BIPOLE III TRANSMISSION PROJECT

BIPOLE III BIRD-WIRE COLLISION MONITORING 2018-2020

Prepared for

Manitoba Hydro

By

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SUMMARY

As part of the Biophysical Monitoring Plan for the Bipole III transmission line, studies were conducted to monitor bird mortality at selected sites caused by bird-wire collisions and to evaluate mitigation effectiveness. Bird-wire collision mortality monitoring occurred at 29 sites using standardized methods along the Bipole III transmission line from 2018-2020. Two types of sites were searched, including Environmentally Significant Sites that supported above average numbers of birds and were fitted with bird diverters due to being a high-risk collision sites, and non-significant sites that supported above average numbers of birds without bird diverters. Each spring and fall, during the major bird migration periods, sites were searched for evidence of bird-wire collisions. Bird carcasses were also planted during searches 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. A bird passage survey was conducted in 2018 to examine the correlation between the number of bird passages and the number of mortalities at sites with and without diverters.

Evidence of 68 bird collisions were observed, with 37 found at sites with bird diverters and 31 at sites without bird diverters. No collision evidence from Threatened or Endangered species were observed during the surveys. The estimated annual collision mortality rate was not significantly different between sites with and without bird diverters. Estimated annual collision mortality rates were found to be 54.78 mortalities/km at sites with diverters and 49.02 mortalities/km at sites without diverters. Even though the mortality rates were similar at the two types of sites, the number of bird passages was found to be approximately 40% higher at sites with bird diverters, meaning the sites fitted with diverters were chosen well and that bird diverters are preventing bird collisions as intended.

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1.0 INTRODUCTION

The Bipole III transmission line is a 500 kilovolt, high voltage, direct current transmission line spanning 1,388 km from the Keewatinohk converter station near Gillam, Manitoba, along the west side of the province to the Riel Converter Station near Winnipeg (Appendix 1). Construction of the transmission line began in the winter of 2014 and was completed in 2018. As part of the Environment Act License requirements, Manitoba Hydro is required to monitor potential impacts of the Bipole III transmission line on birds.

Birds may occasionally collide with towers or transmission lines, causing fatalities or injuries, and can be a significant source of mortality for some species (APLIC 2012; Loss *et al.* 2014). Often, long-distance migrants, nocturnal migrants, and species with high wing-loading (small wings relative to body size) are more susceptible to collisions with these structures (Bevanger 1994; Rioux *et al.* 2013). Local habitat, environmental conditions, and the design of the transmission line also affect the risk posed to migrating birds (Bevanger 1994; Bevanger and Broseth 2001). Generally, birds are able to avoid colliding with these structures 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 significantly reduce bird collisions (Barrientos *et al.* 2012; Morkill and Anderson 1991).

To mitigate some risk posed by the Bipole III transmission line, high-priority areas (Environmentally Sensitive Sites) were selected during the pre-construction period and fitted with bird diverters during construction of the transmission line (Appendix 2). An alternating sequence of Swan-Flight™ Bird Diverter and Bird Flight Diverter were attached to ground conductors to enhance line visibility to birds (Photo 1; Appendix 2). Some sites were fitted with Low Flying Aircraft Cone line markers. Although the function of this diverter was primarily to mark the line and make it more visible to aircraft, these circumstances were also treated as sites having bird diverters. Environmentally Sensitive Sites (ESS's) were identified along the route where there was potential for a high number of bird-wire collisions based on habitat analyses and field surveys (Amec Foster Wheeler 2015; Amec Foster Wheeler 2016; Wood 2019). These sites, along with control sites, not fitted with bird diverters, but also considered to support above average numbers of birds, were monitored for bird collisions during the spring and fall migration periods when birds are most susceptible to collisions.

The objectives of bird collision monitoring were 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 2018).

This report examines the results of bird-wire collision surveys conducted in the spring and fall of 2018, the fall of 2019, and the spring of 2020.

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

2.0 METHODS

2.1 BIRD-WIRE COLLISIONS

Bird-wire collision monitoring is 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 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 lower than the mortality of birds at low-risk areas without bird diverters.

To test these hypotheses, 29 sites were selected for bird-wire collision mortality monitoring along the Bipole III transmission line (Appendix 1). Fifteen of the sites were identified as ESS's that were fitted with bird diverters (Photo 2) and 14 sites were non-significant sites that were not fitted with bird diverters but were expected to have above average bird activity (Wood 2019). Sites ranged in length from 391 m to 562 in length (Table 1), which was generally the distance between two transmission towers.

Each site was surveyed twice during the spring migration and twice during the fall migration with each survey separated by three to 12 days (Table 1). Due to logistical restraints, sites were surveyed in the fall of 2019 and the spring of 2020. During the spring 2020 survey, several sites were unable to be searched due to the wet conditions present in the right-of-way (ROW).

Surveys for bird-wire collisions were conducted at each site by two to five personnel that walked parallel lines spaced 5-10 m apart, for the entire length of the site, below the cleared 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), collision evidence was photographed, and any bird remains found were collected under a federal scientific permit. The remains were later identified to species, where possible, by a qualified biologist. Bird remains were later disposed of according to permit conditions.

Photo 2. Alternating Spiral Swan-Flight and Bird Flight Diverters (top) and Low Flying Aircraft Cones (bottom) on the Bipole III Transmission Line

Photo 3. Personnel conducting the bird collision mortality survey

Table 1. Survey Dates and General Site Characteristics

Site ID	Line Segment	Site Start UTM (Zone 14)	Site End UTM (Zone 14)	Bird Diverters Present	Site Length (m)	Geographic Area for Scavenger Trials	First Check Spring 2018	Second Check Spring 2018	First Check Fall 2018	Second Check Fall 2018	First Check Fall 2019	Second Check Fall 2019	Fist Check Spring 2020	Second Check Spring 2020
Bird 11	S1	530756 5527210	530758 5526689	No	444	1	26-Apr	01-May	29-Aug	06-Sep	28-Aug	03-Sep	14-May	21-May
Bird 13	S1	521457 5556298	521451 5555792	Yes	407	1	25-Apr	01-May	30-Aug	05-Sep	28-Aug	04-Sep	13-May	20-May
Bird 3a	S2	635692 5489124	635180 5489113	Yes	500	1	24-Apr	28-Apr	28-Aug	06-Sep	26-Aug	07-Sep	12-May	19-May
Bird 4	S2	633961 5489076	634434 5489094	No	500	1	24-Apr	27-Apr	29-Aug	07-Sep	26-Aug	07-Sep	12-May	19-May
Bird 5	S2	630167 5489739	630658 5489618	Yes	506	1	24-Apr	27-Apr	29-Aug	07-Sep	26-Aug	07-Sep	14-May	19-May
New Point Road	S2	648684 5525142	648293 5525133	Yes	391	1	25-Apr	29-Apr	28-Aug	05-Sep	27-Aug	03-Sep	12-May	19-May
WPT 18	S1	567791 5497747	567302 5497739	Yes	489	1	25-Apr	02-May	29-Aug	06-Sep	28-Aug	04-Sep	14-May	21-May
WPT10_11_12	S2	611257 5496793	611266 5496376	Yes	417	1	25-Apr	02-May	29-Aug	07-Sep	27-Aug	04-Sep	14-May	21-May
WPT3	S2	650362 5488762	650924 5488772	Yes	562	1	24-Apr	28-Apr	28-Aug	06-Sep	27-Aug	03-Sep	12-May	19-May
WS4	S2	659145 5492036	659586 5492042	Yes	441	1	24-Apr	29-Apr	28-Aug	05-Sep	27-Aug	03-Sep	12-May	19-May
Bird 26	C2	505420 5623524	505610 5623101	No	464	2	26-Apr	30-Apr	31-Aug	04-Sep	31-Aug	06-Sep	13-May	NA
Bird 29	C2	503196 5633730	502989 5634166	No	478	2	26-Apr	29-Apr	30-Aug	08-Sep	30-Aug	04-Sep	NA	NA
Bird 31	C2	499686 5639167	499978 5638802	Yes	468	2	25-Apr	28-Apr	30-Aug	08-Sep	31-Aug	06-Sep	22-May	26-May
Bird 33/35	C2	496814 5644220	497019 5643859	Yes	415	2	25-Apr	28-Apr	30-Aug	05-Sep	30-Aug	04-Sep	13-May	20-May
Bird 37	C2	489866 5656446	490101 5656031	No	477	2	25-Apr	27-Apr	01-Sep	09-Sep	29-Aug	03-Sep	20-May	26-May
Bird 39	C2	489234 5657557	489451 5657175	No	439	2	29-Apr	02-May	31-Aug	04-Sep	29-Aug	03-Sep	20-May	26-May
Bird 293	N4	358558 5828420	358539 5828778	No	500	3	26-Apr	29-Apr	02-Sep	11-Sep	28-Aug	02-Sep	24-May	28-May

Site ID	Line Segment	Site Start UTM (Zone 14)	Site End UTM (Zone 14)	Bird Diverters Present	Site Length (m)	Geographic Area for Scavenger Trials	First Check Spring 2018	Second Check Spring 2018	First Check Fall 2018	Second Check Fall 2018	First Check Fall 2019	Second Check Fall 2019	Fist Check Spring 2020	Second Check Spring 2020
Bird 44	C1	467464 5692716	467087 5693005	No	475	3	27-Apr	30-Apr	01-Sep	09-Sep	29-Aug	03-Sep	22-May	26-May
Bird 53	C1	433687 5718233	434140 5718045	Yes	490	3	28-Apr	01-May	31-Aug	10-Sep	29-Aug	03-Sep	23-May	27-May
Bird 53B	C1	434723 5717750	434269 5717967	Yes	503	3	28-Apr	01-May	31-Aug	10-Sep	29-Aug	03-Sep	23-May	27-May
Bird 79	C1	397913 5762218	398171 5761780	No	500	3	26-Apr	29-Apr	02-Sep	11-Sep	27-Aug	01-Sep	23-May	27-May
Bird 83	N4	372468 5805108	372455 5804602	No	506	3	27-Apr	30-Apr	03-Sep	07-Sep	30-Aug	03-Sep	23-May	27-May
WS62	N4	367771 5811317	367759 5810845	Yes	473	3	27-Apr	30-Apr	03-Sep	07-Sep	28-Aug	02-Sep	23-May	28-May
WS69	N4	363051 5861488	363169 5861114	Yes	391	3	26-Apr	29-Apr	01-Sep	04-Sep	28-Aug	02-Sep	24-May	28-May
Bird 129	N3	363535 5967858	363523 5967391	No	466	4	28-Apr	01-May	03-Sep	06-Sep	30-Aug	05-Sep	24-May	28-May
Bird 130	N3	363599 5970355	363586 5969843	No	512	4	27-Apr	30-Apr	02-Sep	05-Sep	31-Aug	05-Sep	24-May	28-May
Bird 140a	N3	373676 5981089	373411 5980716	Yes	458	4	27-Apr	30-Apr	02-Sep	05-Sep	01-Sep	05-Sep	24-May	NA
Bird 142	N3	380959 5989426	380611 5989084	No	487	4	26-Apr	29-Apr	01-Sep	04-Sep	31-Aug	05-Sep	25-May	29-May
Bird 142a	N3	386710 5996978	386467 5996577	No	468	4	28-Apr	01-May	03-Sep	06-Sep	31-Aug	05-Sep	24-May	28-May

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 the final estimation 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 planting dead birds on the survey sites, these sources of biases can be taken into account and a more accurate estimate of bird collisions can be produced.

Searcher efficiency bias was estimated by placing bird carcasses within the search area in locations unknown to the searchers prior to searches commencing (California Energy Commission 2003; APLIC 2012). The proportion of the planted birds found is then used in the estimation of total collision mortality.

In 2018, three chicken carcasses were placed at random locations within the search area at five different sites (three in the spring and two in the fall). In 2019, quail (*Coturnix* sp.) and wild bird carcasses were planted on the sites. Quail and wild bird species were selected because they were a more accurate representation of species that may be affected by collisions. Under Environment Canada Scientific Permit – Take, Permit No. 19-MB-SC003, 16 bird carcasses were planted at five sites in both spring and fall 2019. In 2020, 26 quail were planted on 26 sites. During all years, the proportion of carcasses found by the searchers was recorded.

Searcher efficiency was calculated for all searchers, not individuals, and the average value from all survey periods was used in the total collision mortality equation. Planted birds removed by scavengers prior to the search were not included in calculating searcher bias.

Searcher efficiency was calculated as:

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

Planted birds were also used to estimate the scavenger removal bias. Search periods were separated by four to 12 days to allow time for potential scavengers to locate planted bird carcasses. In 2018, two chicken carcasses were placed at random locations on the first visit each season at each site. In 2019, 32 carcasses of wild birds and quail were planted at 29 sites for scavenger removal trials. In 2020, 26 quail were planted on 26 sites. Carcasses were considered scavenged if they were missing, or partially consumed.

Survey sites were placed into four different geographic areas, based on their location from north to south (Appendix 1; Wood 2019). This was done to allow for a comparison of scavenger rates in the different areas, as the scavenger community, including species composition and abundance, is likely to differ.

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:

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

Crippling bias, or the estimation of birds that collide with the transmission line and fall out of the search area, or injured birds that move out of the search area, was not included in this report. Crippling bias is difficult to quantify, resource intensive, and typically results in small sample sizes (Bevanger 1999; APLIC 2012). Crippling biases can be applied using estimations from other studies. However, this may be inappropriate and misleading due to differences in species composition (bird size and weight affect potential loss) and habitat differences (APLIC 2012; Rioux *et al.* 2013). Due to these uncertainties around crippling bias, it was not used in the estimates of total collision mortality.

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 four to 12 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 northern portion of the Bipole III transmission line, where surveys were not conducted, has similar levels of mortality in comparison to the areas surveyed.
- 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), daily 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 daily mortality from 2018 to 2020 was compared between sites with diverters to those without diverters using a two-tailed t-test (α= 0.05).

2.2 BIRD PASSAGE SURVEYS

In 2018, bird passage surveys were conducted at each site to examine 1) if sites with bird diverters had a greater number of bird passages compared to sites without diverters, and 2) to examine if measured bird passage was associated with higher levels of mortality. At each site, all birds passing across the ROW, up to two times the height of the wires, were recorded over a period of 90 minutes prior to the bird collision survey. Individual birds were recounted if they passed the ROW multiple times. Birds were identified to species where possible. If the species could not be discerned, the highest grouping was used (*e.g.,* duck species, blackbird species, passerine species). Observers were positioned on the site in an area that provided the best view based on individual characteristics of the site. Other factors, such as having a view of the entire span and areas of high bird activity were also considered in positioning.

To test if there was a difference in the number of bird passages between sites with bird diverters to those without bird diverters, a two-way ANOVA was used. In the analysis, season (spring and fall) and the presence of bird diverters were used as independent variables, and seasonal total bird passage was the dependent variable (Wood 2019).

A linear regression was conducted to examine if measured bird passage was associated with greater levels of mortality using total passage numbers and estimated daily mortality for each site in each season.

3.0 RESULTS

3.1 BIRD COLLISION SURVEYS

Evidence of 68 bird collisions were found during the surveys from 2018 to 2020; 37 were located at sites with bird diverters and 31 were located at sites without bird diverters (Table 2). No species at risk were found during the surveys. The number of collisions at sites with bird diverters ranged from 0 to five and the number of collisions at sites without bird diverters ranged from 0 to 11.

The majority of collisions (46) were found during the spring search periods. One site, Bird 4, had a relatively large number of bird collisions (11) compared to other sites, which ranged from 0 to five.

Table 2. Number of Bird Collisions Found at each Site from 2018-2020

Site ID	Bird Diverters	No. Bird Collisions				Site Total	Grand Total
		Spring 2018	Fall 2018	Fall 2019	Spring 2020		
Bird 13	Present	0	0	1	0	1	37
Bird 140a	Present	0	1	1	0	2	
Bird 31	Present	0	0	0	0	0	
Bird 33/35	Present	0	0	0	3	3	
Bird 3a	Present	0	0	0	1	1	
Bird 5	Present	0	0	0	3	3	
Bird 53	Present	0	1	0	1	2	
Bird 53b	Present	1	2	0	2	5	
New Point Road	Present	3	0	0	1	4	
WPT10/11/12	Present	0	0	0	1	1	
WPT18	Present	2	0	0	2	4	
WPT3	Present	0	0	0	1	1	
WS4	Present	4	0	0	1	5	
WS62	Present	0	0	2	0	2	
WS69	Present	0	2	0	1	3	
Bird 11	Absent	2	0	0	0	2	31
Bird 129	Absent	0	0	0	0	0	
Bird 130	Absent	0	0	0	1	1	
Bird 142	Absent	2	0	0	0	2	
Bird 142a	Absent	1	0	0	1	2	
Bird 26	Absent	0	0	0	0	0	
Bird 29	Absent	0	0	1	0	1	
Bird 293	Absent	3	0	1	0	4	
Bird 37	Absent	0	0	0	0	0	
Bird 39	Absent	1	3	0	1	5	
Bird 4	Absent	0	5	2	4	11	
Bird 44	Absent	0	0	0	0	0	
Bird 79	Absent	1	0	0	0	1	
Bird 83	Absent	0	0	0	2	2	
Total		20	14	8	26	68	68

Searcher efficiency varied with each search period, ranging from 17 to 83.3% (Table 3). Due to the range of searcher efficiency values, the average of all search periods (59%) was used for collision estimations.

Scavenger bias varied with each survey period and between geographic areas in 2019 and 2020 (Table 4). In 2018, scavenger bias was reported as ranging from 60 to nearly 100% (Wood 2019), but detailed results were not published, and calculations used carcass persistence times instead. To estimate collision mortality, the scavenger biases calculated for each geographic area in fall 2019 and spring 2020 were used for the respective years. The average scavenger bias for each geographic area from fall 2019 and spring 2020 was used in the spring and fall 2018 calculations as they are based on results using preferred planted bird types (quail and wild birds).

Table 3. Searcher Efficiency during the Search Periods from 2018-2020

Search Period	Searcher Efficiency (%)
Spring 2018	77.8
Fall 2018	83.3
Fall 2019	17[1]
Spring 2020	58
Average	59

Table 4. Scavenger Bias (%) in Different Geographic Areas from 2019-2020

Geographic Area	Fall 2019	Spring 2020	Average
1	36	80	58
2	50	50	50
3	40	63	52
4	20	50	35
Average	37	61	49

The average mortality estimates ranged from 0 to 10.87 mortalities/week/km at sites with diverters present and from 0 to 26.96 mortalities/week/km at sites without bird diverters (Table 5). Overall, the total daily mortality estimates were not statistically different between sites with and without bird diverters ($p = 0.65$).

The average estimated seasonal mortality rate (over six weeks) at sites with bird diverters was 35.10 mortalities/km and 19.68 mortalities/km, in the spring and fall, respectively, or 54.78 mortalities/km

[1] Several agricultural fields were not harvested in fall 2019 because of wet conditions, which created difficult searching conditions. This in part explains the low number of planted birds found during searches.

annually. For sites without bird diverters, the average estimated seasonal mortality rate (over six weeks) was 29.64 mortalities/km and 19.38 mortalities/km, in the spring and fall, respectively, or 49.02 mortalities/km annually. Overall, the average estimated seasonal mortality rate for the Bipole III transmission line is 32.37 mortalities/km and 19.53 mortalities/km, in the spring and fall respectively, or 51.90 mortalities/km annually.

Collisions appeared to be localised at survey sites, and no apparent pattern of collision mortality is visible among the different geographic areas (Appendix 3). The estimated weekly mortality per km ranged from 3.23 mortalities/km in geographic area 2 to 4.89 mortalities/km in geographic area 1.

Table 5. Estimated Weekly Mortality per km from 2018-2020

Site ID	Bird Diverters	Geographic Area	Estimated Weekly Mortality/km					
			Spring 2018	Fall 2018	Fall 2019	Spring 2020	Average	Overall Average 2018-2020
Bird 13	Present	1	0.00	0.00	11.58	0.00	2.89	4.54
Bird 140a	Present	4	0.00	14.10	18.50	NA	10.87	
Bird 31	Present	2	0.00	0.00	0.00	0.00	0.00	
Bird 33/35	Present	2	0.00	0.00	0.00	24.52	6.13	
Bird 3a	Present	1	0.00	0.00	0.00	4.24	1.06	
Bird 5	Present	1	0.00	0.00	0.00	12.55	3.14	
Bird 53	Present	3	0.00	6.64	0.00	5.49	3.03	
Bird 53b	Present	3	6.48	12.96	0.00	10.69	7.53	
New Point Road	Present	1	22.42	0.00	0.00	5.42	6.96	
WPT10/11/12	Present	1	0.00	0.00	0.00	5.08	1.27	
WPT18	Present	1	17.58	0.00	0.00	12.57	7.54	
WPT3	Present	1	0.00	0.00	0.00	6.18	1.55	
WS4	Present	1	24.82	0.00	0.00	4.81	7.41	
WS62	Present	3	0.00	0.00	17.92	0.00	4.48	
WS69	Present	3	0.00	16.67	0.00	6.88	5.89	
Bird 11	Absent	1	13.47	0.00	0.00	0.00	3.37	4.06
Bird 129	Absent	4	0.00	0.00	0.00	0.00	0.00	
Bird 130	Absent	4	0.00	0.00	0.00	6.62	1.65	
Bird 142	Absent	4	19.89	0.00	0.00	0.00	4.97	
Bird 142a	Absent	4	10.35	0.00	0.00	7.78	4.53	
Bird 26	Absent	2	0.00	0.00	0.00	NA	0.00	
Bird 29	Absent	2	0.00	0.00	7.09	NA	2.36	
Bird 293	Absent	3	19.56	0.00	8.47	0.00	7.01	
Bird 37	Absent	2	0.00	0.00	0.00	0.00	0.00	
Bird 39	Absent	2	8.98	26.94	0.00	7.72	10.91	
Bird 4	Absent	1	0.00	29.22	18.83	16.95	16.25	
Bird 44	Absent	3	0.00	0.00	0.00	0.00	0.00	
Bird 79	Absent	3	6.52	0.00	0.00	0.00	1.63	
Bird 83	Absent	3	0.00	0.00	0.00	10.63	2.66	

Passerine species (Order Passeriformes) made up the largest proportion of mortalities observed along the transmission line. Passerines accounted for 29, or 43% of the total mortalities observed from 2018-2020 (Table 6). Of the passerine species found, the dark-eyed junco was a frequent mortality in the spring of 2018, when six dark-eyed junco mortalities were observed at four separate sites (Table 6). Second to passerines, waterfowl and waterbirds combined accounted for 21 mortalities, or 31% of the total mortalities observed. Waterfowl species (Order Anseriformes), including mallard and Canada goose, also made up a large proportion of the mortalities observed. Waterfowl species accounted for 14 mortalities, or 21% of the total mortalities observed from 2018-2020 (Table 6). Of the waterfowl species, mallard was a frequent mortality, and eight mortalities of this species were found at six sites.

Table 6. Collision Evidence Found During Surveys from 2018-2020

Site	Bird Diverters	Date	UTM Coordinate	Species
Bird 13	Present	4-Sep-19	14 U 521444 5555936	Red-eyed vireo
Bird 140a	Present	1-Sep-19	14 U 373567 5980922	Unknown skeletal remains
Bird 140a	Present	2-Sep-18	14 U 373567 5980921	Sharp-tailed grouse
Bird 33/35	Present	13-May-20	14 U 497001 5643924	Wilson's snipe
Bird 33/35	Present	13-May-20	14 U 496993 5643933	Unknown skeletal remains
Bird 33/35	Present	13-May-20	14 U 496986 5643929	Unknown skeletal remains
Bird 3a	Present	12-May-20	14 U 635228 5489126	American crow
Bird 5	Present	14-May-20	14 U 630498 5489675	Yellow-shafted flicker
Bird 5	Present	14-May-20	14 U 630329 5489686	Savannah sparrow
Bird 5	Present	19-May-20	14 U 630477 5489687	Mallard
Bird 53	Present	23-May-20	14 U 434049 5718068	Gull species
Bird 53	Present	10-Sep-18	14 U 433790 5718212	Unknown species feathers
Bird 53b	Present	27-May-20	14 U 434346 5717919	Common raven
Bird 53b	Present	27-May-20	14 U 434346 5717910	Killdeer
Bird 53b	Present	31-Aug-18	14 U 434326 5717907	American white pelican
Bird 53b	Present	31-Aug-18	14 U 434354 5717915	Rock pigeon
Bird 53b	Present	28-Apr-18	14 U 434317 5718067	Unknown species feathers
New Point Road	Present	25-Apr-18	14 U 648669 5525147	Waterfowl species
New Point Road	Present	25-Apr-18	14 U 648641 5525153	Dark-eyed junco
New Point Road	Present	29-Apr-18	14 U 648354 5525134	Ruby-crowned kinglet
New Point Road	Present	12-May-20	14 U 648471 5525110	Canada goose
WPT10/11/12	Present	14-May-20	14 U 611257 5496522	Savannah sparrow
WPT18	Present	14-May-20	14 U 567744 5497755	Killdeer
WPT18	Present	21-May-20	14 U 567597 5497755	Unknown species feathers
WPT18	Present	2-May-18	14 U 465642 5693401	Waterfowl species
WPT18	Present	2-May-18	14 U 567630 5497770	Yellow-rumped warbler
WPT3	Present	19-May-20	14 U 650752 5488752	Unknown species feathers
WS4	Present	12-May-20	14 U 659442 5492060	Chipping sparrow
WS4	Present	24-Apr-18	14 U 659294 5492054	Dark-eyed junco
WS4	Present	24-Apr-18	14 U 659318 5492050	Mallard
WS4	Present	24-Apr-18	14 U 659552 5492068	Dark-eyed junco
WS4	Present	29-Apr-18	14 U 659393 5492069	Vesper sparrow
WS62	Present	2-Sep-19	14 U 367766 5810848	Mallard
WS62	Present	2-Sep-19	14 U 367764 5810844	Mallard

Site	Bird Diverters	Date	UTM Coordinate	Species
WS69	Present	24-May-20	14 U 363103 5861325	Common raven
WS69	Present	1-Sep-18	14 U 363092 5861448	American crow
WS69	Present	1-Sep-18	14 U 363557 5967811	Unknown skeletal remains
Bird 11	Absent	26-Apr-18	14 U 635549 5489106	Dark-eyed junco
Bird 11	Absent	1-May-18	14 U 530769 5527065	Gull species
Bird 130	Absent	28-May-20	14 U 363569 5969957	Sparrow species
Bird 142	Absent	28-Apr-18	14 U 380944 5989423	Fox sparrow
Bird 142	Absent	28-Apr-18	14 U 380707 5989187	Unknown skeletal remains
Bird 142a	Absent	24-May-20	14 U 386686 5996918	Mallard
Bird 142a	Absent	1-May-18	NA	America tree sparrow
Bird 29	Absent	4-Sep-19	14 U 503137 5633860	American bittern
Bird 293	Absent	2-Sep-19	14 U 358538 5828778	Unknown skeletal remains
Bird 293	Absent	27-Apr-18	14 U 358550 5828642	Dark-eyed junco
Bird 293	Absent	27-Apr-18	14 U 358541 5828799	Dark-eyed junco
Bird 293	Absent	27-Apr-18	14 U 358518 5828825	Ruffed grouse
Bird 39	Absent	20-May-20	14 U 489320 5657381	Mallard
Bird 39	Absent	1-Sep-18	14 U 489382 5657288	Double-crested cormorant
Bird 39	Absent	9-Sep-18	14 U 489389 5657286	Double-crested cormorant
Bird 39	Absent	9-Sep-18	14 U 489343 5657402	Unknown species feathers
Bird 39	Absent	27-Apr-18	14 U 489410 5657233	Black-billed magpie
Bird 4	Absent	26-Aug-19	14 U 634287 5489083	Blue-winged teal
Bird 4	Absent	7-Sep-19	14 U 634378 5489084	Unknown species feathers
Bird 4	Absent	12-May-20	14 U 634289 5489073	Mallard
Bird 4	Absent	12-May-20	14 U 634276 5489088	Waterfowl species
Bird 4	Absent	12-May-20	14 U 634254 5489110	Mallard
Bird 4	Absent	12-May-20	14 U 634278 5489123	Waterfowl species
Bird 4	Absent	29-Aug-18	14 U 634529 5489100	Ovenbird
Bird 4	Absent	7-Sep-18	14 U 634546 5489087	Common yellowthroat
Bird 4	Absent	7-Sep-18	14 U 634369 5489072	American redstart
Bird 4	Absent	7-Sep-18	14 U 634383 5489085	Sparrow species
Bird 4	Absent	7-Sep-18	14 U 634383 5489079	American redstart
Bird 79	Absent	26-Apr-18	14 U 398225 5761727	Snow bunting
Bird 83	Absent	23-May-20	14 U 372470 5804953	Common yellowthroat
Bird 83	Absent	23-May-20	14 U 372480 5804950	Unknown skeletal remains

3.2 BIRD PASSAGE SURVEYS

During bird passage surveys conducted in 2018, a total of 12,835 bird crossings were observed. Sites with bird diverters were observed to have a greater number of bird crossings (7,845), compared to sites without diverters (4,990), but this difference was not found to be statistically significant ($p = 0.13$). Several sites with bird diverters, including sites Bird 13, Bird 3a, Bird 53, had relatively high numbers of bird passages compared to other sites (Table 7).

The season was found to affect the number of bird passage observed in 2018. During the spring passage surveys, a significantly higher ($p = 0.02$) number of bird crossings were observed (8,223), compared to the number of bird crossings in the fall (4,612) (Table 7).

The number of bird passages observed in 2018 was not significantly correlated with the number of mortalities observed ($p= 0.56$). This indicates that the hypothesis that sites with higher bird passages will result in higher number of mortalities is not supported.

Other, qualitative observations were also made during the 2018 bird passage surveys. Birds flying at the height of the transmission lines were observed reacting to and avoiding wires where bird diverters were present (Wood 2019). In particular, larger birds, including American white pelicans, gulls, and waterfowl were observed circling to gain or lose altitude to pass over or under the transmission lines (Wood 2019). At sites with bird diverters, birds were also observed avoiding passing over the section of transmission line with bird diverters, to fly along the transmission line and cross over a spot without bird diverters (Wood 2019).

Table 7. Bird Passages Observed at Each Site in 2018 (Wood 2019)

Site	Bird Diverters	Line Section	Number of Bird Passes								
			Spring				Fall				Grand Total
			Waterbirds	Songbirds	Other Landbirds	Total	Waterbirds	Songbirds	Other Landbirds	Total	
Bird 13	Present	S1	40	639	16	695	321	280	20	621	1,316
Bird 140a	Present	N3	3	12	1	16	23	13	1	37	53
Bird 31	Present	C2	44	30	0	74	26	9	6	41	115
Bird 33/35	Present	C2	26	29	9	64	1	36	5	42	106
Bird 3a	Present	S2	144	864	22	1,030	4	47	7	58	1,088
Bird 5	Present	S2	111	460	21	592	65	170	17	252	844
Bird 53	Present	C1	948	75	1	1,024	173	339	26	538	1,562
Bird 53b	Present	C1	175	85	2	262	20	21	19	60	322
New Point Road	Present	S2	114	67	13	194	11	13	7	31	225
WPT10/11/12	Present	S2	0	170	1	171	0	4	1	5	176
WPT18	Present	S1	192	252	12	456	21	296	3	320	776
WPT3	Present	S2	11	135	5	151	35	14	15	64	215
WS4	Present	S2	58	131	2	191	11	13	1	25	216
WS62	Present	N4	100	179	10	289	29	167	18	214	503
WS69	Present	N4	64	58	7	129	31	153	15	199	328
Bird 11	Absent	S1	28	159	8	195	1	633	23	657	852
Bird 129	Absent	N3	25	6	3	34	1	122	3	126	160
Bird 130	Absent	N3	20	338	4	362	6	249	7	262	624
Bird 142	Absent	N3	16	14	1	31	0	21	3	24	55
Bird 142a	Absent	N3	8	5	8	21	15	40	13	68	89
Bird 26	Absent	C2	15	39	8	62	0	7	0	7	69
Bird 29	Absent	C2	19	218	5	242	0	1	1	2	244
Bird 293	Absent	N4	3	325	1	329	59	169	9	237	566
Bird 37	Absent	C2	57	170	31	258	0	11	4	15	273
Bird 39	Absent	C2	138	57	19	214	34	56	8	98	312

Site	Bird Diverters	Line Section	Number of Bird Passes								
			Spring				Fall				Grand Total
			Waterbirds	Songbirds	Other Landbirds	Total	Waterbirds	Songbirds	Other Landbirds	Total	
Bird 4	Absent	S2	36	127	12	175	2	49	36	87	262
Bird 44	Absent	C1	34	62	20	116	124	202	10	336	452
Bird 79	Absent	C1	10	229	11	250	0	108	19	127	377
Bird 83	Absent	N4	219	341	36	596	0	48	11	59	655

4.0 DISCUSSION

The installation of bird diverters on transmission lines has been proven to significantly reduce bird collisions (Barrientos *et al.* 2012; Brown and Drewien 1995; Morkill and Anderson 1991). Bird diverters along the Bipole III transmission line appear to be placed at effective locations and are also likely preventing bird mortalities. The number of bird passages recorded in 2018 was not significantly different between sites with bird diverters and those without bird diverters. Despite not being statistically significant, sites with bird diverters had 39% more bird passages and final selection of bird diverter sites is validated by these results. It is assumed that bird passage numbers were likely higher at bird diverter sites during the other years even though bird passage surveys were not conducted.

No statistical difference of estimated collision mortality was found between sites with bird diverters to those without bird diverters, and it appears the null hypothesis of no difference of bird mortality between sites with and without bird diverters is accepted. Even though no statistical correlation was found between the number of bird passages and the number of mortalities, this may have been due to mortalities not being found at many of the sites, rather than a lack of correlation. As indicated by many other scientific studies (Barrientos *et al.* 2012; Brown and Drewien 1995; Morkill and Anderson 1991), it is reasonable to assume that the sites with bird diverters would experience greater numbers of mortalities if they were not present. Other explanations for a lack of correlation between bird passages and mortalities may be due to altered bird behaviour (*i.e.,* line avoidance) caused by the presence of the bird diverters, which was observed during the 2018 bird passage surveys. Additionally, passage surveys were limited to the daylight hours and surveys were not conducted at night when many species tend to migrate.

Estimated collision mortality rates observed along the Bipole III transmission line do not appear to be substantially impacting bird populations in the province. No Threatened or Endangered species were found from 2018-2020, and the mortality rates observed were similar to other bird collision studies in the province and elsewhere.

Along the Bipole III transmission line, the average estimated seasonal mortality rate at sites with bird diverters was 35.10 mortalities/km and 19.68 mortalities/km, in the spring and fall, respectively and 29.64 mortalities/km and 19.38 mortalities/km, in the spring and fall, respectively, at sites without bird diverters. These values are consistent with what has been observed in other studies in Manitoba (Table 8). One site at the Keeyask Transmission Project had an estimated mortality rate of 469.09 birds/km but was inflated due to a high scavenger rate bias (WRCS 2018c).

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
Manitoba-Minnesota Transmission Line 2020	NA	NA	NA	NA	99.9	109.6

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

The bird mortality rates observed in this study are also among the rates observed in other published studies. During the migration period at sensitive wetland habitats, Faanes (1987) estimated bird collision mortality rate of 69 birds/km. Another report, which reviewed 32 studies at unmarked transmission power lines found an average of 42.3 ± 17.1 birds/km/year (Rioux *et al.* 2013). However, comparisons of mortality rates between studies may be misleading as sources of bias (*i.e.,* searcher efficiency, scavenger bias, habitat bias) can vary substantially between study locations (Morrison 2002; APLIC 2006).

Collisions appeared to be localised at individual sites, with no groups of sites or areas showing any patterns of increased mortality. One individual site, Bird 4, which does not have bird diverters, had the greatest mortality rate observed of all sites surveyed. This site, which is along the Marsh River and between two sites with bird diverters in proximity, had a moderate number of bird passages relative to other sites. The nearby sites with bird diverters (Bird 5 and Bird 3a), which are in similar habitat, had considerably lower mortality estimates in comparison and highlight the effectiveness of bird diverters, but much higher numbers of bird passages. Presumably, Bird 4 would have reduced bird collisions if it were fitted with bird diverters. This site may be a good candidate for the installation of bird diverters to help reduce the number of mortalities in the area.

Some species appear to be more vulnerable to collisions along the Bipole III transmission line, which is expected. During this survey, passerines and waterfowl species made up most of the collision mortalities observed. Passerines were likely frequently encountered as this order of birds includes more than half of all species, which increases the likelihood of encountering them during bird collision surveys. The relatively large number of dark-eyed juncos found in the spring of 2018 in comparison to other species that were found may have been a unique occurrence as this species was not found again in later searches. Factors including weather, migration timing (day or night), and individual body condition can influence the susceptibility of bird collisions (Bevanger and Drewien 1995).

The large proportion of waterfowl mortalities was consistent with other studies in Canada, which found waterfowl to be a vulnerable group of birds to collisions (Rioux *et al.* 2013). Waterfowl are more susceptible to collisions due to their high body mass and relatively small wing size, which makes them less maneuverable compared to other species. The large proportion of waterfowl mortalities may also be partly attributed to the location of the survey sites. Survey sites were often located at river crossings and waterbodies that provide ideal habitat for waterfowl, increasing the likelihood of encountering these species during collision searches.

The relatively high variation of searcher bias in this study indicates the need for large sample sizes to obtain the most reflective value possible. Additionally, birds that represent the species that would be observed in the field should also be used to avoid creating any bias in the searchers' ability in locating the planted birds. Wild birds, when available, are ideal for this purpose, and quail, which are commercially available, can be a suitable substitute, but only if a range of sizes are used for searches.

5.0 CONCLUSIONS

Bird-wire diverters along the Bipole III transmission line appear to be effective at reducing the number of bird-wire collision mortalities. No Threatened or Endangered species were observed from 2018-2020. Because mortality rate estimates are comparable to other studies in Manitoba and elsewhere, no further mitigative measures are recommended at this time.

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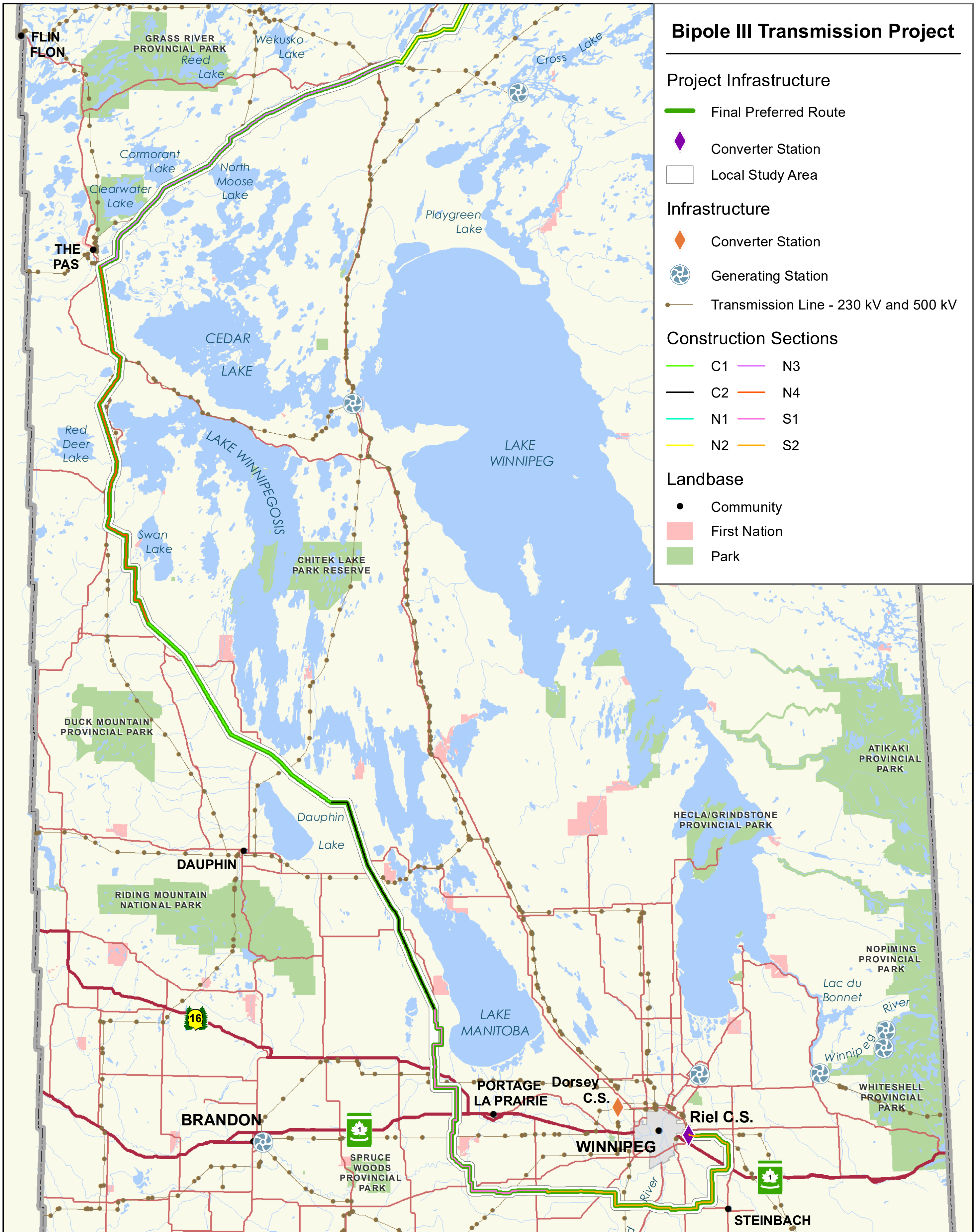
Appendix 1

Map Series

Bird Collision Study Area and Survey Sites



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Manitoba Hydro

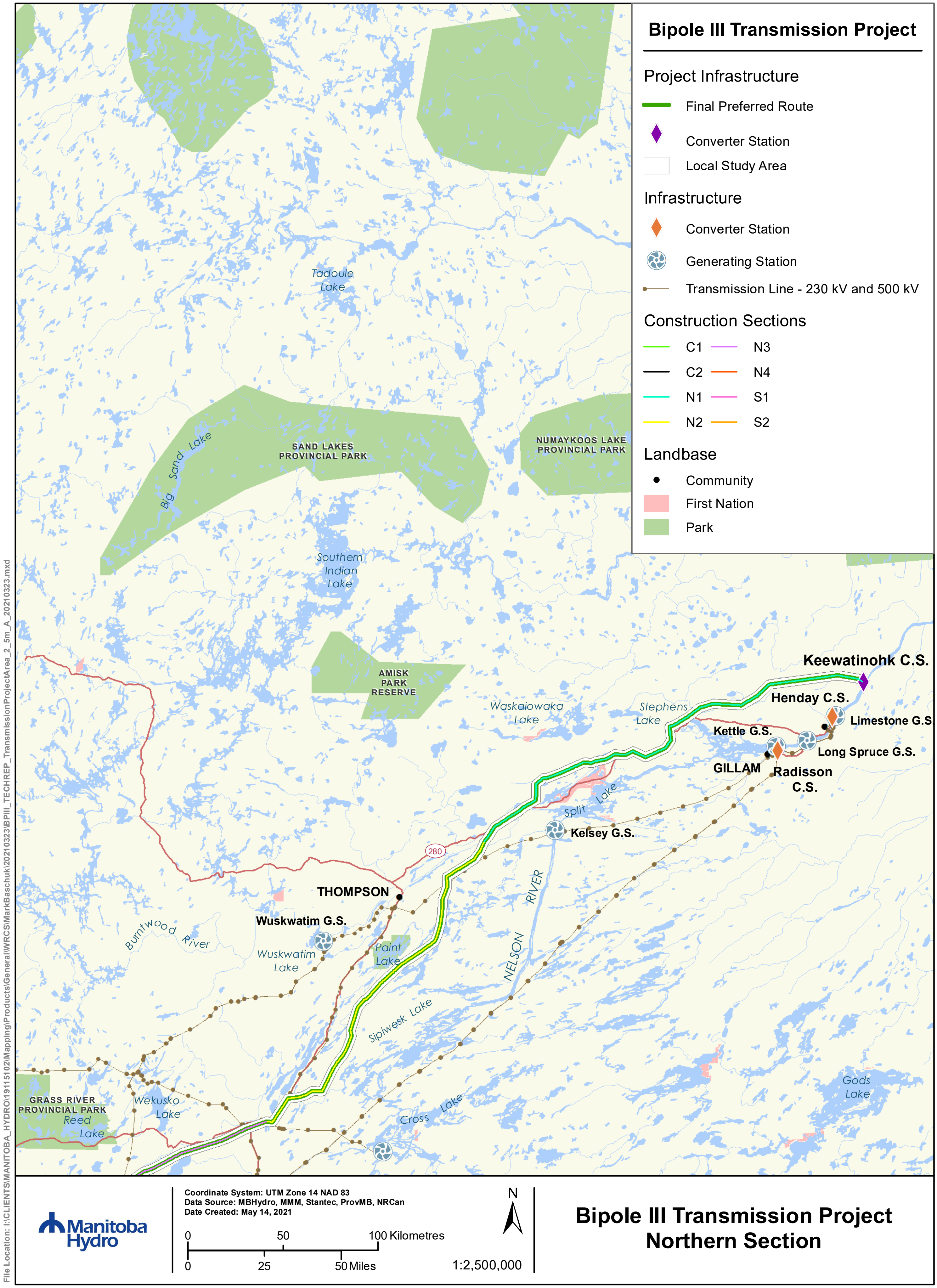
Coordinate System: UTM Zone 14 NAD 83
Data Source: MBHydro, MMM, Stantec, ProvMB, NRCan
Date Created: May 14, 2021

0 50 100 Kilometres
0 25 50 Miles

N

1:2,500,000

Bipole III Transmission Project
Southern and Central Sections


Bipole III Transmission Project
Project Infrastructure
Final Preferred Route
Converter Station
Local Study Area
Infrastructure
Converter Station
Generating Station
Transmission Line - 230 kV and 500 kV
Construction Sections
C1
N3
C2
N4
N1
S1
N2
S2
Landbase
Community
First Nation
Park
Tadoule Lake
Big Sand Lake
SAND LAKES PROVINCIAL PARK
NUMAYKOOS LAKE PROVINCIAL PARK
Southern Indian Lake
AMISK PARK RESERVE
Keewatinohk C.S.
Henday C.S.
Limestone G.S.
Waskaiowaka Lake
Stephens Lake
Kettle G.S.
Long Spruce G.S.
GILLAM
Radisson C.S.
Split Lake
Kelsey G.S.
280
THOMPSON
Wuskwatim G.S.
Burntwood River
Wuskwatim Lake
Paint Lake
NELSON RIVER
Sipiwesk Lake
GRASS RIVER PROVINCIAL PARK
Reed Lake
Wekusko Lake
Cross Lake
Gods Lake
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Manitoba Hydro
Coordinate System: UTM Zone 14 NAD 83
Data Source: MBHydro, MMM, Stantec, ProvMB, NRCan
Date Created: May 14, 2021
0
50
100 Kilometres
0
25
50 Miles
1:2,500,000
N
Bipole III Transmission Project
Northern Section

Manitoba Hydro

Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN
Date Created: May 14, 2021

0 25 50 Kilometres
0 25 50 Miles

N

1:2,500,000

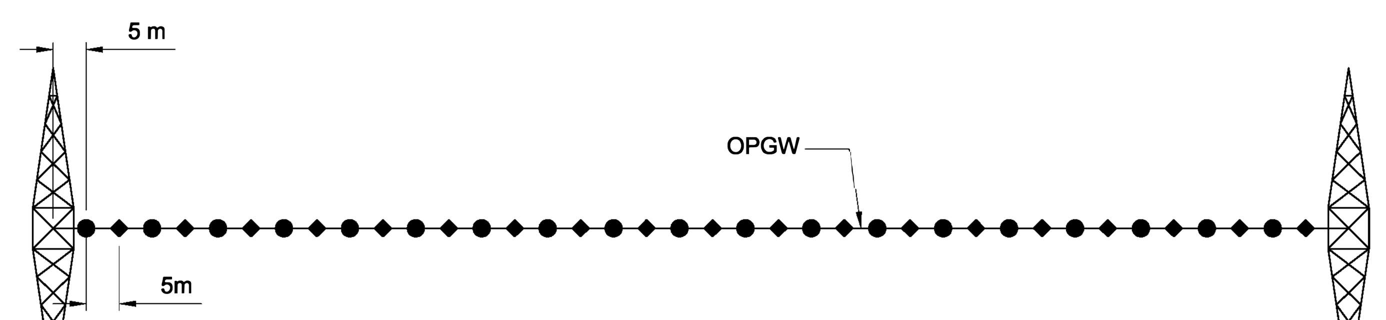
Bird Collision Survey Sites and Geographic Areas

2020

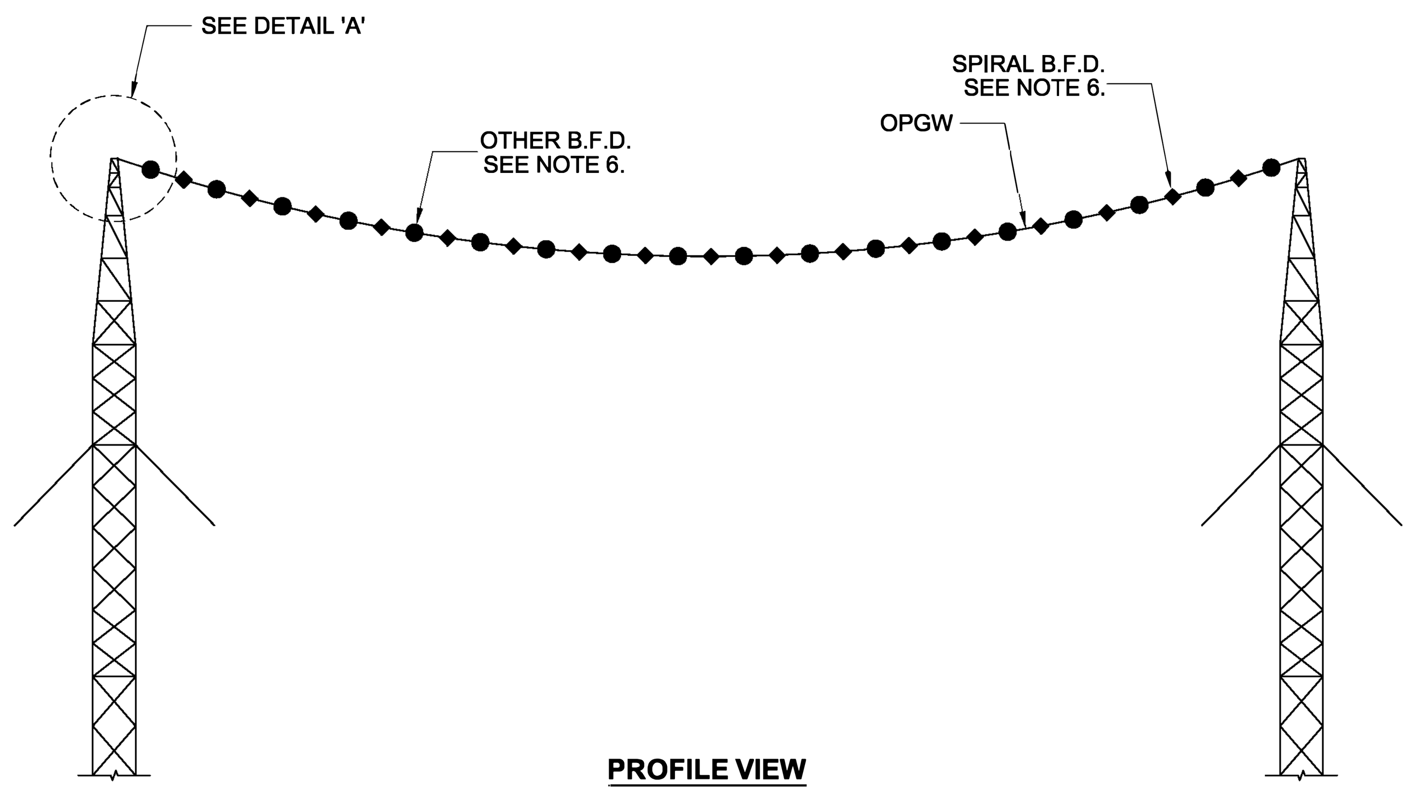
Appendix 2

Locations of Environmentally Sensitive Sites with Bird Diverters and Installation Details

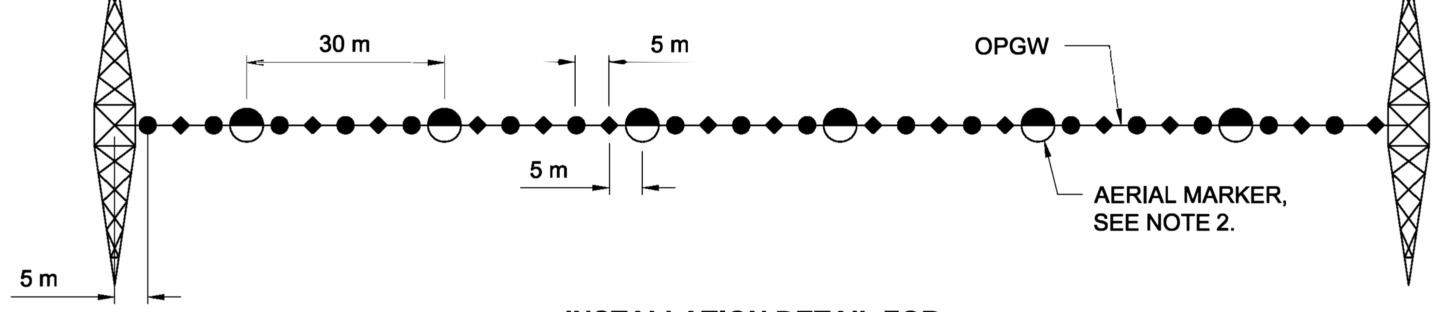
PLAN VIEW OF TRANSMISSION LINE WITH 100% SPAN COVERAGE



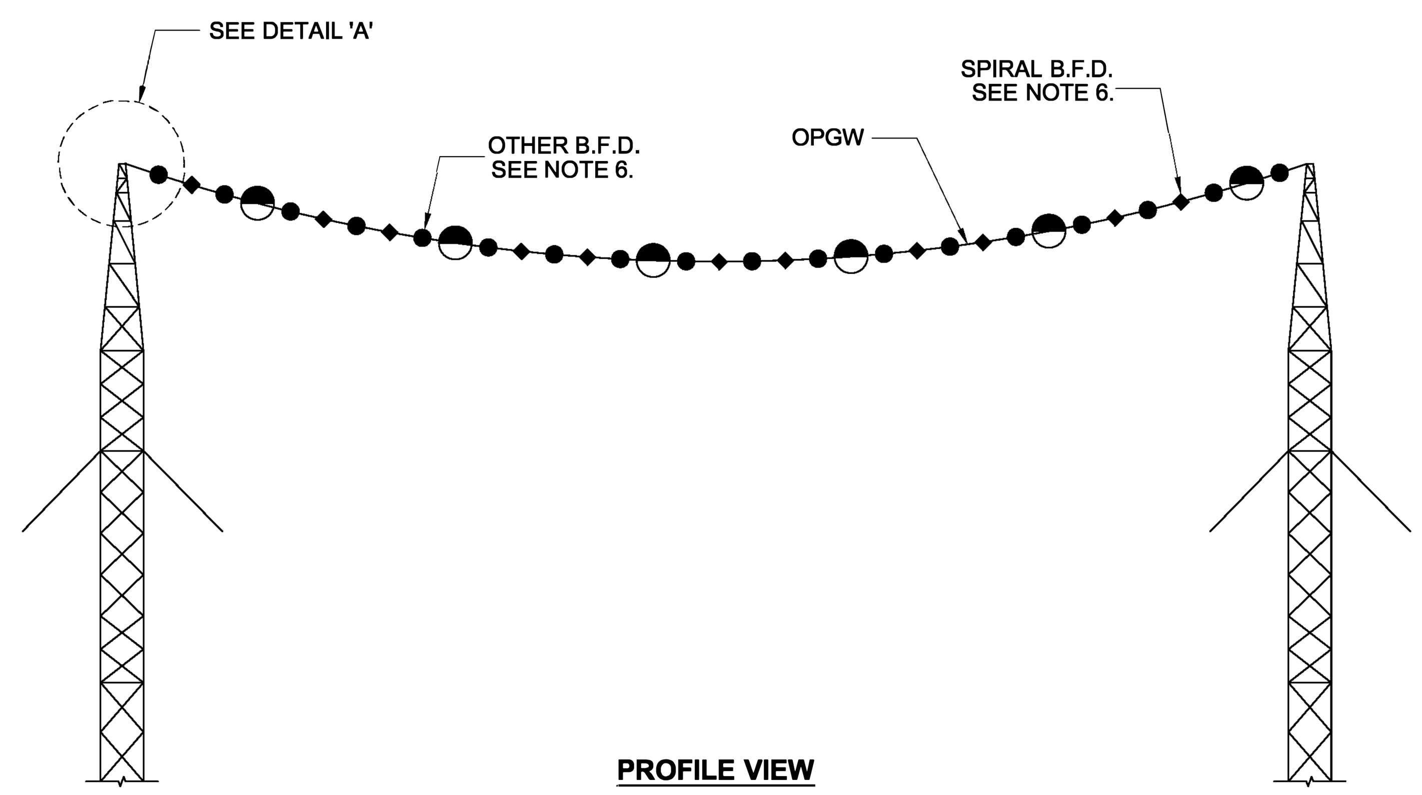
INSTALLATION DETAIL FOR TRANSMISSION LINE WITH ONE SKYWIRE



PROFILE VIEW

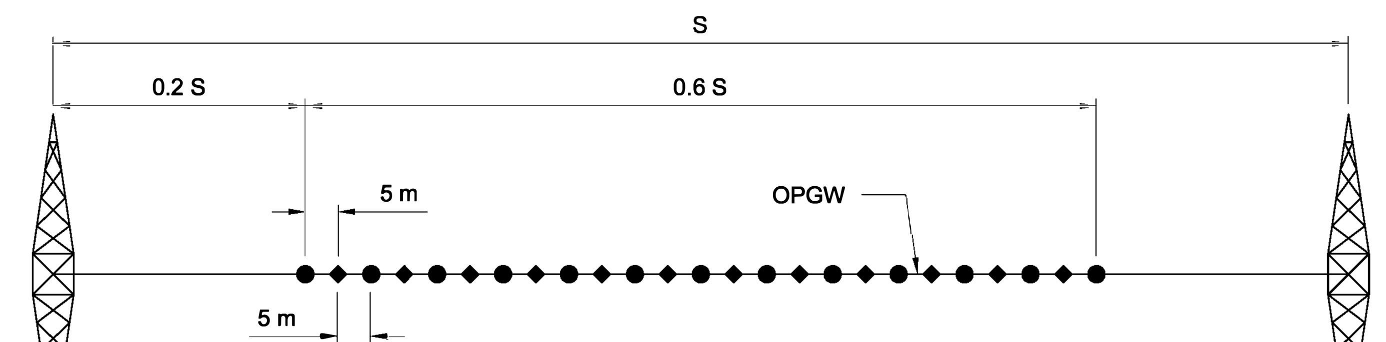


INSTALLATION DETAIL FOR TRANSMISSION LINE WITH ONE SKYWIRE AND AERIAL MARKER CONES

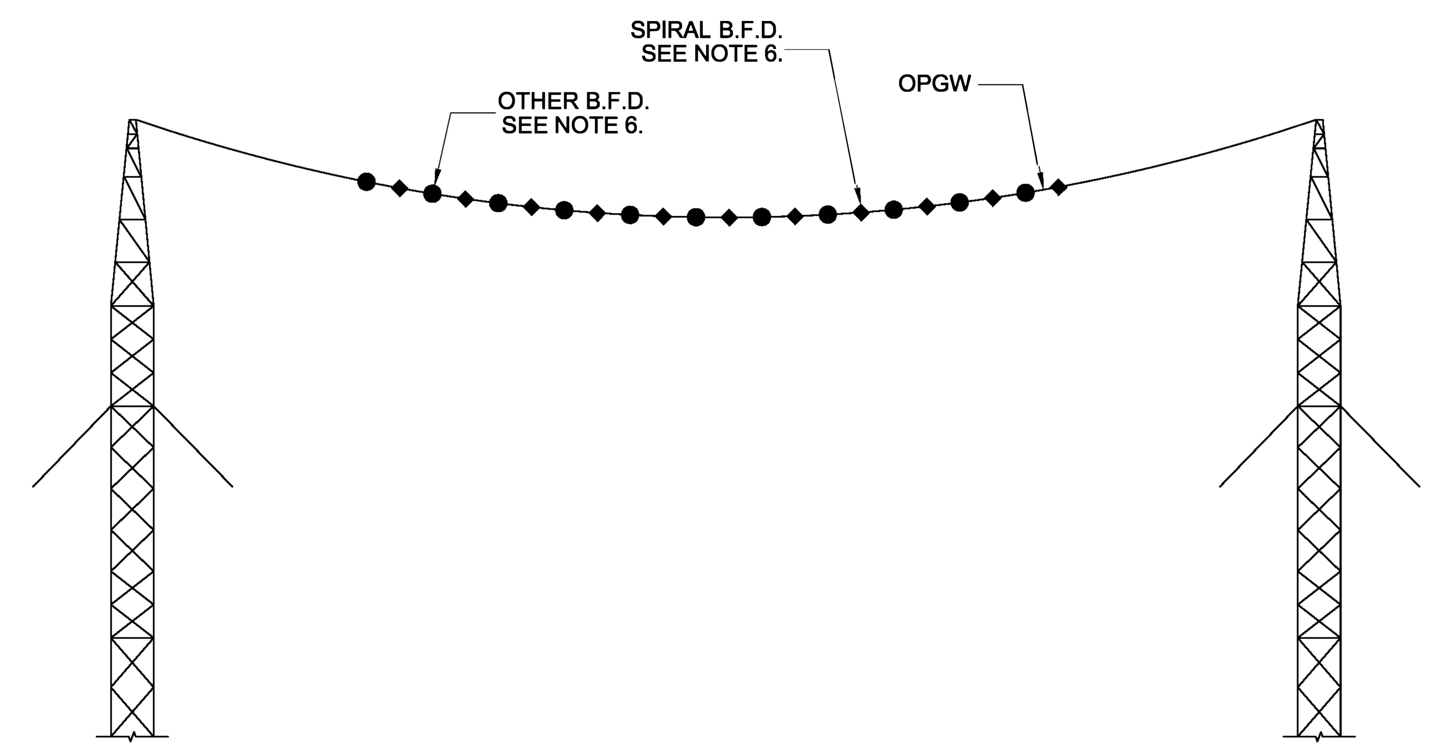


PROFILE VIEW

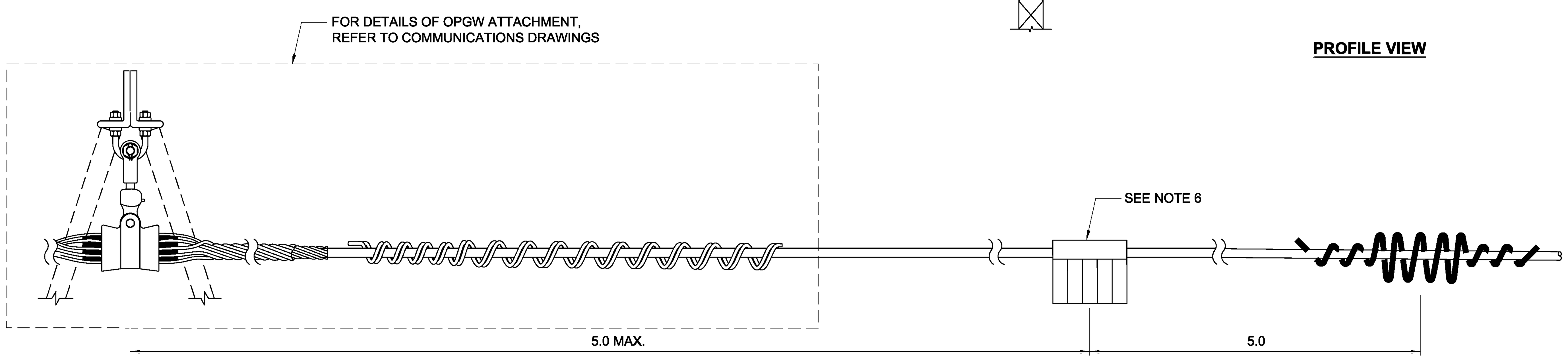
PLAN VIEW OF TRANSMISSION LINE WITH 60% SPAN COVERAGE



INSTALLATION DETAIL FOR TRANSMISSION LINE WITH ONE SKYWIRE



PROFILE VIEW



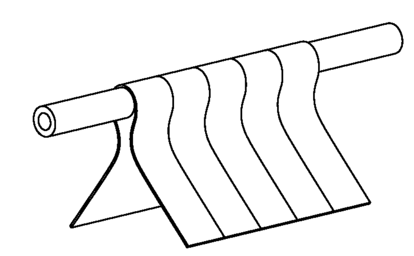
DETAIL A

BILL OF MATERIALS

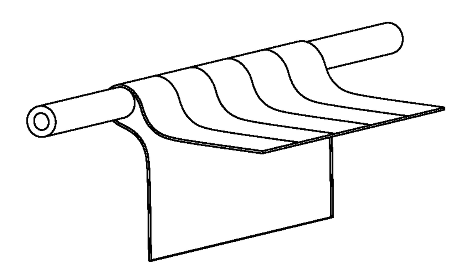
ITEM NO.	QTY.	DESCRIPTION	SUPPLIER	CAT. NO.
413	---	DIVERTER, BIRD FLIGHT FOR 0.20" - 0.56" DIAMETER WIRE	POWER LINE SENTRY	60-37-48
413A	---	DIVERTER, BIRD FLIGHT FOR 0.57" - 1.10" DIAMETER WIRE	POWER LINE SENTRY	60-37-49
414	---	LARGE DIVERTER, SPIRAL BIRD FOR 0.35" - 0.449" DIAMETER WIRE	STORES	60-37-50
414A	---	LARGE DIVERTER, SPIRAL BIRD FOR 0.45" - 0.599" DIAMETER WIRE	STORES	60-37-51
414B	---	LARGE DIVERTER, SPIRAL BIRD FOR 0.600" - 0.770" DIAMETER WIRE	STORES	60-37-52

NOTES:

1. ALL DIMENSIONS IN METRES.
2. BIRD FLIGHT DIVERTER PLACEMENT TO BE DEFINED BY REFERENCE TO REQUIRED AERIAL MARKER CONE LOCATIONS. AN AERIAL MARKER CONE IS USED IN PLACE OF A BIRD FLIGHT DIVERTER.
3. BIRD FLIGHT DIVERTER PLACEMENT AT THE ENDS OF A SPAN MAY BE OMITTED IF THEY INTERFERE WITH SUSPENSION CLAMPS, ARMOUR ROD OR VIBRATION DAMPER PLACEMENT.
4. WHERE BIRD FLIGHT DIVERTERS HAVE A DEFINITE TOP AND BOTTOM, THEY SHALL BE INSTALLED TO HANG PLUMB ON THE CONDUCTOR, AS SHOWN BELOW.



HANGING PLUMB -CORRECT



NOT HANGING PLUMB -INCORRECT

5. REFER TO REFERENCE DRAWINGS FOR AERIAL MARKER CONE SPACING AND INSTALLATION LOCATIONS.
6. SELECT CORRECT BIRD FLIGHT DIVERTER BASED ON OPGW DIAMETER, AS PER TABLE BELOW.

TOWER RANGE	OPGW PROPERTIES			CIIC		SPANS REQUIRING BIRD FLIGHT DIVERTERS
	OPGW PART No.	AFL MECHANICAL DESIGN	OPGW DIAMETER (mm / in)	LARGE SPIRAL	OTHER	
1 - 290	DNO-10700	MC-63/439	11.14 / 0.44	60-37-50	60-37-48	REFER TO SHEET 2
290 - 534 (1000)	DNO-10701	CC-13/51/486	12.35 / 0.49	60-37-51	60-37-48	
534 (1000) - 1134						
1134 - 1140	DNO-10703					
1140 - 1457 (2000)	DNO-10702	MC-63/439	11.14 / 0.44	60-37-50	60-37-48	
1457 (2000) - 2103						
2103 - 2400 (3000)	DNO-10703	CC-13/51/486	12.35 / 0.49	60-37-51	60-37-48	
2400 (3000) - 3421 (4000)						
3421 (4000) - 4271	DNO-10702	MC-63/439	11.14 / 0.44	60-37-50	60-37-48	
4271 - 4291 (5000)	DNO-10594					
4291 (5000) - 5259 (6000)						
5259 (6000) - 6241	DNO-10594	MC-63/81/630	16.00 / 0.63	60-37-52	60-37-49	
6241 - 6332 (7000)						
6332 (7000) - 7340						

LEGEND

- ● OTHER BIRD FLIGHT DIVERTER
- ◆ LARGE SPIRAL BIRD FLIGHT DIVERTER
- AERIAL MARKER

NETWORK No. 239224

REV.	DATE	DESCRIPTION	BY	CKD.	APP.
00	2017/01/31	NETWORK No. 239224. ISSUED FOR CONSTRUCTION.	M.B.	C.W.	R.N.R.

Manitoba Hydro

DRAWN: M.B.	CHECKED: C.W.	SCALE: N.T.S.
DESIGNED: R.N.R.	DATE: 2017/01/31	VOLTAGE: ±500kV

KEEWATINOHK - RIEL ± 500kV HVDC BIPOLE III

AUTHENTICATION FOR CURRENT REVISION

BIRD FLIGHT DIVERTER INSTALLATION DETAIL

DRAWING NUMBER	SHEET	REVISION
1-37080-DD-51210-0001	0001	00

ISO A1 (841 x 594)

REFERENCE DRAWINGS	
BIPOLE III WATER CROSSING DRAWINGS	1-37080-DD-10330-0001 TO 0044
COMMUNICATIONS DRAWINGS	1-85900-DD-68420-0082 TO 0099
BIPOLE III PIPELINE CROSSING DRAWINGS	1-37080-DD-10320-0001 TO 0009
PLAN AND PROFILE	1-37080-DD-10220-0001 TO 0008

REQUIRED BIRD FLIGHT DIVERTER LOCATIONS

CONSTRUCTION ZONE	SPANS FROM TWR - TWR	COVERAGE
N1	4 - 11	60% OF SPAN
	185 - 192	60% OF SPAN
	334 - 345	60% OF SPAN
	516 - 517	100% OF SPAN
	533 - 534 (534 = 1000 ON N2 CONST ZONE)	100% OF SPAN
N2	1048 - 1054	60% OF SPAN
	1062 - 1066	60% OF SPAN
	1086 - 1087	100% OF SPAN
	1102 - 1103	100% OF SPAN
	1107 - 1109	100% OF SPAN
	1118 - 1119	100% OF SPAN
	1130 - 1133	100% OF SPAN
	1169 - 1179	60% OF SPAN
	1190 - 1197	60% OF SPAN
	1197 - 1200	100% OF SPAN
	1200 - 1201	60% OF SPAN
	1394 - 1397	100% OF SPAN
N3	2160 - 2193	60% OF SPAN
	2313 - 2329	60% OF SPAN
	2332 - 2335	100% OF SPAN
	2342 - 2351	60% OF SPAN
	2361 - 2364	100% OF SPAN
	2369 - 2370	100% OF SPAN
	2380 - 2389	60% OF SPAN
N4	3112 - 3126	60% OF SPAN
	3145 - 3147	100% OF SPAN
	3214 - 3222	60% OF SPAN
	3335 - 3337	60% OF SPAN
	3340 - 3343	60% OF SPAN
	3350 - 3352	100% OF SPAN
	3362 - 3364	100% OF SPAN
	3389 - 3391	60% OF SPAN
C1	4176 - 4180	60% OF SPAN
	4184 - 4192	60% OF SPAN
	4218 - 4222	60% OF SPAN
	4236 - 4237	60% OF SPAN
C2	5123 - 5130	60% OF SPAN
	5138 - 5145	60% OF SPAN
	5171 - 5173	60% OF SPAN
	5194 - 5199	60% OF SPAN
	5202 - 5204	60% OF SPAN
	5209 - 5213	60% OF SPAN
S1	6012 - 6015	60% OF SPAN
	6036 - 6039	60% OF SPAN
	6071 - 6073	100% OF SPAN
	6156 - 6158	60% OF SPAN
	6197 - 6201	100% OF SPAN
	6235 - 6244	60% OF SPAN
	6252 - 6254	100% OF SPAN
	6281 - 6290	60% OF SPAN
	6308 - 6316	60% OF SPAN
S2	7074 - 7085	60% OF SPAN
	7135 - 7137	100% OF SPAN
	7147 - 7150	60% OF SPAN
	7185 - 7187	100% OF SPAN
	7209 - 7213	60% OF SPAN
	7337 - 7340	100% OF SPAN

NETWORK No. 239224

REV.	DATE	DESCRIPTION	BY	CKD.	APP.
00	2017/01/31	NETWORK No. 239224. ISSUED FOR CONSTRUCTION.	M.B.	C.W.	R.N.R.

Manitoba Hydro

DRAWN: M.B.	CHECKED: C.W.	SCALE: N.T.S.
DESIGNED: R.N.R.	DATE: 2017/01/31	VOLTAGE: ±500kV

KEEWATINOHK - RIEL ± 500kV HVDC BIPOLE III

AUTHENTICATION FOR CURRENT REVISION

BIRD FLIGHT DIVERTER INSTALLATION DETAIL

DRAWING NUMBER	SHEET	REVISION
1-37080-DD-51210-0001	0002	00

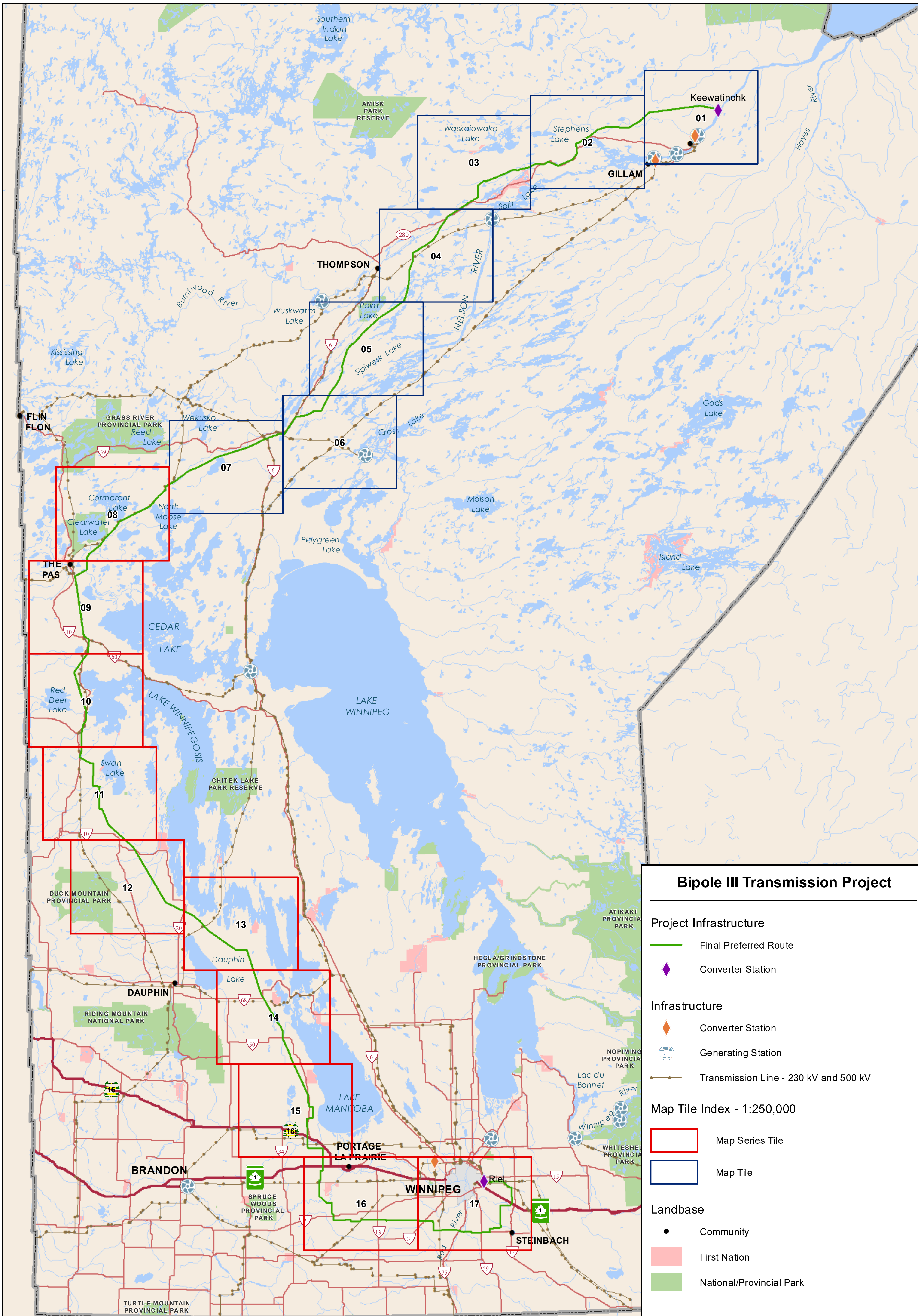
REFERENCE DRAWINGS	
BIPOLE III WATER CROSSING DRAWINGS	1-37080-DD-10330-0001 TO 0044
COMMUNICATIONS DRAWINGS	1-85900-DD-68420-0082 TO 0099
BIPOLE III PIPELINE CROSSING DRAWINGS	1-37080-DD-10320-0001 TO 0009
PLAN AND PROFILE	1-37080-DD-10220-0001 TO 0008

ISO A1 (841 x 594)

Appendix 3

Map Series

Bird Collision Sites and Average Estimated Weekly Mortality per km from 2018-2020



Manitoba Hydro

Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN
Date Created: March 6, 2021

0 25 50 Kilometres
0 25 50 Miles

N

1:2,500,000

Index of Map Series

Bird Collision Surveys 2020

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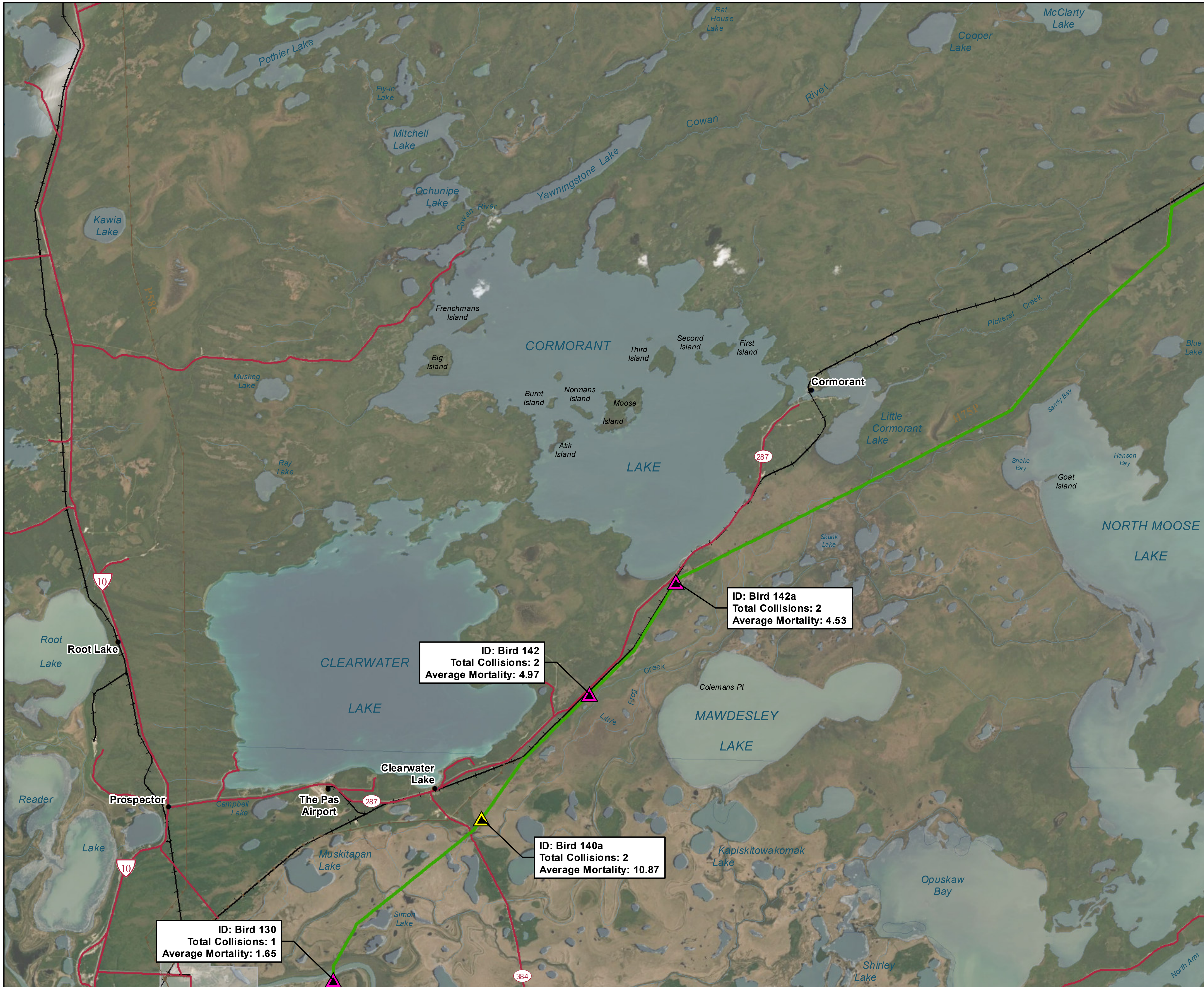


Manitoba Hydro

Bipole III Transmission Project

Project Infrastructure
- Final Preferred Route
- Converter Station Site
- AC Collector Line
- Ground Electrode Line
- Ground Electrode Site
- Construction Power (KN36)
- Construction Power Site
- Construction Camp Site

Infrastructure
- Converter Station
- Generating Station
- Transmission Line

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

Landbase
- Community
- Provincial HWY / Road
- Trans Canada HWY / Yellowhead Route
- Railway
- Abandoned Railway
- City / Town

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

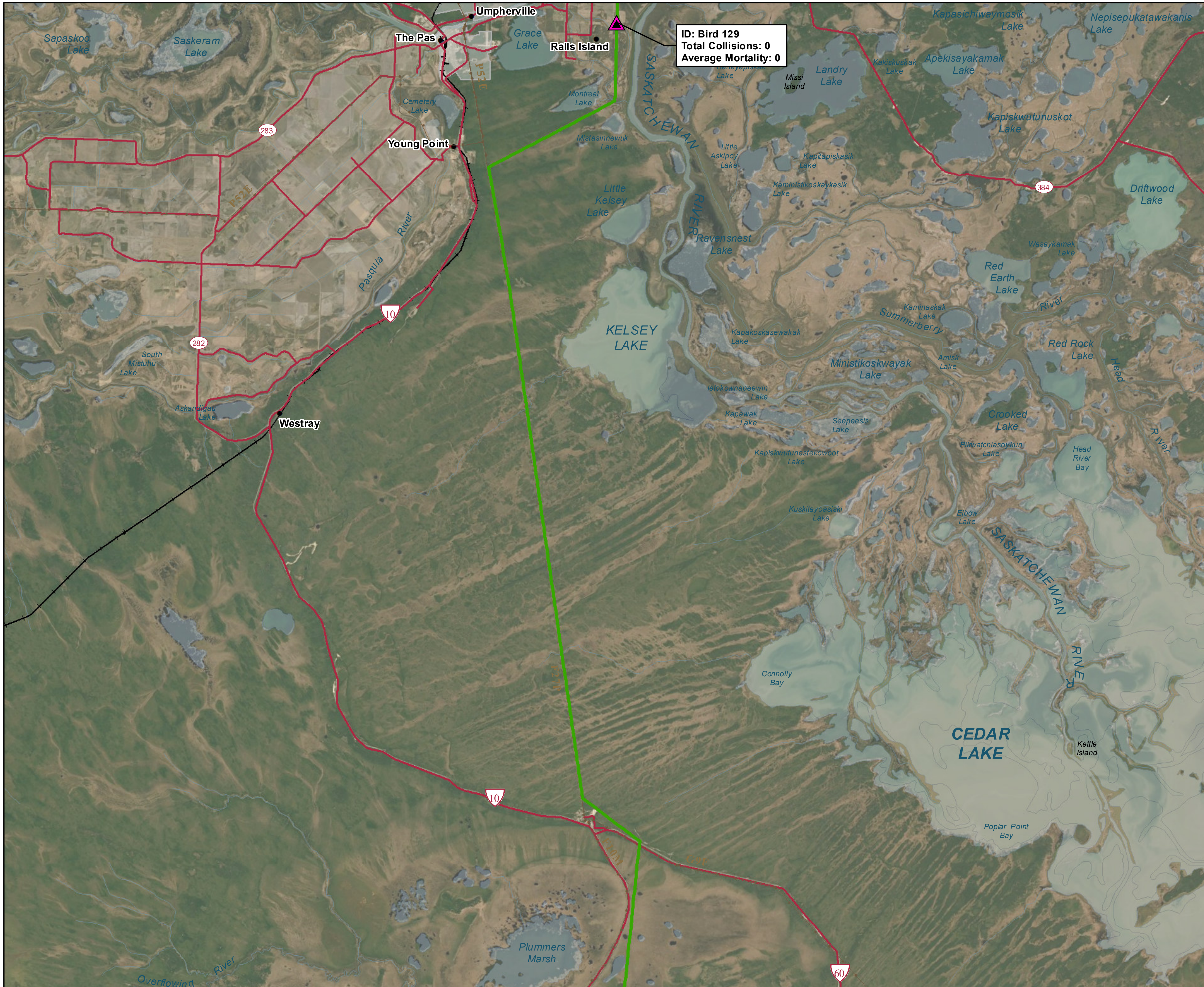
N

0 5 10 Kilometres
0 3 6 Miles
1:250,000

Bird Collision Surveys

2020

Map Series 100 - 08



Manitoba Hydro

Bipole III Transmission Project

Project Infrastructure
- Final Preferred Route
- Converter Station Site
- AC Collector Line
- Ground Electrode Line
- Ground Electrode Site
- Construction Power (KN36)
- Construction Power Site
- Construction Camp Site

Infrastructure
- Converter Station
- Generating Station
- Transmission Line

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

Landbase
- Community
- Provincial HWY / Road
- Trans Canada HWY / Yellowhead Route
- Railway
- Abandoned Railway
- City / Town

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

Date Created: March 6, 2021

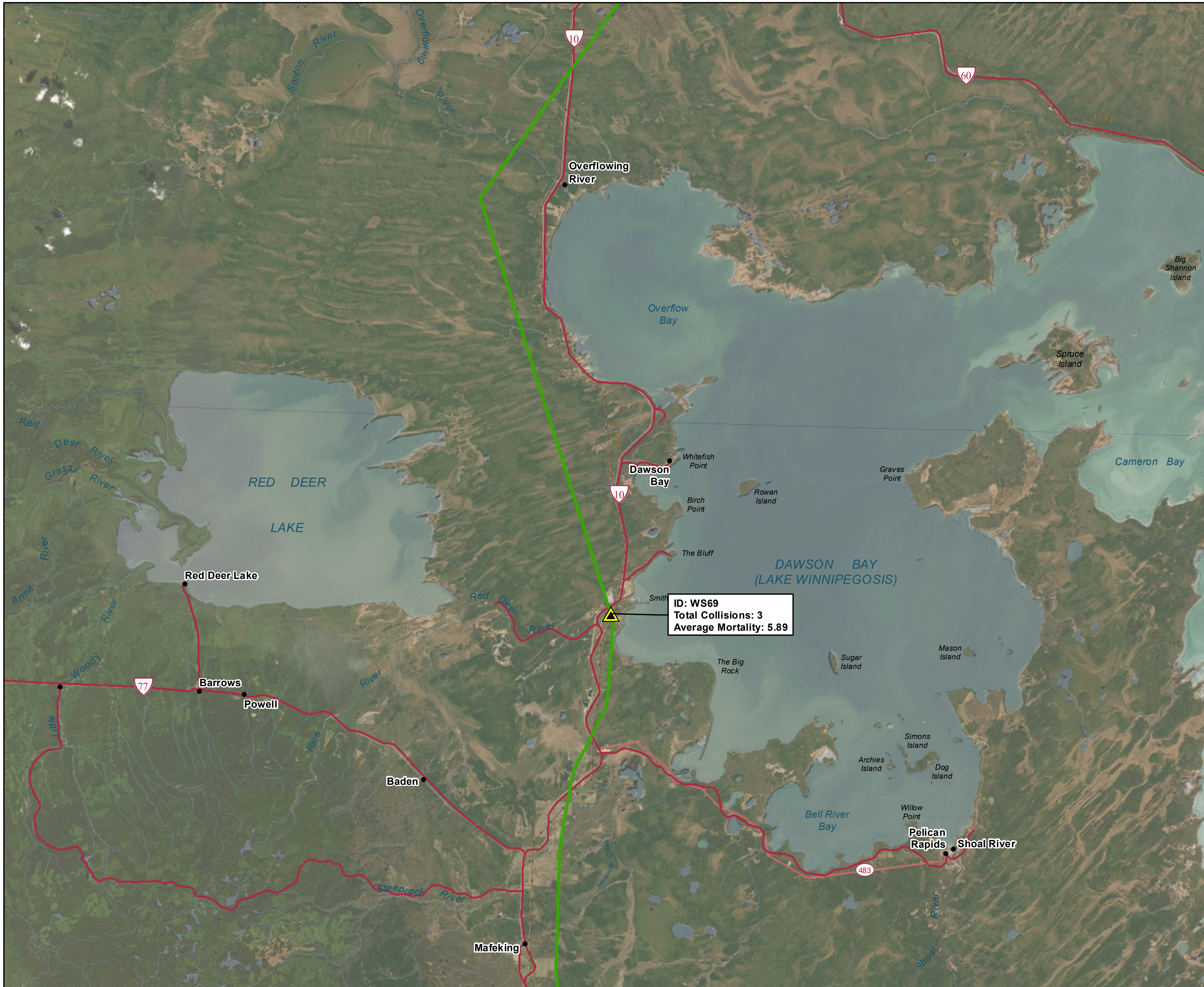
N

0 5 10 Kilometres
0 3 6 Miles
1:250,000

Bird Collision Surveys

2020

Map Series 100 - 09



Manitoba Hydro

Bipole III Transmission Project

Project Infrastructure

- Final Preferred Route
- Converter Station Site
- AC Collector Line
- Ground Electrode Line
- Ground Electrode Site
- Construction Power (KN36)
- Construction Power Site
- Construction Camp Site

Infrastructure

- Converter Station
- Generating Station
- Transmission Line

Bird Collision Survey Location

- Bird Diverter - Absent
- Bird Diverter - Present

Landbase

- Community
- Provincial HWY / Road
- Trans Canada HWY / Yellowhead Route
- Railway
- Abandoned Railway
- City / Town

Coordinate System: UTM Zone 14N NAD83
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Date Created: March 6, 2021

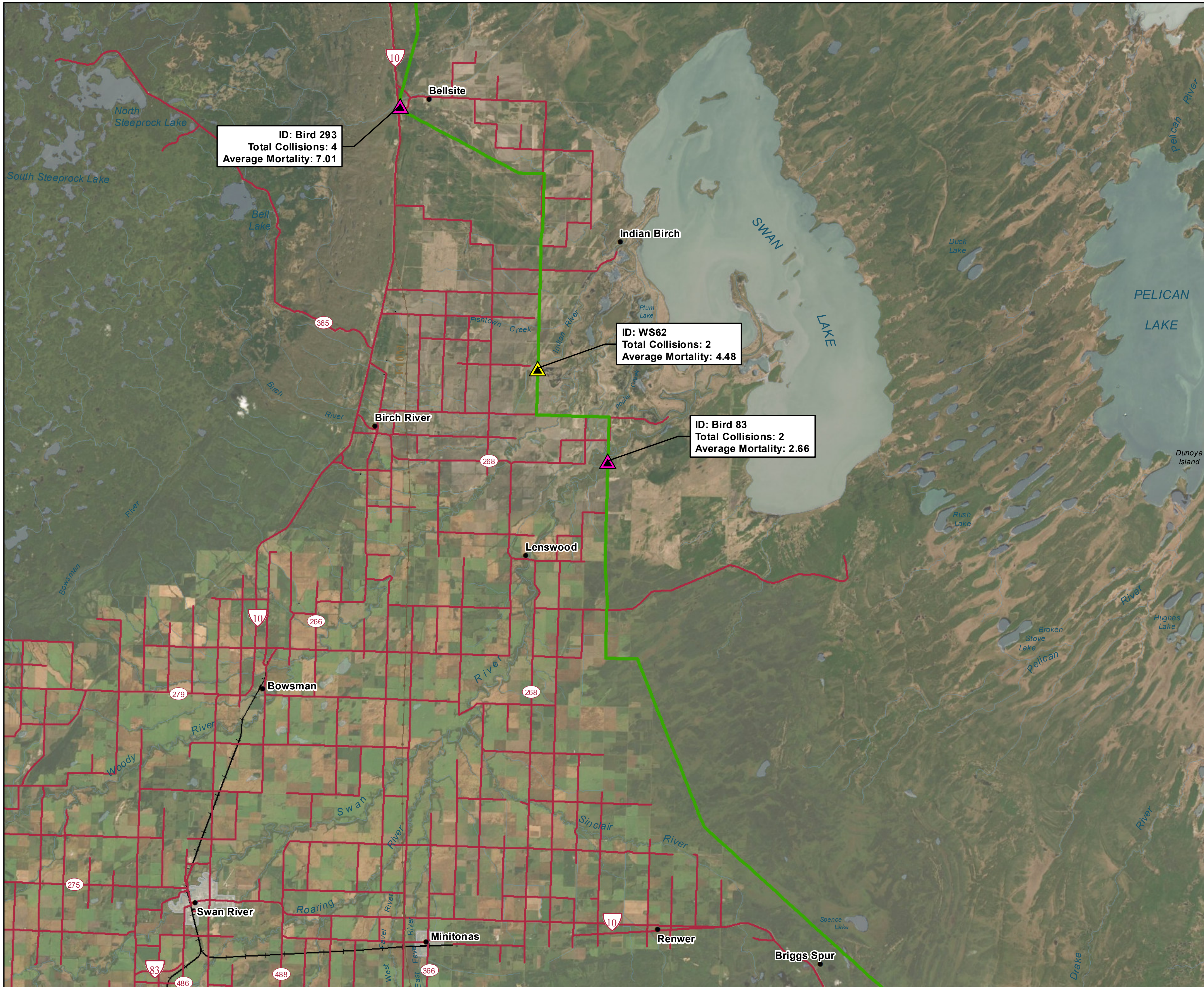
N

0 5 10 Kilometres
0 3 6 Miles
1:250,000

Bird Collision Surveys

2020

Map Series 100 - 10



Manitoba Hydro

Bipole III Transmission Project

Project Infrastructure

- Final Preferred Route
- Converter Station Site
- AC Collector Line
- Ground Electrode Line
- Ground Electrode Site
- Construction Power (KN36)
- Construction Power Site
- Construction Camp Site

Infrastructure

- Converter Station
- Generating Station
- Transmission Line

Bird Collision Survey Location

- Bird Diverter - Absent
- Bird Diverter - Present

Landbase

- Community
- Provincial HWY / Road
- Trans Canada HWY / Yellowhead Route
- Railway
- Abandoned Railway
- City / Town

Coordinate System: UTM Zone 14N NAD83
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Date Created: March 6, 2021

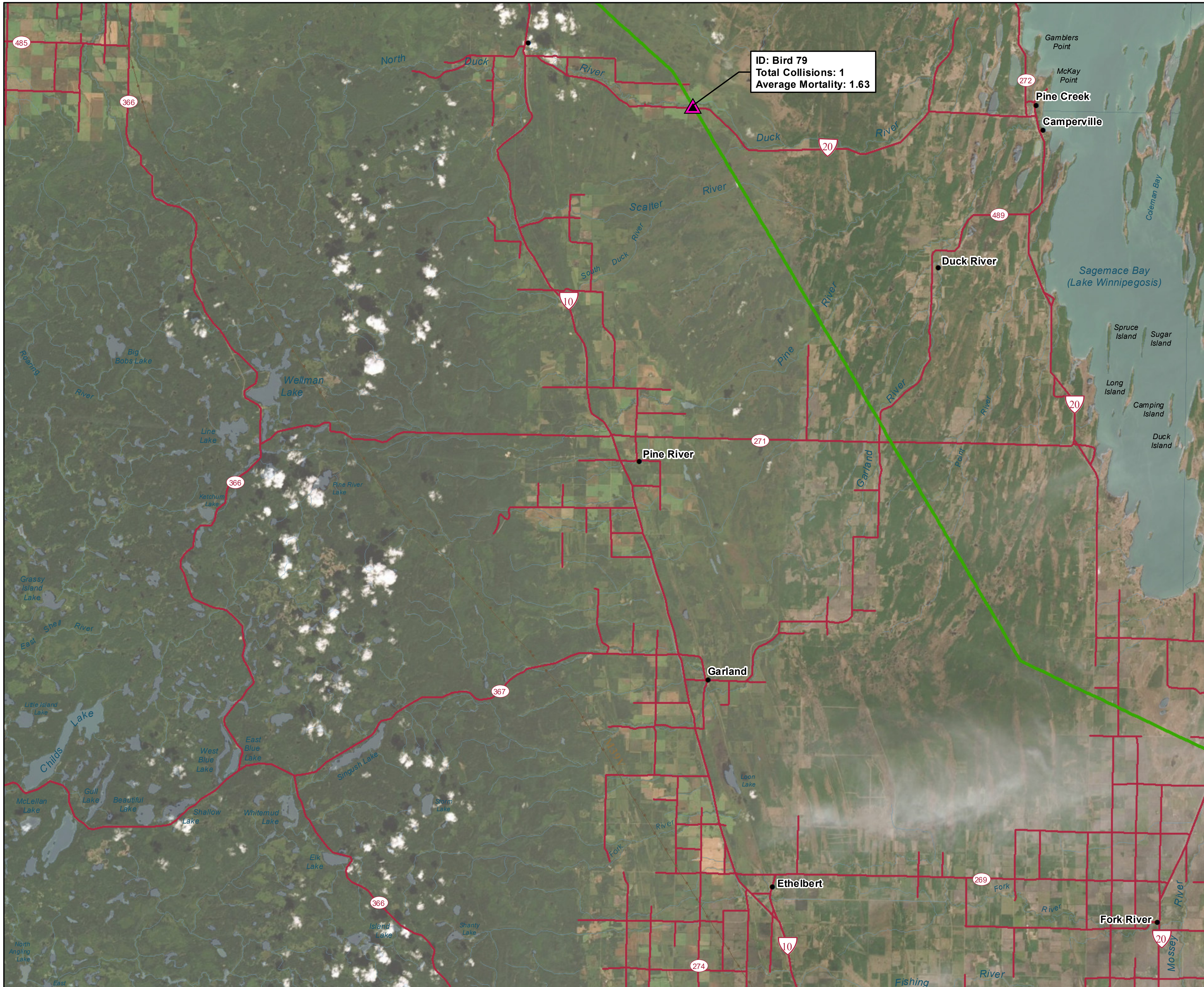
N

0 5 10 Kilometres
0 3 6 Miles
1:250,000

Bird Collision Surveys

2020

Map Series 100 - 11



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Manitoba Hydro

Bipole III Transmission Project

Project Infrastructure
- Final Preferred Route
- Converter Station Site
- AC Collector Line
- Ground Electrode Line
- Ground Electrode Site
- Construction Power (KN36)
- Construction Power Site
- Construction Camp Site

Infrastructure
- Converter Station
- Generating Station
- Transmission Line

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

Landbase
- Community
- Provincial HWY / Road
- Trans Canada HWY / Yellowhead Route
- Railway
- Abandoned Railway
- City / Town

Coordinate System: UTM Zone 14N NAD83
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Date Created: March 6, 2021

N

0 5 10 Kilometres
0 3 6 Miles
1:250,000

Bird Collision Surveys

2020

Map Series 100 - 12

Manitoba Hydro

Bipole III Transmission Project

Project Infrastructure

- Final Preferred Route
- Converter Station Site
- AC Collector Line
- Ground Electrode Line
- Ground Electrode Site
- Construction Power (KN36)
- Construction Power Site
- Construction Camp Site

Infrastructure

- Converter Station
- Generating Station
- Transmission Line

Bird Collision Survey Location

- Bird Diverter - Absent
- Bird Diverter - Present

Landbase

- Community
- Provincial HWY / Road
- Trans Canada HWY / Yellowhead Route
- Railway
- Abandoned Railway
- City / Town

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

Date Created: March 6, 2021

N

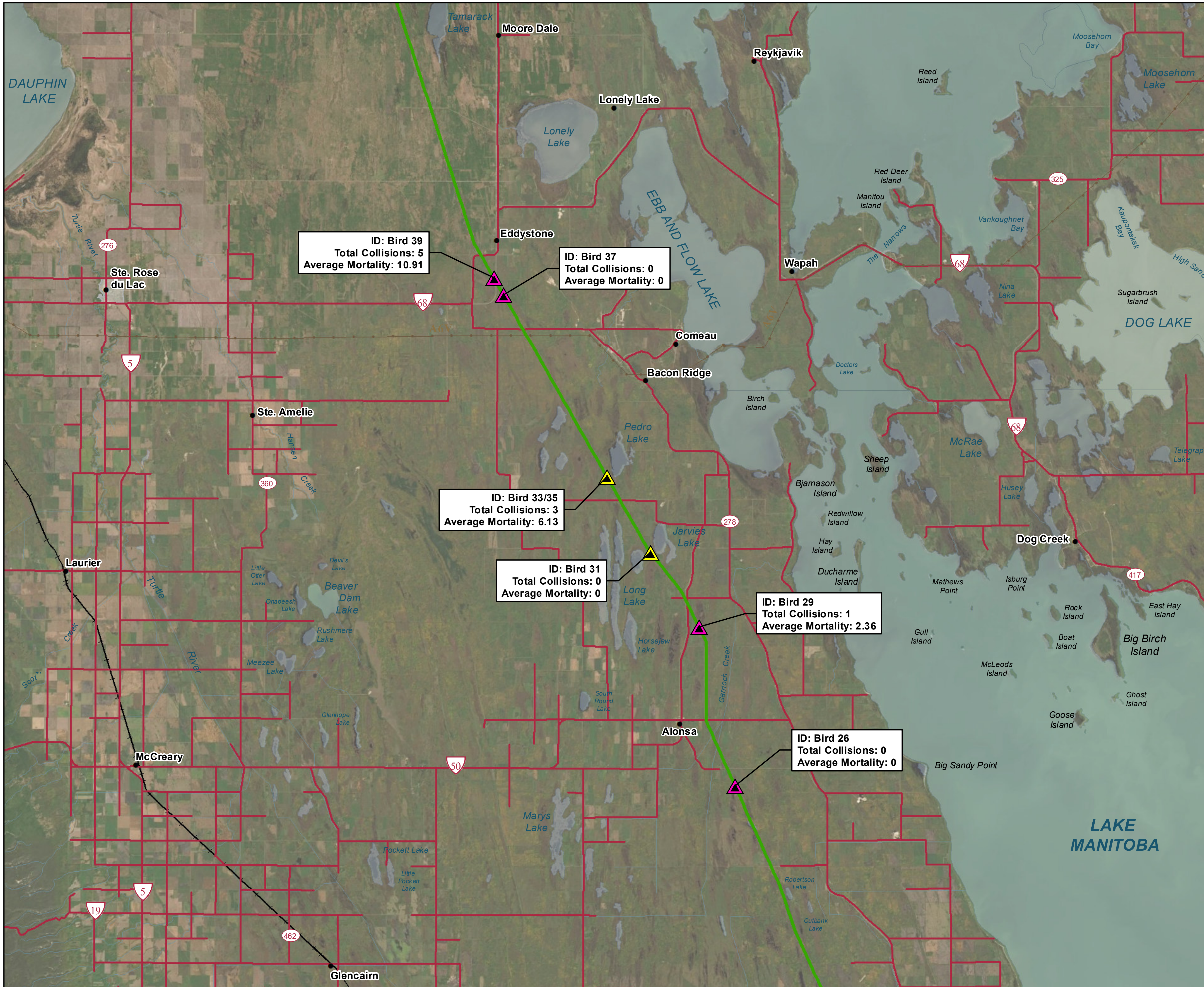
0 5 10 Kilometres
0 3 6 Miles
1:250,000

Bird Collision Surveys

2020

Map Series 100 - 13

File Location: I:\CLIENTS\MANITOBA_HYDRO\19115102\MappingProducts\Wildlife\WRCS\MarkBaschuk\20210401\BPIII_TECHREP_MapSeries100_BirdCollisionSurvey_250k_B_20210406_PAGES.mxd



Manitoba Hydro

Bipole III Transmission Project

Project Infrastructure

- Final Preferred Route
- Converter Station Site
- AC Collector Line
- Ground Electrode Line
- Ground Electrode Site
- Construction Power (KN36)
- Construction Power Site
- Construction Camp Site

Infrastructure

- Converter Station
- Generating Station
- Transmission Line

Bird Collision Survey Location

- Bird Diverter - Absent
- Bird Diverter - Present

Landbase

- Community
- Provincial HWY / Road
- Trans Canada HWY / Yellowhead Route
- Railway
- Abandoned Railway
- City / Town

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Date Created: March 6, 2021

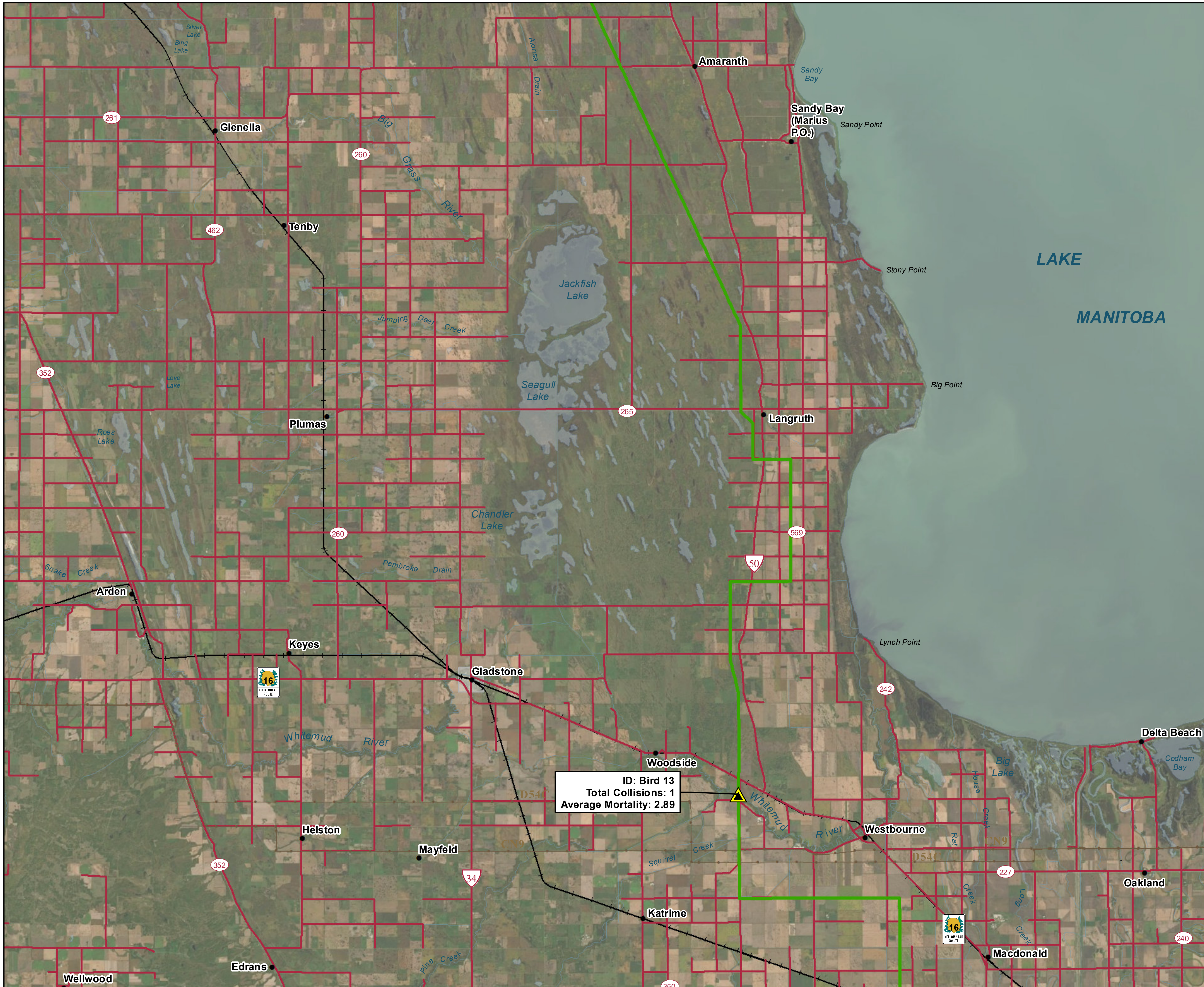
N

0 5 10 Kilometres
0 3 6 Miles
1:250,000

Bird Collision Surveys

2020

Map Series 100 - 14



Manitoba Hydro

Bipole III Transmission Project

Project Infrastructure

- Final Preferred Route
- Converter Station Site
- AC Collector Line
- Ground Electrode Line
- Ground Electrode Site
- Construction Power (KN36)
- Construction Power Site
- Construction Camp Site

Infrastructure

- Converter Station
- Generating Station
- Transmission Line

Bird Collision Survey Location

- Bird Diverter - Absent
- Bird Diverter - Present

Landbase

- Community
- Provincial HWY / Road
- Trans Canada HWY / Yellowhead Route
- Railway
- Abandoned Railway
- City / Town

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Date Created: March 6, 2021

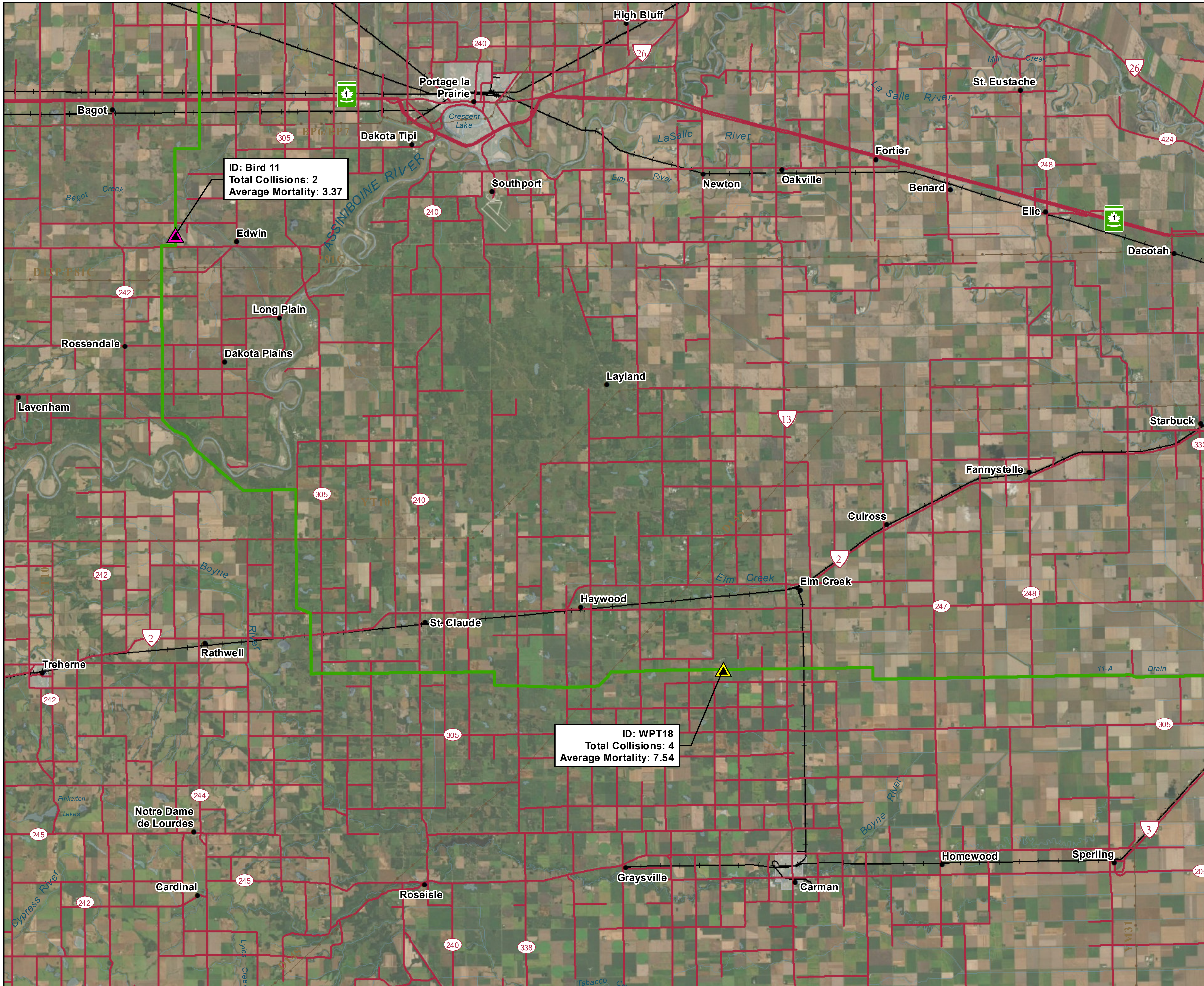
N

0 5 10 Kilometres
0 3 6 Miles
1:250,000

Bird Collision Surveys

2020

Map Series 100 - 15



Manitoba Hydro

Bipole III Transmission Project

Project Infrastructure

- Final Preferred Route
- Converter Station Site
- AC Collector Line
- Ground Electrode Line
- Ground Electrode Site
- Construction Power (KN36)
- Construction Power Site
- Construction Camp Site

Infrastructure

- Converter Station
- Generating Station
- Transmission Line

Bird Collision Survey Location

- Bird Diverter - Absent
- Bird Diverter - Present

Landbase

- Community
- Provincial HWY / Road
- Trans Canada HWY / Yellowhead Route
- Railway
- Abandoned Railway
- City / Town

Coordinate System: UTM Zone 14N NAD83
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Date Created: March 6, 2021

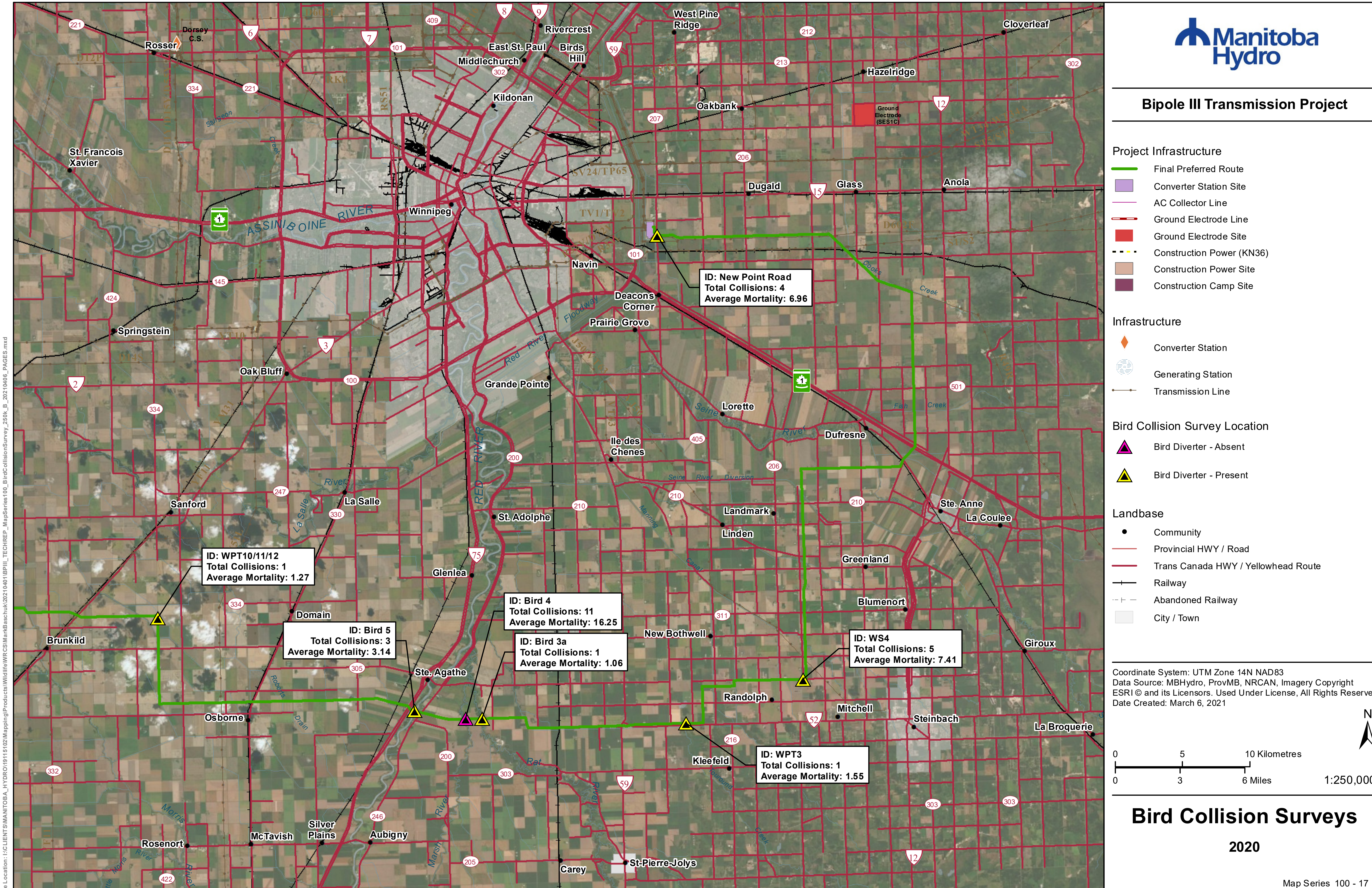
N

0 5 10 Kilometres
0 3 6 Miles
1:250,000

Bird Collision Surveys

2020

Map Series 100 - 16


Manitoba Hydro
Bipole III Transmission Project
Project Infrastructure
Final Preferred Route
Converter Station Site
AC Collector Line
Ground Electrode Line
Ground Electrode Site
Construction Power (KN36)
Construction Power Site
Construction Camp Site
Infrastructure
Converter Station
Generating Station
Transmission Line
Bird Collision Survey Location
Bird Diverter - Absent
Bird Diverter - Present
Landbase
Community
Provincial HWY / Road
Trans Canada HWY / Yellowhead Route
Railway
Abandoned Railway
City / Town
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN, Imagery Copyright
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Date Created: March 6, 2021
N
0 5 10 Kilometres
0 3 6 Miles
1:250,000
Bird Collision Surveys
2020
Map Series 100 - 17
ID: New Point Road
Total Collisions: 4
Average Mortality: 6.96
ID: WPT10/11/12
Total Collisions: 1
Average Mortality: 1.27
ID: Bird 4
Total Collisions: 11
Average Mortality: 16.25
ID: Bird 5
Total Collisions: 3
Average Mortality: 3.14
ID: Bird 3a
Total Collisions: 1
Average Mortality: 1.06
ID: WS4
Total Collisions: 5
Average Mortality: 7.41
ID: WPT3
Total Collisions: 1
Average Mortality: 1.55
Rosser
Dorsey C.S.
Rivercrest
East St. Paul
Middlechurch
Birds Hill
West Pine Ridge
Cloverleaf
Hazelridge
Oakbank
Kildonan
Ground Electrode (SES1C)
St. Francois Xavier
Winnipeg
ASSINIBOINE RIVER
Dugald
Glass
Anola
Navin
Deacons Corner
Prairie Grove
Springstein
Oak Bluff
Grande Pointe
Lorette
Dufresne
Ile des Chenes
Sanford
La Salle
St. Adolphe
Landmark
Linden
Ste. Anne
La Coulee
Greenland
Glenlea
Blumenort
Domain
Brunkild
New Bothwell
Giroux
Ste. Agathe
Randolph
Mitchell
Steinbach
La Broquerie
Osborne
Kleefeld
Silver Plains
Aubigny
McTavish
Rosenort
Carey
St-Pierre-Jolys
RED RIVER
Red River Floodway
Seine River
Seine River Diversion
Cooks Creek
Fish Creek
Morris River
Rat River
Marsh River
Roberts Drain

Appendix 4
Photos

Photo 1. Observers Conducting a Bird-wire Collison Survey, May 2020

Photo 2. Chipping Sparrow Carcass, May 2020

Photo 3. Collision Evidence from a Mallard Mortality, May 2020

Photo 4. Common Raven Partial Carcass, May 2020