality at Power Lines: A BACI Designed Study. PLoS ONE 7 (3).

Bevanger, K. 1994. Three Questions on Energy Transmission and Avian Mortality. Fauna Norvegica Series C Cinclus, 17: 107-114.

Bevanger, K., and H. Broseth. 2001. Bird Collisions with Power Lines – An Experiment with Ptarmigan (Lagopus spp.). Biological Conservation 99: 341-346.

Brown, W.M. and R.C. Drewien. 1995. Evaluation of Two Power Line Markers to Reduce Crane and Waterfowl Collision Mortality. Wildlife Society Bulletin 23 (2): 217-227.

California Energy Commission. 2003. Bird Strike Indicator/Bird Activity Monitor and Field Assessment of Avian Fatalities. Prepared by the Electric Power Research Institute. Available from www.researchgate.net/publication/283088631_Bird_Strike_IndicatorBird_Activity_Monitor_and_Field_Assessment_of_Avian_Fatalities (Accessed March 23, 2021).

CWSEC (Canadian Wildlife Service Environment Canada). 2007. Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds. Prepared by Canadian Wildlife Service/Environment Canada. April 2007. 74 pp.

Faanes, C. A. 1987. Bird behavior and Mortality in Relation to Power lines in Prairie Habitats. General Technical Report 7. Fish and Wildlife Service, U.S. Department of the Interior, 24 p.

Loss, S.R., Will, T., and P.P Marra. 2014. Refining Estimates of Bird Collision and Electrocution Mortality at Power Lines in the United States. PLoS ONE, 9(7): e101565. doi:10.1371/ journal.pone.0101565.

Linestar Utility Supply. 2021. Bird flight diverters and line markers. Available from: https://linestar.ca/specialty-items/wildlife-mitigation/avian-flight-diverters/bird-flight-diverters-and-line-markers/ (Accessed March 11, 2021).

Manitoba Hydro. 2015. Manitoba-Minnesota Transmission Project – Environmental Impact Statement – chapter 9 – Assessment of Potential Effects on Wildlife and Wildlife Habitat. September 2015. 154 pp.

Manitoba Hydro. 2019. Manitoba-Minnesota Transmission Project Environmental Monitoring Plan. Transmission Planning and Design Division. Licensing and Environmental Assessment. April 2019. 162 pp.

Morkill, A.E. and S.H. Anderson. 1991. Effectiveness of Marking Powerlines to Reduce Sandhill Crane Collisions. Wildlife Society Bulletin, 19: 442-449.

Morrison, M. 2002. Searcher Bias and Scavenging Rates in Bird/Wind Energy Studies. National Renewable Energy Laboratory. Available from: www.nrel.gov/docs/fy02osti/30876.pdf (Accessed March 1, 2021).

Philibert, H. Wobeser, G., and R.G. Clark. 1993. Counting dead birds: examination of methods. Journal of Wildlife Diseases 29(2): 284-289.

Preformed Line Products. 2021. Wildlife Protection – Swan-Flight Diverter. Available from: https://preformed.com/energy/distribution/wildlife-protection (Accessed January 22, 2021).

Rioux, S., Savard, J.-P. L. and A.A. Gerick. 2013. Avian Mortalities due to Transmission Line Collisions: A Review of Current Estimates and Field Methods with an Emphasis on Applications to the Canadian Electric Network. Avian Conservation and Ecology 8 (2): 7.

Stantec (Stantec Consulting Ltd.). 2015. Manitoba-Minnesota Transmission Project - Biophysical technical data reports - 1.3 wildlife and wildlife habitat. Prepared for Manitoba Hydro. September 2015. 274 pp.

Wood (Wood Canada Ltd.). 2019. 2018 Avian Monitoring Report Bipole III Transmission Line Project. Prepared for Manitoba Hydro. February 2019. 74 pp.

WRCS (Wildlife Resource Consulting Services MB Inc.). 2017. Bird-wire Collision Monitoring 2016. Keeyask Transmission Project. A report prepared by Licensing and Environmental Assessment Department, Manitoba Hydro, Winnipeg by Wildlife Resource Consulting Services MB Inc., June 2017. 25 pp.

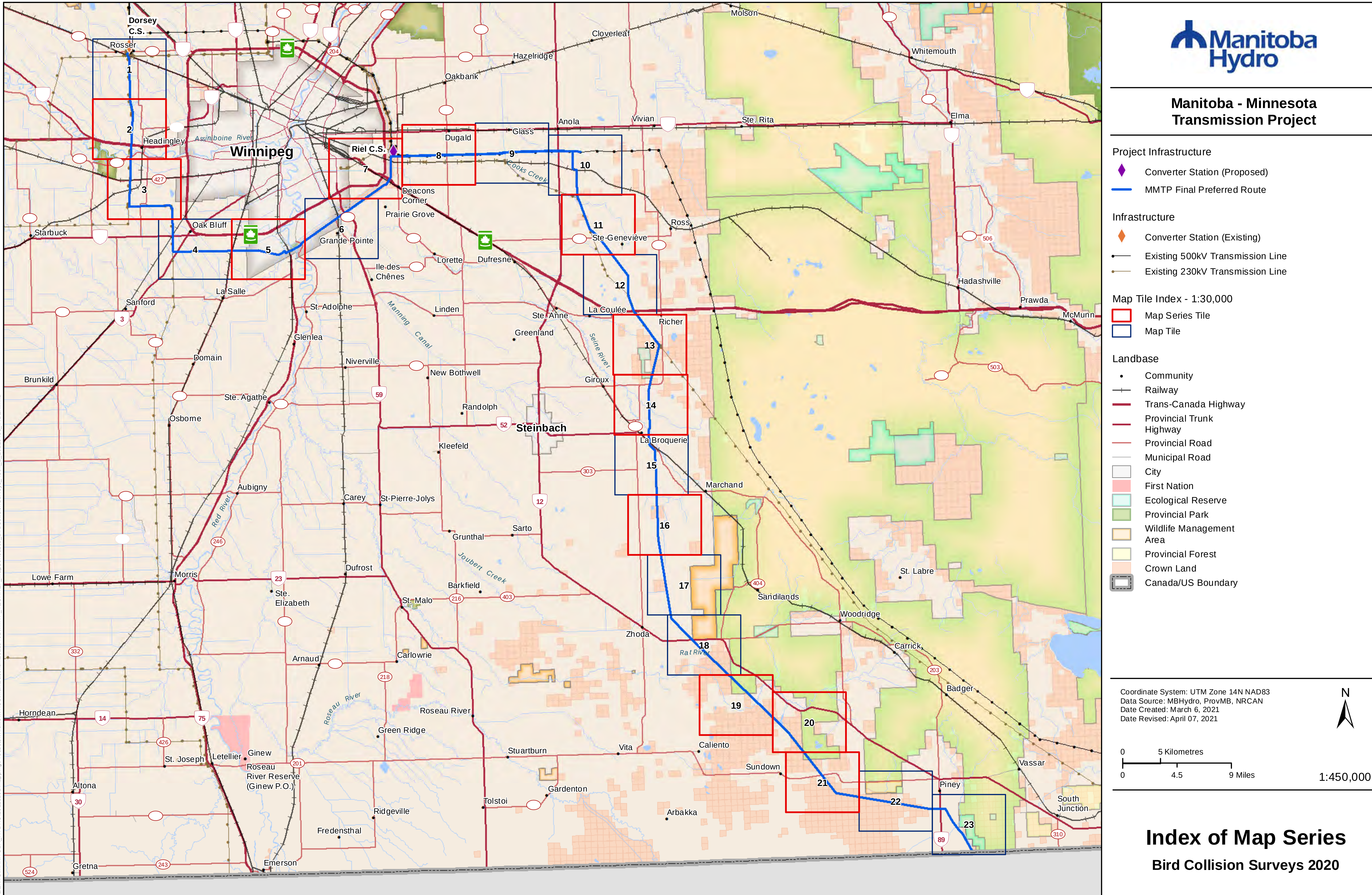
WRCS 2018a. Bird-wire Collision Monitoring 2017. Keeyask Transmission Project. A report prepared by Licensing and Environmental Assessment Department, Manitoba Hydro by Wildlife Resource Consulting Services MB Inc., June 2018. 40 pp.

WRCS. 2018b. Bird-wire Collision Monitoring 2018. Lake Winnipeg East System Improvement (LWESI). A report prepared for Manitoba Hydro by Wildlife Resource Consulting Services MB Inc., December 2018. 20 pp.

WRCS. 2018c. Bird Collision Monitoring Report 2017. Wuskwatim Generation Project. A report prepared for Wuskwatim Power Limited Partnership by Wildlife Resource Consulting Services MB Inc., June 2018. 22 pp.

WRCS. 2021. Bipole III Bird-wire Collision Monitoring 2018-2020. Bipole III Transmission Project. A report prepared for Manitoba Hydro by Wildlife Resource Consulting Services MB Inc., March 2021.

Appendix 1
Bird Collision Map Series


Manitoba Hydro
Manitoba - Minnesota Transmission Project
Project Infrastructure
Converter Station (Proposed)
MMTP Final Preferred Route
Infrastructure
Converter Station (Existing)
Existing 500kV Transmission Line
Existing 230kV Transmission Line
Map Tile Index - 1:30,000
Map Series Tile
Map Tile
Landbase
Community
Railway
Trans-Canada Highway
Provincial Trunk Highway
Provincial Road
Municipal Road
City
First Nation
Ecological Reserve
Provincial Park
Wildlife Management Area
Provincial Forest
Crown Land
Canada/US Boundary
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: March 6, 2021
Date Revised: April 07, 2021
N
0
5 Kilometres
0
4.5
9 Miles
1:450,000
Index of Map Series
Bird Collision Surveys 2020
Dorsey C.S.
Rosser
Headingley
Winnipeg
Riel C.S.
Dugald
Glass
Anola
Vivian
Ste. Rita
Cloverleaf
Hazelridge
Oakbank
Molson
Whitemouth
Elma
Deacons Corner
Prairie Grove
Oak Bluff
Starbuck
Grande Pointe
Lorette
Dufresne
Ile-des-Chênes
Ste-Geneviève
Ross
Hadashville
Prawda
McMunn
La Salle
Sanford
St. Adolphe
Linden
Ste. Anne
La Coulée
Richer
Glenlea
Greenland
Domain
Niverville
New Bothwell
Giroux
Brunkild
Ste. Agathe
Randolph
Steinbach
Osborne
Kleefeld
La Broquerie
Aubigny
Carey
St-Pierre-Jolys
Marchand
Grunthal
Sarto
Morris
Lowe Farm
Dufrost
Ste. Elizabeth
Barkfield
St. Malo
St. Labre
Sandilands
Woodridge
Zhoda
Arnaud
Carlowrie
Carrick
Badger
Horndean
Roseau River
Green Ridge
St. Joseph
Letellier
Ginew
Roseau River Reserve (Ginew P.O.)
Stuartburn
Vita
Caliento
Sundown
Vassar
Piney
South Junction
Altona
Tolstoi
Gardenton
Ridgeville
Arbakka
Fredensthal
Gretna
Emerson
Assiniboine River
Cooks Creek
Manning Canal
Seine River
Red River
Joubert Creek
Rat River
Roseau River
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
I:\CLIENTS\MANITOBA_HYDRO\19115102\Mapping\Products\Wildlife\WRCS\MarkBaschuk\20210401\MMTP_TECHREP_MapSeries100_BirdCollisionSurveys_450k_B_20210406_INDEX.mxd

Manitoba Hydro

Manitoba - Minnesota Transmission Project

Project Infrastructure
- MMTP Final Preferred Route
- Converter Station (Proposed)

Infrastructure
- Converter Station (Existing)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Bird Collision Survey Location
- Bird Diverter - Absent
- Bird Diverter - Present

Landbase
- Community
- Railway
- Trans-Canada Highway
- Provincial Trunk Highway
- Provincial Road
- Municipal Road
- City
- Canada/US Boundary

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright ESRI © and its Licensors. Used Under License, All Rights Reserved.
Date Created: March 6, 2021
Date Revised: April 07, 2021

N

0 0.6 Kilometres
0 0.275 0.55 Miles

1:30,000

Bird Collision Surveys

2020

Map Series 100 - 2

Manitoba Hydro

Manitoba - Minnesota Transmission Project

Project Infrastructure
- MMTP Final Preferred Route
- Converter Station (Proposed)

Infrastructure
- Converter Station (Existing)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Bird Collision Survey Location
- Bird Diverter - Absent
- Bird Diverter - Present

Landbase
- Community
- Railway
- Trans-Canada Highway
- Provincial Trunk Highway
- Provincial Road
- Municipal Road
- City
- Canada/US Boundary

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright
ESRI © and its Licensors. Used Under License, All Rights Reserved.
Date Created: March 6, 2021
Date Revised: April 07, 2021

N

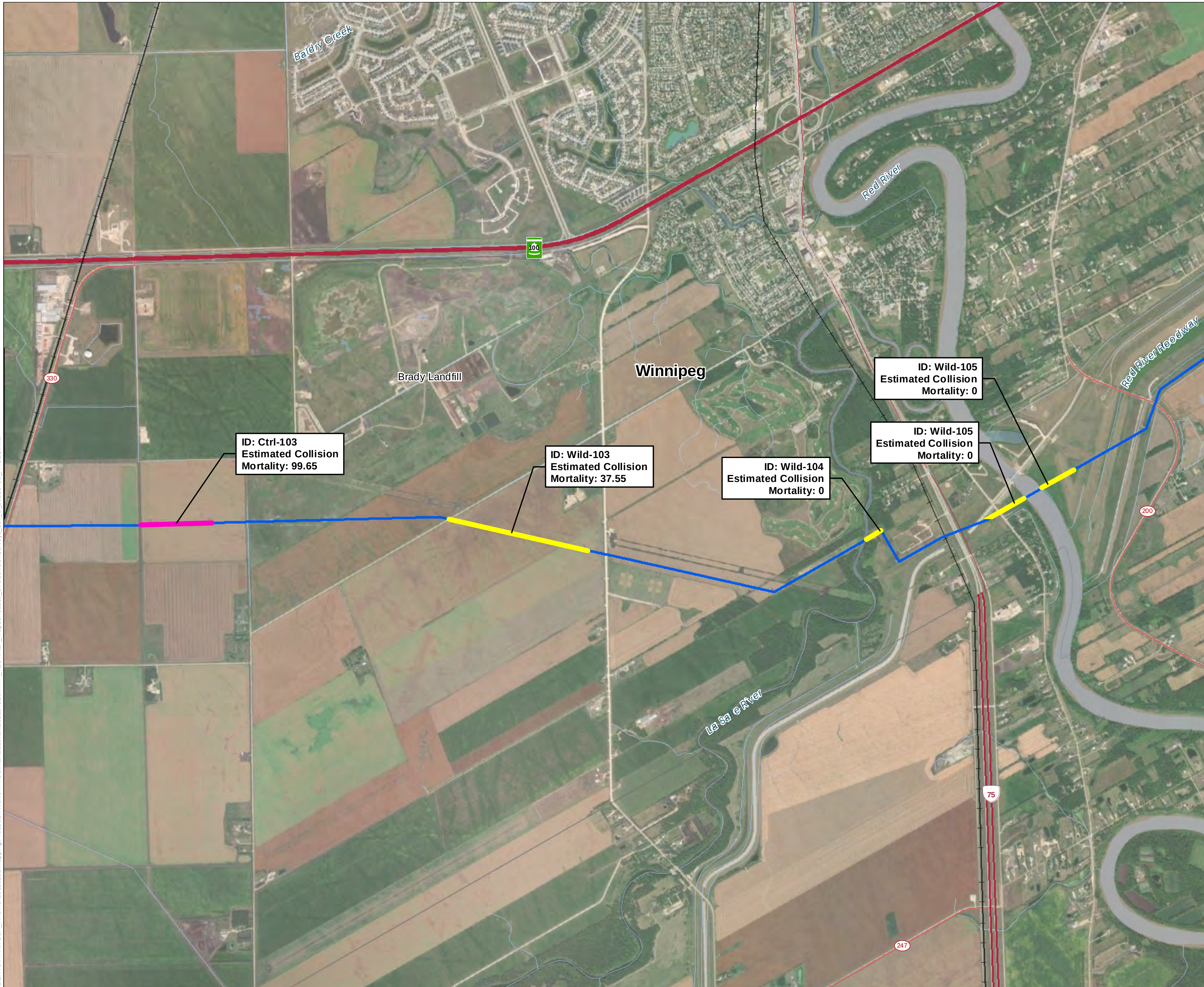
0 0.6 Kilometres
0 0.275 0.55 Miles

1:30,000

Bird Collision Surveys

2020

Map Series 100 - 3



Manitoba Hydro

Manitoba - Minnesota Transmission Project

Project Infrastructure
- MMTP Final Preferred Route
- Converter Station (Proposed)

Infrastructure
- Converter Station (Existing)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Bird Collision Survey Location
- Bird Diverter - Absent
- Bird Diverter - Present

Landbase
- Community
- Railway
- Trans-Canada Highway
- Provincial Trunk Highway
- Provincial Road
- Municipal Road
- City
- Canada/US Boundary

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright
ESRI © and its Licensors. Used Under License, All Rights Reserved.
Date Created: March 6, 2021
Date Revised: April 07, 2021

N

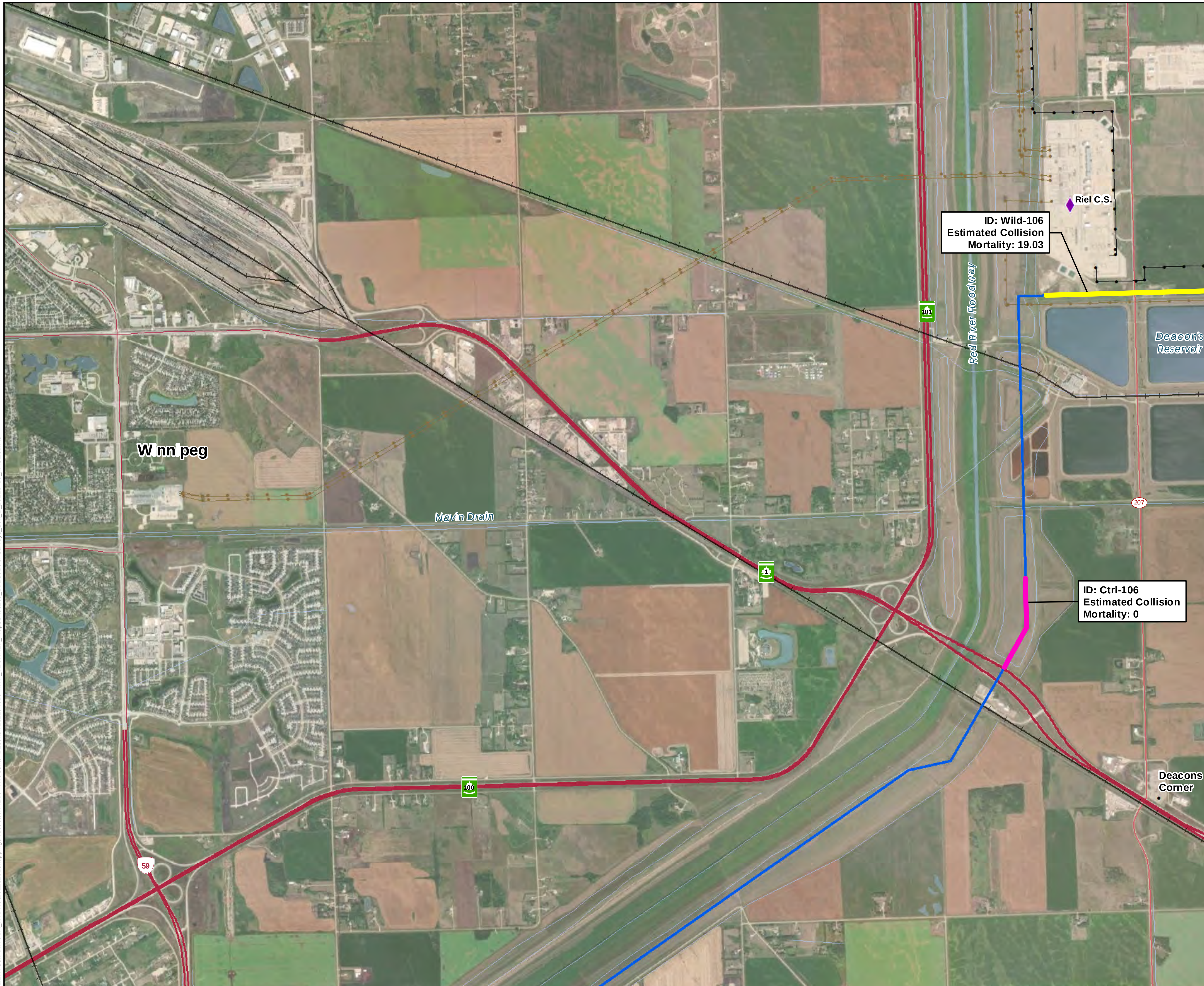
0 0.6 Kilometres
0 0.275 0.55 Miles

1:30,000

Bird Collision Surveys

2020

Map Series 100 - 5



Manitoba Hydro

Manitoba - Minnesota Transmission Project

Project Infrastructure
- MMTP Final Preferred Route
- Converter Station (Proposed)

Infrastructure
- Converter Station (Existing)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Bird Collision Survey Location
- Bird Diverter - Absent
- Bird Diverter - Present

Landbase
- Community
- Railway
- Trans-Canada Highway
- Provincial Trunk Highway
- Provincial Road
- Municipal Road
- City
- Canada/US Boundary

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright ESRI © and its Licensors. Used Under License, All Rights Reserved.
Date Created: March 6, 2021
Date Revised: April 07, 2021

0 0.6 Kilometres
0 0.275 0.55 Miles
1:30,000

Bird Collision Surveys

2020

Map Series 100 - 7

Manitoba Hydro

Manitoba - Minnesota Transmission Project

Project Infrastructure

- MMTP Final Preferred Route
- Converter Station (Proposed)

Infrastructure

- Converter Station (Existing)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Bird Collision Survey Location

- Bird Diverter - Absent
- Bird Diverter - Present

Landbase

- Community
- Railway
- Trans-Canada Highway
- Provincial Trunk Highway
- Provincial Road
- Municipal Road
- City
- Canada/US Boundary

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright

Date Created: March 6, 2021
Date Revised: April 07, 2021

N

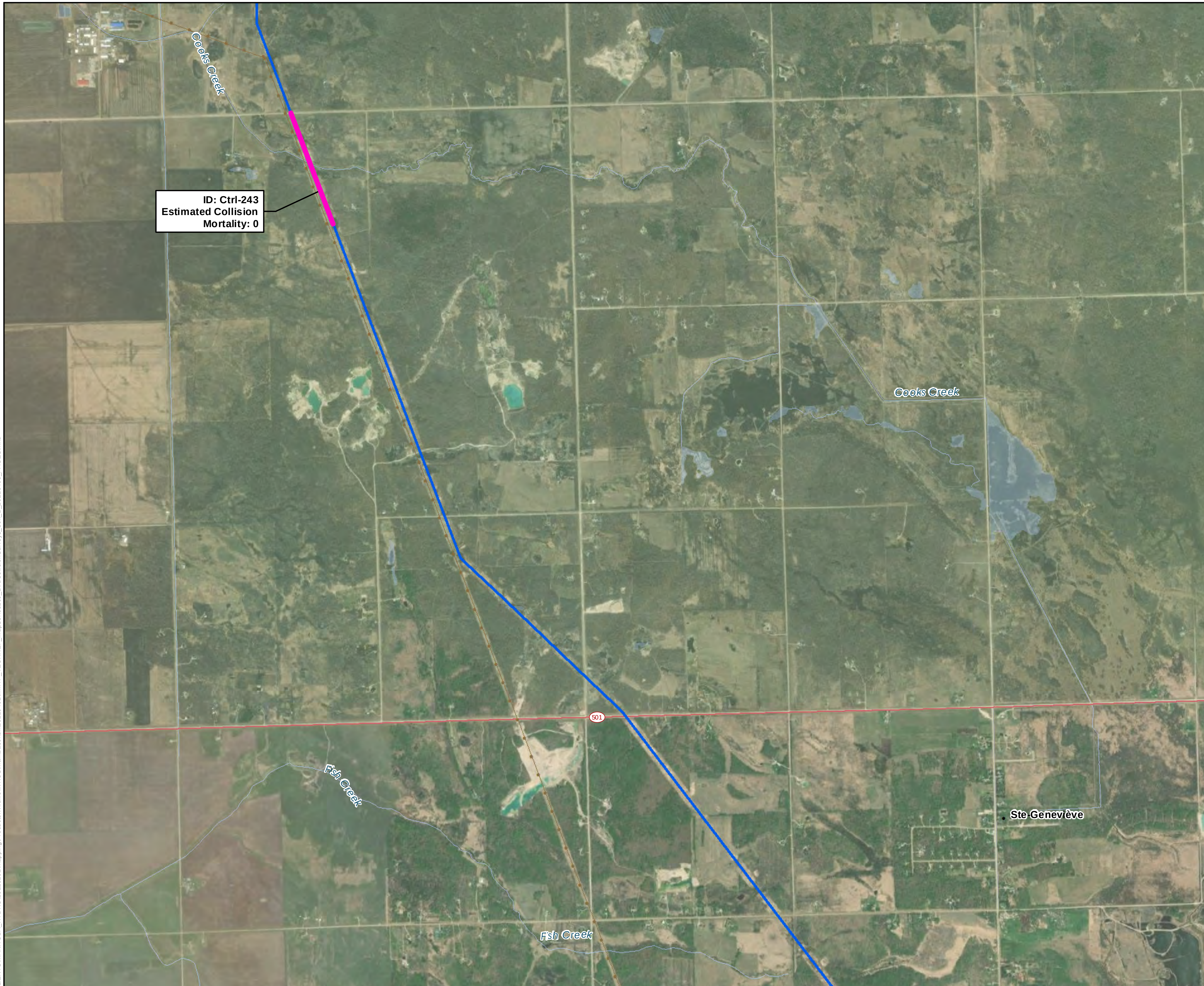
0 0.6 Kilometres
0 0.275 0.55 Miles

1:30,000

Bird Collision Surveys

2020

Map Series 100 - 8



Manitoba Hydro

Manitoba - Minnesota Transmission Project

Project Infrastructure

- MMTP Final Preferred Route
- Converter Station (Proposed)

Infrastructure

- Converter Station (Existing)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Bird Collision Survey Location

- Bird Diverter - Absent
- Bird Diverter - Present

Landbase

- Community
- Railway
- Trans-Canada Highway
- Provincial Trunk Highway
- Provincial Road
- Municipal Road
- City
- Canada/US Boundary

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright ESRI © and its Licensors. Used Under License, All Rights Reserved.
Date Created: March 6, 2021
Date Revised: April 07, 2021

N

0 0.6 Kilometres
0 0.275 0.55 Miles

1:30,000

Bird Collision Surveys

2020

Map Series 100 - 11

I:\CLIENTS\MANITOBA_HYDRO\19115\02\Mapping\Products\Wildlife\WRCS\MarkBaschuk\20210401\MMTP_TECHREP_MapSeries100_BirdCollisionSurveys_30k_B_20210406_PAGES.mxd

Manitoba Hydro

Manitoba - Minnesota Transmission Project

Project Infrastructure
- MMTP Final Preferred Route
- Converter Station (Proposed)

Infrastructure
- Converter Station (Existing)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Bird Collision Survey Location
- Bird Diverter - Absent
- Bird Diverter - Present

Landbase
- Community
- Railway
- Trans-Canada Highway
- Provincial Trunk Highway
- Provincial Road
- Municipal Road
- City
- Canada/US Boundary

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright ESRI © and its Licensors. Used Under License, All Rights Reserved.
Date Created: March 6, 2021
Date Revised: April 07, 2021

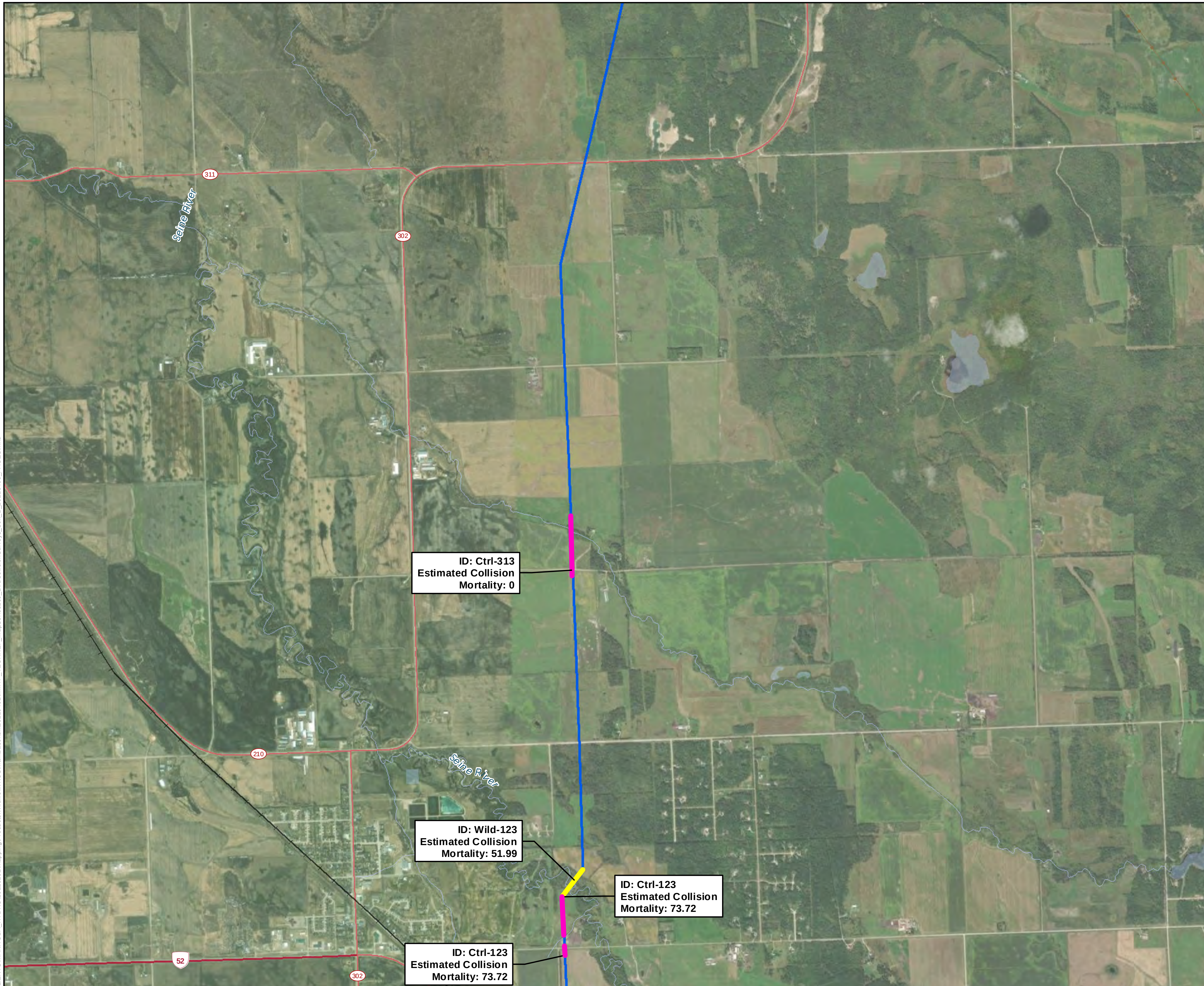
N

0 0.6 Kilometres
0 0.275 0.55 Miles
1:30,000

Bird Collision Surveys

2020

Map Series 100 - 13



Manitoba Hydro

Manitoba - Minnesota Transmission Project

Project Infrastructure
- MMTP Final Preferred Route
- Converter Station (Proposed)

Infrastructure
- Converter Station (Existing)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Bird Collision Survey Location
- Bird Diverter - Absent
- Bird Diverter - Present

Landbase
- Community
- Railway
- Trans-Canada Highway
- Provincial Trunk Highway
- Provincial Road
- Municipal Road
- City
- Canada/US Boundary

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright
ESRI © and its Licensors. Used Under License, All Rights Reserved.
Date Created: March 6, 2021
Date Revised: April 07, 2021

N

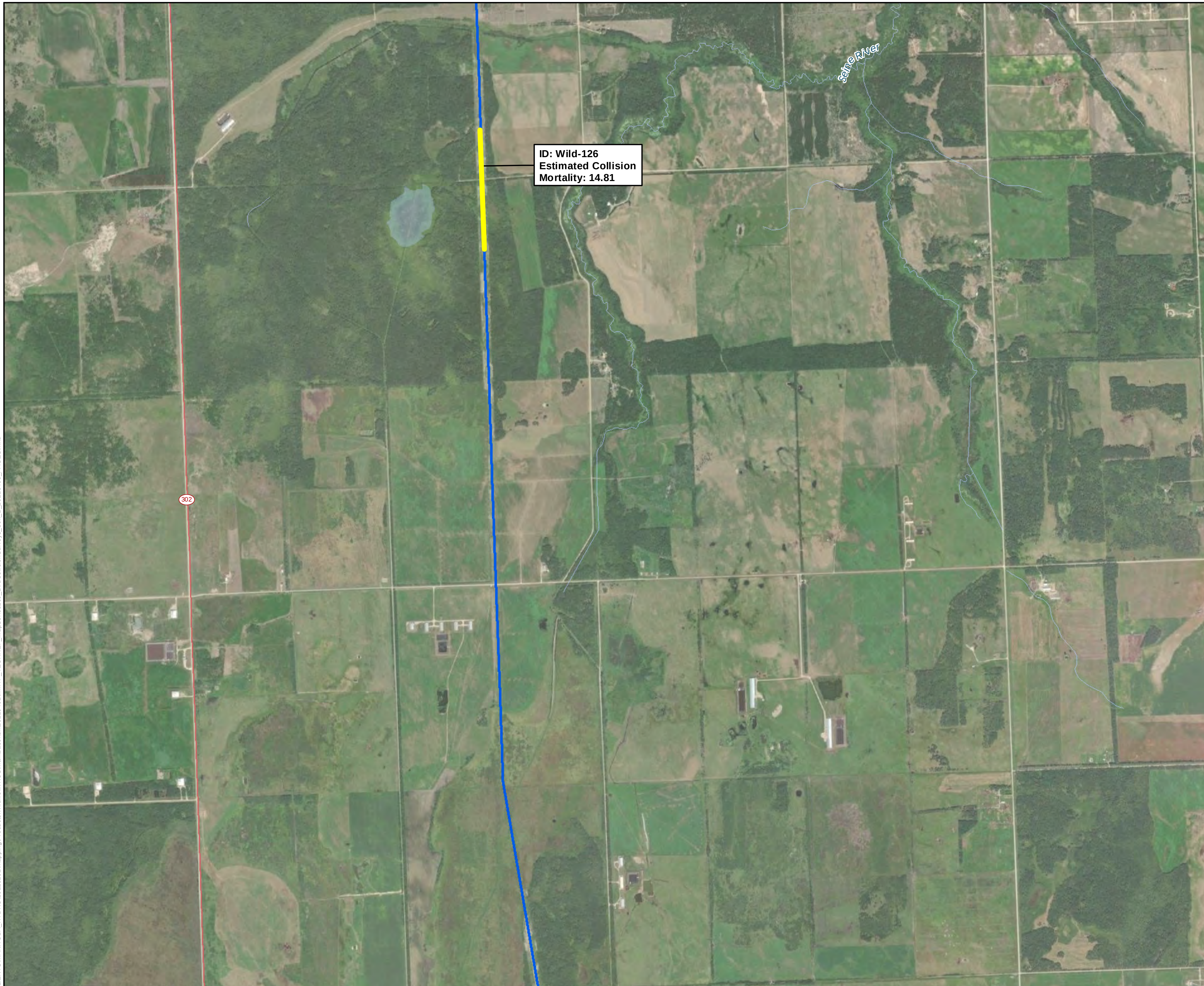
0 0.6 Kilometres
0 0.275 0.55 Miles

1:30,000

Bird Collision Surveys

2020

Map Series 100 - 14



Manitoba Hydro

Manitoba - Minnesota Transmission Project

Project Infrastructure
MMTP Final Preferred Route
Converter Station (Proposed)

Infrastructure
Converter Station (Existing)
Existing 500kV Transmission Line
Existing 230kV Transmission Line

Bird Collision Survey Location
Bird Diverter - Absent
Bird Diverter - Present

Landbase
Community
Railway
Trans-Canada Highway
Provincial Trunk Highway
Provincial Road
Municipal Road
City
Canada/US Boundary

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright

Date Created: March 6, 2021
Date Revised: April 07, 2021

N

0 0.6 Kilometres
0 0.275 0.55 Miles

1:30,000

Bird Collision Surveys

2020

Map Series 100 - 16

Manitoba Hydro

Manitoba - Minnesota Transmission Project

Project Infrastructure

- MMTP Final Preferred Route
- Converter Station (Proposed)

Infrastructure

- Converter Station (Existing)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Bird Collision Survey Location

- Bird Diverter - Absent
- Bird Diverter - Present

Landbase

- Community
- Railway
- Trans-Canada Highway
- Provincial Trunk Highway
- Provincial Road
- Municipal Road
- City
- Canada/US Boundary

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright ESRI © and its Licensors. Used Under License, All Rights Reserved.
Date Created: March 6, 2021
Date Revised: April 07, 2021

N

0 0.6 Kilometres
0 0.275 0.55 Miles

1:30,000

Bird Collision Surveys

2020

Map Series 100 - 19

Manitoba Hydro

Manitoba - Minnesota Transmission Project

Project Infrastructure
- MMTP Final Preferred Route
- Converter Station (Proposed)

Infrastructure
- Converter Station (Existing)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Bird Collision Survey Location
- Bird Diverter - Absent
- Bird Diverter - Present

Landbase
- Community
- Railway
- Trans-Canada Highway
- Provincial Trunk Highway
- Provincial Road
- Municipal Road
- City
- Canada/US Boundary

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright

Date Created: March 6, 2021
Date Revised: April 07, 2021

N

0 0.6 Kilometres
0 0.275 0.55 Miles

1:30,000

Bird Collision Surveys

2020

Map Series 100 - 20

I:\CLIENTS\MANITOBA_HYDRO\19115102\Mapping\Products\Wildlife\WRCS\MarkBaschuk\20210401\MMTP_TECHREP_MapSeries100_BirdCollisionSurveys_30k_B_20210406_PAGES.mxd

Manitoba Hydro

Manitoba - Minnesota Transmission Project

Project Infrastructure
- MMTP Final Preferred Route
- Converter Station (Proposed)

Infrastructure
- Converter Station (Existing)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Bird Collision Survey Location
- Bird Diverter - Absent
- Bird Diverter - Present

Landbase
- Community
- Railway
- Trans-Canada Highway
- Provincial Trunk Highway
- Provincial Road
- Municipal Road
- City
- Canada/US Boundary

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright ESRI © and its Licensors. Used Under License, All Rights Reserved.
Date Created: March 6, 2021
Date Revised: April 07, 2021

N

0 0.6 Kilometres
0 0.275 0.55 Miles

1:30,000

Bird Collision Surveys

2020

Map Series 100 - 21

Appendix 2
Photos

Photo 1. Canada Geese Crossing over the MMTP near Brady Landfill, September 2020

Photo 2. Sora Carcass Observed at Site Ctrl-123, September 2020

Photo 3. Nashville Warbler Carcass Observed at Site Wild-100, September 2020

Photo 4. Vesper Sparrow Carcass Observed at Site Wild-103, September 2020

Photo 5. Black and White Warbler Carcass Observed at Site Wild-118, September 2020

Photo 6. Mallard Partial Carcass Observed at Site Wild-103, September 2020

Photo 7. Remnants of a Quail Carcass Following a Scavenger Bias Period of Seven Days, September 2020. Note: nearly all soft tissue was removed by insects during this time.

APPENDIX E

MANITOBA–MINNESOTA TRANSMISSION PROJECT
Environmental Monitoring Plan

SHARP-TAILED GROUSE MONITORING REPORT 2020

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Services MB Inc.

April 2021

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 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 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.

Pre-construction surveys for sharp-tailed grouse conducted in spring 2017 and 2019 were repeated in 2020, the first year after Project construction. With permission from landowners, two trail cameras were set up to photograph sharp-tailed grouse activity at eight leks. Reconnaissance surveys were then carried out at 76 sites identified as leks or potential leks during previous survey 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) and reference leks (more than 1,500 m from the right-of way) before and after construction to test the effect of the transmission line on grouse alert behaviour, time spent on the lek by grouse, and the abundance of males at lekking sites.

Of the 84 sites surveyed in spring 2020, 16 were identified as leks and 18 were identified as potential leks. No sharp-tailed grouse activity was recorded at 50 sites. Analyses of sharp-tailed grouse abundance and behaviour from approximately 638,000 trail camera photos indicated that 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 sites in 2020 was detected, and no change was observed from the pre- to post-construction period. There was no difference in the mean number of male sharp-tailed grouse photographed at potentially affected and reference leks in 2020. There were more males at potentially affected and reference leks after construction than before, but the difference was not significant. Relatively few predators were photographed in 2020; 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. Monitoring at sharp-tailed grouse leks will continue during post construction and results will be added to the analysis of the effects of transmission line installation on grouse at lekking sites.

STUDY TEAM

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

- Robert Berger – Design, analysis, surveys, and reporting
- Andrea Ambrose – Analysis and reporting
- Mark Baschuk – Mapping
- Derric Trudeau – Survey personnel
- Thomas Wood – Survey personnel

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

LIST OF MAPS

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).

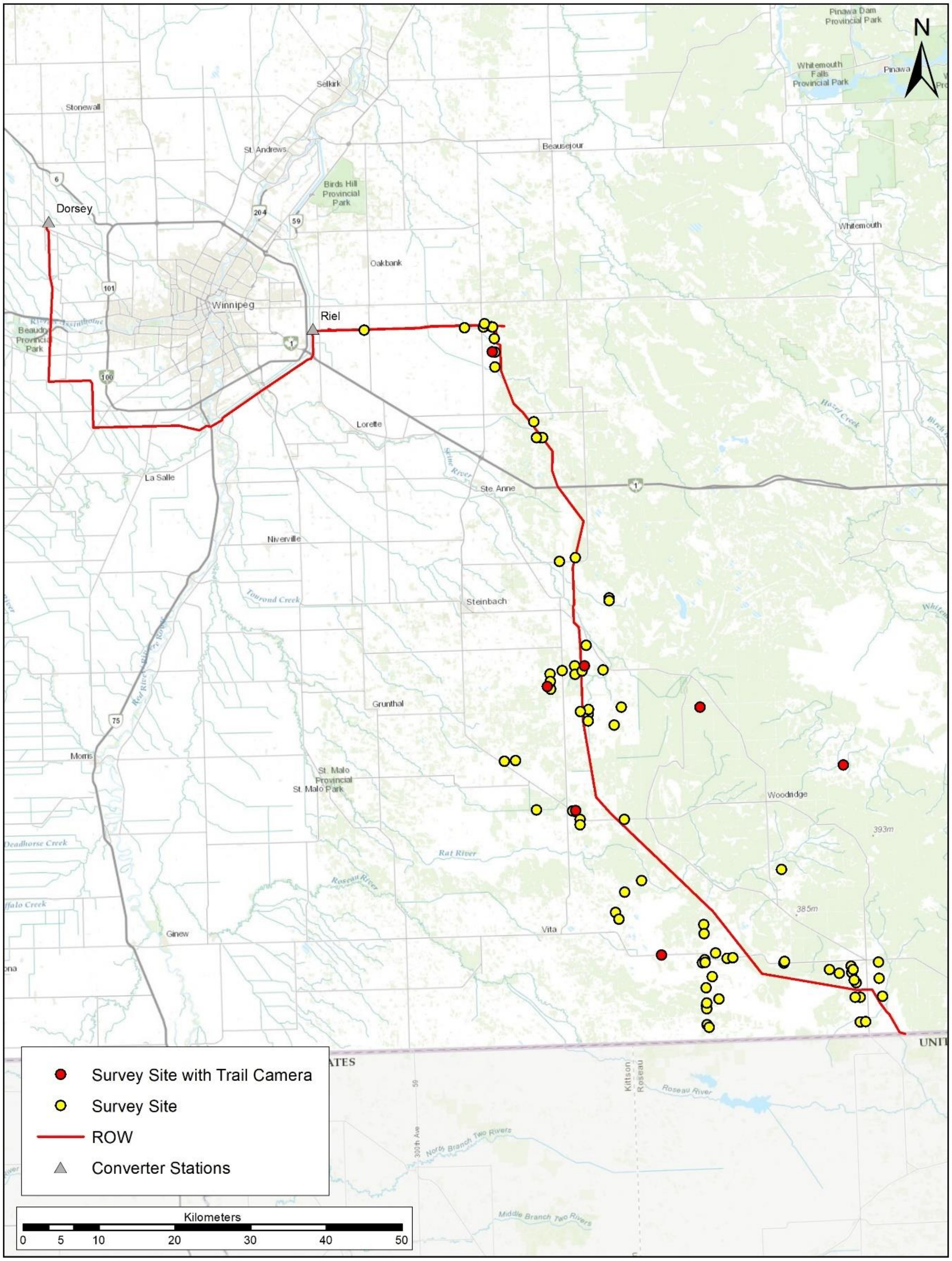
As outlined in the EIS, anticipated Project effects on sharp-tailed grouse included the temporary loss of some habitat at tower sites and the compaction of vegetation cover along the transmission line right-of-way (ROW). Additionally, grouse are vulnerable to increased rates of predation if birds of prey (raptors) use transmission towers as perches when hunting or nesting near leks. 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 sharp-tailed grouse alert behaviour, time spent on the lek, and the abundance of males at lekking sites. A secondary objective was to identify an association between avian and terrestrial predators, sharp-tailed grouse, and transmission lines.

METHODS

Pre-construction surveys for sharp-tailed grouse conducted in spring 2017 and 2019 were repeated in 2020, the first year after Project construction. From March 27 to April 13, 2020, trail cameras were placed at eight known 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 east, 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 14 to 24, 2020, reconnaissance surveys were carried out at 76 sites identified as leks or potential leks during previous survey years, where access was not permitted or could not be obtained from landowners. 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 (*Asio flammeus*), which is a species of conservation concern.

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



Map 1: Locations surveyed for sharp-tailed grouse, spring 2020

Approximately 638,000 trail camera photos were reviewed and the number of grouse and their behaviour were recorded. Photos taken between 5:00 a.m. and 8:00 a.m. 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). If no grouse were photographed on a particular day, the north-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 eight leks, only photos taken over a consistent period (April 15 to May 7, 2020 for seven sites and April 9 to 26, 2020 for one site) were considered in the analyses.

As described in Section 7.3.2.2 of the Environmental Monitoring Plan (Manitoba Hydro 2019), 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 sites) and at leks more than 1,500 m from the ROW centreline (reference sites) over the 17- or 23-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 April 15 to May 7 or April 9 to 26, 2020 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.

RESULTS

Of the 84 sites surveyed in spring 2020, 16 were identified as leks and 18 were identified as potential leks (Map 2; Appendix C). No sharp-tailed grouse activity was recorded at 50 sites, 21 of which were identified as leks and 29 of which were identified as potential leks in 2019. Of the 21 lekking sites that were inactive at the time of the survey, 5 were potentially affected and 16 were reference. Thirty-six percent of the potentially affected leks identified in 2019 were inactive during the 2020 survey. Of the leks identified in 2019, 36% of potentially affected sites and 55% of reference sites were inactive during the 2020 survey. At least one sharp-tailed grouse was heard during passive counts at leks and up to eight were observed at potential leks (Appendix D). Two leks and 8 potential leks were at potentially affected sites and there were 5 leks and 10 potential leks at reference sites.

During the standardized survey period, sharp-tailed grouse were photographed at all eight leks where trail cameras were deployed. Up to 21 individuals were photographed during 15-second intervals from April 9 to May 7, 2020 and up to 16 individuals were observed from April 8 to 13, 2020 (Table 1). A total of 11 photos of grouse were taken at site 042L over 3 days of the 23-day survey period, possibly due to camera placement. This site was removed from further analyses.

Table 1: Maximum number of sharp-tailed grouse observed during on-site active counts (April 8–13, 2020) and from trail camera photos (April 9–May 7, 2020)

Site Type	Site	Active Count	Photo Count
Potentially affected	042L	2	2
	359L	0	9
	369L	7	8
	462L	8	10
Reference	158L	4	5
	263L	14	15
	463L	17	19
	464L	16	21

REDACTED

Map 2: Sharp-tailed grouse leks and potential leks identified in the study area, spring 2020

The greatest proportion of grouse activity photographed was loafing/feeding at four of seven leks (Table 2). Reproductive behaviour (Photo 2), which was observed as early as 5:00 a.m. and typically continued until the end of the programmed photo period at 8:00 a.m., was photographed at all seven leks and was the most frequent activity at three. Flush and alert behaviours were observed at all sites, but there was very little of each (Figure 1). Flush and alert behaviours were greatest at reference sites 463L and 158L, respectively. There was a weak positive correlation between the greatest number of sharp-tailed grouse observed during active counts or in photos and the proportion of behaviours that were reproductive at each lek (Figure 2).

Table 2: Proportion of sharp-tailed grouse behaviours photographed at seven leks from April 9 to May 7, 2020

Site Type	Site	Reproductive	Loafing/Feeding	Flush	Alert	Unknown
Potentially affected	359L	0.43	0.50	<0.01	<0.01	0.06
	369L	0.27	0.64	<0.01	<0.01	0.09
	462L	0.62	0.14	<0.01	0.01	0.22
Reference	158L	0.13	0.69	<0.01	0.07	0.11
	263L	0.36	0.60	<0.01	<0.01	0.04
	463L	0.50	0.46	0.01	<0.01	0.03
	464L	0.52	0.44	<0.01	<0.01	0.04

Photo 2: Sharp-tailed grouse dancing and loafing at site 464L April 20, 2020

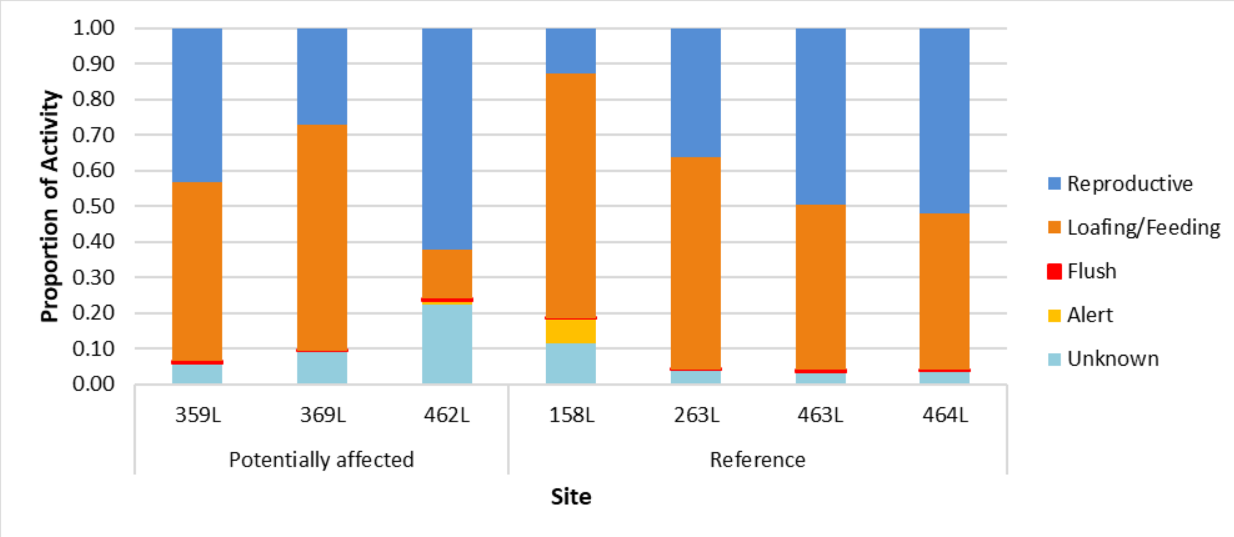


Figure 1: Proportion of sharp-tailed grouse behaviours photographed at seven leks from April 9 to May 7, 2020

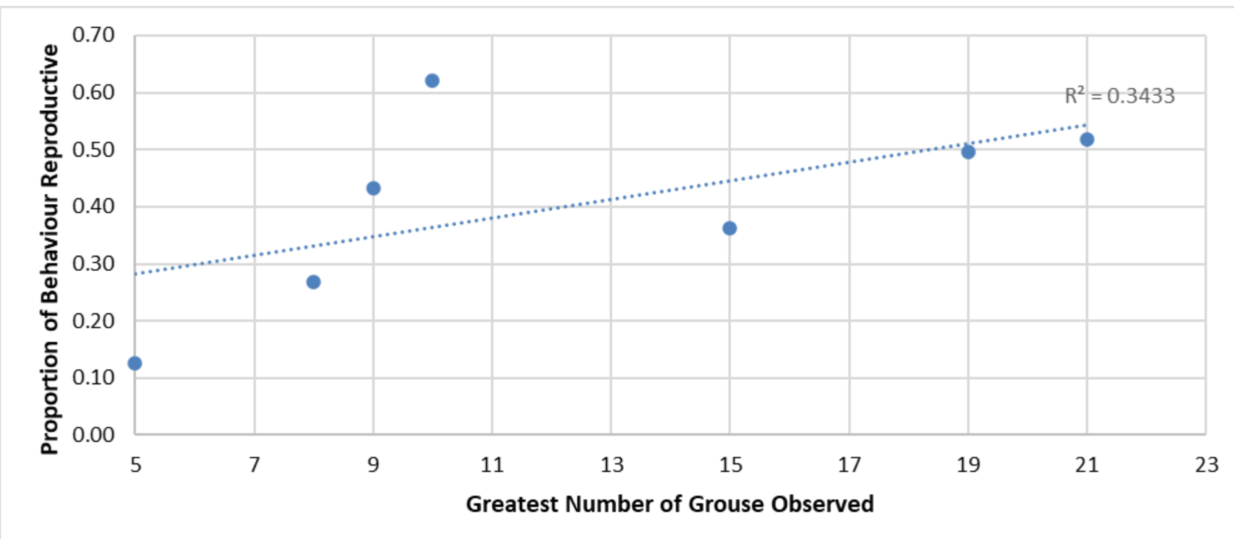


Figure 2: Relationship between the greatest number of sharp-tailed grouse actively counted or photographed and the proportion of behaviours that were reproductive at seven leks from April 8 to May 7, 2020

The maximum number of males photographed per day was 7 or 8 at potentially affected sites and ranged from 4 to 19 at reference sites (Table 3). The mean number of males over the standardized survey period was greatest at reference site 464L.

Table 3: Number of male sharp-tailed grouse photographed at seven leks from April 9 to May 7, 2020

	Site						
	<1,500 m from ROW			>1,500 m from ROW			
Day[1]	359L	369L	462L	158L	263L	463L	464L
1	0	4	6	2	11	0	4
2	0	3	6	2	8	0	16
3	0	4	6	0	9	0	6
4	0	5	6	2	9	0	13
5	0	3	7	2	10	0	19
6	0	5	7	0	11	0	17
7	0	4	5	2	11	0	17
8	3	4	7	2	9	0	11
9	5	5	7	0	11	11	12
10	7	3	6	3	13	7	10
11	4	4	7	1	11	8	13
12	7	5	4	4	9	12	12
13	8	6	6	0	10	9	7
14	8	7	8	2	13	13	13
15	7	6	7	2	11	10	11
16	8	3	7	2	10	7	7
17	7	3	7	2	11	8	11
18	7	4	8	0	13	10	12
19	6	4	–	3	13	10	10
20	7	4	–	3	8	9	9
21	4	6	–	2	8	8	10
22	3	5	–	2	7	10	9
23	7	6	–	0	10	5	11
Maximum	8	7	8	4	13	13	19
Mean	4.3	4.5	6.5	1.7	10.3	6.0	11.3
SD[2]	3.2	1.1	1.0	1.1	1.8	4.9	3.7

1. Photos were analyzed from April 15 to May 7, 2020 at all sites but 462L, where photos were analyzed from April 9 to 26, 2020.
2. Standard deviation.

On average, sharp-tailed grouse spent the greatest proportion of time on-lek at reference sites 263L and 464L in 2020 (0.76; Figure 3). Grouse were photographed on-lek at least 39% of the time at all other sites. Grouse were photographed on-lek an average of 55% of the time at potentially affected sites and 60% of the time on-lek at reference sites. The difference was not significant ($t = 1.98$, $p = 0.21$). During the pre-construction period, trail camera photos were taken at 5 leks in 2017 and 10 leks in 2019 (Wildlife Resource Consulting Services MB Inc. [WRCS] 2018, 2020). A total of five leks were at potentially affected sites and nine leks were at reference sites, one of which (010L) was surveyed both years (Appendix E). Because grouse behaviour was photographed at a small number of leks in 2017 the results were combined with those of

2019 for comparison with 2020, after Project construction was complete. When compared with the pre-construction period, there was no change in the mean proportion of time sharp-tailed grouse spent on-lek before or after construction at potentially affected sites (Table 4). The mean proportion of time grouse spent on-lek at reference sites was significantly greater after construction than before. No effect of transmission line installation on time spent on leks by sharp-tailed grouse was detected.

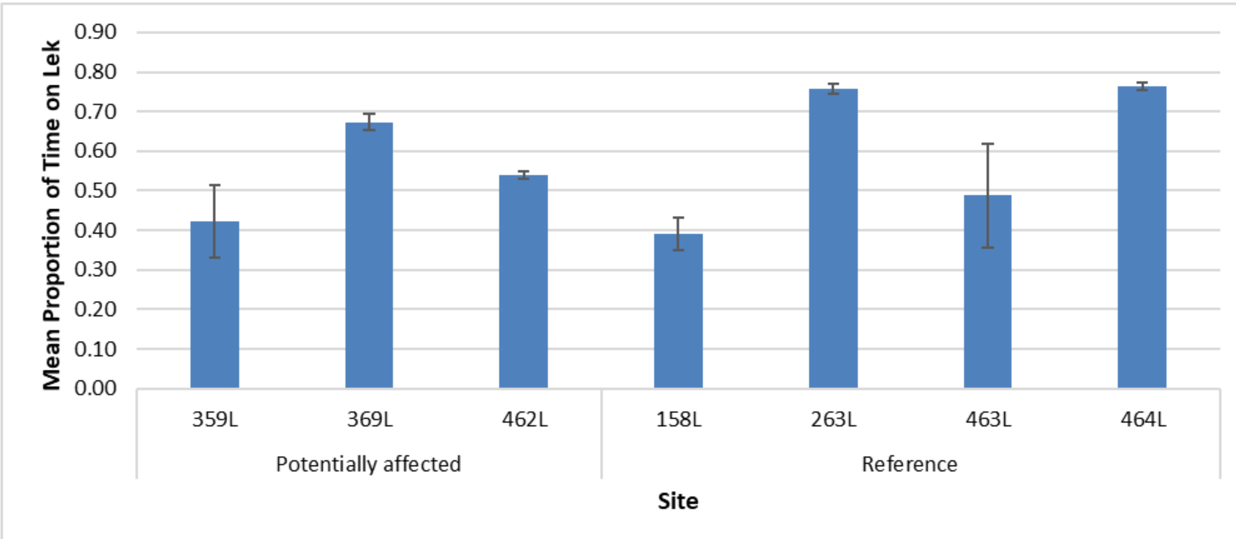


Figure 3: Mean proportion of time sharp-tailed grouse spent on seven leks from April 9 to May 7, 2020

Table 4: Mean proportion of time sharp-tailed grouse spent on leks before (2017 and 2019) and after (2020) construction

Site Type	2017 & 2019			2020				
	Mean	SD	Variance	Mean	SD	Variance	*t*	*p*
Potentially affected	0.56	0.30	0.09	0.55	0.24	0.06	1.98	0.86
Reference	0.47	0.25	0.06	0.60	0.28	0.08	1.97	<0.01

When only known behaviours were considered, there was no significant difference between the mean proportion of reproductive (t = 3.18, p = 0.52), loafing/feeding (t = 2.57, p = 0.50), flush (t = 2.57, p = 0.61), or alert (t = 3.18, p = 0.50) sharp-tailed grouse behaviour at potentially affected and reference sites in 2020. There was more reproductive behaviour at potentially affected and reference sites after construction than before, but the difference was not significant (Table 5). There was less loafing/feeding behaviour at potentially affected and reference sites after construction than before, but the difference was not significant. There was relatively little flush or alert behaviour at potentially affected and reference sites before and after construction. No significant differences were observed, indicating that the installation of the transmission line did not affect alert behaviours.

Table 5: Proportion of known sharp-tailed grouse behaviours before (2017 and 2019) and after (2020) construction

Behaviour	Site Type	2017 & 2019			2020				
		Mean	SD	Variance	Mean	SD	Variance	*t*	*p*
Reproductive	Potentially affected	0.13	0.07	<0.01	0.52	0.26	0.07	4.30	0.12
	Reference	0.27	0.12	0.01	0.39	0.18	0.03	2.18	0.16
Loafing/ Feeding	Potentially affected	0.85	0.05	<0.01	0.47	0.27	0.07	4.30	0.13
	Reference	0.71	0.13	0.02	0.58	0.15	0.02	2.18	0.13
Flush	Potentially affected	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.45	0.55
	Reference	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.18	0.36
Alert	Potentially affected	0.02	0.04	<0.01	0.01	0.01	<0.01	2.78	0.56
	Reference	0.01	0.02	<0.01	0.02	0.04	<0.01	2.18	0.67

In 2020, the mean number of male sharp-tailed grouse was smaller at potentially affected than reference sites (Table 6), but the difference was not significant ($t = 3.18$, $p = 0.24$). When pre-construction photo data from leks surveyed in 2017 and 2019 were combined, the mean number of males was somewhat greater at potentially affected sites than reference sites (Table 6); the difference was not statistically significant ($t = 2.16$, $p = 0.31$). At potentially affected sites, the mean number of males was somewhat greater after construction than before, but there was no significant difference (Table 6). The mean number of males was greater at reference sites after construction than before, but the difference was not significant. No effect of transmission line installation on the abundance of male sharp-tailed grouse at lekking sites was detected.

Table 6: Mean number of male sharp-tailed grouse photographed before (2017 and 2019) and after (2020) construction

Site Type	2017 & 2019			2020				
	Mean	SD	Variance	Mean	SD	Variance	*t*	*p*
Potentially affected	6.60	3.65	13.30	7.67	0.58	0.33	2.78	0.56
Reference	5.00	2.26	5.11	12.25	6.18	38.25	3.18	0.11

No avian or ground predators were observed at the leks and potential leks surveyed in 2020. Coyote (*Canis latrans*), red fox (*Vulpes vulpes*), and unidentified hawks were photographed at three leks (Table 7). At site 369L, a coyote and two sharp-tailed grouse were photographed together on April 30. The coyote paid no attention to the grouse and the grouse did not react to the coyote, other than to glance at it (Photo 3). No other grouse were photographed in the two preceding five-minute periods, possibly indicating that none were flushed when it appeared. A hawk was photographed flying over five grouse dancing at site 463L, none of which reacted (Photo 4). At site 464L, two alert grouse were photographed with a red fox, which had what appeared to be a small prey item in its mouth (Photo 5). A third grouse flushed a moment later. A hawk was also photographed at the same site; no grouse were on-camera at the time or immediately preceding its appearance (Photo 6). There did not appear to be more predator activity at potentially affected than reference sites. Where avian and land predators were photographed with grouse, their presence did not appear to affect grouse behaviour.

Table 7: Predators photographed at sharp-tailed grouse leks April 9 to May 7, 2020

Site Type	Site	Date	Time	Species	Grouse Reaction
Potentially affected	369L	April 30	6:30 a.m.	Coyote	Two grouse, no reaction
Reference	463L	May 4	7:00 a.m.	Hawk sp.	Grouse dancing, no reaction
	464L	April 16	6:20 a.m.	Red fox	Two grouse, alert
		April 30	6:20 a.m.	Hawk sp.	No grouse in photo

In 2017, a coyote was photographed at each of two reference sites. No ground or avian predators were detected at potentially affected sites. In 2019, avian predators were observed at one potentially affected site and two reference sites during the initial survey for sharp-tailed grouse. A northern harrier (*Circus cyaneus*) was photographed at each of two reference sites. No grouse were on-camera at one site and two grouse were flushed at the other.

White-tailed deer (*Odocoileus virginianus*) were photographed at sites 359L, 369L, and 464L and eastern cottontail (*Sylvilagus floridanus*) was photographed at site 369L in 2020 (Appendix F). No other wildlife or environmental observations were made, including short-eared owl.

Photo 3: Coyote and sharp-tailed grouse at site 369L April 30, 2020

Photo 4: Hawk at site 463L May 4, 2020

Photo 5: Red fox and two sharp-tailed grouse (red arrows) at site 464L April 16, 2020

Photo 6: Hawk at site 464L April 30, 2020

DISCUSSION

Fewer sharp-tailed grouse leks were found during the 2020 survey than in 2019, particularly leks further from the ROW. The sharp-tailed grouse population could be declining in the study area as part of the natural ten-year cycle that has been reported for the species (e.g., Keith 1963 in Moss and Watson 2001). The disappearance of small leks or satellite leks (i.e., transient lek active for only one or a few years) supports a possible downturn in the population cycle, but other factors such as habitat loss might also be affecting the population in the region (Baydack 1986; Berger and Baydack 1992).

Approximately 638,000 trail camera photos taken in spring 2020 were analyzed for sharp-tailed grouse behaviour. In 2020, after Project construction, there was no difference in the proportion of alert behaviour at potentially affected and reference leks. When compared with the combined results in 2017 and 2019, there was no difference in the proportion of alert behaviour at leks pre- and post-construction. Alert and flush behaviours comprised a small proportion of sharp-tailed grouse activity at all leks over the three-year study period. There was no difference in the proportion of time grouse were photographed on-lek at potentially affected and reference sites in 2020. No change in the proportion of time spent on-lek at potentially affected sites was observed from the pre-construction period to the first year of operation.

There was no significant difference in the mean number of male sharp-tailed grouse photographed at potentially affected and reference leks in 2020. There were more males at potentially affected and reference leks after construction than before, but the difference was not significant.

Relatively few predators were photographed in 2020. All avian predators were photographed at reference leks. While a coyote was photographed at a potentially affected lek, it had no apparent effect on the behaviour of the single sharp-tailed grouse nearby. There was no increase in predator activity at potentially affected leks relative to the pre-construction period. Data from the remote infrared camera trap arrays situated along the ROW and in adjacent habitat to monitor ungulates and predators will be used to evaluate changes in predator activity as they become available, or after the conclusion of operation monitoring.

No differences in sharp-tailed grouse behaviour or abundance at potentially affected and reference leks were observed during the first year of operation monitoring, or at potentially affected leks when compared with the pre-construction period. As such, no significant effects on sharp-tailed grouse near the transmission line have been identified to date, and no unexpected effects were observed. Monitoring at sharp-tailed grouse leks will continue during Project operation and results will be added to the analysis of the effects of transmission line installation on grouse alert behaviours, time spent on the lek by grouse, and the abundance of males at lekking sites.

LITERATURE CITED

Baydack, R.K. 1986. Sharp-tailed grouse response to lek disturbance in the Carberry Hills of Manitoba. PhD. Thesis. Submitted to the Department of Fishery and Wildlife Biology, Colorado state University, Fort Collins, Colorado. 83 pp.

Berger, R.P. and R.K. Baydack. 1992. Effects of aspen succession on sharp-tailed grouse, *Tympanuchus phasianellus*, in the Interlake region of Manitoba. Canadian Field-Naturalist 106:185–191.

Kiss, B. 2017. Habitat Mitigation Biologist, Manitoba Sustainable Development. Telephone conversation and email correspondence with Robert Berger, Wildlife Resource Consulting Services MB Inc., Winnipeg, MB. February 13, 2017.

Manitoba Hydro. 2019. Manitoba-Minnesota Transmission Project Environmental Monitoring Plan. Manitoba Hydro, Winnipeg, MB. 95 pp.

Moss, R. and A. Watson. 2001. Population cycles in bird of the grouse family (Tetraonidae). Advances in Ecological Research 32: 53–111.

Taylor, P. 2003. Sharp-tailed grouse. In The Birds of Manitoba. Edited by P. Taylor. Manitoba Naturalists Society, Winnipeg, MB. pp. 153–154.

WRCS (Wildlife Resource Consulting Services MB Inc.). 2018. Manitoba-Minnesota Transmission Project Environmental Monitoring Plan Sharp-tailed Grouse Monitoring Report 2017. Prepared for Manitoba Hydro by WRCS, Winnipeg, MB. 28 pp.

WRCS. 2020. Manitoba-Minnesota Transmission Project Environmental Monitoring Plan Sharp-tailed Grouse Monitoring Report 2019. Prepared for Manitoba Hydro by WRCS, Winnipeg, MB. 24 pp.

APPENDIX A

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

	A	B	C	D	E	F	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
1	Image Name	Site	Location	Trigger	Date	Time	START	END	NUMBERGROUSE	REPRODUCTIVE	LOAF_FEED	FLUSH	ALERT	UNKNOWNBEHAV	PREDATORS	SCIENTIFIC_NAME	COMMENT
92	2020-04-08 07-30-00 T 1_30.JPG	369LN	100	T 1/30	4/8/2020	7:30:00 AM	7:30:00 AM	7:30:05 AM	4	0	4	0	0	0	none	na	
93	2020-04-08 07-30-00 T 2_30.JPG	369LN	100	T 2/30	4/8/2020	7:30:00 AM											
94	2020-04-08 07-30-01 T 3_30.JPG	369LN	100	T 3/30	4/8/2020	7:30:01 AM											
95	2020-04-08 07-30-02 T 4_30.JPG	369LN	100	T 4/30	4/8/2020	7:30:02 AM											
96	2020-04-08 07-30-02 T 5_30.JPG	369LN	100	T 5/30	4/8/2020	7:30:02 AM											
97	2020-04-08 07-30-03 T 6_30.JPG	369LN	100	T 6/30	4/8/2020	7:30:03 AM											
98	2020-04-08 07-30-03 T 7_30.JPG	369LN	100	T 7/30	4/8/2020	7:30:03 AM											
99	2020-04-08 07-30-04 T 8_30.JPG	369LN	100	T 8/30	4/8/2020	7:30:04 AM											
100	2020-04-08 07-30-05 T 10_30.JPG	369LN	100	T 10/30	4/8/2020	7:30:05 AM											
101	2020-04-08 07-30-05 T 9_30.JPG	369LN	100	T 9/30	4/8/2020	7:30:05 AM											
102	2020-04-08 07-30-06 T 11_30.JPG	369LN	100	T 11/30	4/8/2020	7:30:06 AM	7:30:06 AM	7:30:10 AM	4	0	4	0	0	0	none	na	
103	2020-04-08 07-30-07 T 12_30.JPG	369LN	100	T 12/30	4/8/2020	7:30:07 AM											
104	2020-04-08 07-30-07 T 13_30.JPG	369LN	100	T 13/30	4/8/2020	7:30:07 AM											
105	2020-04-08 07-30-08 T 14_30.JPG	369LN	100	T 14/30	4/8/2020	7:30:08 AM											
106	2020-04-08 07-30-09 T 15_30.JPG	369LN	100	T 15/30	4/8/2020	7:30:09 AM											
107	2020-04-08 07-30-09 T 16_30.JPG	369LN	100	T 16/30	4/8/2020	7:30:09 AM											
108	2020-04-08 07-30-10 T 17_30.JPG	369LN	100	T 17/30	4/8/2020	7:30:10 AM											
109	2020-04-08 07-30-10 T 18_30.JPG	369LN	100	T 18/30	4/8/2020	7:30:10 AM											
110	2020-04-08 07-30-11 T 19_30.JPG	369LN	100	T 19/30	4/8/2020	7:30:11 AM	7:30:11 AM	7:30:15 AM	4	0	4	0	0	0	none	na	
111	2020-04-08 07-30-11 T 20_30.JPG	369LN	100	T 20/30	4/8/2020	7:30:11 AM											
112	2020-04-08 07-30-12 T 21_30.JPG	369LN	100	T 21/30	4/8/2020	7:30:12 AM											
113	2020-04-08 07-30-13 T 22_30.JPG	369LN	100	T 22/30	4/8/2020	7:30:13 AM											
114	2020-04-08 07-30-14 T 23_30.JPG	369LN	100	T 23/30	4/8/2020	7:30:14 AM											
115	2020-04-08 07-30-14 T 24_30.JPG	369LN	100	T 24/30	4/8/2020	7:30:14 AM											
116	2020-04-08 07-30-15 T 25_30.JPG	369LN	100	T 25/30	4/8/2020	7:30:15 AM											
117	2020-04-08 07-30-15 T 26_30.JPG	369LN	100	T 26/30	4/8/2020	7:30:15 AM											
118	2020-04-08 07-30-16 T 27_30.JPG	369LN	100	T 27/30	4/8/2020	7:30:16 AM											
119	2020-04-08 07-30-17 T 28_30.JPG	369LN	100	T 28/30	4/8/2020	7:30:17 AM											
120	2020-04-08 07-30-17 T 29_30.JPG	369LN	100	T 29/30	4/8/2020	7:30:17 AM											
121	2020-04-08 07-30-18 T 30_30.JPG	369LN	100	T 30/30	4/8/2020	7:30:18 AM											
122	2020-04-08 07-35-00 T 1_30.JPG	369LN	100	T 1/30	4/8/2020	7:35:00 AM	7:35:00 AM	7:35:05 AM	3	0	3	0	0	0	none	na	
123	2020-04-08 07-35-00 T 2_30.JPG	369LN	100	T 2/30	4/8/2020	7:35:00 AM											
124	2020-04-08 07-35-01 T 3_30.JPG	369LN	100	T 3/30	4/8/2020	7:35:01 AM											
125	2020-04-08 07-35-02 T 4_30.JPG	369LN	100	T 4/30	4/8/2020	7:35:02 AM											
126	2020-04-08 07-35-02 T 5_30.JPG	369LN	100	T 5/30	4/8/2020	7:35:02 AM											
127	2020-04-08 07-35-03 T 6_30.JPG	369LN	100	T 6/30	4/8/2020	7:35:03 AM											
128	2020-04-08 07-35-03 T 7_30.JPG	369LN	100	T 7/30	4/8/2020	7:35:03 AM											

369LN 100

APPENDIX B

Camera (north or east facing) used for analysis of grouse behaviour, spring 2020

	Site							
Day[1]	**042L**	**158L**	**263L**	**359L**	**369L**	**462L**	**463L**	**464L**
1	North	North	North	North	East	East	North	East
2	North	East	North	North	North	North	North	North
3	North	North	North	North	North	North	North	East
4	North	North	North	North	East	North	North	North
5	North	North	North	North	East	East	North	North
6	North	North	North	North	East	East	North	North
7	North	East	North	North	East	East	North	North
8	North	North	North	North	East	East	North	North
9	North	North	North	East	East	East	North	North
10	North	North	North	East	North	East	North	North
11	North	North	North	East	East	East	North	North
12	North	North	North	East	North	North	North	North
13	East	North	North	East	East	East	North	North
14	North	North	North	North	East	East	North	North
15	North	North	North	North	East	East	North	North
16	North	North	North	North	East	East	North	North
17	North	North	North	North	East	East	North	North
18	North	North	East	North	East	East	North	North
19	North	North	East	North	East	–	North	North
20	North	North	North	North	East	–	North	North
21	North	North	North	North	East	–	North	North
22	North	North	North	North	East	–	North	North
23	North	North	North	North	East	–	North	North

1. Photos were analyzed from April 15 to May 7, 2020 at all sites but 462L, where photos were analyzed from April 9 to 26.

APPENDIX C

Locations of leks and potential leks surveyed in spring 2020

Site Class	Site Type	Site	Approximate Location	Status in 2019	Status in 2017
Lek	Potentially affected	002L	REDACTED	Lek	Lek
		042L		Lek	Lek
		359L		Lek	Potential lek
		369L		Lek	None
		377L		Lek	None
		462L		Lek	None
	Reference	008L		Lek	Lek
		010L		Lek	Lek
		118L		Potential lek	Potential lek
		158L		Lek	None
		167L		Potential lek	None
		263L		Lek	None
		461L		Lek	None
		463L		Lek	None
		464L		Lek	None
		475L		Lek	None
Potential lek	Potentially affected	003PL		Lek	Lek
		363PL		Potential lek	None
		367PL		Lek	Lek
		371PL		Potential lek	None
		375PL		Lek	Lek
		488PL		–	–
		489PL		–	–
		490PL		–	–
	Reference	070PL		Potential lek	None
		090PL		Lek	Potential lek
		117PL		Lek	None
		169PL		Potential lek	None
		182PL		Potential lek	None
		187PL		Potential lek	None
		362PL		Lek	None
		477PL		Lek	None
		480PL		None	None
		484PL		Lek	None
None	Potentially affected	114		Lek	Lek
		130		Lek	None
		131		Potential lek	None

Site Class	Site Type	Site	Approximate Location	Status in 2019	Status in 2017
None	Potentially affected	206		Potential lek	None
		207		Lek	None
		208		Lek	None
		226		Potential lek	None
		273		Potential lek	None
		279		Potential lek	Lek
		285		Potential lek	None
		349		Potential lek	None
		354		Potential lek	Potential lek
		398		Potential lek	None
		423		Potential lek	None
		424		Potential lek	None
		473		Lek	None
		474		Potential lek	Lek
	Reference	5		Lek	Lek
		6		Lek	Potential lek
		7		Potential lek	Lek
		60		Potential lek	None
		69		Potential lek	None
		72		Potential lek	None
		86		Potential lek	None
		91		Potential lek	None
		93		Lek	None
		112		Lek	Lek
		113		Lek	Potential lek
		136		Potential lek	None
		179		Potential lek	Lek
		221		Potential lek	None
		241		Lek	None
		251		Lek	Lek
		252		Potential lek	Lek
		269		Lek	Potential lek
		298		Potential lek	None
		299		Lek	Potential lek
		301		Potential lek	None
		309		Lek	None
		310		Potential lek	None
		355		Potential lek	Potential lek
		356		Lek	Potential lek
		406		Lek	None
		412		Potential lek	None
		440		Lek	None

Site Class	Site Type	Site	Approximate Location	Status in 2019	Status in 2017
None	Reference	472		Potential lek	None
		476		Lek	None
		485		Lek	None
		486		Potential lek	None
		487		Lek	None

1. Trail cameras deployed.

APPENDIX D

Passive counts of sharp-tailed grouse at leks and potential leks surveyed in spring 2020

Site Class	Site Type	Site	Number of Birds[1]
Lek	Potentially affected	002L	1+
		377L	2+
	Reference	008L	1+
		010L	4
		118L	1+
		167L	1
		475L	7
Potential lek	Potentially affected	003PL	1
		363PL	9
		367PL	1
		371PL	1
		375PL	1+
		488PL	8
		489PL	2
		490PL	3
	Reference	070PL	1+
		090PL	6
		117PL	5
		169PL	6
		182PL	1+
		187PL	2
		362PL	1+
		477PL	6
		480PL	1
		484PL	4

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

APPENDIX E

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

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
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

APPENDIX F

White-tailed deer (red circle) at site 359L May 1, 2020

White-tailed deer (red circle) at site 369L May 8, 2020

White-tailed deer (second indicated in red) at site 464L, east-facing camera May 2, 2020

White-tailed deer at site 464, north-facing camera May 2, 2020

Eastern cottontail at site 369L April 25, 2020