Appendix V4-9D

Hope Bay Project Phase 2:
Migratory Standwatch Surveys Report, 2017

TMAC RESOURCES

Hope Bay Project Phase 2
Migratory Standwatch Surveys
Report

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17V0201
November 2017

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Down to Earth Biology

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1 INTRODUCTION

The Hope Bay Project is located southwest of Cambridge Bay, on the southern shore of Melville Sound in the Kitikmeot region of Nunavut. Phase 2 of the Hope Bay Project is an expansion of the currently operating Doris Project, and continues the development of the Hope Bay Belt, focusing on mining of the Madrid North, Madrid South and Boston deposits. Phase 2 infrastructure includes the installation and operation of wind turbines to provide an alternate power source to the Project. There are two turbines currently proposed for each of the Doris, Madrid and Boston Project areas, for a total of six wind turbines.

This report was prepared as supporting information for the Final Environmental Impact Statement (FEIS) for Phase 2 of the Hope Bay Project. The information was collected specifically for the consideration of impacts on migratory birds in flight from the installation and operation of proposed wind turbines on site.

1.1 BIRDS IN THE HOPE BAY PROJECT AREA

There are ninety-one bird species recorded as migrating through the mainland region of Nunavut, which consists of the area of Nunavut found on the mainland coast (Richards et al. 2002). The majority of bird species migrate south in the fall and return in the spring to breed; however, some species are known to overwinter, including gyrfalcon, snowy owl, common raven and rock ptarmigan.

An overview of birds expected in the study area, including their conservation status, is provided in the Draft Environmental Impact Statement prepared for Phase 2 of the Hope Bay Project (ERM 2016). This report focuses on enhancing the baseline information for potential bird interaction with the wind turbine component of the Phase 2 Proposal. For the purposes of this report, to align with the Phase 2 FEIS, information is summarized by Raptors, Upland Birds, and Waterbirds.

Raptors — Raptors species known to occur in the Kitikmeot region of Nunavut, and expected in the Project area, include: gyrfalcon, peregrine falcon, rough-legged hawk, bald eagle, golden eagle, northern harrier, short-eared owl and snowy owl. Cliff-nesting migratory raptor species typically arrive on the tundra by May, with young typically fledging from mid-July through the end of August (Poole and Bromley 1988).

Upland Breeding Birds — Upland birds are defined as migratory birds that primarily forage and nest in upland areas (i.e., not waterbirds), with the Arctic upland bird community comprised of songbirds, shorebirds, and jaegers. Rock ptarmigan, although not migratory, is also considered an upland bird species for the purposes of this Project due to its importance as a food source to Inuit communities (ERM 2017).

Waterbirds — Waterbirds are defined as birds that primarily forage and / or nest within freshwater waterbodies. Six species of ducks, five species of loons, five species of geese and two species of swans are expected in the Project area.

2 METHODS

Bird migration surveys were completed in the Project area to establish the use of the area by diurnal migrants, including their altitude flying over the Project area in relation to proposed turbine height, and were conducted according to methods outlined in Environment Canada's *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (Environment Canada 2007). Due to weather constraints resulting in safety concerns and access issues, the number of surveys completed was less than the ten days recommended in the protocols. Six days of surveys, totaling 36 hours, were conducted across two sites in spring 2017 in the Doris Project area. The proposed wind turbines in the Boston deposit part of the Project area was incorporated into the Phase 2 assessment after the spring surveys, and the study area was expanded in fall 2017 to include a site in this area. Six days of surveys, totaling 34.5 hours, were conducted across the two sites, one in each of the areas. These two locations provide the northern and southern extents of the migration observations in the Project area and are expected to be indicative of activity in the vicinity of the Madrid proposed turbine locations along this linear corridor.

Standwatch locations were selected to provide the best views of the proposed locations for the proposed turbines, and to provide the clearest available views of the horizon from which migrating birds were expected to appear. Figure 1 and Figure 2 show the locations of the raptor migration survey sites in relation to the Project area. Visibility and sampling limitations are discussed below. Photographs from the survey locations are provided in Appendix A.

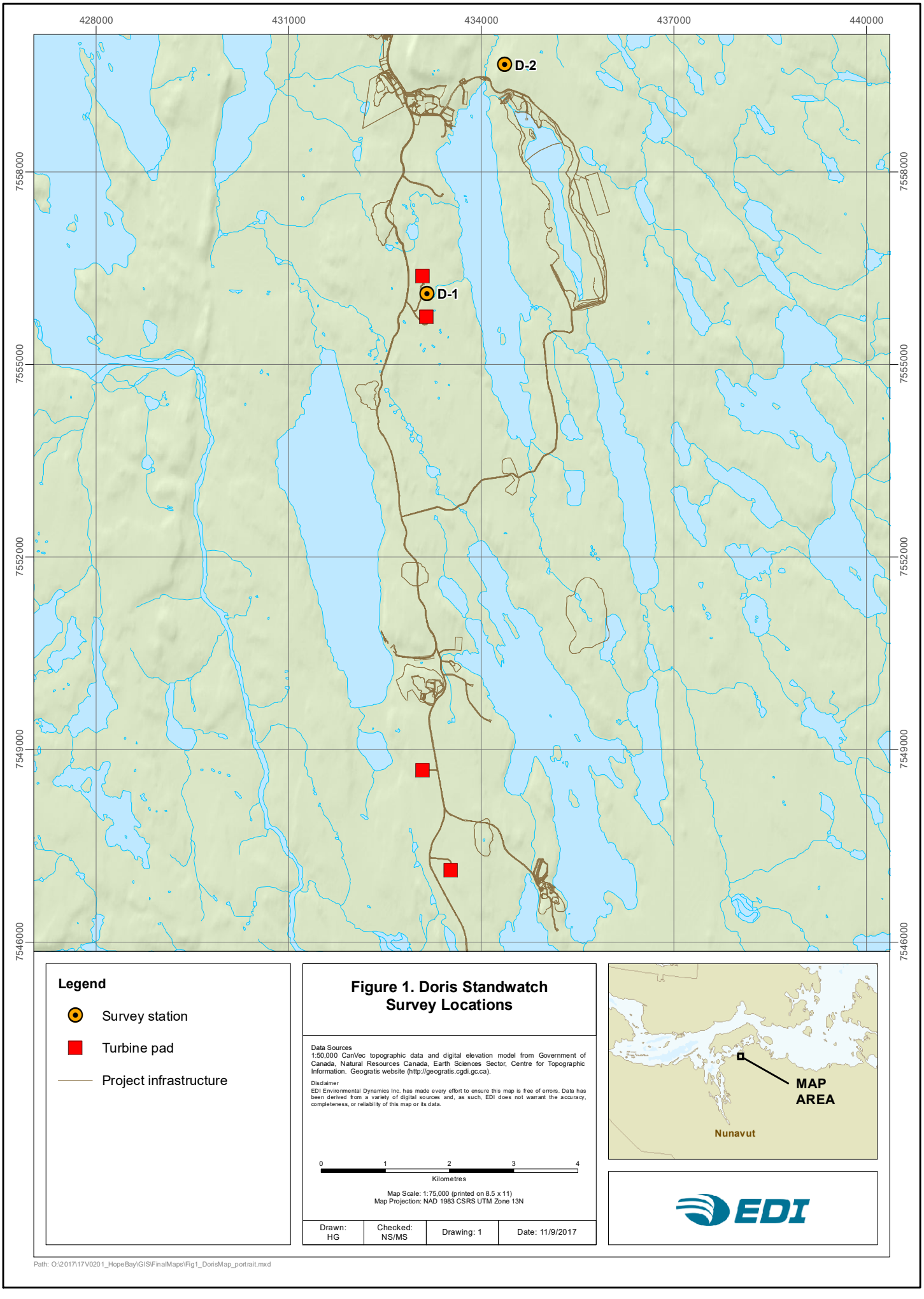
Survey timing was selected to capture bird migration through the Project area based on Environment and Climate Change Canada's regional nesting period of migratory birds in the Arctic Plains and Mountains Region, with the 61–100% initiating breeding by June 5, and concluding breeding by mid-August (ECCC 2017). Surveys were also estimated to try and capture overlapping periods of migration for all three species groups. Based on on-site observations, cliff-nesting migratory raptors arriving in May, and leaving in October, the majority of upland breeding birds arriving in late May and departing by mid-September to October, and migratory waterbirds arriving from early to late May and departing in late August and throughout September (ERM 2016).

Surveys were intended to run in six hour continuous segments, starting at 09:00; however, as visibility became limited due to thick fog moving in, some surveys in spring had to be suspended for 1 to 1.5 hours while surveyors waited for the weather to clear. In fall, one survey started late due to fog, another was called off early due to rain and fog, and another was suspended for 2.75 hours for a crew change. A summary of survey effort is provided in Table 1.

Observations were made by a two-person crew, consisting of one trained observer (R.P.Bio.) and a field assistant, who scanned the sky with unassisted vision and the aid of binoculars. A 20x60 power spotting scope was used to confirm identification of distant birds and on occasion additional birds were detected using the spotting scope. Distance and height estimates were based on observer experience and physical references on the surrounding landscape.

Data recorded in the field included:

- Survey site label, standwatch location (UTM's), elevation (metres);
- Start and end times, the name of the observers;
- Weather conditions (cloud cover, wind in Beaufort scale, wind direction, cloud movement direction, ceiling height, visibility, precipitation, and temperature) at the beginning of each hour, or more often when changes in weather took place;
- Species name, behaviour, the time of the initial sighting and numbers observed;
- Bird distance and direction from the observer, the direction the bird was traveling, and the height above or below observer; and
- Notes on sex, age, race, color morph, etc., and general observations with respect to proposed turbine locations.
- Care was taken not to double-count individuals. Birds which appeared to be using the area for reasons other than migration (i.e., birds foraging, birds moving from perch to perch, birds tending nests or young, etc.) were noted.
- All birds observed were classed as being in one of two categories ("yes" or "no") based upon their estimated flight heights relative to proposed wind turbines rotor heights to assess potential conflict. The classification "within turbine airspace" is an estimate that assumes that the bird was flying at less than the maximum blade height (below 200 m) and above the minimum blade height (50 m), the rotor swept area. There are a number of factors that could bias results including weather conditions, observer bias, and collection methods (Madders and Whitfield 2006). Due to the potential surveyor margin of error in estimating heights, rapid height changes by the birds and the difficulty tracking raptors at lower heights, a ceiling of 200 m was used for this classification — a conservative approach as the actual maximum height of the blades is approximately 160 m.
- Due to the Project area being primarily barren tundra and general flat topography, the survey sites had excellent views from a prominent location in all directions; no limitations in view were encountered. Site photographs are provided in Appendix A.



Legend

- Survey station
- Turbine pad
- Project infrastructure

Figure 1. Doris Standwatch Survey Locations

Data Sources
1:50,000 CanVec topographic data and digital elevation model from Government of Canada, Natural Resources Canada, Earth Sciences Sector, Centre for Topographic Information. Geogratis website (http://geogratis.cgdi.gc.ca).

Disclaimer
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

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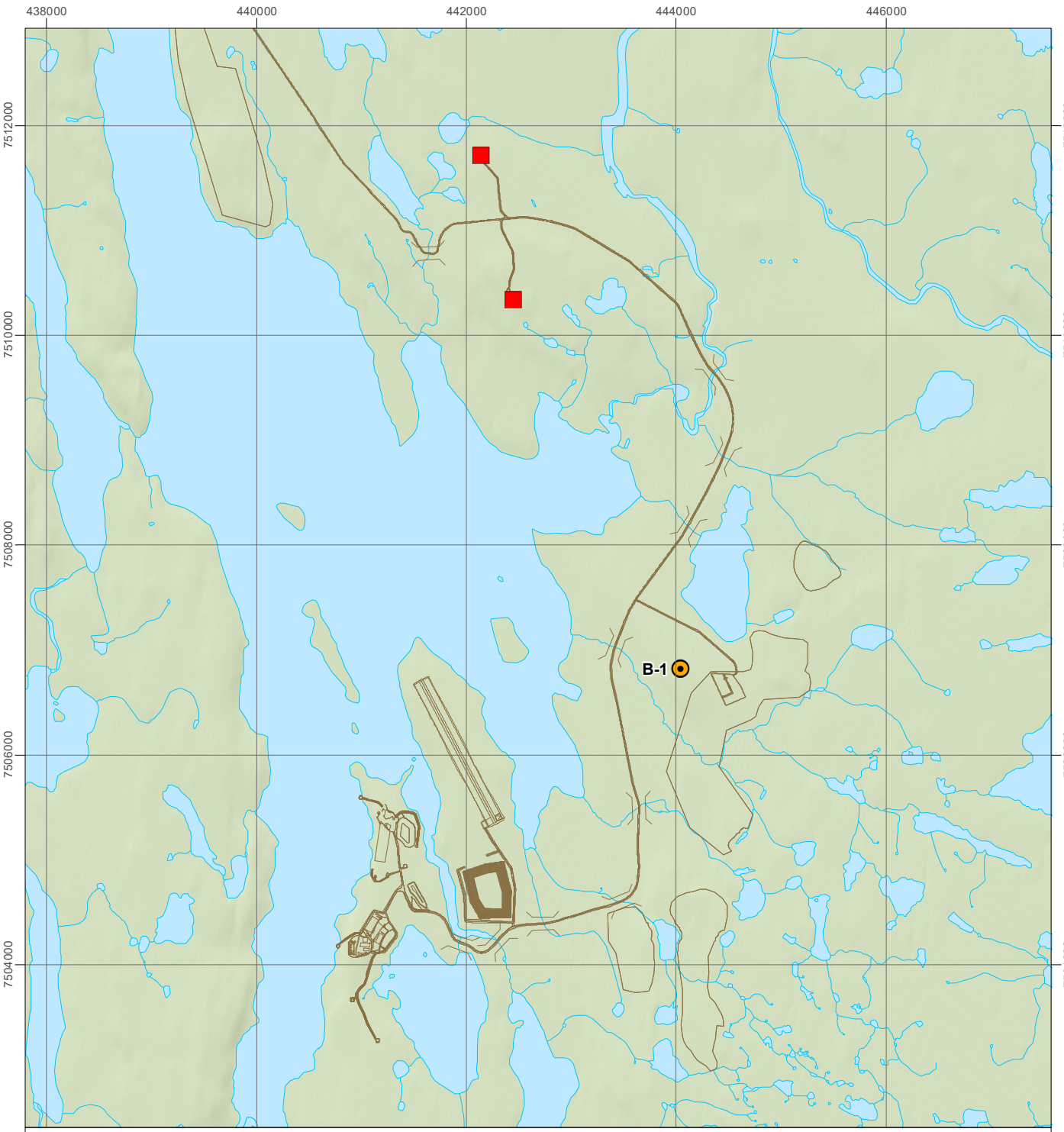

Legend

- Survey station
- Turbine pad
- Project infrastructure

Figure 2. Boston Standwatch Survey Locations

Data Sources
1:50,000 CanVec topographic data and digital elevation model from Government of Canada, Natural Resources Canada, Earth Sciences Sector, Centre for Topographic Information. Geogratis website (http://geogratis.cgdi.gc.ca).

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2.1 SITE DESCRIPTION

Two sites were selected in the Doris deposit part of the Project area for spring migratory standwatch surveys (Table 1). Site D-1 is situated between the two proposed turbines, and gave excellent views for both proposed locations. Site D-2 is located north of the two proposed turbines and also gave good views of the Project area (in optimal weather, visibility was unlimited).

For the fall migratory standwatch surveys, a site was selected in the Boston deposit part of the Project area, site B-1. Site D-1 in the Doris area was selected again for use in the fall surveys.

Table 1. Migration survey locations and effort summary.

Season	Survey Dates	Project Area	Survey Station	Zone	Easting	Northing	No. of Surveys	Effort (hrs)
Spring	May 31; Jun 1, 3 & 5	Doris	D-1	13W	433146	7556111	4	24
Spring	Jun 2 & 4	Doris	D-2	13W	434323	7559677	2	12
Fall	Sep 2, 3 & 4	Boston	B-1	13W	444038	7506823	3	16.5
Fall	Sep 5, 6 & 7	Doris	D-1	13W	433147	7556113	3	18

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3 SURVEY RESULTS

3.1 SPRING

A total of 22 bird species and 1,770 individuals were recorded during spring migration surveys across two sites in the Doris deposit part of the Project area. Spring surveys were completed between May 30 and June 5, 2017.

3.1.1 RAPTORS

Five species of raptors, comprised of 33 individuals, were observed during spring migration surveys. Rough-legged hawk was the most commonly observed species at Site D-1, and short-eared owl was only observed at Site D-2.

A summary of raptor position relative to the proposed turbine airspace is presented in Table 2. Birds were flying relatively low (i.e., 100 m or less), especially in heavy winds (e.g., 25 km/h). Very few birds were traveling above turbine height. Thirty-six percent of all raptors observed were recorded flying at altitudes within turbine airspace.

Site D-1 seemed to have less focused activity (e.g., perching and foraging) and appeared to be a better location from which to observe migrating raptors than the Site D-2. However, though the data may not accurately depict this, the location of Site D-2, on a ridge by a river valley, seemed to have more bird activity and use as a corridor.

Several of the raptors observed were identified as resident birds based on behavior. Several individuals were noted as foraging / hunting and circling overhead. In additional, courtship displays were observed for rough-legged hawk in the vicinity of Site D-1.

Table 2. Number of raptors detected during spring migration surveys relative to number in turbine airspace.

Species	No. of Observations			No. in Turbine Airspace	% in Turbine Airspace
	Site D-1	Site D-2	Total		
Peregrine Falcon	1	1	2	0	0%
Rough-legged Hawk	10	2	12	6	50%
Golden Eagle	4	3	7	6	86%
Common Raven	8	3	11	0	0%
Short-eared Owl	0	1	1	0	0%
Total No. obs	**23**	**10**	**33**	12	36%
Total effort hours	**24**	**12**	**36**	-	-
Passage rates (obs/hr)	**0.96**	**0.83**	**0.92**	-	-

3.1.2 UPLAND BREEDING BIRDS

Six species of upland birds, comprised of 29 individuals, were observed during spring migration surveys. Rock ptarmigan was the most commonly observed species. Three species were only observed at Site D-2: Pomarine jaegar, horned lark, and hoary redpoll. American pipit was only observed at Site D-1. A summary of upland bird position relative to the proposed turbine airspace is presented in Table 3. Birds were flying relatively low (i.e., 20 m or less), especially in heavy winds (e.g., 25 km/hr). Very few birds were traveling above turbine height. Less than one percent of all upland birds observed, consisting of two individuals, was recorded passing through turbine airspace. Most of the rock ptarmigan observed were perched either on the rock bluff or on the ground in the river valley. The single American pipit was observed preforming its breeding display.

Table 3. Number of upland birds detected during spring migration surveys relative to number in turbine airspace.

Species	No. of Observations			No. in Turbine Airspace	% in Turbine Airspace
	Site D-1	Site D-2	Total		
Baird's Sandpiper	1	2	3	2	67%
Pomarine Jaegar	0	4	4	0	0%
Horned Lark	0	1	1	0	0%
American Pipit	3	0	3	0	0%
Hoary Redpoll	0	2	2	0	0%
Rock Ptarmigan	12	4	16	0	0%
Unknown shorebird	2	0	2	0	0%
Total No. obs	**16**	**13**	**31**	2	0.06%
Total effort hours	**24**	**12**	**36**	-	-
Passage rates (obs/hr)	**0.67**	**1.08**	**0.81**	-	-

3.1.3 WATERBIRDS

Eleven species of waterbirds, comprised of approximately 1,700 individuals, were observed during spring migration surveys. Canada goose was the most commonly observed species. A summary of waterbirds' position relative to the proposed turbine airspace is presented in Table 4. Eighty-three percent of all waterbirds observed were recorded flying at altitudes within turbine airspace. One hundred percent of individuals observed for three different species were observed flying through turbine airspace: brant, snow goose, and pacific loon. Eighty-five percent of Canada geese observed, comprised of 1,340 individuals, were recorded as flying through turbine airspace. Site D-2 is situated on a ridge by a river valley and the river outflow of the lake melts early and had several waterfowl using it (observed incidentally).

Table 4. Number of waterbirds detected during spring migration surveys relative to number in turbine airspace.

Species	No. of Observations			No. in Turbine Airspace	% in Turbine Airspace
	Site D-1	Site D-2	Total		
Brant	0	3	3	3	100%
Canada Goose	988	588	1576	1340	85%
Sandhill Crane	2	14	16	7	44%
Snow Goose	4	0	4	4	100%
Tundra Swan	3	3	6	0	0%
Northern Pintail	11	9	20	4	20%
Long-tailed Duck	6	12	18	12	67%
Glaucous Gull	6	5	11	5	45%
Herring Gull	33	6	39	12	31%
Pacific Loon	3	2	5	5	100%
Red-throated Loon	1	0	1	0	0%
Unknown goose sp.	0	11	11	11	100%
Total No. obs	**1057**	**642**	**1699**	1403	83%
Total effort hours	**24**	**12**	**36**	-	-
Passage rates (obs/hr)	**44.0**	**53.5**	**47.2**	-	-

3.1.4 SPRING MIGRATORY PATTERNS

Birds in spring are expected to migrate in a northerly direction from wintering grounds to breeding areas. Of the bird detections where flight direction was known or recorded (perched or hunting birds were not assigned a direction of travel), 74% (n=1268 of 1719) were moving in the expected direction between Northwest to Northeast from the south.

In general, migration appeared to be broad-front, with birds arriving from all southerly directions and heading north. While there was no evidence of topographic features funneling birds to the Project area, it is possible river corridors may have some effect on where birds are moving through.

Generally, birds are travelling relatively low (100 m or less), which is within the turbine airspace, especially in heavy winds, with very few birds traveling above turbine height.

3.2 FALL

A total of 18 bird species, consisting of approximately 3,650 individuals, were recorded during fall migration surveys. Of these, approximately 3,330 individuals, consisting of 15 species, were observed in the Boston deposit part of the Project area. In contrast, only 321 individuals, comprising 14 species, were recorded in the Doris deposit area during fall migration. Fall surveys were conducted between September 2 and 7, 2017.

3.2.1 RAPTORS

A total of six species of raptors, comprised of 26 individuals, were observed during fall migration surveys. All six species, consisting of eight individuals, were observed in the Boston deposit area. Four of the species, totaling 18 individuals, were observed at the Doris deposit area, with common raven observed most frequently, followed by peregrine falcon and rough-legged hawk.

A summary of raptor position relative to the proposed turbine airspace is presented in Table 5. Again, birds were flying relatively low (i.e., 100 m or less), especially in heavy winds (e.g., 25 km/hr). Very few birds were traveling above turbine height. Seventy-five percent (n=6) of raptors observed in the Boston deposit area were flying at altitudes within the turbine airspace, compared to 44% (n=8) in the Doris deposit area. Fifty-four percent of all raptors observed were recorded passing through turbine airspace for both sites combined. A family of peregrine falcons were observed interacting to the east of the Doris site, exhibiting diving and hunting behaviours, including what appeared to be "practice" hunting.

Table 5. Number of raptors detected during fall migration surveys relative to number in turbine airspace.

Species	No. of Observations			No. in Turbine Airspace			% in Turbine Airspace		
	Boston (Site B-1)	Doris (Site D-1)	Total	Boston (Site B-1)	Doris (Site D-1)	Total	Boston (Site B-1)	Doris (Site D-1)	Total
Peregrine Falcon	1	5	6	0	4	4	0%	80%	67%
Gyrfalcon	1	0	1	0	0	0	0%	-	0%
Rough-legged Hawk	2	4	6	2	2	4	100%	50%	67%
Golden Eagle	1	1	2	1	1	2	100%	100%	100%
Common Raven	2	8	10	2	1	3	100%	13%	30%
Bald Eagle	1	0	1	1	0	1	100%	-	100%
Total No. obs	**8**	**18**	**26**	6	8	14	75%	44%	54%
Total effort hours	**16.5**	**18**	**34.5**	-	-	-	-	-	-
Passage rates (obs/hr)	**0.48**	**1.00**	**0.75**	-	-	-	-	-	-

3.2.2 UPLAND BREEDING BIRDS

Two species of upland birds, comprised of 19 individuals, were observed during fall migration surveys, all at the Doris site during a single standwatch survey on September 6. No upland breeding birds were observed during fall migration at the Boston site.

A summary of upland bird position relative to the proposed turbine airspace is presented in Table 6. Birds were flying relatively low (i.e., 20 m or less). None of the upland birds observed were recorded passing through turbine airspace.

Table 6. Number of upland birds detected during fall migration surveys relative to number in turbine airspace.

Species	No. of Observations			No. in Turbine Airspace	% in Turbine Airspace
	Boston (Site B-1)	Doris (Site D-1)	Total		
Hoary Redpoll	0	7	7	0	0%
Rock Ptarmigan	0	12	12	0	0%
Total No. obs	**0**	**19**	**19**	0	0%
Total effort hours	**16.5**	**18**	**34.5**	-	-
Passage rates (obs/hr)	**0**	**1.06**	**0.55**	-	-

3.2.3 WATERBIRDS

Ten species of waterbirds, comprised of approximately 3,600 individuals, were observed during fall migration surveys. A total of 3,325 individuals, comprising nine species, were documented in the Boston deposit area. In contrast, seven species consisting of approximately 280 individuals were recorded in the Doris deposit area. Canada goose, followed by greater white-fronted goose, snow goose then Sandhill crane was the most commonly observed species across both sites.

A summary of waterbird position relative to the proposed turbine airspace is presented in Table 7. Seventy-three percent of all waterbirds observed were recorded passing through turbine airspace. Similar to raptors, 75% (n=2510) of all waterbirds observed in the Boston deposit area were recorded flying through the turbine airspace, compared to 44% (n=127) in the Doris deposit area. Ninety-two percent of Sandhill cranes observed for both sites combined, comprised of 154 individuals, were recorded as flying through turbine airspace. Several tundra swans were observed gathering at the lake northwest of the Boston site during the fall migration surveys, and were likely preparing to migrate south.

Table 7. Number of waterbirds detected during fall migration surveys relative to number in turbine airspace.

Species	No. of Observations			No. in Turbine Airspace			% in Turbine Airspace		
	Boston (Site B-1)	Doris (Site D-1)	Total	Boston (Site B-1)	Doris (Site D-1)	Total	Boston (Site B-1)	Doris (Site D-1)	Total
Canada Goose	640	103	743	486	44	530	76%	43%	71%
Greater White-fronted Goose	606	58	664	469	18	487	77%	31%	73%
Sandhill Crane	160	8	168	147	7	154	92%	88%	92%
Snow Goose	365	37	402	56	17	73	15%	46%	18%
Tundra Swan	19	4	23	2	0	2	11%	0%	9%
Long-tailed Duck	10	0	10	0	0	0	0%	-	0%
Herring Gull	1	1	2	1	0	1	100%	0%	50%
Pacific Loon	14	1	15	7	0	7	50%	0%	47%
Red-throated Loon	0	3	3	0	0	0	-	0%	0%
Yellow-billed Loon	1	0	1	0	0	0	0%	-	0%
Unknown goose sp.	1508	70	1578	1348	40	1388	89%	57%	88%
Unknown loon sp.	1	1	2	1	1	2	100%	100%	100%
Total No. obs	**3325**	**286**	**3611**	2510	127	2644	75%	44%	73%
Total effort hours	**16.5**	**18**	**34.5**	-	-	-	-	-	-
Passage rates (obs/hr)	**201.5**	**15.9**	**104.7**	-	-	-	-	-	-

3.2.4 FALL MIGRATORY PATTERNS

Birds in fall are expected to migrate in a southerly direction from breeding areas to wintering grounds. Of the bird detections where flight direction was known (n=3,652), 88% (n=3,202) were moving in the expected direction of Southwest to Southeast from the north. Wind throughout the surveys was generally from the south or east which is not ideal for fall migration as migrants may delay moving south until favorable conditions exist. Following a change in wind direction to the north-northwest on September 4th, 2017, weather conditions proved ideal for a large movement of migrants observed at the Boston site. On this day, 58% of migrants were observed and the passage rate was 473 per hour, above the average for all other surveys at any location during the fall surveys.

In general, fall migration appeared to be broad-front, with birds arriving from all northerly directions and heading south. Again in the Doris deposit area there is no evidence of topographic features funneling birds through the Project area. At the Boston site, there are a couple lakes on either side of the Project area that may provide some funneling, however, the effect does not appear substantial.

3.3 COMPARISON OF SPRING AND FALL MIGRATION RESULTS

Fall migratory observations were more than spring observations (in fall 3,656 vs 1,763 in spring) with similar species composition (22 species recorded in spring compared to 18 recorded in fall) (Table 8). Passage rates were higher in fall at 106 individuals per hour of effort and 49 individuals per hour of effort in spring. One species of raptor was recorded only in spring (short-eared owl) and two species were recorded only in fall (gyrfalcon and bald eagle). Only two of the upland breeding birds documented during spring migration surveys were recorded in the fall (hoary redpoll and rock ptarmigan). Of the waterbirds, three species were observed only in spring (brant, northern pintail and glaucous gull), and another two species only in fall (greater white-fronted goose and yellow-billed loon).

Table 8. Species composition spring and fall.

Species	Spring	Fall	Total
Peregrine Falcon	2	6	8
Gyrfalcon	0	1	1
Rough-legged Hawk	12	6	18
Golden Eagle	7	2	9
Common Raven	11	10	21
Bald Eagle	0	1	1
Short-eared Owl	1	0	1
Baird's Sandpiper	3	0	3
Pomarine Jaegar	4	0	4
Horned Lark	1	0	1
American Pipit	3	0	3
Hoary Redpoll	2	7	9
Rock Ptarmigan	16	12	28
Brant	3	0	3
Canada Goose	1576	743	2319
Greater White-fronted Goose	0	664	664
Sandhill Crane	16	168	184
Snow Goose	4	402	406
Tundra Swan	6	23	29
Northern Pintail	20	0	20
Long-tailed Duck	18	10	28
Glaucous Gull	11	0	11
Herring Gull	39	2	41
Pacific Loon	5	15	20
Red-throated Loon	1	3	4
Yellow-billed Loon	0	1	1

4 DISCUSSION

More raptors were observed in the Doris deposit area (n=18) than in the Boston deposit area during fall migration. In contrast, a higher number of waterbirds were recorded in the Boston area (n=3325) versus the Doris site (n=286) in the fall season. No upland breeding birds were observed in the Boston area during fall surveys. A higher percentage of both raptors and waterbirds were observed flying through turbine airspace at the Boston site as compared to the Doris site (75% versus 44%) during fall migration surveys.

Based on observations from 2017 surveys, it appears that in the fall birds will move when the wind is from a generally from the north (i.e. tail wind). During the fall migration surveys, the bulk of movement occurred on a single day, when a northerly wind was observed. During the spring migration surveys, birds were observed moving even when a head or crosswind was recorded. In both seasons, migration occurred as a broad front over the Project area with no barriers to movement. In general, migration appears to be very similar in either season with regards to low flight height (< 100 m), broad front trajectories and some weather dependency (i.e. wind).

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APPENDIX A. PHOTOGRAPHS

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Photo 1. Site D-1 – Doris view to South, in Spring

Photo 2. Site D-2 – Doris view to West, in Spring

Photo 3. Site B-1 – Boston view to North, in fall