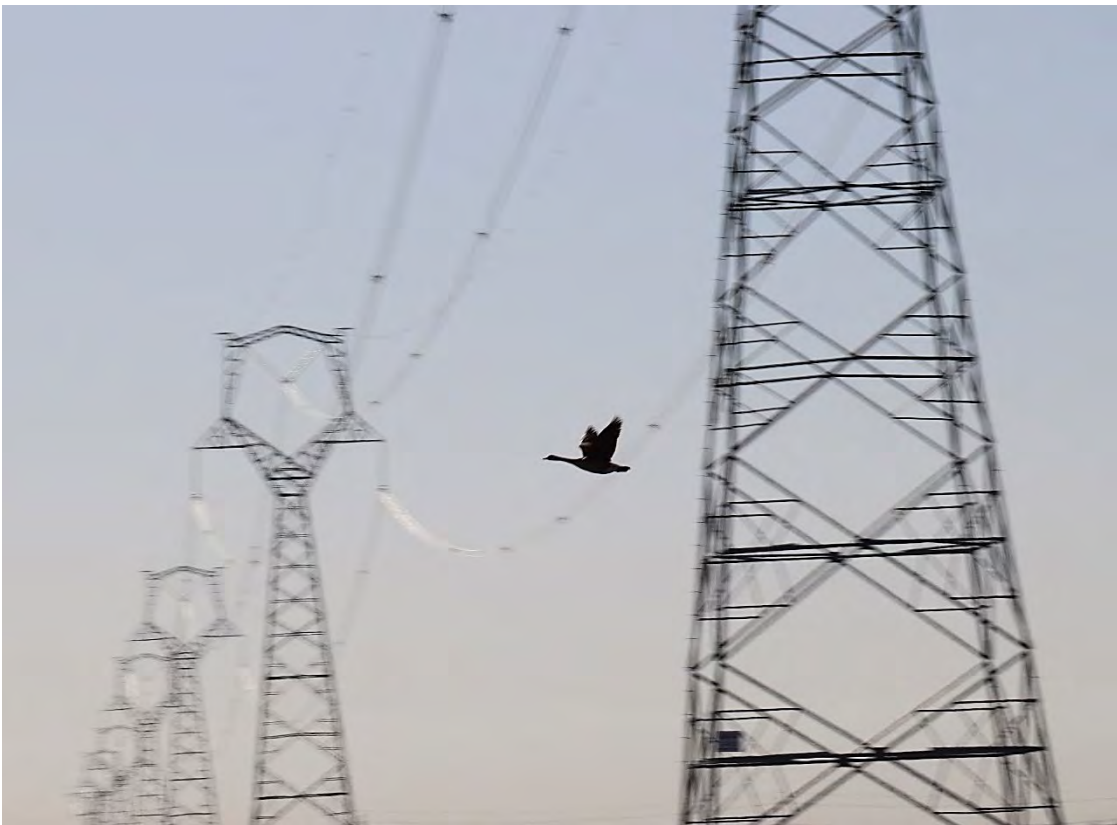


MANITOBA-MINNESOTA TRANSMISSION PROJECT

BIRD-WIRE COLLISION MONITORING 2021



Prepared for

Manitoba Hydro

By

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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 and at 16 sites during the spring, summer, and fall periods of 2021. 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 during each survey period (fall 2020, and spring, summer and fall 2021). A bird movement survey was conducted at each site prior to the collision survey to help evaluate of the effectiveness of the bird diverters.

Evidence of 68 bird collisions were found at the survey sites in 2020 and 2021, with 16 bird collisions found during the fall 2020 surveys, 34 collisions during the spring 2021, nine in the summer 2021, and nine in the fall 2021. Of the total collisions found, 42 were observed at sites with diverters and 12 were observed at control sites.

In 2021, evidence from two species listed under of the Species at Risk Act (SARA) were found. Evidence of a western grebe (*Aechmophorus occidentalis*) and a rusty blackbird (*Euphagus carolinus*), both listed as a species Special Concern under Schedule 1, were found at two different sites.

The estimated weekly mortality per km ranged from 43.8 to 576.1 mortalities/km at sites with bird diverters, and 15.6 to 108.6 mortalities/km at control sites. The estimated weekly mortality per km was not significantly different between sites with bird diverters and control sites, but the number of bird movements was significantly higher at sites with bird diverters, suggesting the bird diverters are effective. The collision mortality estimates observed in this study were higher than the range of other collision mortality studies that have occurred within the province due to high scavenger rates and the relatively high number of collisions found at some sites. Further mitigation measures should be considered at several sites, including sites with and without bird diverters, to reduce the number of bird collisions.

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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 an 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 2020/2021 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 and the spring, summer, and fall of 2021.







2.0 METHODS

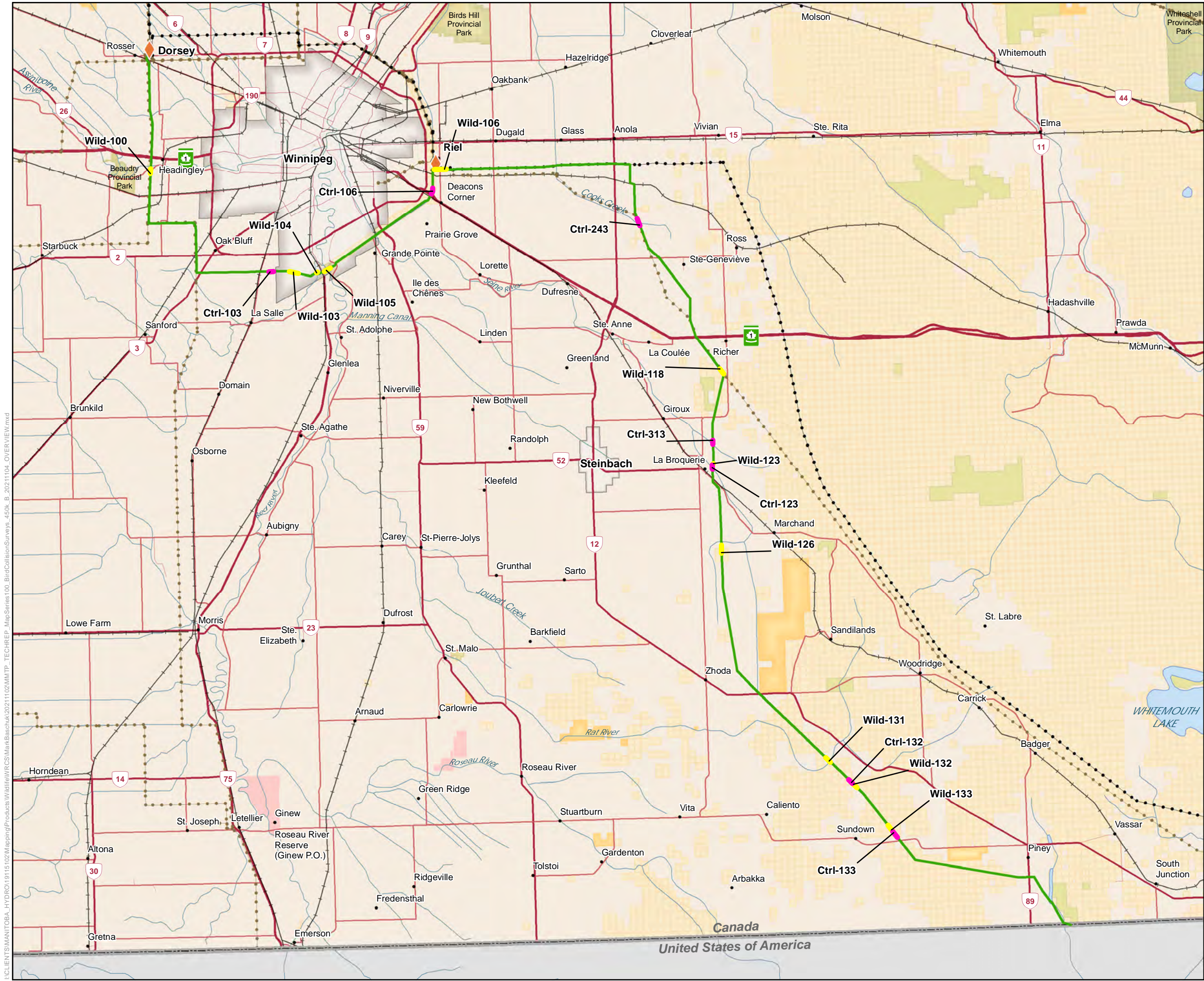
2.1 BIRD-WIRE COLLISION MONITORING

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).

Bird-wire collision monitoring occurred during the fall of 2020 and during the spring, summer, and fall periods of 2021. In 2020, 18 sites were surveyed twice with each survey separated by five to seven days (Table 1). In 2021, 16 sites were surveyed twice in the spring, summer, and fall periods (Table 1). The conditions at two sites, Ctrl-133 and Wild-133, were too wet to allow for collision monitoring and were not searched in 2021. Surveys for bird-wire collisions were conducted at each site by four personnel in 2020, or five to six personnel in 2021. Personnel 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 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) and collision evidence was identified to species where possible and photographed.



Manitoba - Minnesota Transmission Project

Project Infrastructure

- ◆ Converter Station (Existing)
- MMTP Final Preferred Route

Infrastructure

- 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
- City
- First Nation Lands
- Ecological Reserve
- Wildlife Management Area
- Provincial Park
- Crown Lands

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: November 05, 2021
Date Revised: November 09, 2021



0 5 Kilometres
0 4.5 9 Miles

1:450,000

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

Site ID	UTM Start	UTM End	Bird Diverters	Environmentally Sensitive Site	Site Length (m)	Fall 2020		Spring 2021		Summer 2021		Fall 2021	
						Visit 1 Date	Visit 2 Date	Visit 1 Date	Visit 2 Date	Visit 1 Date	Visit 2 Date	Visit 1 Date	Visit 2 Date
Wild-100	14N 612852 5524260	14N 612874 5524824	Present	Assiniboine River	565	Sep-10	Sep-15	May-4	May-11	Jun-1	Jun-8	Aug-24	Aug-31
Wild-103	14N 631009 5511990	14N 629896 5512242	Present	Brady Landfill	1141	Sep-10	Sep-16	May-4	May-11	Jun-1	Jun-8	Aug-24	Aug-31
Wild-104	14N 633256 5512083	14N 633375 5512151	Present	La Salle River	136	Sep-10	Sep-16	May-4	May-11	Jun-1	Jun-8	Aug-24	Aug-31
Wild-105	14N 634221 5512238	14N 634926 5512641	Present	Red River	647	Sep-10	Sep-16	May-4	May-11	Jun-1	Jun-8	Aug-24	Aug-31
Wild-106	14N 647686 5524747	14N 647892 5524753	Present	Deacon Reservoir	1501	Sep-11	Sep-16	May-4	May-11	Jun-1	Jun-8	Aug-24	Aug-31
Wild-118	14N 682799 5500258	14N 683261 5499642	Present	Richer Lake (Waterfowl Sensitivity Area)	770	Sep-11	Sep-17	May-5	May-12	Jun-2	Jun-9	Aug-25	Sep-1
Wild-123	14N 682009 5488650	14N 681841 5488433	Present	Seine River	275	Sep-14	Sep-21	May-5	May-12	Jun-2	Jun-8	Aug-25	Sep-1
Wild-126	14N 682967 5478612	14N 682999 5477647	Present	Breeding Habitat Sensitive Area	965	Sep-14	Sep-21	May-5	May-12	Jun-2	Jun-9	Aug-25	Sep-1
Wild-131	14N 696364 5451953	14N 695776 5452518	Present	Rat River	816	Sep-15	Sep-21	May-6	May-13	Jun-3	Jun-10	Aug-26	Sep-2
Wild-132	14N 699047 5449373	14N 699635 5448809	Present	Lonesand Lake (Waterfowl Sensitivity Area)	814	Sep-15	Sep-21	May-6	May-12	Jun-3	Jun-10	Aug-26	Sep-2
Wild-133	14N 703436 5444197	14N 704026 5443449	Present	Sundown Lake and Wetland Sensitive Area	952	Sep-11	Sep-17	NA	NA	NA	NA	NA	NA
Ctrl-103	14N 627981 5512213	14N 627408 5512198	Absent	Brady Landfill	573	Sep-10	Sep-16	May-4	May-11	Jun-1	Jun-8	Aug-24	Aug-31

MANITOBA-MINNESOTA TRANSMISSION PROJECT

Site ID	UTM Start	UTM End	Bird Diverters	Environmentally Sensitive Site	Site Length (m)	Fall 2020		Spring 2021		Summer 2021		Fall 2021	
						Visit 1 Date	Visit 2 Date	Visit 1 Date	Visit 2 Date	Visit 1 Date	Visit 2 Date	Visit 1 Date	Visit 2 Date
Ctrl-106	14N 647519 5522464	14N 647351 5521749	Absent	Deacon Reservoir	761	Sep-10	Sep-16	May-4	May-11	Jun-1	Jun-9	Aug-25	Aug-31
Ctrl-123	14N 681842 5488432	14N 681863 5487958	Absent	Seine River	388	Sep-14	Sep-21	May-5	May-12	Jun-2	Jun-9	Aug-25	Sep-1
Ctrl-132	14N 698589 5449814	14N 699047 5449373	Absent	Lonesand Lake (Waterfowl Sensitivity Area)	636	Sep-15	Sep-21	May-6	May-13	Jun-3	Jun-10	Aug-26	Sep-2
Ctrl-133	14N 704027 5443448	14N 704580 5442747	Absent	Sundown Lake and Wetland Sensitive Area	893	Sep-11	Sep-17	NA	NA	NA	NA	NA	NA
Ctrl-243	14N 672961 5517848	14N 672621 5518744	Absent	Cook's Creek	959	Sep-11	Sep-16	May-5	May-12	Jun-2	Jun-9	Aug-25	Sep-1
Ctrl-313	14N 681909 5491500	14N 681923 5491016	Absent	Unnamed Creek	485	Sep-14	Sep-21	May-5	May-12	Jun-2	Jun-9	Aug-25	Sep-1



Photo 3. Personnel Conducting a Bird-mortality Collision Survey along the MMTP right-of-way, May 2021

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 quail (*Coturnix sp.*) carcasses, sourced from a commercial supplier, within search areas in locations unknown to the searchers prior to searches commencing (California Energy Commission 2003; APLIC 2012). In 2020, one quail was planted at 14 sites, and in 2021 two quail were planted at 15 sites during each survey period (spring, summer, fall) 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 for sites with bird diverters and control sites for each survey period. The overall searcher efficiency for each survey period, including both sites with bird diverters and control sites, was used in final calculations as it provided a larger sample size and better estimation of searcher efficiency.

Searcher efficiency was calculated as:

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

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. The scavenger bias for sites with bird diverters and control sites for each survey period was used in final calculations to account for differences in scavenger presence between the site types.

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 estimated weekly mortality per km between control sites and sites with bird diverters for each of the survey periods (Fall 2020, Spring 2021, Summer 2021, and Fall 2021) was compared using a Wilcoxon Rank Sum test ($\alpha = 0.05$).

2.2 BIRD MOVEMENT SURVEYS

To provide a comparison of bird activity between the sites with bird diverters to the control sites, a bird movement survey was conducted in 2021. As sites fitted with bird diverters were chosen because they were shown to have high numbers of bird movements observed prior to construction (Stantec 2015; Manitoba Hydro 2015), a comparison of bird movements with control sites is useful in helping to determine if bird diverters are working successfully. Bird movement surveys were conducted at all sites, except for site Wild-123, prior to searching for bird carcasses. All five or six personnel were involved monitoring bird activity across and around the ROW for 15 minutes at each bird wire collision site. The number, species (where possible), approximate flight height in relation to tower height, and general cardinal direction of birds crossing the ROW was recorded. A Wilcoxon Rank Sum test ($\alpha = 0.05$) was used to test for a difference of bird movements between sites with bird diverters and control sites.

3.0 RESULTS

3.1 BIRD-WIRE COLLISION SURVEYS

Evidence of 68 bird collisions were found at the survey sites in 2020 and 2021, with 16 bird collisions found during the fall 2020 surveys, 34 collisions during the spring 2021, nine in the summer 2021, and nine in the fall 2021. Of the total collisions found, 42 were observed at sites with diverters and 12 were observed at control sites (Table 2).

In 2021, evidence from two species listed under of the Species at Risk Act (SARA) were found. Evidence of a western grebe (*Aechmophorus occidentalis*) and a rusty blackbird (*Euphagus carolinus*), both listed as a species Special Concern under Schedule 1, were found at two different sites (Table 2).

Several sites, including Wild-103, Wild-105, Wild-106, Ctrl-103, Ctrl-106, and Ctrl-123 had relatively high numbers of collisions in comparison to other sites. The Wild-106 site, at the Deacon Reservoir, had the greatest number of collisions found with 15, with 10 of these occurring in the spring 2021 period.

Searcher efficiency ranged from a low of 0.14 (14%) in fall 2020, to a high of 0.67 (67%) in spring 2021 (Table 3-Table 6). Scavenging biases ranged low of 0.67 (33%) in the fall of 2020 to a high of 0.06 (94%) in the spring of 2021 (Table 3-Table 6). Scavenging biases were particularly high in the spring and summer of 2021, compared to the other survey periods.

The estimated weekly mortality per km ranged from 43.8 to 576.1 mortalities/km at sites with bird diverters, and 15.6 to 108.6 mortalities/km at control sites (Table 3-Table 6; Appendix 2). The estimated weekly mortality per km was not significantly different between sites with bird diverters and control sites ($p = 0.52$).

Table 2. Bird Collision Evidence Observed Along the MMTP in 2020 and 2021

Site	Bird Diverters	Date	Period	Species	Total Collisions	Average Weekly Mortality/km	UTM
Wild-100	Present	May 4, 2021	Spring 2021	Common Goldeneye	3	24.9	14 U 612883 5524776
Wild-100		August 24, 2021	Fall 2021	Unknown Gull			14 U 612858 5524359
Wild-100		Sept. 15, 2020	Fall 2020	Nashville Warbler			14 U 612875 5524591
Wild-103		May 11, 2021	Spring 2021	Unknown Waterfowl	8	26.8	14 U 630864 5512006
Wild-103		May 11, 2021	Spring 2021	Least Flycatcher			14 U 630605 5512109
Wild-103		June 8, 2021	Summer 2021	Alder Flycatcher			14 U 630019 5512216
Wild-103		Aug. 24, 2021	Fall 2021	Western Grebe			14 U 630473 5512123
Wild-103		Aug. 24, 2021	Fall 2021	Unknown Gull			14 U 630474 5512090
Wild-103		Sept.10, 2020	Fall 2021	Mallard			14 U 631000 5511988
Wild-103		Sept. 16, 2020	Fall 2021	Vesper sparrow			14 U 629994 5512220
Wild-103		Sept. 16, 2020	Fall 2021	Unknown Waterfowl			14 U 630780 5512069
Wild-104		May 11, 2021	Spring 2021	Unknown Waterfowl	1	45.6	14 U 634314 5512299
Wild-105		May 4, 2021	Spring 2021	Unknown Gull	6	52.9	14 U 634274 5512251
Wild-105		May 4, 2021	Spring 2021	Unknown Species			14 U 634248 5512274
Wild-105		May 4, 2021	Spring 2021	Rusty Blackbird			14 U 634260 5512302
Wild-105		May 4, 2021	Spring 2021	Unknown Gull			14 U 634925 5512606
Wild-105		May 4, 2021	Spring 2021	Savannah Sparrow			14 U 672314 5520469
Wild-105		June 1, 2021	Summer 2021	Mallard			14 U 634746 5512516
Wild-106		May 4, 2021	Spring 2021	Canada Goose	15	51.8	14 U 648329 5524766
Wild-106		May 4, 2021	Spring 2021	Unknown Species			14 U 648555 5524784
Wild-106		May 4, 2021	Spring 2021	Harris's Sparrow			14 U 648981 5524782
Wild-106		May 4, 2021	Spring 2021	Unknown Passerine			14 U 672318 5520277
Wild-106		May 4, 2021	Spring 2021	Swamp Sparrow			14 U 649010 5524783
Wild-106		May 4, 2021	Spring 2021	Sharp-tailed Grouse			14 U 648007 5524739
Wild-106		May 4, 2021	Spring 2021	Common Loon			14 U 647729 5524781
Wild-106		May 4, 2021	Spring 2021	Unknown Waterfowl			14 U 648036 5524785
Wild-106		May 11, 2021	Spring 2021	Marsh Wren			14 U 649044 5524786

Site	Bird Diverters	Date	Period	Species	Total Collisions	Average Weekly Mortality/km	UTM
Wild-106		May 11, 2021	Spring 2021	Yellow-rumped Warbler			14 U 648932 5524793
Wild-106		June 8, 2021	Summer 2021	Northern Shoveler			14 U 647746 5524779
Wild-106		June 8, 2021	Summer 2021	Canada Goose			14 U 647909 5524755
Wild-106		Aug. 24, 2021	Fall 2021	Double-crested Cormorant			14 U 647882 5524743
Wild-106		Sept. 16, 2020	Fall 2020	Unknown Species			14 U 649178 5524784
Wild-106		Sept. 16, 2020	Fall 2020	Unknown Gull			14 U 648329 5524766
Wild-118		May 12, 2021	Spring 2021	Orange-crowned Warbler	2	12.7	14 U 683043 5499948
Wild-118		Sept. 17, 2020	Fall 2020	Black and White Warbler			14 U 682886 5500146
Wild-123		Sept. 21, 2020	Fall 2020	Vesper Sparrow	1	13.0	14 U 682001 5488644
Wild-126		Sept. 14, 2020	Fall 2020	Sora	1	3.7	14 U 682987 5478433
Wild-131		May 6, 2021	Spring 2021	Unknown Waterfowl	2	15.2	14 U 696148 5452194
Wild-131		May 13, 2021	Spring 2021	Unknown Waterfowl			14 U 698902 5449514
Wild-132		June 3, 2021	Summer 2021	Canada Goose	2	8.2	14 U 699590 5448857
Wild-132		Sep. 15 2020	Fall 2020	Unknown Species			14 U 699563 5448878
Ctrl-103	Absent	May 4, 2021	Spring 2021	Mallard	9	41.9	14 U 627557 5512249
Ctrl-103		May 4, 2021	Spring 2021	Sora			14 U 627705 5512225
Ctrl-103		May 4, 2021	Spring 2021	Savannah Sparrow			14 U 627711 5512218
Ctrl-103		May 11, 2021	Spring 2021	Dark-eyed Junco			14 U 627813 5512194
Ctrl-103		Aug. 24, 2021	Fall 2021	Wood Duck			14 U 627819 5512204
Ctrl-103		Sept.10, 2020	Fall 2020	Canada Goose			14 U 627907 5512177
Ctrl-103		Sept.10, 2020	Fall 2020	Unknown Gull			14 U 627896 5512231
Ctrl-103		Sept.10, 2020	Fall 2020	Mallard			14 U 627684 5512220
Ctrl-103		Sept. 16, 2020	Fall 2020	Canada goose			14 U 627629 5512197
Ctrl-106		May 4, 2021	Spring 2021	Sharp-tailed Grouse	7	18.9	14 U 647425 5521897
Ctrl-106		June 1, 2021	Summer 2021	Unknown Species			14 U 647412 5521914
Ctrl-106		June 1, 2021	Summer 2021	Sharp-tailed Grouse			14 U 647520 5522468
Ctrl-106		June 9, 2021	Summer 2021	American Crow			14 U 672952 5517865
Ctrl-106		Aug. 25, 2021	Fall 2021	Unknown Species			14 U 647541 5522251
Ctrl-106		Aug. 25, 2021	Fall 2021	Northern Shoveler			14 U 647522 5522284

Site	Bird Diverters	Date	Period	Species	Total Collisions	Average Weekly Mortality/km	UTM
Ctrl-106		Aug. 31, 2021	Fall 2021	Sora			14 U 647437 5521883
Ctrl-123		May 5, 2021	Spring 2021	Red-breasted Merganser	7	46.7	14 U 681870 5488219
Ctrl-123		May 5, 2021	Spring 2021	Green-winged Teal			14 U 681844 5487987
Ctrl-123		May 5, 2021	Spring 2021	Unknown Blackbird			14 U 681835 5488259
Ctrl-123		May 12, 2021	Spring 2021	Northern Pintail			14 U 681852 5488375
Ctrl-123		May 12, 2021	Spring 2021	Sharp-tailed Grouse			14 U 681859 5488366
Ctrl-123		Sept. 21, 2020	Fall 2020	Sora			14 U 681865 5488312
Ctrl-123		Sept. 21, 2020	Fall 2020	Magnolia warbler			14 U 681846 5488031
Ctrl-132		NA	NA	NA	0	0.0	NA
Ctrl-243		May 5, 2021	Spring 2021	Unknown Waterfowl	2	5.6	14 U 672770 5518381
Ctrl-243		June 2, 2021	Summer 2021	Bald Eagle			14 U 672879 5518001
Ctrl-313		May 12, 2021	Spring 2021	Marsh Wren	1	6.1	14 U 681907 5491240

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

Site Type	Total Length (km)	Searched Length (km)	No. Collisions	No. Birds Planted	No. Birds Not Scavenged	No. Planted Birds Found	Searcher Efficiency	Scavenger Bias	Habitat Bias	Est. Weekly Mortality*	Est. Weekly Mortality/km	Est. Seasonal Mortality/km**
Bird Diverters Absent (Control)	4.69	4.69	6	6	4	2	0.33	0.67	1	85.7	18.3	109.6
Bird Diverters Present	8.58	8.58	10	8	3	0	0	0.38	1	142.9	16.6	99.9
Total	13.28	13.28	16	14	7	2	0.14	0.5	1	228.6	17.2	103.3

* Calculations used the total scavenger bias due to larger sample size

**Multiplied by a factor of six weeks

Table 4. Bird Collision Survey Results and Estimated Mortalities along the Manitoba-Minnesota Transmission Project in Spring 2021

Site Type	Total Length (km)	Searched Length (km)	No. Collisions	No. Birds Planted	No. Birds Not Scavenged	No. Planted Birds Found	Searcher Efficiency	Scavenger Bias	Habitat Bias	Est. Weekly Mortality	Est. Weekly Mortality/km	Est. Seasonal Mortality/km*
Bird Diverters Absent (Control)	3.80	3.68	12	12	2	9	0.75	0.17	0.97	108.6	28.6	153.5
Bird Diverters Present	7.63	7.24	22	18	1	11	0.61	0.06	0.95	576.1	75.5	453.0
Total	11.43	10.92	34	30	3	20	0.67	0.1	0.96	528.6	46.3	277.5

*Multiplied by a factor of six weeks

Table 5. Bird Collision Survey Results and Estimated Mortalities along the Manitoba-Minnesota Transmission Project in Summer 2021

Site Type	Total Length (km)	Searched Length (km)	No. Collisions	No. Birds Planted	No. Birds Not Scavenged	No. Planted Birds Found	Searcher Efficiency	Scavenger Bias	Habitat Bias	Est. Weekly Mortality	Est. Weekly Mortality/km	Est. Seasonal Mortality/km*
Bird Diverters Absent (Control)	3.80	3.68	4	12	2	6	0.5	0.17	0.97	51.6	13.6	81.6
Bird Diverters Present	7.63	7.49	5	18	3	8	0.44	0.17	0.98	63.9	8.4	50.4
Total	11.43	11.17	9	30	5	14	0.47	0.17	0.98	114.9	10.1	60.6

*Multiplied by a factor of six weeks

Table 6. Bird Collision Survey Results and Estimated Mortalities along the Manitoba-Minnesota Transmission Project in Fall 2021

Site Type	Total Length (km)	Searched Length (km)	No. Collisions	No. Birds Planted	No. Birds Not Scavenged	No. Planted Birds Found	Searcher Efficiency	Scavenger Bias	Habitat Bias	Est. Weekly Mortality	Est. Weekly Mortality/km	Est. Seasonal Mortality/km*
Bird Diverters Absent (Control)	3.80	3.68	4	12	6	5	0.42	0.5	0.97	15.6	4.1	24.6
Bird Diverters Present	7.63	7.49	5	18	4	11	0.61	0.22	0.98	43.8	5.7	34.2
Total	11.43	11.17	9	30	10	16	0.53	0.33	0.98	52.5	4.6	27.6

*Multiplied by a factor of six weeks

3.2 BIRD MOVEMENT SURVEYS

Bird movements were significantly higher at sites with bird diverters compared to control sites ($p = 0.02$). Several sites, including Wild-100 and Wild-106 had high numbers of bird movements in comparison to other sites. Most movements at these sites were from gulls and Canada geese (*Branta canadensis*) crossing over the ROW (Appendix 1).

Table 7. Bird Movement Numbers and Site Type Average During Each Survey Period in 2021

Site	Bird Diverters	Spring 2021	Spring 2021 Average	Summer 2021	Summer 2021 Average	Fall 2021	Fall 2021 Average
Wild-100	Present	63	20	59	50	90	145
Wild-103		22		282		1,045	
Wild-104		21		28		23	
Wild-105		1		20		16	
Wild-106		16		25		46	
Wild-118		30		12		72	
Wild-126		5		8		1	
Wild-131		25		11		1	
Wild-132		1		5		10	
Ctrl-103	Absent	1	21	7	11	11	8
Ctrl-106		4		8		17	
Ctrl-123		80		20		6	
Ctrl-132		6		13		1	
Ctrl-243		15		5		10	
Ctrl-313		18		10		3	

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. Sites with bird diverters supported a significantly greater number of bird movements in 2021 compared to control sites, but there was no significant difference found of the estimated number of mortalities per km between the different site types.

The estimated collision mortality rates observed in 2020 and 2021 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). By adding the estimated seasonal mortality per km for the spring and fall 2021 periods, for a comparison of annual mortality produced in 2014, in 2021 at bird diverter sites there is an estimated 487.3 mortalities/km annually and 178.1 mortalities/km annually at control sites. For both site types this is greater than the 120.8 mortalities/km annually at high-risk sites in 2014 (Stantec 2015). Some of the difference in annual mortality observed in this study compared to the studies listed in Table 4 may be due to differences in bird abundance and diversity due to latitude of the study sites. This study was conducted in southern Manitoba, where bird diversity and abundance tend to be higher in comparison to the other studies that were conducted in more northern locations. A greater abundance and diversity of birds could result in greater numbers of collisions.

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 8. 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 apparent high rates of bird collision mortality along the MMTP, particularly at sites with bird diverters in the spring 2021 period, may be attributed to the high scavenger rates observed and the relatively high number of collisions observed at some sites. At sites with bird diverters in spring 2021, scavengers took 94% of all the planted bird carcasses, which amplified the collision mortality estimates.

Despite the presence of bird diverters, some sites, including Wild-105 and Wild-106 had relatively high bird mortality estimates in comparison to other sites. The majority of bird collisions observed at these sites occurred in the spring of 2021. It is possible that the waterbodies at sites Wild-105 and Wild-106, the Red River and Deacon Reservoir, respectively, may provide some of the earliest open water habitat in spring due to the presence of flowing or circulating water. Open water habitat is attractive to species groups such as waterfowl and gulls, which are commonly found during collision surveys.

Another factor that may have influenced the collision mortality at site Wild-106 could be the presence of several other transmission lines adjacent to the MMTP that lack bird diverters (Appendix 3). There are three other transmission lines parallel to the MMTP, two of which do not have bird diverters along the Deacon Reservoir. These transmission lines could contribute to bird mortalities in the area and along the MMTP ROW if crippled birds end up at site Wild-106.

Other sites, including site Ctrl-103, near the Brady Landfill also experienced relatively high bird collisions compared to other sites. Bird movements at site Ctrl-103 were not high in 2021, but the nearby site, Wild-103, saw the highest number of bird movements in 2021, and large numbers of Canada geese and observed crossing directly overhead of the MMTP in 2020. Due to the close proximity of the Brady Landfill to site Ctrl-103, it is possible that large numbers of bird movements occur at the site that were not observed in 2021, which result in the relatively high number of collisions.

Additional mitigation may be beneficial at several sites to reduce bird collisions. Site Wild-106, which is already fitted with bird diverters still had a relatively high number of mortalities, presumably due to the proximity of open water habitat created by the Deacon Reservoir and potentially the nearby, unmarked transmission lines. Additional line markers, such as aircraft cone markers could be added to the MMTP to make it more visible to passing birds. Bird diverters could also be installed on the nearby transmission lines along the Deacon Reservoir to reduce the number of bird collisions caused by these lines.

If possible, to reduce the suitability of the Deacon Reservoir to birds, particularly in the spring, bird deterrent measures, including propane cannons or predator effigies could be installed at the reservoir in collaboration with the City of Winnipeg. Bird hazing could also be attempted to reduce habitat suitability of the reservoir but may be problematic due to being labour intensive. Other sites, including Ctrl-103 near the Brady Landfill and Ctrl-123 near the Seine River, which also had relatively high mortality rates could be suitable candidates for the installation of bird diverters to reduce collisions.

Future surveys conducted during the spring and summer of 2022 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.

5.0 CONCLUSIONS

Bird-wire diverters along the MMTP appear to be effective at reducing the number of bird-wire collision mortalities. Two Endangered species were observed as collision mortalities in 2021 at two separate sites. Estimated collision mortality rates along the MMTP appear to be higher in comparison to other studies in Manitoba and in North America. Several sites, including some already fitted with bird diverters could be improved with additional mitigation measures. Additional bird collision monitoring will continue in the spring and summer of 2022 as part of operation monitoring.

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Appendix 1

Bird Movement Observations 2021

Table 1. Number of Bird Movements Observed at Sites During Each Survey Period in 2021

Site	Bird Diverters	Species	Spring	Summer	Fall	Total	Grand Total
Wild-100	Present	American Crow	2	4	20	26	212
		American Robin	4	1	2	7	
		Bald Eagle	0	0	2	2	
		Blackbird Spp.	6	0	0	6	
		Black-capped Chickadee	0	0	2	2	
		Brewer's Blackbird	5	0	0	5	
		Canada Goose	2	0	18	20	
		Cedar Waxwing	0	29	0	29	
		Clay-coloured Sparrow	0	1	0	1	
		Duck Spp.	7	1	1	9	
		Eastern Kingbird	0	2	0	2	
		Franklin's Gull	10	0	0	10	
		Gull Spp.	3	0	32	35	
		Mallard	4	1	0	5	
		Merlin	1	2	1	4	
		Northern Flicker	0	2	1	3	
		Red-tailed Hawk	0	1	0	1	
		Red-winged Blackbird	13	13	0	26	
		Ring-billed Gull	3	0	0	3	
		Ruby-throated Hummingbird	0	0	1	1	
		Sandhill Crane	1	0	0	1	
		Savannah Sparrow	0	2	0	2	
		Song Sparrow	1	0	0	1	
		Sparrow Spp.	0	0	7	7	
		Unknown Sp..	0	0	1	1	
		White-breasted Nuthatch	1	0	2	3	
Wild-103	Present	American Robin	4	0	0	4	1,349
		Brewer's Blackbird	5	0	0	5	
		Canada Goose	6	277	2	285	
		Duck Spp.	2	0	30	32	
		Gull Spp.	0	0	1,012	1,012	
		Peregrine Falcon	3	0	0	3	
		Red-winged Blackbird	1	5	0	6	
		Ring-billed Gull	0	0	1	1	
		Swainson's Hawk	1	0	0	1	
Wild-104	Present	American Crow	0	1	0	1	72
		American Goldfinch	0	4	0	4	
		American Robin	0	0	1	1	
		American White Pelican	0	3	2	5	
		Blackbird Spp.	4	0	6	10	

Site	Bird Diverters	Species	Spring	Summer	Fall	Total	Grand Total
		Black-capped Chickadee	0	0	1	1	
		Blue Jay	0	1	11	12	
		Brown-headed Cowbird	0	1	0	1	
		Canada Goose	3	0	0	3	
		Downy Woodpecker	0	0	1	1	
		Duck Spp.	4	0	0	4	
		Franklin's Gull	2	0	0	2	
		Gull Spp.	1	0	0	1	
		Mallard	0	2	0	2	
		Red-tailed Hawk	1	2	1	4	
		Red-winged Blackbird	0	12	0	12	
		Western Kingbird	0	1	0	1	
		White-breasted Nuthatch	5	1	0	6	
		Yellow Warbler	1	0	0	1	
Wild-105	Present	American Goldfinch	0	0	2	2	37
		American White Pelican	0	0	6	6	
		Black-billed Magpie	1	0	0	1	
		Blackbird Spp.	0	3	0	3	
		Blue Jay	0	1	0	1	
		Cooper's Hawk	0	1	0	1	
		Franklin's Gull	0	0	2	2	
		Gull Spp.	0	0	3	3	
		Mallard	0	2	0	2	
		Mourning Dove	0	2	0	2	
		Red-tailed Hawk	0	3	1	4	
		Red-winged Blackbird	0	2	0	2	
		Ring-billed Gull	0	0	2	2	
		Western Kingbird	0	1	0	1	
		Western Meadowlark	0	3	0	3	
		Woodpecker Spp.	0	1	0	1	
		Yellow Warbler	0	1	0	1	
Wild-106	Present	American White Pelican	0	0	1	1	87
		Baltimore Oriole	0	1	0	1	
		Blackbird Spp.	5	0	0	5	
		Common Grackle	1	0	0	1	
		Franklin's Gull	7	0	0	7	
		Killdeer	1	2	0	3	
		Mourning Dove	0	3	19	22	
		Orchard Oriole	0	1	0	1	
		Red-winged Blackbird	0	14	24	38	
		Song Sparrow	2	0	0	2	

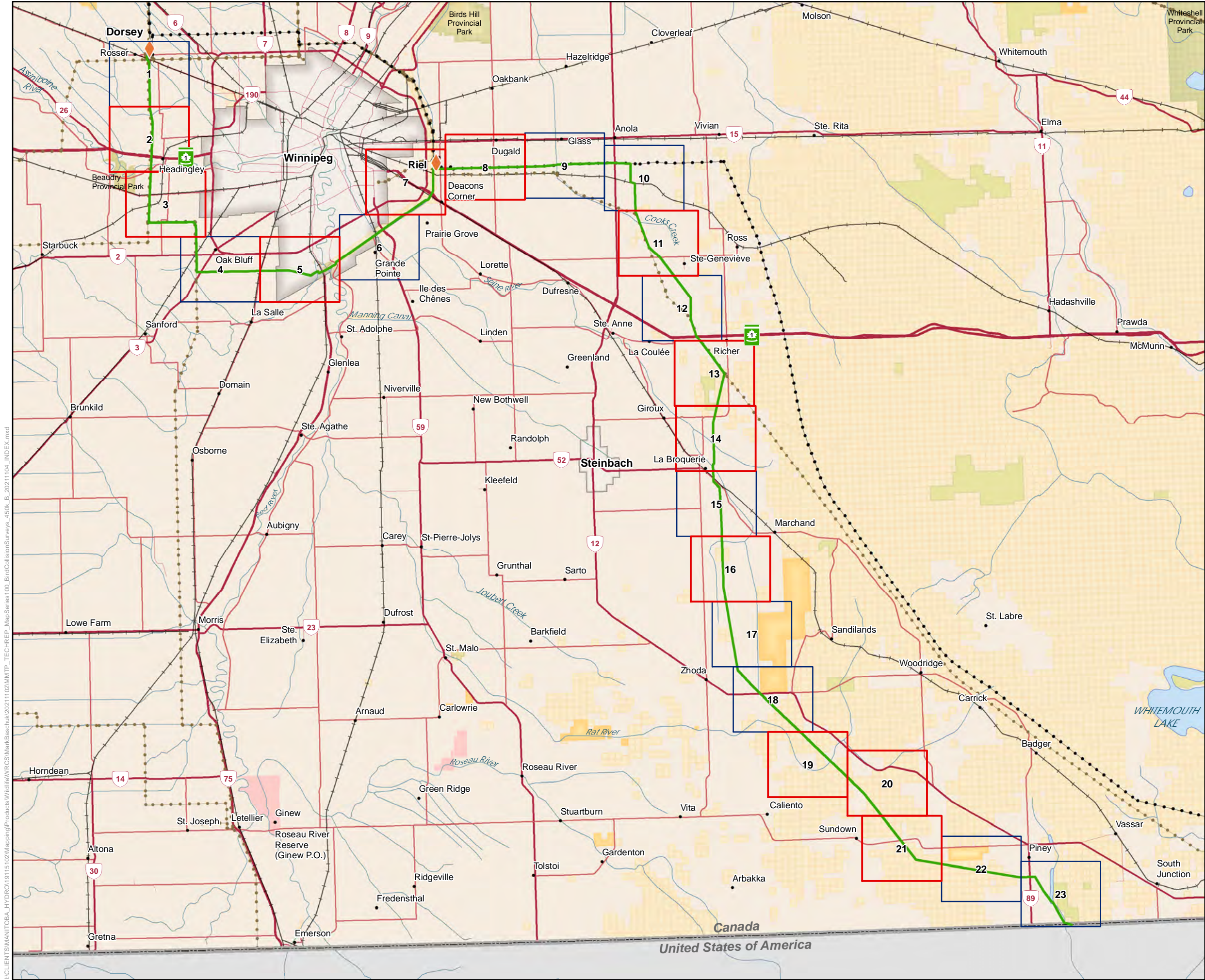
Site	Bird Diverters	Species	Spring	Summer	Fall	Total	Grand Total
		Swainson's Hawk	0	0	2	2	
		Tree Swallow	0	1	0	1	
		Western Kingbird	0	3	0	3	
Wild-118	Present	American Crow	1	0	0	1	114
		American Robin	12	0	0	12	
		Blue Jay	1	0	0	1	
		Brewer's Blackbird	8	0	0	8	
		Common Raven	0	10	0	10	
		Franklin's Gull	0	0	70	70	
		Great-crested Flycatcher	0	2	0	2	
		Red-winged Blackbird	7	0	0	7	
		Sandhill Crane	0	0	2	2	
		Yellow Warbler	1	0	0	1	
Wild-123	Present	Downy Woodpecker	1	0	0	1	30
		Pileated Woodpecker	1	0	0	1	
		Wild126	5	8	1	14	
		American Goldfinch	0	4	0	4	
		American Robin	0	1	0	1	
		Baltimore Oriole	0	1	0	1	
		Blackbird Spp.	3	0	0	3	
		Blue Jay	0	0	1	1	
		Northern Flicker	2	0	0	2	
		Red-tailed Hawk	0	1	0	1	
		Ruby-throated Hummingbird	0	1	0	1	
Wild-131	Present	Blackbird Spp.	5	3	0	8	37
		Brewer's Blackbird	1	1	0	2	
		Canada Goose	2	0	0	2	
		Cedar Waxwing	0	3	0	3	
		Common Grackle	1	0	0	1	
		Common Yellowthroat	0	2	0	2	
		Duck Spp.	1	0	0	1	
		Killdeer	2	0	0	2	
		Merlin	0	0	1	1	
		Mourning Dove	2	0	0	2	
		Red-winged Blackbird	10	2	0	12	
		Trumpeter Swan	1	0	0	1	
Wild-132	Present	American Crow	0	2	10	12	16
		Mourning Dove	0	2	0	2	
		None	0	0	0	0	
		Ruby-throated Hummingbird	0	1	0	1	
		Sandhill Crane	1	0	0	1	

Site	Bird Diverters	Species	Spring	Summer	Fall	Total	Grand Total
Ctrl-103	Absent	American Crow	0	0	1	1	19
		Canada Goose	0	0	3	3	
		Duck Spp.	0	1	0	1	
		Hawk Spp.	0	1	0	1	
		Lincoln Sparrow	1	0	0	1	
		Northern Harrier	0	1	0	1	
		Red-winged Blackbird	0	4	0	4	
		Sparrow Spp.	0	0	7	7	
Ctrl-106	Absent	Barn Swallow	0	0	3	3	29
		Blackbird Spp.	0	3	0	3	
		Canada Goose	0	0	10	10	
		Duck Spp.	1	0	0	1	
		Hawk Spp.	1	0	0	1	
		Northern Harrier	0	0	1	1	
		Red-tailed Hawk	0	2	3	5	
		Red-winged Blackbird	0	3	0	3	
		Sharp-tailed Grouse	2	0	0	2	
Ctrl-123	Absent	American Crow	0	1	0	1	106
		American Robin	1	2	0	3	
		Bald Eagle	0	0	4	4	
		Blue Jay	2	0	0	2	
		Brown-headed Cowbird	0	1	0	1	
		Canada Goose	2	0	0	2	
		Common Grackle	0	2	0	2	
		Common Raven	1	0	0	1	
		Eastern Kingbird	0	2	0	2	
		Killdeer	0	1	0	1	
		Mallard	2	0	0	2	
		Mourning Dove	0	2	0	2	
		Red-tailed Hawk	0	0	1	1	
		Red-winged Blackbird	64	9	0	73	
		Rock Pigeon	3	0	0	3	
		Turkey Vulture	1	0	1	2	
		Western Kingbird	1	0	0	1	
		Western Meadowlark	2	0	0	2	
		Yellow-headed Blackbird	1	0	0	1	
Ctrl-132	Absent	American Crow	2	1	0	3	20
		Blackbird Spp.	0	1	0	1	
		Canada Goose	1	0	0	1	
		Chipping Sparrow	1	0	0	1	
		Killdeer	2	0	0	2	

Site	Bird Diverters	Species	Spring	Summer	Fall	Total	Grand Total
		Mallard	0	9	0	9	
		Northern Flicker	0	0	1	1	
		Warbler Spp.	0	2	0	2	
Ctrl-243	Absent	American Crow	1	0	4	5	30
		American Robin	1	0	2	3	
		Bald Eagle	0	0	2	2	
		Black-billed Magpie	2	3	0	5	
		Blackbird Spp.	2	0	0	2	
		Blue Jay	3	0	0	3	
		Brewer's Blackbird	5	0	0	5	
		Canada Goose	0	0	1	1	
		Common Grackle	1	0	0	1	
		Merlin	0	0	1	1	
		Red-winged Blackbird	0	2	0	2	
Ctrl-313	Absent	American Crow	0	1	0	1	31
		American Robin	0	1	0	1	
		Black-billed Magpie	0	1	0	1	
		Brewer's Blackbird	2	0	0	2	
		Common Grackle	0	3	0	3	
		Common Raven	1	4	2	7	
		Mallard	10	0	0	10	
		Red-winged Blackbird	3	0	0	3	
		Turkey Vulture	2	0	1	3	
Total			315	521	1,353	2,189	2,189

Appendix 2

Bird Collision Map Series



Manitoba - Minnesota Transmission Project

Project Infrastructure

- ◆ Converter Station (Existing)
- MMTP Final Preferred Route

Infrastructure

- 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
- City
- First Nation Lands
- Ecological Reserve
- Wildlife Management Area
- Provincial Park
- Crown Lands

Coordinate System: UTM Zone 14N NAD83
 Data Source: MBHydro, ProvMB, NRCAN
 Date Created: November 05, 2021
 Date Revised: November 09, 2021



0 5 Kilometres
 0 4.5 9 Miles

1:450,000

Index of Map Series



Bird Collision Surveys 2021

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Manitoba - Minnesota Transmission Project



Project Infrastructure

-  Converter Station (Existing)
-  MMTP Final Preferred Route

Infrastructure

-  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
-  City
-  Canada/US Boundary

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0 0.6 Kilometres
0 0.275 0.55 Miles

1:30,000

Bird Collision Surveys 2021

ID: Wild-100
Estimated Collision
Mortality: 24.9



Manitoba - Minnesota
Transmission Project

Project Infrastructure

- ◆ Converter Station (Existing)
- MMTP Final Preferred Route

Infrastructure

- Existing 500kV Transmission Line
- Existing 230kV Transmission Line

Bird Collision Survey Location

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Landbase

- Community
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Winnipeg

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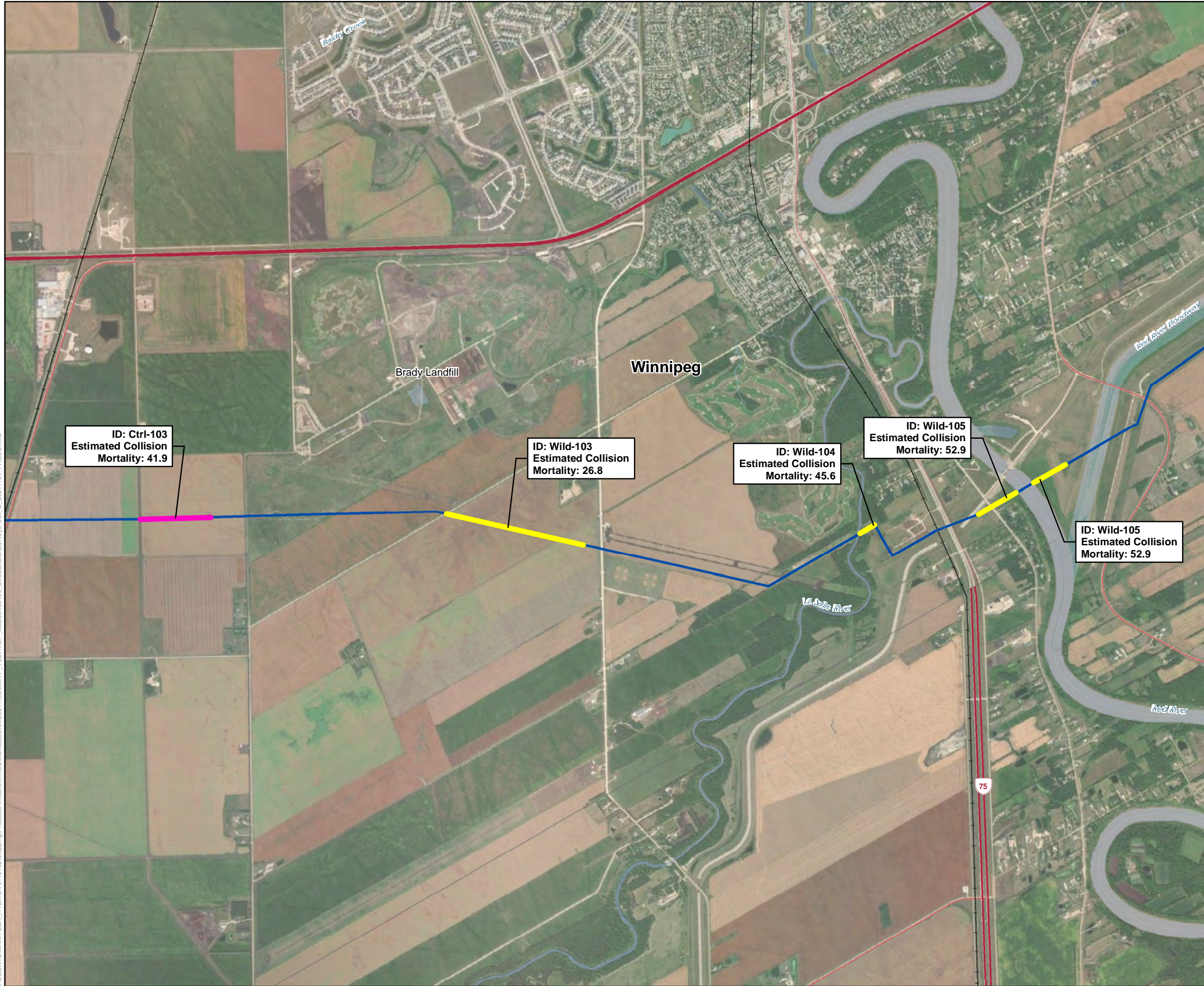


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Bird Collision Surveys
2021

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Manitoba - Minnesota
Transmission Project

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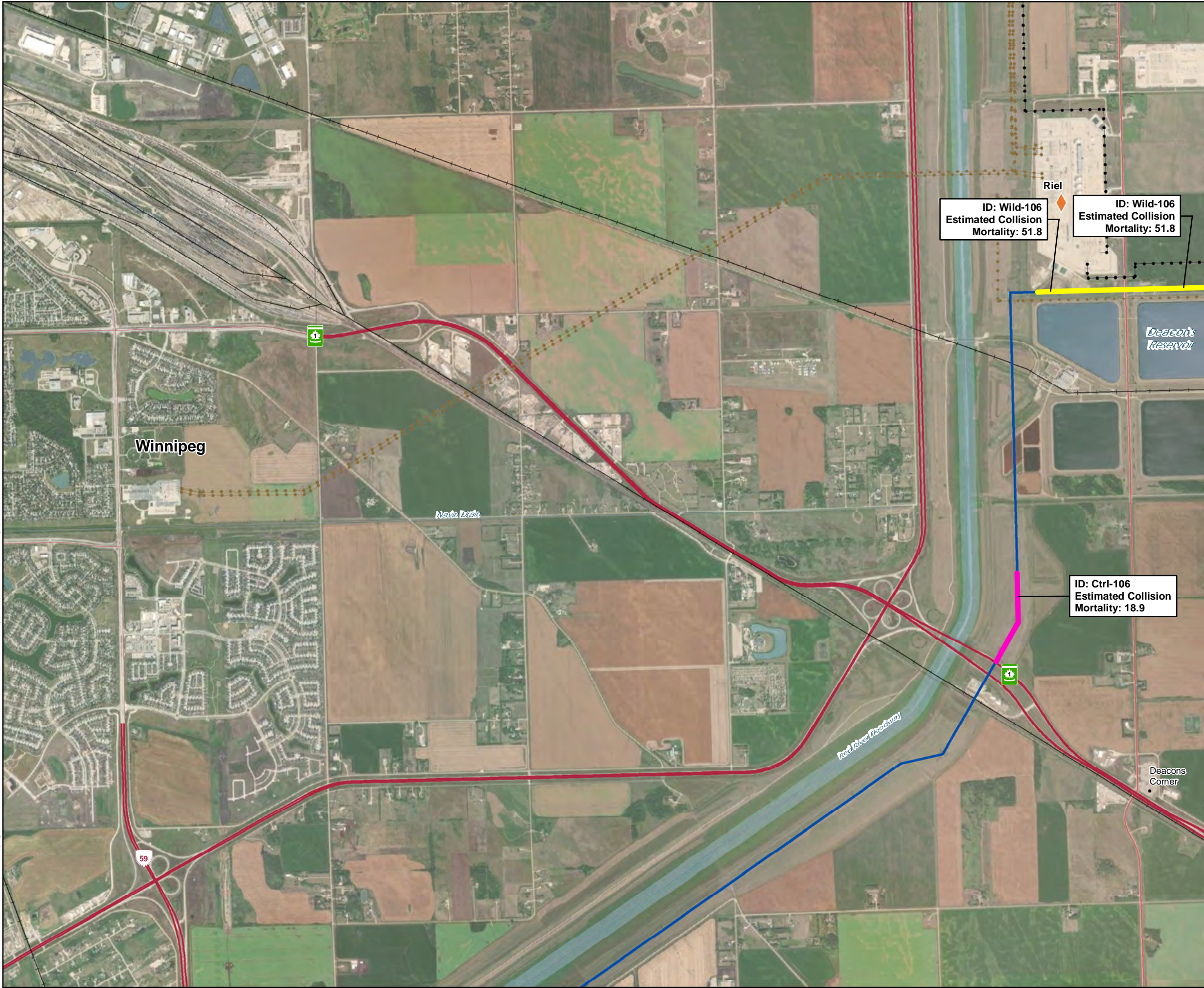


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Bird Collision Surveys
2021

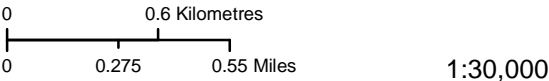
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Manitoba - Minnesota
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Bird Collision Surveys
2021

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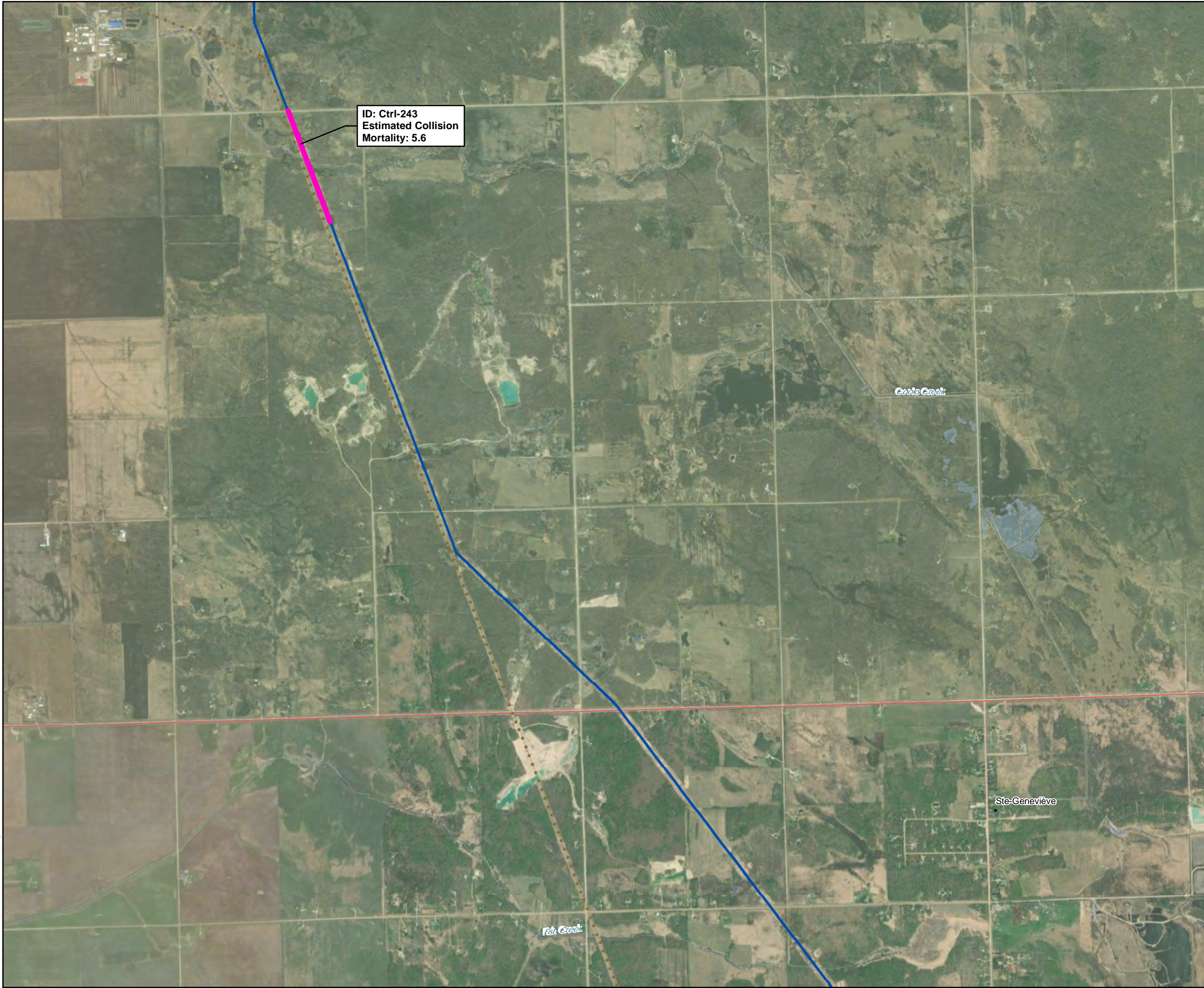


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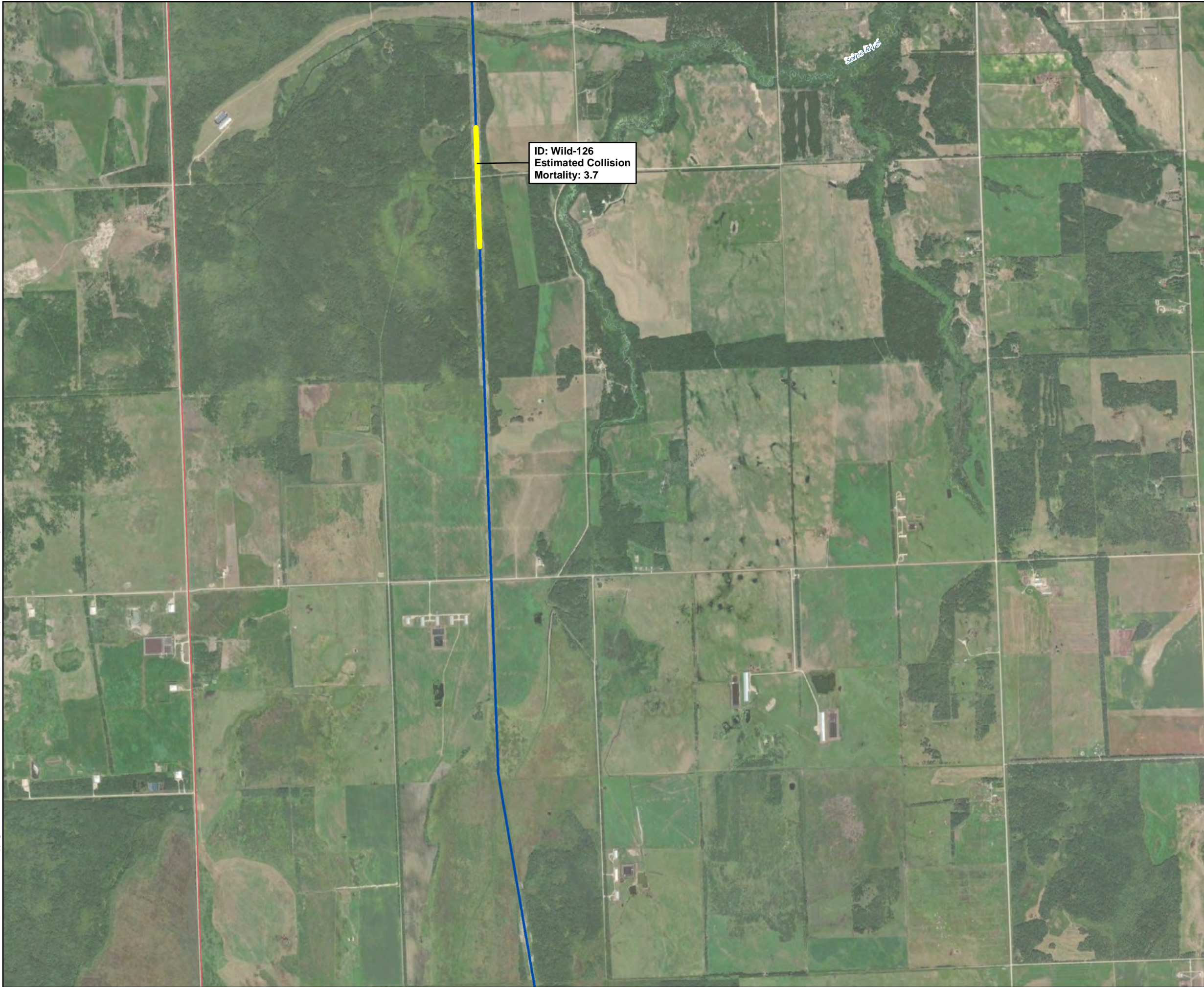


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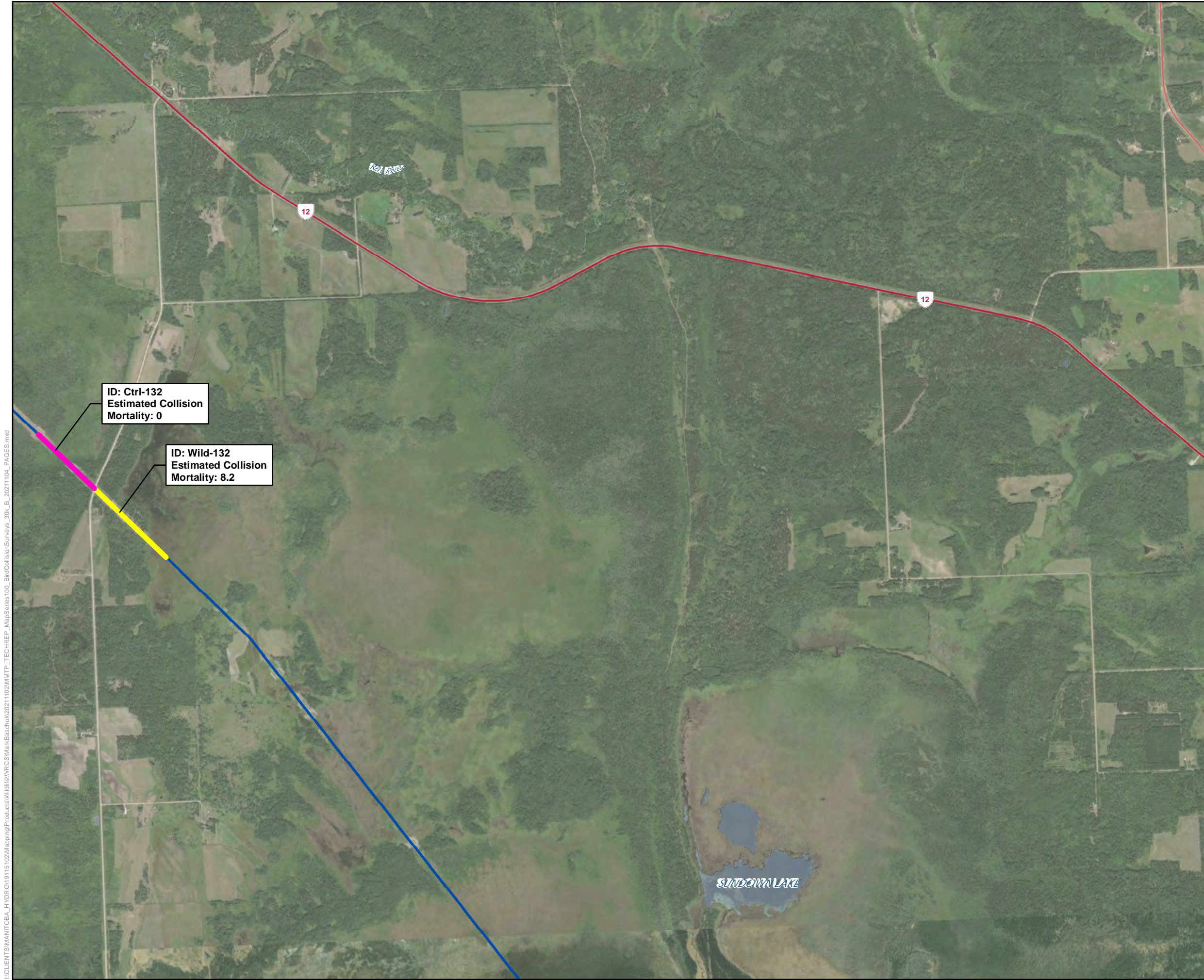
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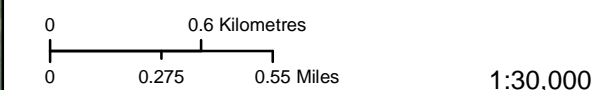
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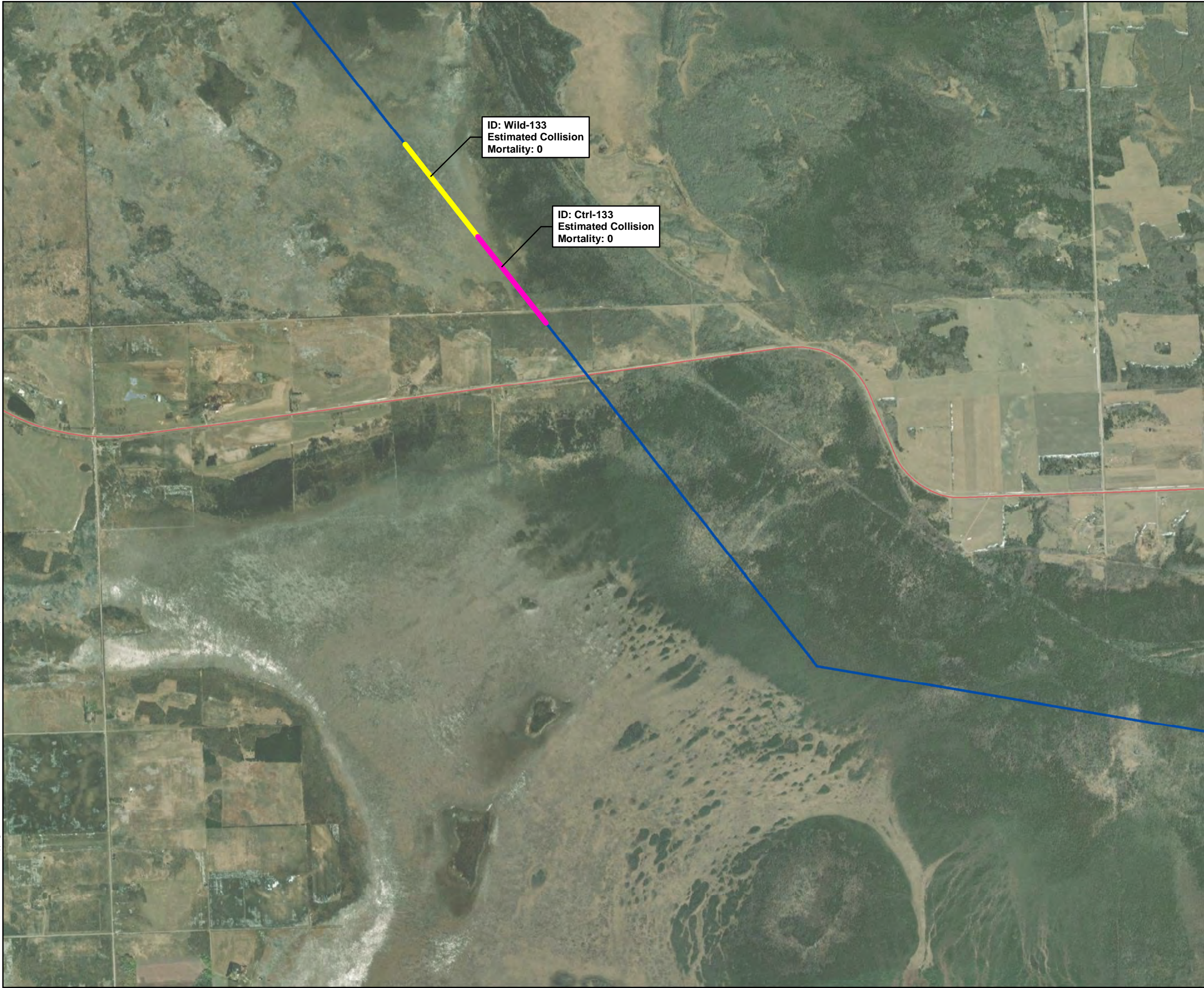
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Bird Collision Surveys 2021

Appendix 3

Photos



Photo 1. Site Wild-106, facing east, with the Manitoba-Minnesota Transmission Project (foreground) and a parallel transmission line without bird diverters (background)



Photo 2. Site Wild-106, facing west, with the Manitoba-Minnesota Transmission Project (centre), a parallel transmission line without bird diverters (left), and Riel Converter Station (right)



Photo 3. Canada Geese Crossing over the MMTP near Brady Landfill, September 2020



Photo 4. Sora Carcass Observed at Site Ctrl-123, September 2020



Photo 5. Nashville Warbler Carcass Observed at Site Wild-100, September 2020



Photo 5. Vesper Sparrow Carcass Observed at Site Wild-103, September 2020



Photo 6. Black and White Warbler Carcass Observed at Site Wild-118, September 2020



Photo 7. Rusty Blackbird Carcass Observed at Site Wild-106, May 2021



Photo 8. Western Grebe Carcass Observed at Site Wild-103, August 2021



Photo 9. Common Loon Carcass Observed at Site Wild 106, May 2021



Photo 10. Double-crested Cormorant Carcass Observed at Site Wild 106, August 2021



Photo 11. Bald Eagle Carcass Observed at Site Ctrl-243, June 2021



Photo 12. Sora Carcass Observed at Site Ctrl-103, May 2021



Photo 13. Savannah Sparrow Carcass Observed at Site Ctrl-103, May 2021

