POKESHAW BLACK ROCK
WIND POWER PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT REGISTRATION DOCUMENT

PROPONENT

Pokeshaw Black Rock Wind Limited Partnership

Report Prepared by:
McCallum Environmental Ltd.
July 2019

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Environmental Assessment Registration Document

Name of Project:
Pokeshaw Black Rock Wind Project
Location: Pokeshaw, Gloucester County, New Brunswick
Pokeshaw Black Rock Wind Limited Partnership
5657 Spring Garden Road, Suite 700
Halifax, Nova Scotia, Canada
B3J 3R4

Report Prepared by:

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Date: July 2019

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EXECUTIVE SUMMARY

Pokeshaw Black Rock Wind Project (PBRWP) is a 20 MW wind energy project proposed to be built on private land in an area approximately 2 km southeast of Pokeshaw, NB. PBRWP is a partnership between the Pokeshaw Black Rock Community Recreation Council (PBRRC) and Community Wind Farms Inc. (a NS based corporation).

PBRWP will consist of five 4 MW wind turbines, each with a total height of up to 200 m. The total 20 MW capacity of the Project will produce enough renewable energy for approximately 6,000 local homes. Construction activities will begin in June 2020 and continue until December 2020. Approximately 2,500 m of existing road will be upgraded and approximately 2,400 m of new roads will be built as part of the Project. The energy produced by PBRWP will feed into the 69 kV transmission line located on the adjacent Highway 135.

Based on the land accessible for PBRWP and the environmental constraints present, a "buildable area" was defined for PBRWP. Within the buildable area, PBRWP maximized setbacks from sensitive environmental features to the fullest extent possible (i.e. wetlands and watercourses, rare species) and designed infrastructure to be located on previously disturbed areas (i.e. existing woods roads and clear-cut areas where feasible).

Multiple wetlands are present within the Project Area all of which have been avoided by proposed Wind Turbine Generators (WTG's). A small portion of one wetland (WL7) will be altered for the purposes of constructing an access road to WTG5. Proposed Project infrastructure has been setback from wetlands to maximum extent possible. Setbacks between WTG's and wetlands are 249 m, 188 m, 99 m, 53 m and 113 m (WTG1-WTG5 respectively).

One watercourse (headwaters of Riviere du Nord) exists within the eastern extent of the Project Area approximately 94 m south east from WTG4. At this location the watercourse is approximately 2 m wide and comprises slow moving to stagnant water in low flow conditions. The watercourse provides low quality juvenile rearing habitat for salmonid fish species.

Species at Risk inventories within the Project Area revealed that one vascular plant species (Menzies Rattlesnake-Plantain – S2) was identified in western portions of the Study Area. This species will be unaffected by PBRWP. One lichen Species of Conservation Interest (SOCI) species (Shingle Lichen S3/S4) was identified within WL3 and will also be unaffected. No fauna Species at Risk (SAR) or SOCI species were identified during field surveys, however based on habitat present it is possible one of the following SAR could utilize the Study Area: Canada Lynx, Eastern Cougar, Maritime Shrew, Southern Bog Lemming and Northern Bog Lemming. None of the habitat present is considered critical for these species however, and additional habitat is provided within adjacent forested land, and the region in general.

Watercourse 1 provides potential low-quality habitat (access) for Snapping Turtle and the Wood Turtle (both SAR), however limited water depths and substrate types within each feature limits the ability for them to provide suitable overwintering and nesting habitat. No Snapping Turtle or Wood Turtles were observed during field surveys, nor is there any specific habitat present within the Study Area for these species. It is possible turtles may utilize on site wetlands from time to time for overland travel.

There are no background records of bat hibernacula within 5 km of the Study Area, nor was there evidence of hibernacula identified during field surveys. Potential bat roosting and foraging habitat is present throughout the Study Area (i.e. within forested land and edge habitat). Bat monitoring was completed within the Study Area during the breeding and migratory periods in 2018. Three SAR bats (Little brown myotis, Northern long eared myotis and the Tri-coloured bat) were identified during the monitoring period along with other migratory species. Of the four locations monitored within the Project Area, the average migratory bat passes per night was measured at 1.73. When using the Alberta framework for determining Project risk, this equate to a "potential moderate risk of bat fatalities". Mitigation for effects to bats is provided in this document including the implementation of post-construction monitoring to determine potential mortality of bats.

The Project Area is situated 1 km southeast of the Pokeshaw Rock Important Bird Area (IBA) boundary. Pokeshaw Rock is a sea stack that comprises steep, sheer cliffs that rise approximately 16 m from the sea and hosts a breeding colony of Double-crested Cormorants and a variety of seabirds have also been observed in the area. An extensive bird survey program was implemented to characterize avian activity within the Study Area, as well as to evaluate bird passage movements during migration periods and daily diurnal movements of birds. Point count and transect surveys were completed within the Study Area during Spring 2018, Breeding 2018, Fall 2018 and Breeding 2019 to evaluate on-site avian activity. Watch count locations were surveyed within and surrounding the Study Area during Spring, Summer and Fall 2018 to evaluate bird movements (including the seabirds utilizing the IBA). Winter surveys were completed in 2019 to document resident bird populations.

A total of 9,271 minutes (154 hours and 30 mins) of surveys were completed over five seasons. These surveys resulted in the observation of 22,590 individual birds, representing 116 species of which (14%) were observed within or over the Study Area and the remaining 76% were observed outside the Study Area. A higher number of birds were observed during the spring migration period, compared to during the fall migration and breeding periods. The highest bird counts were observed during watch count surveys in all three seasons. These high numbers are due to large flocks of Double-crested Cormorants, Canada Geese, and Black Scoters that were seen on the coast. Large concentrations of Double-crested Cormorants were observed on the Pokeshaw Rock IBA. Birds of this species were observed flying to, and leaving this colony following coastal and overland routes, however, they were not observed in significant numbers flying directly above the Study Area (16 individuals in spring and no individuals in fall were observed flying over the Study Area which represents <0.1% of these species observed. Although no mass migratory movements were witnessed, many diurnal flights were observed. A portion of these flights occurred over the Study Area. In spring 2% of flights occurred over the Study Area, but only 0.8% of flights occurred over the Study Area and within the Rotor Swept Arc (RSA) of proposed WTG's. In fall, 28% of flights occurred over the Study Area, and 26% occurred both over the Study Area and within the RSA. The larger percentage in fall was due to several flocks of Canadian Geese that were either flying to or from a peat/cranberry reservoir located to the north of the Study Area. These were not migratory flights, as the geese were observed remaining in the area.

During breeding surveys within the Study Area, a total of 796 individuals representing 63 species were observed. Two confirmed breeders were identified, and multiple probable breeders across the habitat present. All the species identified are native species in this area of New Brunswick and the province in general and observed within the typical and common habitat associated with the Study Area and surrounding landscape. The majority of observations comprised one, two or three individuals. No large flocks of birds were observed during breeding bird surveys. The most abundant species group observed on site during the breeding bird period was passerines (n=687), followed by other landbirds (n=33). The natural portions of the Study Area comprise a good intermix of natural forested land, cleared areas, and old pasture habitat which has created edge habitat suitable for bird foraging. However, no critical habitat for any birds identified during surveys is present within the Study Area.

Eighteen SAR/SOCI birds were identified during bird surveys of which 12 were observed within the Study Area. Of those identified within the Study Area some were observed in close proximity to proposed WTG's (i.e. Eastern Wood-Pewee at WTG3 and Eastern Wood-Pewee, Killdeer and Pine Siskin in within 200 m of WTG1). No breeding evidence was noted during these observations, however of particular note is that no unique habitat was identified for these species at any of the proposed WTG locations or access road routes. Additional habitat for all SAR/SOCI is available in surrounding undeveloped land.

Based on the species identified, and their flight behaviors observed bird mortality predictions were made for PBRWP. The results of this predictive tool indicate that 0.364 birds may collide with one turbine per year at PBRWP, and 1.105 birds may collide with turbines across the entire PBRWP (5 turbines). These predictions fall below the average mortality rates in Atlantic Canada and nationally. Mitigation for effects to birds is provided in this document including the implementation of post-construction monitoring to determine potential mortality of birds.

Natural areas remaining following Project construction will continue to include disturbed and undisturbed tracts of forests, agricultural areas, wetlands, or stands of trees or other vegetation within the Project Area. These forested natural areas are continuous, and provide suitable habitat, travelling corridors, thermal and security cover for wildlife, and are representative of forest systems throughout the Project Area and in adjacent undeveloped land. Habitat fragmentation will be minimal, based on the size of the Project. There are no areas of cultural significance identified during assessments of historical resources. As well there are no adverse effects anticipated on health and socio-economic conditions, physical and cultural heritage areas, traditional land use, as a result of environmental changes from the Project.

In order to maintain public safety, PBRWP has maximized setbacks between proposed WTG's and public roads to the extent possible. This takes into consideration potential effects of ice throw and/or blade throw during a turbine malfunction. Furthermore, potential effects of high winds and infrastructure fire have been accounted for in this document. Engineers licensed to practice in New Brunswick will provide the final sign-off on the approved turbine model prior to the Project being constructed.

PBRWP has maximized residential setbacks with the closest residence being located approximately 1,419 meters from proposed WTG1. Sound models indicate that the regulatory criterion of 40 dBA for sound output from the five WTG's, at any identified receptors within a 2,600 meter radius of the Project Area is not expected to be exceeded. Shadow Flicker modeling also complies with Health Canada guidelines of not exceeding 30 hours per year and 30 minutes per day at any of the receptors within a 2,600 meter radius of the Project Area.

Public and First Nations Engagement has been ongoing for PBRWP since 2018 and has included the implementation of a Public Information Open House (June 2019). A separate Public and First Nations Engagement Summary Report is in the process of being compiled and will document the outreach to date.

PBRWP initiated an Electromagnetic Interference Study (EMI Study) including consultation with mandatory contacts as specified by the Radio Advisory Board of Canada (RABC). The results of the EMI to date show that the turbines do not pose any serious interference with existing radio, telecommunication or radar systems in the area.

The magnitude of disturbance and risk associated with the Project are all considered minimal given the size of the Project and the mitigation techniques and technologies currently available. Furthermore, this assessment concludes there are no significant environmental concerns and no significant impacts expected that cannot be effectively mitigated through well established and acceptable practices, or ongoing monitoring and response. Residual environmental effects have been determined to be minimal or low for identified VECs.

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LIST OF ACRONYMS

ACCDC	Atlantic Canadian Conservation Data Centre
AQHI	Air Quality Health Index
ARD	Acid Rock Drainage
ATV	All-terrain vehicle
BOP	Balance of Plant
BSC	Bird Studies Canada
CEAA	Canadian Environmental Assessment Act
CCME	Canadian Council of Ministers of the Environment
C&D	Construction & demolition
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWF	Community Wind Farms Inc.
CWS	Canadian Wildlife Service
DWCS	Department of Wellness, Culture and Sport
EA	Environmental Assessment
EC	Environment Canada
ECCC	Environment and Climate Change Canada
EPP	Environmental Protection Plan
ERD	Department of Energy and Resource Development
FPS	Forest Planning and Stewardship Branch
GPS	Global Positioning System
HA	Hectares
HAP	Habitat Assessment Points
HRIA	Heritage Resource Impact Assessment
IBA	Important Bird Area
IH	Intolerant Hardwoods
IA	Industrial Approval
KM	Kilometer
LAA	Local Assessment Area
LORESS	Locally Owned Renewable Energy Small Scale program
LPM	Litres Per Minute
Ltd	Limited
M	Meters
MBBA	Maritime Breeding Bird Atlas
MBS	Migratory Bird Sanctuary
MEL	McCallum Environmental Ltd.
MW	Mixedwood
NBDELG	New Brunswick Department of Environment and Local Government
NBFCP	New Brunswick's Future Climate Projections
NBHN	New Brunswick Hydrographic Network
OWLS	Online Well Log System
PBRRC	Pokeshaw Black Rock Recreation Council
PBRWP	Pokeshaw Black Rock Wind Project
PC	Point Counts
PID	Property Identification Number

PPE	Personal Protective Equipment
PSW	Provincially Significant Wetlands
RAA	Regional Assessment Area
SAR	Species at Risk
SARA	Species at Risk Act
SFM	Shadow Flicker Modelling
SOCI	Species of Conservation Interest
S-rank	Status rank
SH	Spruce-hemlock
TH	Tolerant Hardwood
UTM	Universal Transform Mercator
VEC	Valued Ecosystem Components
WESP	Wetland Ecosystem Services Protocol
WC	Watercourse
WL	Wetland
WTG	Wind Turbine Generator

1 GENERAL INFORMATION

The Project summary is provided below.

Table 1. Project Summary

<table>
<tr><td>General Project Information</td><td colspan="3">Pokeshaw Black Rock Wind Project (PBRWP) will be a 20 MW wind energy project located on privately owned land in Pokeshaw, New Brunswick. PBRWP will be owned by Pokeshaw Black Rock Wind Limited Partnership which will be incorporated as a Limited Partnership between Community Wind Farms Inc. and Pokeshaw Black Rock Recreation Council</td></tr>
<tr><td>PBRWP Name</td><td colspan="3">Pokeshaw Black Rock Wind Limited Partnership (PBRWP) will be incorporated as a Limited Partnership between Community Wind farms Inc. and Pokeshaw Black Rock Recreation Council.</td></tr>
<tr><td>PBRWP Contact Information</td><td colspan="3">Pokeshaw Black Rock Wind Project
c/o Community Wind Farms Inc.
5657 Spring Garden Road, Suite 700
Halifax, Nova Scotia B3J 3R4 Canada

Business: (902) 527-3158
Facsimile: (902) 201-5400
email: keith@communitywind.ca</td></tr>
<tr><td>PBRWP Project Director</td><td colspan="3">Keith Towse
Chief Executive Officer</td></tr>
<tr><td>Project Location</td><td colspan="3">The project will be located approximately 2 km southeast of Pokeshaw, NB on privately owned land. The Wind Turbine Generators (WTGs) will be spaced along the southeast side of the Ridge Road, and northeast of Highway 135 in Gloucester County.</td></tr>
<tr><td>Landowner(s)</td><td colspan="3">There are 20 privately owned participating PIDs within the Project Area, owned by 16 landowners. Approximately 9 of the PIDs will have some form of project infrastructure built on them. A full list of landowners and PID details is found in Section 2.5.</td></tr>
<tr><td rowspan="6">Closest distance from a turbine to a residence</td><td>WTG#</td><td>Distance</td><td>Receptor ID</td></tr>
<tr><td>WTG1</td><td>1,419 m</td><td>receptor ID: P</td></tr>
<tr><td>WTG2</td><td>1,858 m</td><td>receptor ID: A</td></tr>
<tr><td>WTG3</td><td>2,293 m</td><td>receptor ID: E</td></tr>
<tr><td>WTG4</td><td>1,982 m</td><td>receptor ID: U</td></tr>
<tr><td>WTG5</td><td>1,578 m</td><td>receptor ID: F</td></tr>
<tr><td>Federal Involvement, Permits and Authorizations</td><td colspan="3">The following federal legislation and permits apply:
1. NAV Canada Land Use Permit
2. Transport Canada Aeronautical Obstacle Evaluation
3. Species at Risk Act
4. Migratory Bird Conventions Act
5. Canadian Wildlife Service, Research permit for post construction carcass searching and collection.</td></tr>
</table>

Provincial Authorities issuing Approvals	Department of Environment and Local Government (DELG) Department of Transport and Infrastructure (DTI)
Required Provincial Permits & Authorizations	The following permits, authorizations and/or approvals may be required for this Project which will allow for the construction and operation of the Project 1. *Clean Environment Act,* Environmental Impact Assessment Regulation, registration and approval by the Sustainable Development and Impact Evaluation Branch of the DELG; 2. *Clean Environment Act,* Water Quality Regulation, permit for a Watercourse and Wetland Alteration if within 30m of a watercourse or wetland; 3. *Electricity Act,* Renewable Resource Regulations, approval for construction of a new energy generation facility.
Provincial Regulatory Authorities Consulted during EA and Project Development Process	New Brunswick Environment and Local Government (NBELG) Environmental Impact Assessment Branch: • Susan Dean, Project Manager Department of Energy and Resource Development (ERD) Crown Lands Branch (Planning Section) • Colette Lemieux, Environmental Impact Assessment Coordinator • Hubert Askanas, Biologist Species At Risk Office of Aboriginal Affairs: • Mary Ann Mann, Project Executive Department of Transport and Infrastructure • Daniel LeBlanc, District Engineer
Municipal Authorities	Chaleur Regional Service Commission
Required Municipal Permits & Authorizations	Building Permit – will be issued on receipt of approved Environmental Assessment and before the construction begins
Environmental Assessment Document Completed By:	Andy Walter, B.Sc. Emma Posluns, MSc. Robert McCallum, P.Biol **McCallum Environmental Ltd.** Suite 115, 2 Bluewater Road Bedford, NS. B4B 1G7

2 PROJECT INFORMATION

The following sections outline the project overview, project rationale, PBRWP profile, the environmental assessment team, a description of the Project location, and proposed Project timelines.

2.1 Project Overview

The Pokeshaw Black Rock Wind Project (PBRWP) is a 20 MW wind energy project proposed to be built on private land in an area approximately 2 km southeast of Pokeshaw, NB. The project was awarded under New Brunswick's Locally Owned Renewable Energy Small Scale (LORESS) program. The LORESS program allows NB Power to procure 40 MW of renewable energy from First Nations and 40 MW of renewable energy from local entities. The PBRWP is a partnership between the Pokeshaw Black Rock Recreation Council (PBRRC) and Community Wind Farms Inc. (a NS based corporation).

PBRWP will consist of five 4 MW wind turbines, each with a total height of up to 200 m. The total 20 MW capacity of the project will produce enough renewable energy for approximately 6000 local homes. Construction activities will begin in June 2020 and continue until December 2020. Approximately 2,500 m of existing road will be upgraded and approximately 2,400 m of new roads will be built as part of the project. The energy produced by the project will feed into the 69 kV transmission line located on the adjacent Highway 135.

2.2 Project Rationale

The purpose and need of the undertaking is to support New Brunswick in meeting their goal of 40% of electricity from renewable sources by the year 2020. Currently, approximately 28% of the energy used in the province is from renewable sources (NBERD, 2019c). New Brunswick Power, through LORESS, aims to obtain a total of 80MW of renewable energy from participating local entities. In their Integrated Resource Plan, New Brunswick Power notes that their public engagement survey, which gathered online information from over a thousand participants, showed that clean energy is a high priority for New Brunswickers (NBP, 2017). If approved, the PBRWP will contribute to this common goal.

2.3 PBRWLP Profile

Pokeshaw Black Rock Wind Limited Partnership will be a limited partnership between the Pokeshaw Black Rock Recreation Council Inc. (PBRRC) and Community Wind Farms Inc (CWF) which will own the Project. The PBRRC is a NB non-profit organization made up of local community members. The majority interests of this partnership will be owned by PBRRC and they will receive substantial benefits from the Project and remain an active partner throughout the life of the Project. The Project is being developed and constructed by CWF.

Community Wind Farms Inc. is a private independent renewable power developer, focused on the development, construction and operation of wind projects in the Maritimes. Its principals have extensive experience in renewable energy project development and finance. CWF has worked with community groups, Mi'kmaq, and Maliseet First Nations across Atlantic Canada.

Community Wind Farms Inc. Executive Management Team consists of:

- Keith Towse, Chief Executive Officer
- Bill MacLean, President

The Environmental Assessment Project Team is:

- Robert McCallum, P.Biol, McCallum Environmental Ltd. – Environmental Impact Assessment
- Andy Walter, B.Sc., McCallum Environmental Ltd. – Environmental Impact Assessment
- Emma Posluns, M.Sc., McCallum Environmental Ltd. – Environmental Impact Assessment
- Roland Chiasson – Avian Surveys
- Bill MacLean, Community Wind Farms Inc. – First Nations/Community Engagement
- Dante Manchester, B.Eng, IFE Canada – Project Management
- Jason Jeandron, Archaeological Prospectors – Archaeological Study

2.4 Project Location

The Project Area for the PBRWP is located approximately 2 km southeast from the community of Pokeshaw, and 1.5 km north of the community of Black Rock in Gloucester County, New Brunswick (Figure 1, Appendix A). The Project Area is bordered by Highway 135 and by Ridge Road, which extends from Highway 135, northeastward though the Project Area. The New Brunswick Trail intersects the Ridge Road approximately 250m northeast of the Project Area boundary and a NB Power Transmission Power Line borders the southwestern extent of the Project Area adjacent to Highway 135. The Project Area is otherwise bounded by undeveloped forested land, while the headwaters of Rivière du Nord (North River) intersects a small portion of the southeastern section of the Project Area.

2.5 Participating Properties

As indicated on Figure 2 (Appendix A) the PBRWP includes 20 privately owned participating properties. Infrastructure will be located on 9 of these properties and the remaining lie within the Project boundary. The Project also extends along one provincially owned road (Ridge Road). Property ownership details are provided in Table 2.

Table 2. Participating Properties

Property Identification Number	Property Owner	Infrastructure Present on Property
20150868	Name Withheld	Substation (1000 m^2) Approx. 100 m new access road. (700 m^2) Electrical collector circuit to substation.
20080420	Name Withheld	None
20629317	Name Withheld	None

Property Identification Number	Property Owner	Infrastructure Present on Property
20078531	Name Withheld	None
20080560	Name Withheld	None
20597902	Name Withheld	Approx. 140 m of existing road to be upgraded Approximately 50 m of new access road. (500 m^2) Electrical collector circuit along access road.
20463774	Name Withheld	Approx. 100 m of new access road. (1,000 m^2) One crane pad and wind turbine. (4,300 m^2) Electrical collector circuit along access road.
20798013	Name Withheld	Bisected by Ridge Rd., to be upgraded. Portion of crane pad storage area (200 m^2)
20080164	Name Withheld	None
20706909	Name Withheld	Approx. 250 m of new access road. (2,500 m^2) One crane pad and wind turbine. (4,300 m^2) Electrical collector circuit along access road.
20598439	Name Withheld	Approx. 1000 m of new access road (10,000 m^2). One full crane pad and wind turbine (4,300 m^2) One crane pad with wind turbine on property line. (4,000 m^2) Electrical collector circuit along access road.
20811477	Name Withheld	None.
20502993	Name Withheld	Approx. 150 m of new access road. (1500 m^2)
20672937	Name Withheld	Approx. 175 m of new access road. (1750 m^2) One crane pad and wind turbine (4300 m^2)
20080578	Name Withheld	None
20503470	Name Withheld	None
20081337	Name Withheld.	None
20081345	Name Withheld	One wind turbine on property line. (500 m^2)
20502878	Name Withheld	None
20489720	Name Withheld	None

Consent for the infrastructure proposed on each participating property will be provided to NBDELG EIA Branch under a separate cover.

2.6 Anticipated Schedule of Activities

The following milestone schedule (see Table 3) outlines the Project schedule.

Table 3. Schedule of Project Activities

Task	Anticipated Completion/Duration
Environmental Studies	April 2018 – June 2019
First Nation Engagement	May 2018 – February 2020
Public Engagement	May 2018 – March 2020 (and throughout lifetime of the Project)
Environmental Assessment Registration	July 2019
Anticipated EA Decision	October 2019
Provincial Permitting	October 2019 – June 2020
Project Construction	June 2020 – December 2020
PBRWP Operational Life	Approximately 30 years, consistent with anticipated operational life of WTG.
Reclamation	At end of Operational Life

2.7 Project Components

Project components are discussed in the sections that follow and as well are provided on Figure 3 (Appendix A).

2.7.1 Turbine Characteristics

The final turbine manufacturer has not been decided; however, the following maximum turbine characteristics will not be exceeded:

Turbine output: Up to 4.0 megawatts (MW)
Hub Height: up to 132 metres
Blade Length: up to 63 metres
Rotor Diameter: up to 130 metres
Total Height: up to 200 metres

Wind turbines and supporting structures typically consist of nine key components:

- tower foundations;

- three or four steel tower sections, stacked;
- nacelle;
- three rotor blades;
- hub;
- generator;
- internal nacelle or tower situated transformer;
- electrical and grounding wires; and
- locking doorway to access the interior of the tower at the base.

Tower foundations may range from three to four metres in depth and over 20 metres wide depending upon site-specific soil conditions and the height of the tower.

The nacelle includes the gearbox (if applicable) and electric generator, as well as blade and turbine control equipment, sensors, and cooling/heating equipment. These components are located at the top of the tower and are connected to the blades via a main shaft through the hub.

All transformers and switchgear are inside of the tower and will be required for each turbine to step up the electricity created in the generator to 34.5 kV medium voltage. The electrical collection system will be comprised of a series of above and below ground power lines starting inside the turbine foundation. The underground sections will be between 80m and 100m long, before the cables are mounted overhead starting with a riser pole and continuing with standard wood utility poles every 40 m to 60 m.

Turbine lighting will meet the design requirements and quality assurance for lights required under *Canadian Aviation Regulations 2019-1*, Part VI - General Operating and Flight Rules, Standard 621, Chapter 12 – Marking and Lighting of Wind turbines and Wind farms. Turbines with an overall height greater than 150m must use CL-864 medium intensity, flashing red beacon lights to delineate the perimeter of a wind farm. The highest turbine (based on topographic elevation), must also be lighted (along with any other turbines deem to need lighting). Once turbines reach a height of 60m or greater during construction, they must be lit with temporary lighting (Transport Canada, 2019). PBRWP have received the Aeronautical Assessment for Obstacle Evaluation Approval from Transport Canada.

2.7.2 Turbine Locations

PBRWP includes five turbines, each of which is sited on forested land (either previously clear cut or undisturbed). Siting of turbines was carried out in consideration of multiple constraints (i.e. wind resource, environmental considerations and land access). Section 3.4 of this document outlines the process involved in optimizing the turbine layout. Final turbine locations are provided in Table 4 and indicated on Figure 3 (Appendix A). Turbine heights are provided in Table 5.

Table 4. Turbine Locations

Turbine ID	NAD 1983 CSRS New Brunswick Stereographic		WGS 1984 UTM Zone 20N		Geographic Coordinates	
	X	Y	East	North	Lon	Lat
WTG1	2595332	7642010	333057	5293192	-65.2282	47.7705
WTG2	2595650	7642430	333393	5293597	-65.2238	47.7742

Turbine ID	NAD 1983 CSRS New Brunswick Stereographic		WGS 1984 UTM Zone 20N		Geographic Coordinates	
WTG3	2595814	7642857	333576	5294016	-65.2216	47.7780
WTG4	2596114	7642559	333862	5293705	-65.2176	47.7753
WTG5	2596009	7643700	333809	5294850	-65.2188	47.7856

Table 5. Turbine Heights

Turbine ID	Site Elevation		Total Height WTG		Total Height Above Sea Level	
	[m]	[feet]	[m]	[feet]	[m]	[feet]
WTG1	37	121.6	200.0	656.2	237	778
WTG2	32	104.9	200.0	656.2	232	761
WTG3	26	85.1	200.0	656.2	226	741
WTG4	26	85.6	200.0	656.2	226	742
WTG5	23	74.8	200.0	656.2	223	731

2.7.3 Substation

Electricity generated by the PBRWP will be transmitted through the electrical collection system to a substation located within the PBRWP lands located within PID 20150868 closest to Highway 135 (428141.61 m E; 5780842.30 m N) and covers approximately one hectare. The substation is located on wooded land. An overhead transmission line will run approximately 100 m from this substation to an existing 69 kV NB Power line (L0063).

2.7.4 Interconnection

An interconnection feasibility review was conducted by NB Power in June 2017, and a System Impact Study is currently being carried out. It is anticipated that no technical issues will be found with the connection of the PBRWP to the 69 kV line L0063. Further feasibility reviews are expected to be conducted by NB Power prior to engineering and construction of the Project.

2.7.5 Access Roads

The main access to the PBRWP starts at the intersection between Highway 135 and the public unmaintained Ridge Road. The initial extent (~200 m) of Ridge Road is in good condition and can be used as the primary access to the PBRWP with minimal modifications. Deterioration of the road occurs as it extends eastward (noticeably at +1,000 m beyond the intersection). A general upgrade of Ridge Road is considered as the best option to grant safe and logistically efficient access to construction equipment, turbine components and maintenance vehicles. Approximately 2,500 m of Ridge Road will be upgraded to 8 m width (gravelled surface) and will incorporate roadside ditches on both sides of the road. This work will be completed within the current Right of Way of Ridge Road.

From Ridge Road, four separate 6 m wide access roads will be constructed to gain access to the five turbine sites. Existing logging roads will be upgraded and used where possible. New roads will be routed, engineered and constructed in such a way to avoid impacts to wetland habitat where possible. The roads are designed to be as short as possible in order to reduce material demand, costs, and environmental impacts. The total length of all access roads will be approximately 2,0400 m.

Access roads will be constructed as all-weather all-season roads. Each access road will be designed to landowner specifications, long term requirements, and as constraints warrant. In addition, approaches from high grade roads/highways will be constructed as required for access. Access roads will be built to accommodate the oversize loads and large weights of the WTG components. Following construction, access roads may be gated at the discretion of the landowner.

The PBRWP will provide local residents with a construction schedule to mitigate the anticipated interruption in use of access along Ridge Road.

Further information regarding construction techniques can be found in Section 2.8.1.

2.7.6 Collector Lines

Approximately 5 km of new collector circuit will be installed, using a mix of above and below ground methods. The collector system will be a 3-phase, 34.5 kV medium voltage circuit.

From the foundation of each WTG, 80-100 m of underground cable will be run to a riser pole adjacent to the access road and crane pads. The underground cables are contained in conduits that are buried in sand trenches and marked with warning tape according to specification.

The remainder of the collector system will remain above ground until it reaches the substation. The above ground section will consist of standard wood utility poles spaced approximately 50 m apart, with appropriate guying as required. Pole mounted disconnect switches and additional safety and regulating equipment will be installed as required. A fibre-optic communication system will be underbuilt on the collector system and will be used to monitor and control the PBRWP remotely.

The overhead collector lines will be installed adjacent to the access roads wherever possible. In some areas it may be required to build the collector lines independent from the access roads in order to maintain straight lines required to minimize excess guying.

2.7.7 Meteorological Towers

One meteorological tower (met) is installed on the PBRWP lands at 424368.4 E; 5782730 N (NAD 83, Zone 12). It has been in service and collecting data since December 2016. The met tower will be decommissioned prior to the start of construction of the PBRWP.

2.7.8 Temporary Components

During the construction phases of the PBRWP, a storage yard (or multiple storage areas) will be required to store construction equipment, turbine components, crane components, tool containers, offices, waste bins, parking and other necessary components.

Temporary workspace will be required along access roads and pad sites and will be taken as required and following approval from affected landowners. Temporary workspaces may be reclaimed following construction at the discretion of the landowner.

Borrow pits may be required to provide necessary fill for access road or pad site creation. All borrow pits will be taken as required and following approval from affected landowners and will maintain all setbacks as required and as indicated in this document.

All temporary components will be located on private lands and will maintain all setbacks as required and as indicated in this document.

2.8 Project Activities

The following sections outline the activities associated with the Construction and Operational phases of the Project.

Table 6 outlines the general order of activities associated with the development of a wind power project.

Table 6. Construction Phases

Phase	Details	Approximate Timing*
Pre-Construction		
	• Notification of residents/landowners of construction commencement • Survey turbine site locations in field • Survey access roads on PBRWP lands • Delivery and set up of temporary facilities – construction offices, workers trailers, temporary washroom facilities, etc. • Construction equipment delivery	February – March 2020
Construction		
General	• Clearing of soils • Construction of storage yards • Construction of temporary workspace	June 2020
Civil	• Stripping, storage and stabilization of surface soils along access roads, at turbine locations, at substation, at other required work areas • Construction of access roads, ditches, water crossings, including water management. • Construction of temporary workspace(s) • Construction of turbine locations and crane pads • Installation of erosion and sediment control structures • Site grading	July – December 2020

Phase	Details	Approximate Timing*
	• Compaction testing of roads • Creation of crane pads using crushed rock • Excavation of foundations • Pouring of concrete 'mud mat' working surface • Installation of re-bar and formwork for turbine foundations • Pouring of concrete for foundations • Testing of concrete foundations • Installation of site drainage (aka - weeping tile) at base of turbine foundations • Backfilling of foundations with previously excavated soils • Reclamation of surplus soils • Grading of site	
Turbines	• Turbine component delivery • Crane delivery • Tower/turbine erection • Install turbine electrical systems & (if necessary) pad mount transformers	July – November 2020
Collection System	• Soil stripping and excavation of trenches for underground electrical system • Installation of utility poles. • Hanging wires and associated infrastructure • Install and connect underground collector system • Terminations in turbine and/or at pad mount transformer. • Testing & commissioning	August – November 2020
Collector Substation	• Delivery of equipment • Installation of equipment foundations and station ground grid • Installation of equipment support structures • Installation of transformer, switch gear, protection and control systems, control building, conduits, wiring, and terminations • System testing	August – November 2020
Operations & Maintenance		

Phase	Details	Approximate Timing*
	• Reclamation of subsoils and disturbed surface soils • Weed control • Re-seeding of disturbed soils • Grading of roads • Road maintenance • Culvert maintenance • Turbine maintenance • Sub-station maintenance • Equipment testing	December 2020 – December 2050
Decommissioning		
	• De-energize facility • Removal of above ground infrastructure which includes turbine blades, nacelles, tower components, and other support structures • Removal of crane pads and gravel from access roads • Recontouring of crane pads and access road grades • Reclamation of surface soils • Re-seeding or re-planting Reclamation monitoring	To be determined

** Timing is based on an EIA Approval date of October 1, 2019.*

2.8.1 Construction

The construction phase of the Project is described below by type of infrastructure required. The proposed construction hours will typically be between 7am-6pm Monday to Saturday. The construction period is expected to employ approximately 120 people.

Equipment proposed to be used for construction of the Project infrastructure includes:

- Bulldozers;
- Dump trucks;
- Compaction Rollers;
- Excavators;
- Cranes;
- Drill rigs;
- Graders;
- Generators;

- Personnel vehicles;
- Site/Office Trailers;
- Storage Containers;
- Concrete Trucks;
- Forklift or telehandlers; and,
- Delivery vehicles.

Project Access and Equipment Delivery
Access to the Project site during the construction period will be via the Ridge Road (Figure 3, Appendix A). All construction equipment and vehicles can access the Ridge Road from Highway 135, from either direction and as such, no detours or road closures are expected to be required. Turbine component delivery will be via Highway 11 & Highway 135. During turbine component delivery, signage and traffic control will be required at the intersection of Ridge Road and Highway 135. For larger components such as tower segments and blades, the highway intersection will be widened to provide the necessary turning radius.

2.8.1.1 **Turbine Foundations**

The following describes the proposed turbine foundations:
- Turbine bases will be excavated to appropriate dimensions (determined by engineering requirements);
- Excavated subsoil will be piled on location for use in padding of the tower base or for eventual removal;
- It is assumed that each turbine base will require installation of a support structure using over 500 cubic metres (m^3) of cement and re-bar. As a result, 1000+ m^3 of subsoil will require excavation and relocation. As per results of a previous geotechnical investigation completed at the site in 2018, the requirement for blasting is not expected. A portion of this soil will be used to backfill and level the crane pad area. During construction operations, landowners and municipalities will be approached to discuss how best to remove excess subsoil from turbines on their land(s).
- Pouring of concrete slab;
- Installation of internal formwork;
- Installation of rebar followed by external formwork and other required infrastructure;
- Transport of concrete (the supplier location is to be determined);
- Pouring of concrete;
- Curing and testing (tests taken throughout pouring process); and,
- Backfilling.

The erection of a turbine requires a large level work area for safe operation and the following site dimensions (Table 7) will be typical for the PBRWP.

Table 7. Infrastructure Dimensions and Workspace

Infrastructure	Dimensions of Workspace Required
Permanent: turbine base with underground power cables	25 m diameter, dependent on final turbine selection

Infrastructure	Dimensions of Workspace Required
Permanent: crane pad	70 m x 43 m
Temporary workspace (required for storage of turbine blades, nacelle, and tower sections during the erection process)	100 m x 100 m (including the crane pad)

2.8.1.2 **Turbine Erection**

The erection of turbines is based upon specific site conditions found at each turbine pad. Engineered lifts are required for each turbine component and the scope and details of each lift are outside the scope of this plan. General turbine erection guidelines include:

- Lifting and construction equipment placed on the ground and leveling techniques (clay capping, mats, planks or rig hydraulics) used, if required, for the safe operation of equipment.
- Plan equipment moves in fair conditions if possible (i.e., dry or frozen ground conditions).
- Ensure adequate working space is available and authorized for use.
- Stay on leased lands (i.e., do not go offsite).
- Lifts only conducted in appropriate wind speeds.
- Clean up spills.
- Document activities.
- Once equipment has been moved offsite, construct adequately sized and properly spaced work areas.
- Recontour (i.e., restore drainage); and,
- Re-vegetate.

2.8.1.3 **Roads**

The following construction activities will take place for new roads:

- Road areas will be clear cut and grubbed. Salvageable lumber will be stockpiled for the landowners at their request. Excess organic material will be stockpiled temporarily.
- Cut and fill will be implemented in the cleared area, which will be graded and levelled to the engineering specification.
- A suitable compacted subgrade will be verified by a geotechnical engineer.
- Geotextile fabrics may be used as specified by the civil engineer,
- Culverts will be installed to maintain natural drainage according to the erosion and drainage controls specified by the civil engineering drawings.
- Borrow areas may also be proposed in areas where there is insufficient material to construct an access road capable of hauling equipment to and from the sites;
- All final access road construction and design will be completed in accordance with both landowner and turbine manufacturer requirements.
- Public road upgrades that may be required to accommodate PBRWP construction requirements will be completed in accordance with DTI requirements.

2.8.1.4 **Collector Lines**

Underground Electrical system collector lines will be constructed by:
1. Stripping surface soils along the route.
2. Excavation of a trench to approximately 1.5 to 2 metres deep.
3. Installation of a sand or gravel bed along the base of the trench.
4. Laying and interconnection of below ground cables and conduits.
5. Backfilling of trench with excavated material (parent materials). Excess soils that will result in a ridge along the trench will be removed and disposed of at an approved location.
6. Replacement of subsoils.
7. Replacement of topsoil.
8. Re-seeding as per landowner and erosion control requirements.

Overhead Electrical system collector lines will be constructed by:
1. Surveying of pole locations;
2. Drilling to a specified depth;
3. Installing wood poles;
4. Installing cross-arm supports and pole mounted infrastructure;
5. Unspooling and stringing of power lines and fiber optic cable;
6. Guying;
7. Interconnection with substation and underground sections;
8. Testing & commissioning

2.8.1.5 **Resource/Material Requirements**

The PBRWP's raw materials include standard building materials for construction, including aggregate, concrete, wood, and metal. To the extent possible, where these materials are available in sufficient quality, quantity, and at competitive prices, they will be procured, or in the case of concrete, manufactured locally.

Beyond the materials required for construction of the PBRWP, resource requirements for ongoing operation of the PBRWP include the existing land base required for the turbines, access roads, power lines, and other facilities.

Local gravel resources will be used if the source material meets the quality and quantity of the PBRWP's material requirements.

Fuels, oils, and lubricants will be on-site for use in equipment during the construction phase, as well as the use of lubricants and fluids for the maintenance of the turbines, transformers, and substation. Spill kits will be available on site and will be used in the event of accidental spills and/or leaks.

2.8.1.6 **Waste Disposal**

The construction period will not result in large quantities of waste material. Typical waste will comprise construction and demolition (C&D) waste including wood, packaging plastics and cardboard, excess cables, scrap metal, etc. Disposal of waste materials throughout the construction period will be done so via local waste handling facilities operated by the local municipalities. As appropriate, materials suitable for recycling will be separated, reused and/or recycled. Appropriate waste containers will be installed during the construction period at each turbine site and at the site offices.

In the case that excess topsoil is prevalent during the construction period, topsoil will be disposed of at a private site within the Project Area. Similarly, merchantable timber removed as part of the construction phase will be provided to landowners.

2.8.1.7 <u>**Operation and Maintenance**</u>

Routine maintenance activities will continue through the operating period of the Project and will include maintenance visits by technicians in pickup trucks or service vehicles. Maintenance visits can be expected on a daily, weekly or monthly basis for a project of this size. Maintenance may periodically require bucket trucks to service the collector lines. Road maintenance and plowing will be conducted as necessary. The amount of maintenance cannot be forecast at this time.

There are limited waste by-products created from the wind energy generation process. Some waste will be produced from ongoing maintenance for the turbine facilities (e.g., lubrication and hydraulic fluids). Hazardous waste materials will not be generated in large quantities and will be disposed of through disposal methods as regulated in the Province of New Brunswick.

Non-hazardous waste will be disposed of through conventional, local waste handling facilities operated by local municipalities. As appropriate, materials suitable for recycling will be reused and/or recycled.

3 ENVIRONMENTAL ASSESSMENT SCOPE

New Brunswick's *Environmental Impact Assessment Regulation* provides a legislative framework for proactive environmental planning, including opportunities for public involvement (NBDELG, 2019a). The PBRWP requires a provincial environmental impact assessment registration as it is considered a *Registration Category 1* undertaking (an electric power generating facility with a production rating of three megawatts or more).

The scope of the assessment for the Project was ultimately determined by taking the following factors into consideration.

3.1 Site Sensitivity

The determination of site sensitivity and Level of Concern was initially undertaken in accordance with the following documents:

- *Guide to Environmental Impact Assessment in New Brunswick* (Environment and Local Government, 2012); and its associated Wind Sector additional information document.
- *Wind Turbines and Birds. A Guidance Document for Environmental Assessment.* (CWS, 2007a);
- *Recommended Protocols for Monitoring Impacts of Turbines on Birds (*CWS, 2007b); and

- *Additional Information Requirements for Wind Turbines ((Environment and Local Government, 2019).*

Consultation with Environment and Climate Change Canada's (ECCC) Canadian Wildlife Service (CWS), ERD's Forest Planning and Stewardship (FPS) Branch and NBDELG was subsequently undertaken during May 2018.

The Level of Concern for the Project was evaluated via species records (avifauna, terrestrial wildlife and vegetation) from various sources and databases, as well as from direct observations within the Project Area. In addition, consideration of site-specific characteristics of the Project Area was accounted for in the determination process. As part of this process, a review of potential significant avifauna (bird) use of the regional area, and presence of important habitats for birds were reviewed within and surrounding the Study Area and a Priority Species List was developed.

3.1.1 Regional Bird Use

A review of the New Brunswick forestry and non-forestry data show the Project Area to be situated in predominantly forested habitat dominated by mature intolerant hardwood, with lesser amounts of Black Spruce and Balsam Fir mix (see Section 5.4.1 for detailed discussion of Habitat). Three areas described as "agricultural plots" and one area described as industrial (an inactive gravel pit) were identified within the Project Area. A review of aerial imagery indicates that a small man-made pond exists within the northern extent of the Project Area.

No large bodies of water are located within 500 m of the Project Area, with the Bay de Chaleur and Pokeshaw River located 2.5km north, and 1.5 km west of the Project Area respectively. The headwaters of the Rivière du Nord exist in southern portions of the Project Area. However, as a 1st order stream it is not expected to be large enough to significantly concentrate foraging or migratory movements. No regulated wetlands are identified by the GeoNB wetland database (2019) within the proposed Project Area.

The Project Area is not known to contain any major islands, peninsulas or ridgelines which may funnel bird movement. At this time, there is no knowledge of a large heron, gull or tern colony located within the Project Area, however the Pokeshaw Rock Important Bird Area (IBA) boundary (NB005) is located 1km to the northwest of the Project Area. Pokeshaw Rock is a sea stack that possesses steep, sheer cliffs that rise approximately 16 m from the sea, with the cap being only 30 by 40m in diameter. It is devoid of vegetation and hosts a breeding colony of Double-crested Cormorants. According to Bird Studies Canada a variety of seabirds have also been observed in the area, including Black Guillemot, Razorbill, Great Black-backed Gull, Herring Gull, and Surf Scoter (2019a).

One of the considerations used for determining the location of Project Area was to maintain a 1km buffer from the IBA.

In addition to the Pokeshaw Rock IBA there are five additional IBAs within 50km of the Project Area as indicated below and in Figure 4 (Appendix A):

1. Miscou Island (IBA NBO21; Bird Studies Canada, 2019c) is located approximately 47km northeast of the Project Area and is characterised by a series of sandy costal beaches and enclosed lagoons. The island provides nesting opportunities for Piping Plover and relatively large numbers of shorebirds and waterfowl also use the beaches and lagoons. At least five species of shorebirds have been recorded in large numbers: Greater Yellowlegs, Lesser Yellowlegs, Red Knot, Least Sandpiper and Pectoral Sandpiper. Northern Gannets are also known to feed off the northern regions of the island in large numbers (up to 1000).
2. Beaches of Pokemouche and Grand Passage Inkerman (IBA NB006; Bird Studies Canada, 2019a) is located approximately 34km southeast of the Project Area. This IBA is located on the east shore of northeast New Brunswick and is characterized by a system of barrier beaches and dunes that shield several bays and salt marshes from the ocean. The IBA supports a significant portion of Atlantic Canadas breeding Piping Plover. High numbers of Black Ducks have also been observed at this IBA during the Spring nesting season.
3. Adjacent to the Pokemouche IBA lies Green Point IBA (IBA040; Bird Studies Canada, 2019b) which is characterized by a system of wide barrier beaches and sand dunes. Green Point IBA also supports a breeding population of Piping Plover.
4. The Tracadie Bay and Sandspit (IBA NB014; Bird Studies Canada, 2019f) lies approximately 32km from the Project Area also on the eastern shore of NB. Encompassing an 8km stretch of barrier beaches, wash overs and sand dunes this IBA encloses Tracadie Bay and supports Piping Plover and staging waterfowl and shorebirds.
5. Immediately South of IBA NB014 lies the Pointe-à-Bouleau IBA (IBA NB028; Bird Studies Canada, 2019d). This IBA comprises a 3.5km sandspit incorporating barrier beach, swift flowing channel, low lying dunes and wash overs provides a significant population of Piping Plovers. This location also supports hundreds of staging waterfowl and shorebirds including Canada Geese and Ruddy Turnstones, White-rumped Sandpipers, Semipalmated Sandpipers.

Source: Bird Studies Canada (2019b-f).

The closest RAMSAR wetland is located approximately 80 km southeast in Tabusintac Lagoon and River Estuary. The closest significant migration staging area for waterfowl and shorebirds is the Inkerman Migratory Bird Sanctuary, approximately 51 km southeast. The Bay de Chaleur and Pokeshaw River are the nearest water bodies, located 2.5 km north and 1.5 km west of the Study Area respectively. There are no migratory bird sanctuaries within 50km of the Study Area.

The habitats provided within these aforementioned IBAs are not consistent with habitat available within the Project Area. The IBAs are associated with coastal colonial nesting species and shorebirds.

3.1.2 Priority Species

The purpose of the development of a Priority Species list is to identify a broad list of species that have the potential to be present within the PBRWP Study Area. This priority species list is first determined by reviewing and compiling species from the following sources and comparing them against known habitat within the PBRWP Study Area. The sources included:

1) Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2019) and the *Federal Species-at Risk Act* (SARA 2019). All species listed as Endangered, Threatened, or of Special Concern;
2) *New Brunswick Species at Risk Act* (NBSARA 2012). All species listed as Endangered, Threatened, or Species of Special Concern; and,
3) Conservation Rank: All species designated as S1, S2 or S3 or any combination thereof (i.e. S3S4 is considered a Priority Species) as defined by the Atlantic Canadian Conservation Data Centre (ACCDC).
4) Maritime Breeding Bird Atlas square summary (square 20LT39) (MBBA 2019).

The data that is retrieved from the above resources and used in the development of the Priority Species List includes species of conservation interest (SOCI) that have ACCDC or rarity ranks (i.e., ACCDC S1, S2 and S3), and Species at Risk (SAR) which are listed on SARA, COSEWIC or NBSARA.

Data from ACCDC is obtained through information requests. The ACCDC then provides records of rare species existing or historically found within the 20km of the Study Area. The results of the database search were also reviewed to identify species that could be potentially located within the Study Area (based on recorded sightings within, or in close proximity to the Study Area, and general geographic and habitat requirements).

The priority list of species was then narrowed by broad geographic area and specific habitat requirements for each species. The habitat requirements were then compared against the known, or expected habitat, at the PBRWP Study Area. For example, if a listed species on the *New Brunswick Species at Risk Act* (NBSARA) required open water lake habitat, and no open water lake habitat is present inside the Project Area footprint, this species was not carried forward to the final list of Priority Species for field assessments within the Study Area.

A short list was finally created to outline those species with the highest potential of occurring within the PBRWP Study Area, based on distribution and historical documentation.

The Priority Species List is provided in Appendix B. The short list of of federally and provincially protected species identified within 20km of the Study Area is provided in Table 8 below. For avifaunal Priority Species, breeding status as documented in the Maritime Breeding Bird Atlas square summary (square 20LT39) is also included. If the species was observed during atlas surveys, with no breeding evidence noted, this is indicated below as well.

Table 8. Short List of federally and provincially protected species.

Scientific Name	Common Name	COSEWIC	SARA	NBSARA	ACCDC S Rank	Distance	MBBA
**Riparia riparia*	Bank Swallow	Threatened	Threatened		S2S3B, S2S3M	1.6 ± 7.0	Probable
**Hirundo rustica*	Barn Swallow	Threatened	Threatened	Endangered	S3B, S3M	2.3 ± 0.0	Possible
Degelia plumbea	Blue Felt Lichen	Special Concern	Special Concern	Special Concern	S1	NA	NA
**Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Threatened	S3B, S3M	1.6 ± 7.0	Probable
**Wilsonia canadensis*	Canada Warbler	Threatened	Threatened	Threatened	S3S4B, S3S4M	1.9 ± 0.0	NA
Chordeiles minor	Common Nighthawk	Threatened	Threatened	Threatened	S3B	NA	NA
Contopus virens	Eastern Wood-Pewee	Special Concern		Special Concern	S4B	NA	NA
**Sturnella magna*	Eastern Meadowlark	Threatened		Threatened	S1S2B	3.7 ± 0.0	NA
Myotis lucifugus	Little Brown Myotis	Endangered	Endangered	Endangered	S1	NA	NA
Danaus plexippus	Monarch	Endangered	Special Concern	Special Concern	S3B, S3M	NA	NA
Myotis septentrionalis	Northern Long-eared Myotis	Endangered	Endangered		SNA	NA	NA
Contopus cooperi	Olive-sided Flycatcher	Threatened	Threatened	Threatened	S3S4B	NA	NA
Charadrius melodus melodus	Piping Plover melodus ssp	Endangered	Endangered	Endangered	S1B	12.7 ± 7.0	Obs
Calidris canutus rufa	Red Knot rufa ssp	Endangered	NA	Endangered	S2M	15.9 ± 0.0	NA
Euphagus carolinus	Rusty Blackbird	Special Concern	Special Concern	Special Concern	S3B, S3M	15.1 ± 7.0	NA
Asio flammeus	Short-eared Owl	Special Concern	Special Concern	NA	S1S2B	NA	NA
Buteo lineatus	Red-shouldered Hawk		Special Concern		S2B, S2M	11.6 ± 7.0	NA
**Hylocichla mustelina*	Wood Thrush	Threatened	Threatened	Threatened	S1S2B, S1S2M	2.1 ± 1.0	NA

*Indicates Priority Species identified within 5km of the Project Area as per the ACCDC report

According to data provided by the ACCDC and displayed in Table 8, of the Priority Species found within 20km of the Study Area, 6 SAR have been historically identified within 5km of the Study Area and suitable habitat for these species is also present. These species are as follows:

1. Bank Swallow – Eight observations from 1960 to June 2012. The Bank Swallow nests in a wide variety of sites including natural and artificial areas that have vertical banks. Nest burrows are excavated in sand-silt substrates of riverbanks, bluffs, aggregate pits, road cuts, and soil piles. Threats to the Bank Swallow include loss of breeding and foraging habitat, vehicle collisions, pesticide use, and impacts of climate change (COSEWIC, 2014).

2. Barn Swallow – Four observations between 2003 and 2012. The nesting habitat of Barn Swallows is primarily artificial structures such as barns, houses, bridges, and other buildings. These birds use open habitats for foraging. Recent declines in Barn Swallow populations are thought to be due to loss of nesting and foraging habitats, decrease in insect populations, and climate change (COSEWIC, 2011a).

3. Bobolink - Thirty-four observations from 1960 to June 2014. The Bobolink nests on the ground, usually on wet soil at the base of large nonwoody plants typically in pastures and fields. This species is a grassland species that nests in pastures, old hayfields and other grassy areas. As outlined in the COSEWIC Assessment and Status Report for the Bobolink (2010), the main threat to this species is incidental mortality as a result of agricultural activities such as haying (COSEWIC, 2010).

4. Canada Warbler – One observation from 1998. Breeding habitat for the Canada Warbler consists of a variety of landscapes, but commonly comprises of moist forests with a dense deciduous shrub layer. Nests are built on or near the ground on raised hummocks, within root masses, rotting tree stumps, clumps of grass and rock cavities (Environment Canada, 2016b).

5. Eastern Meadowlark – One observation from 2012. Eastern Meadowlark prefer grassland habitats such as native prairies and savannahs; they also use non-native pastureland, agricultural fields, and meadows. Their population decline may be due to conversion of forage cropland to row crops, agricultural practices, nest predation, livestock overgrazing, and pesticide use (COSEWIC, 2011b).

6. Wood Thrush – One observation from 2000. The Wood Thrush mostly nests in large forest mosaics but has been known to nest in smaller forests as well. It prefers mature deciduous and mixed forests containing saplings and well-developed understory layers. Habitat degradation and fragmentation, and nest parasitism and predation are the main threats to Wood Thrush breeding grounds (COSEWIC, 2012b).

3.1.3 Site Sensitivity Determination

The overall level of concern category is determined using a matrix provided by Environment Canada-CWS (2007), which incorporates site sensitivity and size of the facility.

A list of parameters to aid in determination of site sensitivity is provided in the *EA Guidance Document: Wind Turbines and Birds* (CWS, 2007). Using the lists of parameters provided in this guidance document, a Project may be identified to have site sensitivity of either very high, high, medium or low. In the *"Avian Survey Program Design Pokeshaw Wind Power Project ("Project"), Pokeshaw, New Brunswick" (MEL 2018)* document submitted by the PBRWP to NBDELG in April 2018, the site sensitivity of the Project was determined 'high' as a result of the expectation that the Project Area and adjacent lands would contain species of conservation interest (i.e. SAR or SOCI) This was based on the single SAR, the Bobolink, being documented within 5km of the Project Area within the past 5 years. The remaining five SAR discussed above were identified in excess of five years ago.   However, subsequent feedback from FPS (April 2018) indicated that this determination was misleading and that in fact "*birds with aerial flight displays and Partners in Flight/Canadian Wildlife Service Priority Species are described as species of high conservation concern and that SAR presence is linked to a "Very High" Potential Sensitivity".* Further to this, FPS provided the following information:

> *"The FPS Branch recognizes that there may be deficiencies in the occurrence data[1], which hinders the ability to determine site sensitivity. Rather than recommend a level of concern category 4, due to the historical presence of SAR, the FPS Branch recommends a level of concern category 3, with the possibility of a reduction to 2 depending on the results of the bird surveys (as per the second paragraph on page 16 of Wind Turbines and Birds (CWS, 2007). The PBRWLP should be prepared to perform 2-3 years of post-construction monitoring and 2 years of carcass searches, if it is deemed necessary".*

In addition to these comments, FPS stated their concern that birds "at risk" (i.e. by the SARA, Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or provincial/territorial threat ranking, or the presence of the residence(s) of individuals of that species if listed under the SARA, or presence of critical habitat for such species) have the possibility of interacting with turbines.

Feedback regarding the site sensitivity of the Project was also provided by CWS in May 2018. The feedback received indicated that *"CWS classify all turbine sites with wind turbines greater than 150m in height as Very High site sensitivity because they are within a known migratory corridor as per Table 1 in CWS (2007a) guidance document. Turbine heights greater than 150m in height are in the 150 – 600 m nocturnal flight corridor of songbirds (Horton et al. 2016)"* (personal communication, Paul Vanderlaan, Director, Environmental Impact Assessment Branch, August 2018). As a result of this site sensitivity designation, ECCC recommended an extensive monitoring program at the Pokeshaw Wind Project (PBRWP) including a minimum of two years acoustical and radar monitoring along with standard monitoring sufficient for a "very high" sites sensitivity designation.

An ongoing dialogue between the PBRWP, other wind developers in NB, NB Power and the NBDELG has taken place during 2018 and 2019 regarding site sensitivity for projects comprising turbines of >150m in height, and their subsequent pre-construction (baseline) monitoring efforts. The recently published "Additional Information for Wind Turbines document (NBELG 2019a), and discussions between the PBRWP and DELG has resulted in the PBRWP to be classified as "Very High" site sensitivity. NBDELG and the PBRWP has agreed to complete one year of radar and acoustic monitoring as soon as possible, either during the construction phase or the first year of post-construction (personal communication, Paul Vanderlaan, Director, Environmental Impact Assessment Branch, August 2018).

Additional detail regarding monitoring methods and effort completed to date is provided in Section 4.1.5.

3.1.3.1 Size of the Facility

The proposed Project involves construction of five turbines. According to Table 9, the facility size is considered **small**.

Table 9. Facility Size

Size	Definition
Very Large	Contain more than 100 turbines
Large	Contain 41-100 turbines
Medium	Contain 11-40 turbines
Small	**Contain 1-10 turbines**

Level of Concern
Prior to commencement of consultation with DELG, CWS and FPS and completion of field surveys, the PBRWP determined the level of concern for the Project using the framework provided in the *Wind Turbines and Birds. A Guidance Document for Environmental Assessment.* (CWS, 2007a), and *Recommended Protocols for Monitoring Impacts of Turbines on Birds (*CWS, 2007b). Based on this framework, and as shown in Table 10, with a high site sensitivity and small size (<10 turbines), the Level of Concern Category for this Project would have been considered Category 2 depending on the results of future bird surveys.

Table 10. Potential Future Project Category

Facility Size	Site Sensitivity			
	Very High	**High**	Medium	Low
Very Large	Category 4	Category 4	Category 3	Category 2
Large	Category 4	Category 3	Category 2	Category 2
Medium	Category 4	Category 3	Category 2	Category 1
Small	Category 4	**Category 2**	Category 1	Category 1

However, following FPS' recommendations outlined in Section 3.1.3, due to total expected turbine height of >150m, the PBRWP was to be considered a site sensitivity of Very High which is equivalent to a Category 4 Project. Therefore, although a one-year radar and acoustic monitoring study will be completed for the Project, PBRWP implemented an avian baseline monitoring program sufficient to meet the requirements of a Category 4 Project. Category 4 Projects require the highest level of effort (i.e. completed over a calendar year, and post-construction follow-up surveys, spread over two to three years and sometimes more, would likely be required to determine changes in bird use of the area associated with construction of the turbines) (CWS, 2007a).

3.2 Boundaries of the Assessment- Spatial and Temporal

Spatial boundaries of the EIA are defined by the PBRWP Project Area and the PBRWP Study Area (Figures 2 and 5, Appendix A)

The Project Area extends across the properties as listed in Table 2 (Section 2.4), and is designed to buffer and surround all proposed wind project infrastructure (i.e. turbines, access roads and substation).
The Study Area pertains to lands in which biophysical studies were completed in support of this EIA Registration document. All assessments were completed within the Study Area with the exception of the following, expanded area evaluations:

1. Avian Studies included the completion of off-site Watch Count locations which were identified to provide the surveyor an optimum view plane across the Project Area. These locations are discussed further in Section 4.1.5.
2. The community of Pokeshaw was considered for the purpose of data collection relating to existing socioeconomic conditions and evaluation;
3. Residences located within a 2.6 km buffer of the Project Area were assessed as potential receptors to evaluate sound and shadow flicker;
4. Various distances from the Project Area were used throughout the description of desktop study results and the Electro Magnetic Interference (EMI) study, and;
5. Various distances were from the Project Area were evaluated as part of other modeling studies completed including:
    a. Noise Modelling – 2.6 km (closest residential receptor);
    b. Shadow Flicker Modelling - 2.6 km (closest residential receptor), and
    c. Viewshed – 15 km

The temporal boundaries of the PBRWP include the construction, operation and maintenance, and decommissioning phases of the Project, and associated activities.

3.3 Assessment Scope

The EIA focused on specific environmental components called Valued Ecosystem Components (VECs). VECs are specific components of the biophysical, socio-economic, human health and cultural environments. VECs may be important on a local, national or even international scale. The scope of the assessment for this Project included: the selection and assessment of potential VECs; evaluation of the potential VEC interactions with Project activities, identification of environmental effects, if any, for each VEC; identification of mitigation that could be used to reduce the environmental effects, and determination of the significance of residual environmental effects once mitigation was implemented.

3.4 Site Optimization and Constraints

A key aspect of planning the PBRWP was the determination of suitable lands for development including the identification of specific infrastructure locations (i.e. turbine, access road and substation location(s)).

This section details how the PBRWP lands and buildable area was rationalized:

A. Site Optimization: determination of the most appropriate location for the PBRWP to maximize power yields and to minimize overall impact on the landscape.
B. Constraints Analysis: Analysis used to determine appropriate lands for the PBRWP.

3.4.1 Site Optimization

This section describes how multiple factors were considered to determine the footprint for the PBRWP. These factors include technical (i.e., wind resource), financial, construction, socio-economic, landowner, biophysical, as well as community and stakeholder feedback.

The determination of the most appropriate location for the PBRWP turbines helps to minimize the overall impact on the landscape. Detailed planning and analysis were completed to determine available lands and to ensure that the turbines can be located within a buildable area. Minimization of the PBRWP footprint allows the PBRWP to reduce the impact on the environment and reduce construction and development costs.

PBRWP lands were chosen for the following reasons:

1. Very good wind regime to make PBRWP economically viable;
2. Presence of adequate, relatively level land base for placement of turbines and balance of plant (BOP);
3. Presence of previously disturbed land (i.e. clear-cut);
4. Existence of a network of current woods road infrastructure to reduce overall habitat fragmentation and reduce overall construction costs;
5. Ability to locate turbines to meet regulatory setbacks;
6. Proximity to the existing transmission system to connect PBRWP to the grid with a reasonable length of interconnection from the substation;
7. No unique or isolated habitat types identified within the Project Area;
8. No NBDELG Regulated Wetlands within the Project Area;
9. Suitable available land area to allow for adequate setbacks between turbines. Turbines can only be located a certain distance from each other to limit the wind turbulence they create, which can interfere with adjacent turbines. This interference makes each turbine less productive. Furthermore, turbine manufacturers may not allow turbines to be erected if the threshold for turbulence intensity is exceeded, as turbulences might induce stress to major components and will reduce the lifetime of the turbines; and
10. Support from local landowners.

3.4.2 Constraints Analysis

Once the general process of site optimization was completed and a Project Area confirmed, a more detailed and site-specific process of constraints analysis was completed.

Detailed planning and analysis were completed to determine available lands (based on the factors described above) and to ensure that infrastructure can be located within the smallest footprint.

Site specific constraints that were used for PBRWP are as follows:

1. Landowner(s): Consultation with landowners in the area revealed that some lands were not available for development.
2. Private versus Public land: No turbines will be located on public lands, except that approx. 2.5 km of the electrical collection system will be installed within the right of way of the Ridge Road, which is public land.
3. Topographical Constraints: Known data from federal and provincial topographic maps can be used to determine optimal locations for turbine placement. Slopes in excess of 15% can be eliminated from the available land base due to construction restrictions.
4. Road Setbacks: As per consultation with the Department of Transportation and Infrastructure, setbacks between wind turbines and existing roads are required.
5. Power Line Setbacks: NB Power has confirmed that setbacks between wind turbines and power line infrastructure are required.
6. Setbacks between turbines: Adequate distances between turbines are necessary in order to minimize energy losses due to wake and turbulence.
7. Noise limitations: Health Canada guidelines advise a maximum of 40 dBA at any residential receptor. Predictive noise modelling with worst case assumptions was completed for PBRWP as discussed further in Section 8.
8. Shadow flicker limitations: Health Canada guidelines, which state a maximum of 30 hours per year and 30 minutes per any one day at any residential receptor, were used to support the siting of wind turbine locations. Predictive shadow flicker modelling with worst case assumptions was completed for PBRWP as discussed further in Section 9.
9. Environmental Setbacks: as a result of biophysical baseline surveys completed in support of PBRWP, setbacks from proposed infrastructure have been imposed on wetlands, watercourses and unique habitat where Species at Risk (SAR) birds were observed to the extent possible (i.e. taking into consideration the other constraints described above). Additional information related to setbacks from these features is provided below. A discussion of potential impacts to these features and mitigation measures to reduce potential impacts is provided in Section 14.
10. Protected Areas: the Pokeshaw Rock Important Bird Area (IBA) boundary lies 1,100 m northeast of the Project Area. The nearest turbine (WTG5) is 2,789 m from the Pokeshaw Rock itself.
11. Electromagnetic Infrastructure Consultation Zones: Wind turbines can cause interference with existing electromagnetic infrastructure, such as radio towers and point-to-point microwave links. PBRWP infrastructure is sited according to the Radio Advisory Board of Canada (RABC) guidelines, as outlined in Appendix G.
12. Archaeology: PBRWP infrastructure is sited to avoid direct impact to archaeological resources. The Archaeological Predictive Model and a Heritage Resource Impact Assessment was completed as part of PBRWP. Results of the studies are provided in Section 7.
13. Wind Regime: Potential turbine sites are selected based on the wind regime specific to PBRWP lands from validated wind measurements. Collection of site-specific data for wind speed and direction are crucial to determining site potential. Once specific turbine site determinations were modeled, considerations of the loss of output due to mutual interference between turbines is factored in. Wind regime mapping was used to identify optimal wind resource areas within the land base. This allows for effective placement of the turbines to maximize power generation from the wind resource for PBRWP based upon expected energy outputs within the modeled wind regimes. Additional information regarding Wind Analysis is provided in the following section.

3.4.2.1 **Wind Analysis**

The wind regime on site was initially analyzed with satellite re-analysis data, such as Merra2, which suggested that wind conditions at the site are very good. A 60 m tubular met mast was installed in December 2016, to confirm this analysis. The tower is equipped with 6 anemometers; two at each height of 38 m, 48 m and 58 m. Additional instrumentation includes two wind vanes, a thermometer, and air pressure and humidity sensors. Together, the data can be used to profile wind speed and wind direction, as well as climate conditions.

In total, the data collection period has exceeded 25.5 months, providing data from 24 months for analysis. Some losses were caused by icing in the measurement data and were excluded for wind speed and direction assessment, respectively used to assess likely production losses due to iced turbine blades.

In order to decrease uncertainty regarding wind speeds and direction at the likely hub height of 132m, a SoDAR wind measurement system (AQSystems AQ 510) was installed for 7.5 months between May 10th, 2018 and December 21st, 2018. A photo of the SoDAR and met mast installation at Pokeshaw is provided in Appendix C.

Measurements confirm the strong wind resource and suitability of the PBRWP as a very productive site for wind energy. Using industry standard protocols, the site can be classified as an upper class II (IEC 61400-1:2005) site. This outcome confirms the conditions stated in the NB Wind Resource Map with average wind speeds of 7 – 8 m/s at heights of 80m.

Table 11 - PBRWP Wind Statistics - Wind Speed, Turbulence, Max Wind Speeds

PBRWP Wind Statistics	Mean WS, LT corr.	Turbulence Intensity > 4 m/s	Max. Wind Speed [m/s]	
	m/s	%	10 min V_{ref}	u 50 y
60 m	6.46	13.1	23.4	/
85 m	7.40	11.1	26.4	33.4
100 m	7.84	10.4	26.8	36.1
115 m	8.14	9.9	25.5	38.9
125 m	8.32	9.6	25.9	40.5
135 m	8.48	9.4	25.9	42.8
150 m	8.70	9.1	/	/

In order to grant efficient harnessing of the wind resource, the alignment of the five proposed turbines was positioned perpendicular to the main wind direction of west-northwest. The stretch of the Ridge Road is ideally aligned to locate the turbines in a row at an angle of approximately 90 degrees to the prevailing wind direction. This layout also accommodates extreme winds, as it reduces the impact of turbulences in strong wind periods by placing the turbines side by side in prevailing wind conditions, and not one in front of the other.

3.4.3 Setbacks for Final Layout

As per the NBELG EIA Sector Guidelines for Wind Turbines, among other considerations, specific attention should be made for birds and bats, wildlife at risk and archaeological resources when siting wind turbines. Information relating to these environmental components (and others) are discussed separately in their associated chapters in Sections 5, 6 and 7. Potential impacts, an Effects Assessment and Mitigation (including associated setbacks) for these components, is provided in Section 14. A general discussion of setbacks applied to the siting of Project infrastructure, however, is provided below.

The development of the infrastructure layout for the PBRWP was done so by determining a “buildable area”. The buildable area takes into consideration all constraints listed above, applies all setbacks (environmental and non-environmental) to identify land area available for the siting of Project infrastructure. Constraints applicable to the Project and the resulting buildable area are provided on Figure 6 (Appendix A).

Table 12 presents the setbacks (and resulting buildable area) from proposed Project infrastructure associated with the PBRWP and provides an explanation of each setback and rationale for the location of Project Infrastructure.

Table 12. Environmental Constraints and Setbacks

Constraint	Setback/Constraint Definition	Setback/constraint (m)	Constraint/Setback Applied?	Rationale for Infrastructure Location
Wind Regime	Wind turbine guidelines recommend a setback of approximately five (5) times rotor diameter between wind turbines, which may give a more efficient layout.	650 m based on 5 times rotor diameter (130m).	422m based on 3.2 times rotor diameter.	Although this reduces efficiency, the setback was reduced to allow for maintaining other constraints noted in this Table (i.e. wetland setbacks). Despite the relatively short setbacks between the turbines, the final turbine layout provides a stable ratio of yield over development area. A distance of less than 3.6 times rotor diameter cannot be applied at this site due to turbulences and impact of shear on turbine major components.
Land Ownership	Development not possible in non-participating properties.	Fall height or 200 m based on a 200 m max height.	Yes	Infrastructure located to avoid non participating properties.
Topographical Constraints	Areas exhibiting slopes >15% avoided.	No setbacks	N/A	No areas exhibiting slopes >15% within Project Area.
Road Setbacks	NBDTI require setbacks between proposed turbines and public roads.	500 m from provincially owned and maintained roads. 1.5 times total height (300 m) from provincially owned and unmaintained roads.	300 m from Ridge Road– Yes 500 m from Highway 135 - Yes	Turbines located outside of road setback areas.
Power Line Setbacks	NB Power require setbacks between proposed turbines and power lines.	180 m from power line.	Yes	Turbines located outside of power line setback areas.
Noise Limitations	To ensure a maximum of 40 dBA at any residential receptor is not exceeded.	40 dBA	Yes	Turbines located beyond the modelled 40dBA limits. See Section 8 for more information.

Constraint	Setback/Constraint Definition	Setback/constraint (m)	Constraint/Setback Applied?	Rationale for Infrastructure Location
Shadow Flicker	To ensure a maximum of 30 hours per year and 30 minutes per any one day of shadow flicker is not exceeded.	30 hr/year 30 min/day	Yes	Turbines located beyond the modelled limits noted. See Section 9 for more information.
Visual Impacts	No specific setbacks pertaining to turbine locations and visual impacts from residential and public places.	No setbacks applicable	N/A	Turbines positioned in buildable area but sited to minimize visual impact to the maximum extent possible. Additional information regarding visual impact analysis, potential impacts and mitigation are provided in Sections 4.5, 10, and 14.2.11 respectively.
Electromagnetic Infrastructure Consultation Zones	Various consultation areas are defined by the Radio Advisory Board of Canada (RABC).	Various	Yes	Turbines located outside of the Electromagnetic Infrastructure Consultation Zone. See Section 11 and Appendix G for more information.
Wetlands	No setback applicable between wetlands and wind turbines on Private land in NB.	No setbacks applicable on private land.	WTG1 (centre) – 249 m from WL#2 WTG2 (centre) – 188 m from WL#10 WTG3 (centre) – 99 m from WL#3 WTG4 (centre) – 53 m from WL#10 WTG5 (centre) – 113 m from WL#7	Wind turbines were sited within the buildable area and setback from wetland locations to the maximum extent possible. Additional information regarding wetland functions, potential impacts and mitigation are provided in Sections 4.1.7, 5.5.1, and 14.2.7 respectively.
Watercourses	No setback applicable between watercourses and wind turbines on Private land in NB.	No setbacks applicable on private land.	WTG1 (centre) – 224 m from Riviere du Nord WTG2 (centre) – 379 m from Riviere du Nord	Wind turbines were sited within the buildable area and setback from the one watercourse (Riviere du Nord) to the maximum extent possible.

Constraint	Setback/Constraint Definition	Setback/constraint (m)	Constraint/Setback Applied?	Rationale for Infrastructure Location
			WTG3 (centre) – >515 m from Riviere du Nord WTG4 (centre) – 94 m from Riviere du Nord WTG5 (centre) – >1000 m from Riviere du Nord	Additional information regarding the characteristics, potential impacts and mitigation of Riviere du Nord are provided in Sections 4.1.7, 5.5.2, and 14.2.6 respectively.
Birds	The Pokeshaw Rock Important Bird Area (IBA) boundary (NB005)	1km	Yes	All project infrastructure has been sited outside of the Pokeshaw Rock IBA with a minimum distance of 1,228m (to the IBA boundary) and 2,714m to the Pokeshaw Rock itself.
	While there are no specific setbacks pertaining to turbine locations and SAR/SOCI birds, efforts were made to relocate turbines away from any field observations of SAR/SOCI birds. No unique habitat was identified across the Project Area for SAR/SOCI birds that isn't readily available in adjacent lands.	No setbacks applicable	No	As a result of observations of SAR/SOCI bird species, turbines were microsited to avoid these locations to the maximum extent possible, within the buildable area. No unique habitat for SAR/SOCI birds was identified across the Project Area.
Bats	No specific setbacks pertaining to turbine locations and bat activity in New Brunswick.	N/A	N/A	Turbines have been setback from suitable bat habitat (i.e. riparian areas, open water) to the maximum extent possible.
Archaeology	Setbacks to archaeological resources (if present) likely required from Project infrastructure.	Various depending on historical resource encountered.	No	Results of a Heritage Resource Impact Assessment indicate no historical resources within the Project Area. No setbacks/constraints apply.

As a result of the constraints analysis performed, and the identification of additional environmental factors during field surveys, the Project Team have determined the optimized layout for the PBRWP. This process has involved consideration of comments provided by government departments to date including DELG, Environment and Climate Change Canada's Canadian Wildlife Service (CWS), Department of Energy and Resource Development (ERD) Crown Lands Branch (Planning Section) and the Department of Transport and Infrastructure. The Project Team have optimized the infrastructure layout to minimize potential environmental interaction, while ensuring the PBRWP is an economically viable Project. **As such taking all constraints into account, the infrastructure layout presented in this Registration Document reflects the best option for the PBRWP.**

3.4.4 Discussion of Alternatives

The Project location was selected based on a number of factors listed above in Sections 3.4.1 and 3.4.3. Other turbine locations were considered throughout the design process. In addition, other Project locations beyond Pokeshaw, NB were considered as alternatives.

Within the development process of the Project Area, proposed turbine locations were considered; notably to the west of Highway 135. Wind resource, property access and land use (agriculture) were determining factors in the inability to move forward with these locations. Additional micrositing of turbines occurred within the main Project Area to avoid locations where SAR bird species were observed, to maximize wetland and watercourse setbacks and avoid non participating properties.

As part of the LORESS Request for Expressions Of Interest, the PBRWP also considered other Project locations within New Brunswick. This included the completion of feasibility studies, environmental constraints analysis and cost benefit analysis to determine suitable locations. Other locations, in central New Brunswick and close to Sackville, NB were submitted as part of the LORESS screening process, however, the Pokeshaw location was determined to be the more favourable Project as determined by the LORESS process.

4 ASSESSMENT METHODOLOGIES

The EIA registration document for the PBRWP describes the biophysical, social, and economic environment. All VECs were identified, and the potential for interaction between individual VECs and Project activities were determined.

The Project Team, through an evaluation of the VECs, identified Project environmental effects that, post-mitigation, have the potential for a residual effect on the environment. The significance of these residual effects was then determined and evaluated (Section 14).

This chapter details the following key aspects of the EIA methodologies:

A. Biophysical: birds, bats, species at risk, wildlife, vegetation and habitat, watercourse evaluation, and wetland functional assessment and delineation.
B. Archaeological Resource Assessment.
C. Sound Modelling.
D. Shadow Flicker Modelling.
E. Visual Impact Analysis.

4.1 Biophysical Assessments

In April of 2018, field assessments were initiated. Assessments continued through June 2019 complying with the requirements for an undertaking as defined in New Brunswick's *Environmental Impact Assessment Regulation*. The field assessments focused on highlighting the ecological linkages within the Study Area, as well as with the habitats surrounding the Study Area. The field components included:

1. Habitat surveys;
2. Botanical surveys (late and early) for Priority Species;
3. Winter wildlife surveys;
4. Herpetofauna, mammal and other taxonomic group surveys for Priority Species;
5. Avian baseline surveys: spring migration, breeding bird, fall bird migration, raptor nest surveys and Common Nighthawk surveys;
6. Bat surveys;
7. Wetland and watercourse identification and evaluation;
8. Archaeological assessments- Phase I (Desktop) and Phase II (Field).

4.1.1 <u>Habitat Surveys</u>

The desktop and field methodologies used for the habitat assessments are provided below.

4.1.1.1 Desktop Review

During August 2018, a desktop review was conducted using the available GIS forestry layers to determine the major forest and land use types within the Study Area. Forestry cover data was obtained from the Department of Energy and Resource and Development (ERD) Forest Inventory databased accessed through GeoNB (GeoNB, 2019).

4.1.1.2 Field Surveys

Five transects were created on ArcGIS 10.4.1 to cover key forest types found within the Study Area. Sufficient amount of wetland habitat data was anticipated to be collected during the wetland assessments (see section 5.5.1), therefore, transects covering only upland habitats were created in this initial scoping exercise. Transects determined from the desktop review were used as a rough estimate to where surveys should take place.

On August 29th – 31st, 2018 habitat assessments were completed within the Study Area by Mr. John Gallop, P.Biol and Mr. Louis Charron. The transects were adjusted in the field based on the presence of disturbances not detected during the desktop review (e.g. cut block) and the complexity and variation of the canopy. While the surveyors walked the transects, Habitat Assessment Points (HAP) were surveyed when plant community structure changes were observed.

Habitat surveys were also completed in June 2019 at proposed turbine locations.

Habitat types were recorded at each HAP as per *the Atlantic Canada Ecosystems Classification Keys* (NCC, 2016). During the assessments, the following information was documented:

- Habitat type was determined using the *Atlantic Canada Ecosystems Classification Keys* (NCC, 2016). To determine the habitat type present within the Project Area, the ecosystem (e.g. wooded wetlands, open freshwater, open woodlands etc.) and the community (e.g. Floodplain Forest [FP], Tolerant Hardwood Forest [TH] etc.) was determined using the key. The habitat type (e.g. TH4, TH6 etc.) are recurring and identifiable plant communities which reflect differences in site conditions (e.g. soil nutrient and moisture regime), natural disturbance regimes and successional stage. For example, TH4 is a tolerant hardwood forest group dominated by Sugar Maple and White Ash vegetation type, while TH6 is a tolerant hardwood forest group dominated by Red Oak and Yellow Birch vegetation type.
- Stand Age classification (Over-mature, Mature, Immature and Regenerating) was determined through qualitative observations of multiple factors such as total basal area, level of canopy coverage, microtopography and species composition (including epiphytic lichen community composition) of the understory herb and shrub layers.
- Natural or anthropogenic disturbance is recorded in each site. The level and type of disturbance is identified. Examples of anthropogenic disturbances include timber harvesting or road

development. Natural disturbance regimes include fire, pests, wind throw and natural senescence.

- Representative photos were taken of each site.

It is also important to note that the habitat survey methods and results are presented with the acknowledgment of three biases which have been built into the survey methods. These are as follows:

- Bias towards upland habitat. This bias was purposefully built into the survey methods with the understanding that all wetlands within the Study Area were delineated and evaluated in detail through completion of the separate wetland study.
- The second bias is towards forested landscapes as opposed to non-forested landscapes. In this context, clear cut lands, or those which have experienced timber harvesting of any sort, are still considered forested because the removal of timber is only a temporary disturbance. Non-forested portions of the landscape, such as roads or extensive gravel areas, often associated with historic mine workings, were not assessed during the habitat survey simply because they lack forest cover and their capability for supporting forest cover in the foreseeable future is low based on the level of disturbance present
- The third bias in this survey is that habitat surveys were completed at discrete points and no effort was made to delineate the extent of that habitat type around those points. As such, the ability to extrapolate habitat survey results across the entire Project Area is limited. These habitat survey points are meant to describe habitat in 'snapshots' of specific locations and completed to provide a summary of habitats present within the Study Area and also to inform specific biophysical field surveys. The results of the habitat survey describe the diversity of habitat types present throughout the Study Area and the relative abundance thereof, rather than absolute percent cover of each habitat type throughout the Study Area. As stated above, habitat surveys were also completed at each individual WTG.

4.1.2 Vascular Plant Surveys

The following are the desktop and field survey methodologies used during the vascular plant survey program.

4.1.2.1 **Desktop Review**

Prior to undertaking the field assessment, a detailed desktop review of known vascular plant observations and potential habitat for rare plants within the Study Area was conducted. The desktop review process involved three components: a review of the ACCDC database results, a review of mapped wetland habitat and a review of the Priority Species List.

4.1.2.2 **Field Survey**

Surveys focused on identifying vascular plant Priority Species as well as identifying general vegetative communities within the Study Area. Early and late surveys were completed by John Gallop, P.Biol on June 11th- 13th and August 29th – 30th, 2018 to capture vascular plant species with different flowering periods throughout the growing season.

Mr. Gallop walked meandering transects and targeted land features with higher rare plant potential such as tolerant hardwood landscapes, seepages, wetlands and floodplains. Every wetland within the Study Area was visited and assessed for vascular plant rarities. A general species list was made of vascular plant species observed. In addition to targeting the aforementioned habitats, disturbed habitats such as clearings and road ditches were assessed as a variety of Priority Species can be known to thrive in these habitats. In the event that a specimen could not be identified in the field, specimens were photographed and/or collected and pressed for identification at a later time. All SAR and/or SOCI species observed were georeferenced, counted, photographed, and their habitat was recorded. The following literature was referenced during the surveys and the identification process:

- Roland's Flora of Nova Scotia (Zinck, 1998);
- Flora of New Brunswick (Hinds M. , 2000);
- GoBotany Digital Keys (Go Botany, 2019);
- Sedges of Maine: A Field Guide to Cyperaceae (Aresenault, 2013)

4.1.3 Lichens

The following are the desktop and field survey methodologies implemented as part of the lichen study across the Study Area.

4.1.3.1 **Field Surveys**

Lichen observations were collected concurrent to the vascular plant surveys. A general list of lichen species and any SAR/SOCI species observed were georeferenced, counted, photographed and habitat was recorded at the lichen location.

While the specific habitat requirements of each of priority lichen species varies slightly, many require mature to over-mature forests; stand age is one of the greatest determinants of the presence of many rare epiphytic lichens (i.e. lichens which grow on other plants) (McMullin et al., 2008). During the vascular plant surveys any of the aforementioned habitat observed was assessed for lichen species. In the event that a lichen specimen could not be readily identified in the field, photos and/or specimens were collected and identified at a later date. If necessary, collected samples were inspected with microscopy and standard chemical spot tests in accordance with Brodo, Sharnoff and Sharnoff (2001) to identify to the species level. The following literature was referenced during the surveys and identification process:

- The Macrolichens of New England (Hinds & Hinds, 2007);
- Lichens of North America (Brodo, Sharnoff, & Sharnoff, 2001);
- Keys to Lichens of North American – Revised and Expanded (Brodo, Sharnoff, & Sharnoff, 2016);
- Microlichens of the Pacific Northwest – Volume 1 – Key to The Genera (McCune, 2009a);
- Microlichens of the Pacific Northwest – Volume 2 – Key to the Species (McCune, 2009b);
- Common Lichens of Northeastern North America (McMullin & Anderson, 2014)

4.1.4 Wildlife Surveys

Wildlife surveys were completed throughout the Study Area by Roland Chiasson during avian surveys and by MEL staff during biophysical surveys.

4.1.4.1 **Winter Wildlife**

Winter wildlife surveys were completed in January and February of 2019. The survey involved the completion of 8 transects within the Study Area (Figure 7b, Appendix A). The transects were walked and all signs of wildlife, including tracks, scat, browse, and hair snags that were observed were recorded. Any birds that were present or could be heard were also recorded. Locations of observations were geo-referenced with a handheld GPS unit.

4.1.4.2 **Herpetofauna Surveys**

Habitat survey results within the Study Area indicated that there was limited habitat potential within the Study Area for priority herptofaunal species (Wood Turtle and Snapping Turtle), therefore, no targeted herpetofauna surveys were undertaken. However, all watercourses were evaluated for wood turtle habitat during wetland and watercourse surveys in 2018, and efforts were made to locate these species including overturning rocks and inspection of crevices, fallen logs and other potential habitats. Incidental observations of herptofauna across the Study Area were documented during all field surveys completed through 2018.

4.1.5 Avian

As discussed in Section 3.1.3 (Site Sensitivity Determination), PBRWP implemented an avian survey program at the PBRWP consistent with a Project classified as "Very High" site sensitivity. As well, the avian study took into consideration comments provided by CWS during the consultation stages of the Project with NBDELG.

Avian field monitoring programs were completed by Birder Roland Chiasson to meet the expectations of the site sensitivity. The following surveys were completed:

- Eight rounds of Spring migration monitoring (including passage migration/diurnal watch counts and point counts) (April 30, May 1, May 5, May 6, May 11, May 12, May 14, May 15, May 18, May 19, May 23, May 24, May 26, May 31, 2018);
- Two rounds of Breeding bird point count monitoring supplemented by 4 standardized area searches (June 10 and June 30, 2018)), two further rounds of Breeding bird point count monitoring (June 13 and July 2, 2019), and eight rounds of passage migration/diurnal watch count monitoring during breeding season (June 9, June 13, June 14, June 17, June 18, June 29, July 9, and July 17, 2018). In addition, one, round of Common Nighthawk surveys was completed (June 29, 2018).
- Eight rounds of Fall migration monitoring (including passage migration/diurnal watch counts, point counts and transects) (August 3, August 19, August 20, August 29, August 30, September 7, September 8, September 13, September 14, September 18, September 19, September 26, September 27, October 3, October 4, October 9, October 10, 2018); and,
- Two rounds of Winter Surveys (January 12 and February 6, 2019).

CWS guidance recommends that point counts be completed along established transects during non-breeding seasons (CWS, 2007b). However, during this project, point count surveys, which were supplemented by non-standardized transect surveys in-between them in the Fall, were considered by MEL and the birder as an effective method for determining avian abundance and diversity within the Study Area and surrounding landscape. Point counts were spaced a minimum of 250m apart and the birder walked from point count to point count, recording observations en route. A series of point counts rather than transects were completed during the Fall and Spring surveys because the risk of double counting birds is significantly reduced during these seasons when bird activity can be more intense especially within smaller areas. When birds are recorded at specific and discrete locations, the surveys are more standardized and repeatable. Given the size of the Project Area, and the close proximity and frequency of point counts, point count surveys were deemed to provide comprehensive coverage during both migration seasons. During the Fall period however, where bird activity is dominated more so by migration activity and not localized movement, which is typically seen during Spring, double counting is less likely and as such, point count surveys were supplemented with transect surveys.

Point counts were accessed by foot, and any incidental observations of species not encountered during point count surveys, or Priority Species, were also recorded. It should be noted that all bird data collected within the Study Area are noted in the following sections and included in the overall analysis. Point count locations located in the broader Study Area, but beyond the Study Area boundaries can be used as off-site control locations for future post construction monitoring should it be required. Point counts are described in more detail in the following seasonal methodology sections.

Passage migration/diurnal watch counts were surveyed during spring, breeding and fall seasons. Locations that provided good vantage points over the Study Area were surveyed in addition to the coastal location at Pokeshaw Rock. Throughout the surveying periods, locations were adjusted to capitalize on better vantage points and in reaction to observed bird activity. Survey timing was also modified to capture different times of the day and various tide events. Watch counts are described in more detail in the following sections.

As a result of the proximity of the Study Area to the Pokeshaw Rock IBA, Double-crested Cormorant activity was a particular focus during the watch count surveys. Furthermore, Watch Count 1 (WC1), Pokeshaw Beach, remained a consistent location throughout, while other watch count survey locations were adjusted to adapt to changing Double-crested Cormorant activities throughout the year.

During all surveys, weather conditions (i.e., precipitation and visibility) were monitored and confirmed to be within the parameters required by monitoring programs such as ECCC's Breeding Bird Survey. If weather conditions changed during a survey to the point that they were unsuitable (i.e. high wind, rain, fog, etc.), the survey was postponed until suitable conditions were available.

Bird observations were recorded at four distance regimes, within a 50m radius, 50 to 100 m radius, outside the 100m radius, and flyovers. Each time a flyover was observed, it's flight height and direction were recorded to support behavioural observation, and to support the calculation of risk of collision for each bird group. For each point count, a record was made of the start time, and a hand-held GPS unit was used to geo-reference its location. General observations including the temperature, visibility, wind speed, date, start and end time and point count were also recorded. Bearings were taken for Priority Species observed both during dedicated survey periods and incidentally.

Point count surveys began at, or within, half an hour of sunrise and were completed within four-and-a-half hours or by 10:00 a.m., whichever came first. Ten-minute point counts were completed at each survey location, during all seasonal surveys except where noted otherwise (i.e. Common Nighthawk surveys). Point count locations are shown in Figure 7a (Appendix A).

Table 13. Point Count Locations

Point Count	Location (Latitude & Longitude)	Point Count	Location (Latitude & Longitude)
PC1	N47° 45.830' W65° 14.484'	PC14	N47° 47.021' W65° 13.035'
PC2	N47° 45.965' W65° 14.283'	PC15	N47° 46.108' W65° 13.950'
PC3	N47° 46.003' W65° 14.028'	PC16	N47° 46.535' W65° 13.465'
PC4	N47° 46.281' W65° 13.975'	PC17	N47° 46.557' W65° 13.883'
PC5	N47° 46.353' W65° 13.715'	PC18	N47° 46.721' W65° 13.889'
PC6	N47° 46.611' W65° 13.614'	PC19	N47° 46.933' W65° 13.721'
PC7	N47° 46.905' W65° 13.509'	PC20	N47° 47.133' W65° 13.126'
PC8	N47° 46.523' W65° 13.131'	PC21	N47° 46.680' W65° 13.294'
PC9	N47° 46.762' W65° 13.366'	PC22	N47° 46.517' W65° 13.057'
PC10	N47° 46.888' W65° 13.276'	PC23	N47° 46.453' W65° 13.428'
PC11	N47° 47.090' W65° 13.436'	PC24	N47° 46.228' W65° 13.687'
PC12	N47° 47.187' W65° 13.384'	PC25	N47° 47.246' W65° 13.256'
PC13	N47° 47.341' W65° 13.314'	PC26	N47° 46.047' W65° 14.220'

The passage migration watch counts were completed during spring and fall migration, and breeding season (2018 only) to supplement the point count and transect data collected within the Study Area (see Table 14 below). During these surveys, observed birds were recorded along with their passing height, direction and notes on behaviour. General observations including the temperature, visibility, wind speed, and date were also recorded.

Watch count surveys were completed at various times of the day and at various tidal stages. A watch count is a behavioral study which is intended to primarily determine how birds are using the area, especially to determine whether they are regularly flying through areas that will be swept by blades after the turbines are built, or are using sites or habitats that will be directly affected by the construction process (CWS, 2007b). Transect surveys also supplemented point count surveys during fall migration, and non-standardized area searches occurred during breeding season. The methods for these surveys are described in greater detail below. Watch count locations are shown in Figure 7b (Appendix A).

Table 14. Watch Count Locations and Descriptions

Watch Count	Location (Latitude & Longitude)	Description
Watch Count 1 (WC1)	N47° 47.335' W65° 15.096'	Located with a view of Pokeshaw Rock, Pokeshaw Beach and a 360° view plane. WC1 provided a clear ability to determine flight paths of leaving and returning diurnally active birds and migratory routes. Behavioural characteristics of birds utilizing the coastal environment adjacent to Pokeshaw Rock were recorded from this location.
Watch Count 2 (WC2)	N47° 45.212' W65° 13.502'	WC2 is at a higher elevation than the Project Area and provides a good view plane across middle sections of the site. WC2 offered an open sky view of potential fly path routes across the Project Area.
Watch Count 3 (WC3)	N47° 46.265' W65° 13.829'	WC3 was a higher portion of land in a clear cut that offered a 360° view of the Project Area. It was used as an alternate to WC2 as it provided more accurate detail regarding on site passerine use of the Project Area and determination of potential Double-crested Cormorant flight paths.
Watch Count 4 (WC4)	N47° 46.556' W65° 13.655'	This location was an alternate to WC3 as it was closer to the observed Double-crested Cormorant activity, eastward of the Project Area and still provided a 360° view of the Project Area.

Watch Count	Location (Latitude & Longitude)	Description
Watch Count 5a (WC5a)	N47° 47.576' W65° 14.727'	WC5a was located at the entrance to the neighbouring peat/cranberry facility and chosen to better understand Double-crested Cormorant activity.
Watch Count 5b (WC5b)	N47° 47.479' W65° 14.218'	WC5b was located at the reservoir of the neighbouring peat/cranberry facility which was observed to be utilized by waterbirds.

Detailed descriptions of each survey methodology are provided in the following sections.

4.1.5.1 Spring Migration

Point Counts

Spring migration point count surveys were completed by Roland Chaisson on May 1, May 6, May 12, May 14, May 19, May 24, May 26, and May 31, 2018. Surveys were conducted at nineteen-point count stations within the Study Area (Figure 7a, Appendix A). Table 15 provides the dates in which surveys were performed.

Table 15. Spring Migration Point Count Locations, Dates and Effort

Point Count	Location (Latitude & Longitude)	Dates	Effort (minutes)
PC1	N47° 45.830' W65° 14.484'	May 1, May 6, May 12, May 14, May 19, May 24, May 26, May 31, 2018	8 x 10 minute/Point Count = 80 minutes
PC2	N47° 45.965' W65° 14.283'	May 1, May 6, May 12, May 14, May 19, May 24, May 26, May 31, 2018	8 x 10 minute/Point Count = 80 minutes
PC3	N47° 46.003' W65° 14.028'	May 1, May 6, May 12, May 14, May 19, May 24, May 26, May 31, 2018	8 x 10 minute/Point Count = 80 minutes
PC4	N47° 46.281' W65° 13.975'	May 1, May 6, May 12, May 14, May 19, May 24, May 26, May 31, 2018	8 x 10 minute/Point Count = 80 minutes
PC5	N47° 46.353' W65° 13.715'	May 1, May 6, May 12, May 14, May 19, May 24, May 26, May 31, 2018	8 x 10 minute/Point Count = 80 minutes
PC6	N47° 46.611' W65° 13.614'	May 1, May 6, May 12, May 14, May 19, May 24, May 26, May 31, 2018	8 x 10 minute/Point Count = 80 minutes
PC7	N47° 46.905' W65° 13.509'	May 1, May 6, May 12, May 14, May 19, May 24, May 26, May 31, 2018	8 x 10 minute/Point Count = 80 minutes
PC8	N47° 46.523' W65° 13.131'	May 12, May 14, May 19, May 24, 2018	4 x 10 minute/Point Count = 40 minutes
PC9	N47° 46.762' W65° 13.366'	May 1, May 12, May 14, May 19, May 24, May 26, May 31, 2018	7 x 10 minute/Point Count = 70 minutes

Point Count	Location (Latitude & Longitude)	Dates	Effort (minutes)
PC10	N47° 46.888' W65° 13.276'	May 6, May 12, May 14, May 19, May 24, May 26, May 31, 2018	7 x 10 minute/Point Count = 70 minutes
PC11	N47° 47.090' W65° 13.436'	May 1, May 6, May 12, May 14, May 19, May 24, May 26, May 31, 2018	8 x 10 minute/Point Count = 80 minutes
PC12	N47° 47.187' W65° 13.384'	May 1, May 6, May 12, May 14, May 19, May 24, May 26, May 31, 2018	8 x 10 minute/Point Count = 80 minutes
PC13	N47° 47.341' W65° 13.314'	May 6, May 12, May 14, May 19, 2018	4 x 10 minute/Point Count = 40 minutes
PC14	N47° 47.021' W65° 13.035'	May 6, May 12, May 14, May 19, May 24, 2018	5 x 10 minute/Point Count = 50 minutes
PC15	N47° 46.108' W65° 13.950'	May 24, May 26, May 31, 2018	3 x 10 minute/Point Count = 30 minutes
PC16	N47° 46.535' W65° 13.465'	May 24, May 26, May 31, 2018	3 x 10 minute/Point Count = 30 minutes
PC17	N47° 46.557' W65° 13.883'	May 26, May 31, 2018	2 x 10 minute/Point Count = 20 minutes
PC18	N47° 46.721' W65° 13.889'	May 26, May 31, 2018	2 x 10 minute/Point Count = 20 minutes
PC19	N47° 46.933' W65° 13.721'	May 26, May 31, 2018	2 x 10 minute/Point Count = 20 minutes
Total Surveying Time			**1,110 minutes**

Passage Migration/Diurnal Watch Counts

Spring migration watch count surveys were completed by Roland Chaisson on April 30, May 5, May 6, May 11, May 12, May 14, May 15, May 18, May 19, May 23, May 24, May 26, and May 31, 2018. Surveys were conducted at four watch count stations: two within, and two surrounding the Project Area.

- WC1 was selected for its proximity to Pokeshaw Rock and clear viewplane;
- WC2 was selected for its good vantage point; it's located on higher land southeast of the Project Area;
- WC3 was selected for its good vantage point within the Project Area; it's located within clearcut; and,
- WC4 was selected for its sight lines of Double-crested Cormorant activity and still provided a 360° view of the Project Area.

Generally, each watch count was surveyed for two hours per survey round with effort split between the early morning and late morning to capture varying tidal cycles. On certain occasions watch count length was longer (2, 2.25 or 3.5 hours). Bird movement on these days was fairly active and the surveyor stayed to witness movement patterns. WC1 was surveyed for a total of 1,010 minutes/16.8 hours over 13 visits. Watch count 2 (WC2) was surveyed for a total of 240 minutes/4 hours over 2 visits. Watch Count 3 (WC3) was surveyed for a total of 660 minutes/11 hours over 11 visits. Watch Count 4 (WC4) was surveyed for a total of 60 minutes/2 hours over 1 visit. Certain watch count locations (i.e. WC1 and WC3) provided better vantage points as the season progressed, while at others (i.e. WC2 and WC4), minimal bird activity was identified, and the locations were deemed less efficient and therefore dropped from the survey.

Table 16. Spring Migration Watch Count Locations, Dates and Effort

Watch Count	Location (Latitude & Longitude)	Dates	Effort (minutes)
WC1	N47° 47.335' W65° 15.096'	April 30, May 5, May 6, May 11, May 12, May 14, May 15, May 18, May 19, May 23, May 24, May 26, May 31, 2018	935
WC2	N47° 45.212' W65° 13.502'	April 30, May 15, 2018	240
WC3	N47° 46.265' W65° 13.829'	May 5, May 6, May 11, May 12, May 14, May 18, May 19, May 23, May 24, May 26, May 31, 2018	660
WC4	N47° 46.556' W65° 13.655'	May 12, 2018	60

4.1.5.2 <u>**Breeding Birds**</u>

<u>Point Counts</u>

Point count surveys for breeding birds were conducted by Roland Chiasson on June 10 and 30, 2018, and June 13 and July 2, 2019 at twenty-five point count stations surveyed during the late spring (Figure 7a, Appendix A). Table 17 provides the dates in which surveys were performed.

Table 17. Breeding Bird Point Count Locations, Dates and Effort

Point Count	Location (Latitude & Longitude)	Dates	Effort (minutes)
PC1	N47° 45.830' W65° 14.484'	June 10, June 30, 2018	2 x 10 minute/Point Count = 20 minutes
PC2	N47° 45.965' W65° 14.283'	June 10, June 30, 2018	2 x 10 minute/Point Count = 20 minutes
PC3	N47° 46.003' W65° 14.028'	June 10, June 30, 2018	2 x 10 minute/Point Count = 20 minutes
PC4	N47° 46.281' W65° 13.975'	June 10, June 30, 2018, June 13, 2019, June 13, 2019, July 2, 2019	2 x 10 minute/Point Count = 20 minutes
PC5	N47° 46.353' W65° 13.715'	June 10, June 30, 2018, June 13, 2019, June 13, 2019, July 2, 2019	2 x 10 minute/Point Count = 20 minutes
PC6	N47° 46.611’ W65° 13.614’	June 10, June 30, 2018, June 13, 2019, June 13, 2019, July 2, 2019	2 x 10 minute/Point Count = 20 minutes
PC7	N47° 46.905’ W65°	June 10, June 30, 2018	2 x 10 minute/Point Count =

Point Count	Location (Latitude & Longitude)	Dates	Effort (minutes)
	13.509’		20 minutes
PC9	N47° 46.523’ W65° 13.131’	June 10, June 30, 2018	2 x 10 minute/Point Count = 20 minutes
PC10	N47° 46.762’ W65° 13.366’	June 10, June 30, 2018	2 x 10 minute/Point Count = 20 minutes
PC11	N47° 46.888’ W65° 13.276’	June 10, June 30, 2018, June 13, 2019, June 13, 2019, July 2, 2019	2 x 10 minute/Point Count = 20 minutes
PC12	N47° 47.090’ W65° 13.436’	June 10, June 30, 2018	2 x 10 minute/Point Count = 20 minutes
PC14	N47° 47.021' W65° 13.035'	June 13, 2019	2 x 10 minute/Point Count = 20 minutes
PC15	N47° 46.108' W65° 13.950'	June 10, June 30, 2018, June 13, 2019, June 13, 2019, July 2, 2019	2 x 10 minute/Point Count = 20 minutes
PC16	N47° 46.535' W65° 13.465'	June 10, June 30, 2018	2 x 10 minute/Point Count = 20 minutes
PC17	N47° 46.557' W65° 13.883'	June 10, June 30, 2018	2 x 10 minute/Point Count = 20 minutes
PC18	N47° 46.721' W65° 13.889'	June 10, June 30, 2018	2 x 10 minute/Point Count = 20 minutes
PC19	N47° 46.933' W65° 13.721'	June 10, June 30, 2018	2 x 10 minute/Point Count = 20 minutes
PC20	N47° 47.133' W65° 13.126'	June 13, 2019, July 2, 2019	2 x 10 minute/Point Count = 20 minutes
PC21	N47° 46.680' W65° 13.294'	June 13, 2019, July 2, 2019	2 x 10 minute/Point Count = 20 minutes
PC22	N47° 46.517' W65° 13.057'	June 13, 2019, July 2, 2019	2 x 10 minute/Point Count = 20 minutes
PC23	N47° 46.453' W65° 13.428'	June 13, 2019, July 2, 2019	2 x 10 minute/Point Count = 20 minutes
PC24	N47° 46.228' W65° 13.687'	June 13, 2019, July 2, 2019	2 x 10 minute/Point Count = 20 minutes
PC25	N47° 47.246' W65° 13.256'	June 13, 2019, July 2, 2019	2 x 10 minute/Point Count = 20 minutes
PC26	N47° 46.047' W65° 14.220'	June 13, 2019, July 2, 2019	2 x 10 minute/Point Count = 20 minutes
Total Survey Time			**480 minutes**

Two rounds of surveys for breeding birds were conducted in 2018, and two additional rounds were completed in 2019 to capture early and late breeding periods. The surveys were conducted using the same methodology completed during the spring migration point count surveys.

Passage Migration/Diurnal Watch Counts

Breeding bird watch count surveys were completed by Roland Chiasson on June 9, June 13, June 14, June 17, June 18, June 29, July 9, and July 17, 2018. Surveys were conducted at four watch count (WC) stations each of which was specifically chosen to understand diurnal (i.e. daily) movements of birds (Figure 7b, Appendix A).

- WC1a and WC1b was selected for its proximity to Pokeshaw Rock and clear view plane;
- WC4 was selected for its sight lines of Double-crested Cormorant activity and still provided a 360° view of the Study Area;
- WC5a was selected instead of the previously observed WC2 and WC3 because migratory activity had slowed by this point. Additionally, WC5a provided a better vantage point from which to view Double-crested Cormorant activity and their use of the cranberry facility reservoir; and,
- WC5b replaced WC5a, as its vantage point across the Study Area and reservoir proved better. It was used on multiple dates.

Surveys were generally completed for 1-2 hours repeated twice daily (for a total of 2-4 hours). WC1 was surveyed for a total of 975 minutes. WC4 was surveyed for a total of 180 minutes. Watch Count 5b (WC5b) was surveyed for a total of 130 minutes. Watch Count 5a (WC5a) was surveyed once for 30 minutes (used as a mechanism to investigate its suitability for as a future watch count location), however, it was not determined to provide a good vantage point and was dropped from further surveys.

Breeding watch count locations and effort is provided in Table 18.

Table 18. Breeding Bird Watch Count Locations, Dates and Effort

Point Count	Location (Latitude & Longitude)	Dates	Effort (minutes)
WC1	N47° 47.335' W65° 15.096'	June 9, June 13, June 14, June 17, June 18, June 29, July 9, July 17, 2018	975
WC4	N47° 46.556' W65° 13.655'	June 9, June 13, June 14, 2018	180
WC5a	N47° 47.576' W65° 14.727'	June 13, 2018	30
WC5b	N47° 47.576' W65° 14.727'	July 9, July 17, 2018	130
Total Time Surveyed			**1,315 minutes**

Transects

Supplemental transect surveys were completed on June 10, 2018 en route to four-point count locations. During these searches, the surveyor was on foot moving at a normal walking pace while scanning the surrounding environment for birds (Figure 7b, Appendix A).

Table 19. Breeding Bird Transect Survey Dates

Transect	Dates
T1-2	June 10, 2018
T4	June 10, 2018
T5	June 10, 2018
T19	June 10, 2018

4.1.5.3 Common Nighthawk Surveys

The Common Nighthawk (*Chordeiles minor*) prefers to nest in gravelly substrates and is best detected while foraging for insects shortly after sunset. Suitable habitat is available for this species within the portions of the Study Area, therefore dedicated surveys for the Common Nighthawk were conducted in conjunction with breeding season surveys. These surveys took place on June 29, 2018 at dusk (30 minutes before sunset to 1 hour after sunset), as described in the Common Nighthawk Survey Protocol (Saskatchewan Ministry of Environment, 2015). Five survey point count locations were surveyed once by Roland Chiasson (Figure 7b, Appendix A). A call-playback survey was used to detect the presence of Common Nighthawk. This involves three-minutes of passive listening, followed by a call playback that included 30-seconds of the conspecific Common Nighthawk call followed by 30-seconds of silence (or passive surveying), repeated for three-minutes (i.e. three times), as described by the Saskatchewan Ministry of Environment (2015). The point count locations are situated throughout the Study Area surrounded by a variety of habitats including forest, regenerating forest, cut block, agricultural fields, and gravel pits.

4.1.5.4 Raptor Nest Surveys

Raptor nest surveys were completed throughout the Study Area by Roland Chiasson during avian surveys and by MEL staff during other biophysical surveys. A concentrated level of effort was completed during winter 2019 surveys during leaf free conditions, when nests are easier to identify visually.

4.1.5.5 Fall Migration

Point Counts

Fall migration point count surveys were completed by Roland Chaisson on August 20, August 30, September 8, September 14, September 19, September 27, October 4, and October 10, 2018. Surveys were conducted at the same point count stations surveyed within the spring (Figure 7a, Appendix A). Table 20 provides the dates in which surveys were performed.

Table 20. Fall Migration Point Count Locations, Dates and Effort

Point Count	Location (Latitude & Longitude)	Dates	Effort
PC1	N47° 45.830' W65° 14.484'	August 30, September 14, September 27, October 10, 2018	4 x 10 minute/Point Count = 40

Point Count	Location (Latitude & Longitude)	Dates	Effort
			minutes
PC2	N47° 45.965' W65° 14.283'	August 30, September 14, September 27, October 10, 2018	4 x 10 minute/Point Count = 40 minutes
PC3	N47° 46.003' W65° 14.028'	August 20, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	8 x 10 minute/Point Count = 80 minutes
PC4	N47° 46.281' W65° 13.975'	August 20, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	8 x 10 minute/Point Count = 80 minutes
PC5	N47° 46.353' W65° 13.715'	August 20, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	8 x 10 minute/Point Count = 80 minutes
PC6	N47° 46.611' W65° 13.614'	August 20, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	8 x 10 minute/Point Count = 80 minutes
PC7	N47° 46.905' W65° 13.509'	August 20, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	8 x 10 minute/Point Count = 80 minutes
PC8	N47° 46.523' W65° 13.131'	August 20, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	8 x 10 minute/Point Count = 80 minutes
PC9	N47° 46.762' W65° 13.366'	August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	6 x 10 minute/Point Count = 60 minutes
PC10	N47° 46.888' W65° 13.276'	August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	7 x 10 minute/Point Count = 70 minutes
PC11	N47° 47.090' W65° 13.436'	August 20, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	8 x 10 minute/Point Count = 80 minutes
PC12	N47° 47.187' W65° 13.384'	August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	7 x 10 minute/Point Count = 70 minutes
PC14	N47° 47.021' W65° 13.035'	August 20, 2018	1 x 10 minute/Point Count = 10 minutes
PC14b	N47° 47.009' W65° 13.071'	August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	7 x 10 minute/Point Count = 70 minutes

Point Count	Location (Latitude & Longitude)	Dates	Effort
PC15	N47° 46.108' W65° 13.950'	August 20, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	8 x 10 minute/Point Count = 80 minutes
PC16	N47° 46.535' W65° 13.465'	August 20, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	8 x 10 minute/Point Count = 80 minutes
PC17	N47° 46.557' W65° 13.883'	August 20, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	8 x 10 minute/Point Count = 80 minutes
PC18	N47° 46.721' W65° 13.889'	August 20, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	8 x 10 minute/Point Count = 80 minutes
PC19	N47° 46.933' W65° 13.721'	September 8, September 19, October 4, 2018	3 x 10 minute/Point Count = 30 minutes
Total Survey Time			**1,280 minutes**

Passage Migration/Diurnal Watch Counts

Fall migration watch count surveys were completed by Roland Chaisson on August 3, August 19, August 29, August 30, September 7, September 8, September 13, September 14, September 18, September 19, September 26, September 27, October 3, October 4, October 9, October 10, 2018. Surveys were conducted at five watch count stations: two within, and three surrounding the Study Area.

- WC1 was selected for its proximity to Pokeshaw Rock and clear view plane;
- WC3 was selected for its good vantage point within the Study Area; it's located within clear-cut;
- WC4 was selected for its sight lines of Double-crested Cormorant activity; and,
- WC5b was selected for its vantage point across the Study Area and clear sight lines of Double-crested Cormorant activity at the cranberry facility reservoir.

Watch count locations and descriptions for surveying at the locations is provided in Table 21. Watch counts were generally 2 hours in duration, completed once per day. WC1 was surveyed for a total of 947 minutes/15.8 hours over 14 surveys. WC3 was surveyed for a total of 960 minutes/16 hours across 8 surveys. WC4 was surveyed for a total of 240 minutes/4 hours across 2 surveys. WC5b was surveyed a total of 370 minutes/6 hours across 8 surveys. Certain watch count locations (i.e. WC1 and WC3) provided better vantage points as the season progressed, while others (i.e. WC4) were less efficient and were therefore visited less often.

Table 21. Fall Migration Watch Count Locations, Dates and Effort

Watch Count	Location (Latitude & Longitude)	Dates	Effort (minutes)
WC1	N47° 47.335' W65° 15.096'	August 3, August 19, August 30, September 7, September 8, September 13, September 14, September 18, September 19, September 26, September 27, October 3, October 4, October 10, 2018	947
WC3	N47° 46.265' W65° 13.829'	August 20, August 29, September 8, September 14, September 18, September 27, October 3, October 9 (August 30, incidental observation only) , 2018	960
WC4	N47° 46.556' W65° 13.655'	October 4, October 10, 2018	240
WC5b	N47° 47.479' W65° 14.218'	August 3, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018	370

Transects

Supplemental transect surveys were completed on August 20, August 30, September 8, September 14, September 19, September 27, October 4, and October 10, 2018 en route between point count locations. During these searches, the surveyor was on foot moving at a normal walking pace while scanning the surrounding environment for birds (Figure 7b, Appendix A). Transect locations are also provided in Table 22 (below).

Table 22. Fall Migration Transect Survey Dates

Transect	Dates
T1-2	August 30, September 14, September 27, October 10, 2018
T3-15	August 20, 2018
T3-Bat3	August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018
T4	August 20, 2018
T5	August 20, August 30, September 14, September 19, September 27, October 4, October 10, 2018
T6-16	August 20, 2018
T6-18	August 20, 2018
T7-9	August 20, 2018
T7-11	August 20, 2018
T9-8	August 20, August 30, September 8, September 14, September 19, September 27, October

Transect	Dates
	4, October 10, 2018
T10-14	August 20, 2018
T11-10	August 20, August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018
T11-12	August 20, 2018
T15-4	August 20, 2018
T17-18	August 20, 2018
T18-7	August 20, 2018
T18-16	August 30, September 8, September 14, September 19, September 27, October 4, October 10, 2018
T19-7	September 8, September 19, October 4, 2018
Transect north of PC8	August 3, 2018

4.1.5.6 **Winter Surveys**

Winter surveys were completed by Roland Chiasson on January 12 and February 6, 2019. Surveys were conducted along transects throughout the Study Area (Figure 7b, Appendix A).

During transect surveys, the surveyor was on foot moving at a normal walking pace while scanning the surrounding environment for birds.

Table 23. Winter Transect Survey Dates

Transect	Dates
T1	12-Jan & 6-Feb
T2	12-Jan & 6-Feb
T3	12-Jan & 6-Feb
T4	12-Jan & 6-Feb
T5	12-Jan & 6-Feb
T6	12-Jan & 6-Feb
T7	12-Jan & 6-Feb
T8	12-Jan & 6-Feb

4.1.5.7 **Analysis**

Bird species were identified based on functional bird groups to understand how each group of birds is using the Study Area and adjacent lands. These functional groups are as follows:

1. Waterfowl: Ducks, geese, or other large aquatic birds, especially when regarded as game.
2. Shorebirds: Waders, from the Order Charadriiformes.

3. Other waterbirds: Includes seabirds (i.e. marine birds), grebes (Order Podicipediformes), loons (Order Gaviiformes), Ciconiiformes (i.e. storks, herons, egrets, ibises, spoonbills, etc.), pelicans (Order Pelicaniformes), flamingos (Order Phoenicopteriformes), Gruiformes (i.e. cranes and rails), kingfishers, and dippers (the only family of passerines considered waterbirds).
4. Diurnal Raptors: Birds within the families Accipitridae (i.e. hawks, eagles, buzzards, harriers, kites and old-world vultures), Pandidonidae (i.e. Osprey), Sagittariidae (i.e. Secretary bird), Falconidae (i.e. falcons, caracaras, and forest falcons), Cathartidae (i.e. new world vultures), and one species from the Order Strigiformes (i.e. Hawk Owl).
5. Nocturnal Raptors: Birds of the Order Strigiformes (i.e. owls; with exception of the Hawk Owl, which is a diurnal species of owl).
6. Passerines: Any bird of the Order Passeriformes, which includes more than half of all bird species. This is with exception of the dippers, which are a passerine considered a waterbird.
7. Other Landbirds: Birds within the Orders Galliformes (i.e. quail, pheasant, and grouse), Columbiformes (i.e. pigeons and doves), Cuculiformes (i.e. cuckoos), Caprimulgiformes (i.e. nighthawks and whip-poor-wills), Apodiformes (i.e. swifts and hummingbirds), and Piciformes (i.e. woodpeckers, flickers and sapsuckers).

Abundance, frequency and behaviour of species and groups were analyzed along with flight height of birds observed flying over the Study Area. Height was analyzed in relation to the Rotor Swept Arc (RSA) of the turbine.

As well, an evaluation of on-site passerine behavior was completed included evidence of breeding, and presence of Priority Species and their habitat.

4.1.5.8 **Bird Mortality Estimating**

Wind turbines can pose a threat to migrating birds, which are occasionally killed by collisions with moving turbine blades (Environment Canada, 2007; Richardson, 1998; Zimmerline et al., 2013). In an attempt to understand the potential effects (i.e. estimated bird mortalities due to turbine collisions), bird mortality estimates were calculated.

As described in previous sections, during all avian surveys, flight height and direction was recorded for all birds observed in flight either over the Study Area or over the surrounding landscape. For the purpose of this analysis, flyover data from Spring Migration and Breeding Bird Surveys was combined, as late migrants may have been moving through the Study Area through June. Analysis was conducted for individual species and species groups, which are divided into the same groups as described in the previous section.

To estimate bird mortality associated with the Project, a guidance document from the Scottish Natural Heritage (SNH) was followed. This document outlines how to calculate a theoretical collision risk for birds and wind power projects (Scottish Natural Heritage, 2010). This method of risk assessment was used by MEL for four other wind power projects in Alberta in 2016 and 2017. Two of these projects have received Alberta Environment and Parks regulatory approval.

The guidance document recognizes that in practice, most birds display avoidance behaviours to avoid turbines and other structures when possible (Everaert, 2014; Larsen & Guillemette, 2007). Therefore, an avoidance rate by species group is applied in calculations. The results of the calculations are next moderated by an important factor that represents the proportion of birds likely to take effective avoiding action. Calculations can be used for birds that regularly fly through an air space (i.e. birds that move from roosting to feeding areas each day) and for birds that use the entire air space around a windfarm (i.e. birds that occupy a recognized territory).

The calculations are completed in two stages and are as follows:

Stage 1

1. Identify a risk window (W), a window of width equal to the width of the Project Area across the general bird flight direction, and of height equal to the maximum height of the highest turbine. The cross-sectional area (W) equals width x height.

2. Estimate the number of birds (**n**) flying through this risk window. This data was calculated from the total bird species counted and the estimated population. Population estimates are calculated as follows:

   - Number of survey locations (a)
   - Survey location observation areas (b)
   - Project area in m^2 (c)
   - Average # birds per (b) = (d)
   - Population of birds that are in the turbine vicinity that could interact with a turbine at a given time = (c/b) x (d) = (e)
   - Number of birds in the risk window = ((e)/ Survey time) x total flight hours in a season* (i.e., spring, breeding, fall) = (**n**)

   *The total time estimates (in hours) for survey seasons are based on the assumption of 12 hours of flight time per day.

3. Calculate the area occupied by the turbines.
   RSA = Rotor Swept Arc area in m^2
   A = Total RSA for all turbines, number of turbines x RSA

4. Express the total RSA as a proportion of the risk window (A/W)

5. Number of birds passing through rotors (**n**) equals the number of birds through the risk window x proportion of area occupied by rotors = **n** x (A/W)

6. The weighted average flight height of birds flying within the RSA was multiplied by the total bird flights in the risk area to estimate the number of bird flights through the RSA. This number was carried forward into stage 2.

Stage 2

This stage addresses the probability of a bird hitting a turbine blade while in flight. These calculations take the following variables into account: body length, wingspan, average flight speed, flight behaviour (gliding vs. flapping), pitch of turbine blades, turbine rotation speed, distance of the bird from the turbine hub, turbine blade chord width, angle of bird in relation to the turbine, and wind direction (upwind vs. downwind). The calculations were done using a model spreadsheet developed by the Scottish Natural Heritage and available from https://www.nature.scot/professional-advice/planning-and-development/renewable-energy-development/types-renewable-technologies/onshore-wind-energy/wind-farm-impacts-birds (2000).

A number of assumptions are made in order to complete this stage. It is assumed that a bird shape is a simple cross form, with the wings falling halfway between nose and tail. It is assumed that turbines are aligned in the plane of the risk window. It is assumed that bird velocity remains constant despite upwind and downwind changes. Lastly, turbine thickness is not included in the calculations, which simplify the turbine into just 2-dimensions.

Probability of collision vary by bird group. The inputs provided for the models are based upon average characteristics of species as follows:

1. Waterfowl: Bird Length[1] = 1.0 m
   Wingspan = 1.56 m
   F: Flapping (0) or Gliding (1) = 1
   Bird Speed[2] = 22 m/sec

2. Shorebirds: Bird Length = 0.3 m
   Wingspan = 0.4 m
   F: Flapping (0) or Gliding (1) = 0
   Bird Speed[3] = 14 m/sec

1 All lengths and wingspan taken from Cornell Lab of Ornithology. 2017. All about birds. www.allaboutbirds.org
2 R. Meinertzhagen, 1954. Speed and Altitude of Bird Flight. Journal of Avian Science. Vol 97. – Snow Goose
3 R. Meinertzhagen, 1954. Speed and Altitude of Bird Flight. Journal of Avian Science. Vol 97. - Killdeer

3. Passerines	Bird Length = 0.2 m
Wingspan = 0.35 m
F: Flapping (0) or Gliding (1) = 0
Bird Speed[4]= 15 m/sec

4. Raptors	Bird Length = 0.5 m
Wingspan = 1.22 m
F: Flapping (0) or Gliding (1) = 0
Bird Speed[5]= 9.8 m/sec

Separate mortality calculations were not performed for the species group Other waterbirds and Other landbirds. Instead the observed birds within the former group were combined with the Waterfowl species group, and the latter were combined with the Shorebirds species group. It was determined that birds within the combined groups had similar average characteristics based on length, wingspan, flight movement, and flight speed. Diurnal and Nocturnal raptors were combined into Raptors.

Despite the above listed assumptions and certain limitations, MEL has used the mortality estimation calculator to provide qualitative insights into the impact of turbine placement on bird populations for the Pokeshaw Wind Project.

4.1.6 Bats

The following are the desktop and field survey methodologies which used during the bat survey program.

4.1.6.1 **Desktop Review**

A desktop review for known bat hibernacula nearby and within the Study Area was completed. As part of this task the known open adits (mine openings) database in New Brunswick was reviewed (GeoNB. 2019). This database was reviewed for all of Gloucester County, New Brunswick to identify any potential for bat hibernacula within the regional vicinity of the Study Area. The ACCDC report, the Government of Canada Species at Risk Act Recovery Strategy for bats and the NB Museum Databases were also consulted.

4 R. Meinertzhagen, 1954. Speed and Altitude of Bird Flight. Journal of Avian Science. Vol 97. – Horned Lark
5 R. Meinertzhagen, 1954. Speed and Altitude of Bird Flight. Journal of Avian Science. Vol 97. –Red Tailed Hawk

4.1.6.2 **Field Survey**

Bat monitoring was designed based on the protocols described in *Bats and Wind Turbines: Pre-siting and Pre-construction Protocols* (Lausen, Baerwald, Gruver, & Barclay, 2010), and *Pre-construction Bat Survey Guidelines for Wind Farm development in NB* (NBDNR, 2009).

The goal of the bat survey was to provide a representative sampling of bat activity across the Study Area. Preliminary evidence indicates that this will facilitate estimates of the relative risk to bats from wind turbines at proposed sites (E. Baerwald, unpubl. data), but at present it cannot guarantee that sites with low levels of activity will result in fewer deaths than sites with higher levels of activity (Lausen, Baerwald, Gruver, & Barclay, 2010).

Specifically, the recommended surveys are designed to determine:

1. Species occurrence and diversity

2. Activity levels (e.g., relative abundance, seasonal timing, daily timing)

In support of identifying bat detector locations, the Project Team utilized the following guidance provided in the document *Pre-Construction Bat Survey Guidelines for Wind Farm development in NB* (NB Department of Natural Resources, 2009), which states that:

"Survey stations are stationary points that are positioned in such a way as to provide adequate coverage of the spatial distribution of the proposed wind turbine placements (e.g., if known, survey stations should be established at sites where wind turbines are proposed to be constructed, to the extent possible; if turbine locations are not known, survey stations should cover the full spatial extent of the site and all habitat types)".

Additionally, during habitat surveys within the Study Area, MEL biologists were also looking for any signs of habitat that could support winter bat hibernation (i.e. caves, abandoned mines/shafts or other sub-grade access features). During the same surveys, habitat observations were collected to support the development of the bat monitoring locations.

The ERD Forest Inventory database was reviewed to support the identification of suitable bat detector placement locations, and this was supplemented by field observations completed during 2018 Spring bird surveys. Section 5.4.1 outlines the composition of on-site habitat; bat detector placement is shown in Figure 8 (Appendix A) along with the ERD Forest Inventory database.

The ERD Forest Inventory database and field observations show the Study Area to be predominantly forested habitat dominated by mature intolerant hardwood species with lesser amounts of Black Spruce and Balsam Fir mix. Three areas described as agricultural plots and one area described as industrial were identified within the Study Area. A review of aerial imagery indicates that a small man-made pond exists within southern portions of the Study Area adjacent to Ridge Road.

The five proposed turbine locations are spaced across the eastern portion of the Study Area. Therefore, the proposed bat monitoring locations were established along the forested edges of the identified agricultural areas and the small pond. The edge habitat and open surface water locations were selected as potential feeding, travelling or hydrating congregational areas for bat activity within the Study Area.

Proposed bat monitor locations (n=3) were provided to NBDELG and ERD in March 2018. Bat monitor locations are provided on Figure 8 (Appendix A). These three locations were located as follows:

- Bat Monitor 1 (BM1) – In a regenerating clear-cut between a forested edge and agricultural field in northern portions of the Study Area;
- Bat Monitor 2 (BM2) - At the edge of an existing woods road and clear cut along the eastern extent of the Study Area;
- Bat Monitor 3 (BM3) – Within a cleared area adjacent to an anthropogenic pond, in the southern extent, of the eastern portion of the Study Area.

Feedback was provided from ERD to the Project Team on April 27th, 2018 requesting an additional (fourth) bat monitor be placed in western portions of the Study Area (BM4a). BM4a is located along the edge of an agricultural field and forested habitat in the western portion of the Study Area.

Additional consultation was completed between the Project Team and DELG via a meeting and the submission of a biophysical update report in August 2018. Among other items, the biophysical update included information pertaining to the updated turbine layout at that time, and field results including wetland locations. Feedback as a result of these updates were provided to the Project Team by ERD requesting the placement of a bat monitor to a location in-between Wetlands 6 and 3. This location was chosen to better represent a proposed turbine location (i.e. WTG3), and representative of habitat which bats may potentially utilize (i.e. edge habitat associated with the existing woods road and adjacent to wetlands). Since the western extent of the Study Area (west of Highway 135) was not being considered for a future WTG. BM4a was re-positioned at a new location between wetlands 6 and 3 and re-named BM4b.

4.1.6.3 **Bat Monitoring**

Wildlife Acoustic SM4BAT FS Bioacoustic Recorders (SM4BAT) were installed, by John Gallop, P.Biol and Ryan Gardiner (BSc) (MEL), data was collected and downloaded in the field by Roland Chiasson. Acoustic bat monitoring was conducted to evaluate relative activity patterns by species or species groups over the monitoring period across the Study Area.

Four SM4BAT detectors (Bat Monitors 1 - 4 (BM1 - BM4a) were set up on the dates indicated in Table 24. As discussed above, BM4a was relocated at the request of ERD on August 29, 2018 to collect data closer to proposed turbines, and in-between Wetland 3 and 6. Bat monitor locations are provided on Figure 8 (Appendix A).

The on-site MET tower does not comprise a hoist, therefore SM4BAT detectors were hand erected on wooden scaffolding structures at heights of approximately 4.5m.

Table 24. Detector Information

Unit	BM 1	BM 2	BM 3	BM 4a	BM 4b
UTM (Zone 20T)	333687.15 m E 5294657.57 m N	333944.52 m E 5293795.92 m N	332517.77 m E 5292973.44 m N	331888.00 m E 5292044.00 m N	333495.99 m E 5294151.32 m N
Installed/Monitoring Start	June 11, 2018	June 11, 2018	June 11, 2018	June 11, 2018	Aug. 29, 2018
Monitoring ended	Oct. 15, 2018	Oct. 15, 2018	Oct. 15, 2018	Aug. 28, 2018	Oct. 15, 2018
Height Installed above ground	4.5 m	4.5 m	4.5 m	4.5 m	4.5 m
Detector nights	123	126	126	78	47

The data collected at the bat monitoring locations was anticipated to provide an accurate estimation of species and bat passes across the landscape within the Study Area.

4.1.6.3.1 Acoustic Detector Information

SM4BAT detectors record ultrasonic bat calls through a transducer (microphone) and record them on a compact flash card for later download and analysis (Wildlife Acoustics, 2019).

The SM4BAT detectors are equipped with SMM-U1 microphones which operate omnidirectionally. The microphones were further equipped with a foam windscreen to reduce wind interference and exposure to precipitation. Each microphone was pointed just below the horizontal to protect from precipitation while maximizing the volume of detection. The distance of microphone sensitivity to ultrasonic calls is subject to multiple design and environmental factors, however, with the dominant factor being atmospheric absorption of frequencies. Manufacture estimates state that the SMM-U1 microphone has a spherical detection volume with a 22.1m radius for 40 kHz frequencies, which increases (38.8 m) for lower (20 kHz) and decreases (6.5 m) for higher (100 kHz) frequencies. Prior to SM4BAT detector deployment the SMM-U1 microphones were calibrated to the manufacture's specifications.

All SM4BAT detectors operate in waterproof casements and are powered by 4 D-Cell batteries. Data was downloaded and the function of all SM4BAT detectors was checked at approximately two-week intervals during the study period.

4.1.6.3.2 Bat Detector Software

Two specialized software systems (Kaleidoscope Pro and Analook) were used by a qualified biologist to identify recorded bat files to species or species group. Kaleidoscope Pro (KSPro) uses sophisticated modelling to match recorded calls to an internal reference library, similar to voice recognition techniques. Analook was used to construct frequency/time graphs from the bat calls recorded by the SM4BAT detectors. For each call, the slope, maximum frequency (i.e., the highest frequency), minimum frequency (i.e., the lowest frequency), and duration were determined, as those variables are believed to be species-specific, and can hence be used in comparison to recorded calls. Each variable was then compared with a library of reference calls collected from individual bats that had been identified to species. Subsequently, the data was reviewed by the qualified biologist in order to define the species producing the bat call[1].

Bat calls (call) were defined as a single, recognizable vocalization from one bat, and a bat pass (pass) as one or more sequential calls, representing calls from a single bat, recorded in one SM4BAT digital file. To best determine bat counts (number of individual bats) multiple bat passes of the same species were grouped as one individual bat if the bat passes occurred within the same 1-minute time block. The 1-minute time block was selected as it provides the most appropriate time scale reflective of subtle changes in bat activity (Miller, 2001).

Where echolocation recordings could be identified to species, they were classified as follows:

- EPFU - *Eptesicus fuscus* (Big brown bat)
- LABO - *Lasionycteris borealis* (Eastern red bat).
- LACI - *Lasiurus cinereus* (hoary bat);
- LANO - *Lasionycteris noctivagans* (silver-haired bat);
- MYLU - *Myotis lucifugus* (little brown bat)
- MYSE - *Myotis septentrionalis* (Northern long-eared myotis)
- PESU – *Perimyotis subflavus* (Tricolored bat)

Due to insufficient calls/pass or overlap in identifying call characteristics passes that could not be identified to species were grouped into the following categories:

- EPFU/LANO - *Eptesicus fuscus Lasionycteris noctivagans* (silver-haired bat/big brown bat);
- LABO/PESU - *Lasionycteris borealis/Perimyotis subflavus* (Eastern red bat / Tricolored bat),
- Myotis – *Myotis lucifugus/Myotis. Septentrionalis* (little brown bat/Northern long-eared myotis),
- LowF – Low frequency bats include (LACI/LANO/EPFU)
- HighF – High frequency bats include (LABO/MYLU/MYSE/PESU)

[1] *Ryan Gardiner received Bat Acoustic training held by Cori Lausen of the Wildlife Conservation Society of Canada in June 2017. Training included site selection, data collection techniques, use of available software and species identification processes.*

4.1.6.4 **Monitoring Period**

Bat Monitors 1 – 3 were installed on June 11, 2018 and ran continuously through to the Fall migratory season ceasing on October 15, 2018 (Figure 1, below). Data collection ceased due to a malfunction in BM1 on Oct. 1, 2018. Data collection was re-established during the following equipment check on Oct. 4, 2018. Bat Monitor 4a was also installed on June 11, 2018 but was moved on August 29, 2018 at the request of ERD (discussed previously). The new location was re-named BM4b and collected data between August 29, 2018 to October 15, 2018. Apart from the malfunction to BM1 discussed above, no additional malfunctions occurred during the monitoring periods of BM 2, 3, 4a or 4b. All bat monitors were collected from the field on November 12, 2018.

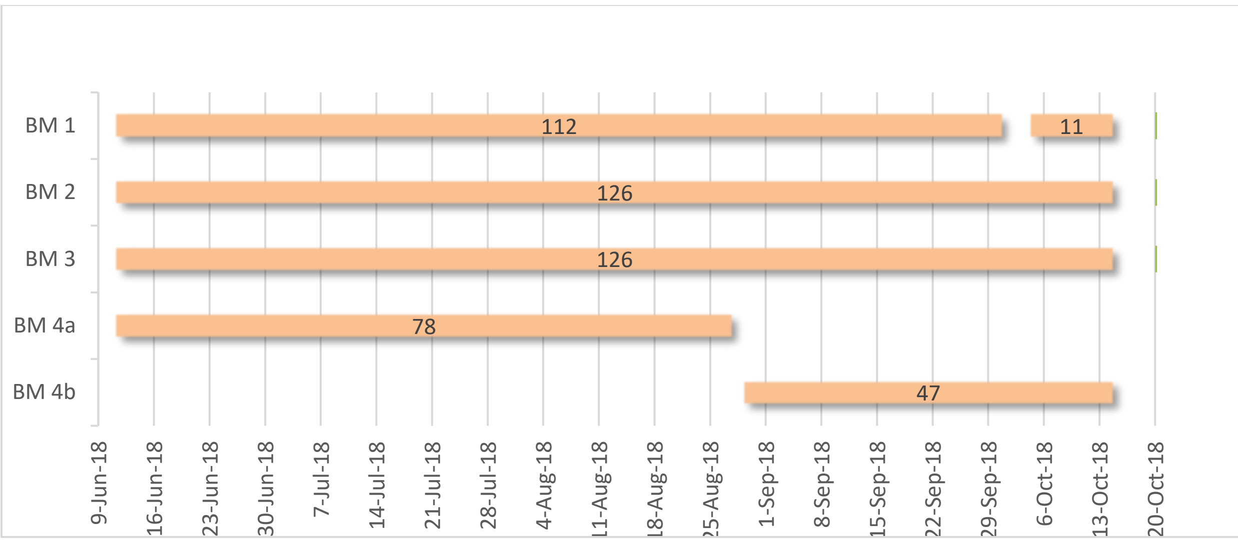

Figure 1: Bat Monitor Operation Schedule

The detectors were programmed to record bat passes from a half an hour before sunset, to a half an hour after sunrise to determine relative activity patterns by species or species groups over the monitoring period.

4.1.7 Wetlands and Watercourses

4.1.7.1 **Desktop Review**

The Study Team reviewed geospatial data accessed from GeoNB (2016) during the desktop review of aquatic ecosystems, focusing primarily on the New Brunswick Hydrographic Network (NBHN). In addition, the recently developed Draft Wetlands Reference Map (DELG, 2017) was reviewed to evaluate the potential presence of wetland habitat within the Study Area. A desktop review of available topographic maps, appropriate provincial databases and aerial photography was completed to aid in determination of watercourses in the Study Area. Topography maps were reviewed (1:50,000, 1:30,000, and 1:10,000) to identify all mapped watercourses. Mapped watercourses were identified from the New Brunswick Hydrographic Network (Figure 9, Appendix A) (Government of New Brunswick, 2014).

The goal of the desktop evaluation was to identify where wetlands, watercourses, or waterbodies may be located based on mapped systems, topography, forest cover type and satellite imagery.

4.1.7.2 **Field survey**

Field surveys were conducted in June and August 2018, and June 2019 across the Study Area by Mr. Ryan Gardiner and Mr. John Gallop (2018) and Mr. Andy Walter (BSC) (2019) to confirm presence of mapped wetlands and watercourses, and identify other aquatic features that maybe present upon the landscape, in line with the following New Brunswick's Clean Water Act definitions (GNB, 1989):

Wetlands are land that:

> *(a) either periodically or permanently, has a water table at, near or above the land's surface or that is saturated with water, and*
> *(b) sustains aquatic processes as indicated by the presence of hydric soils, hydrophytic vegetation and biological activities adapted to wet conditions.*

Watercourses are:

> *the full width and length, including the bed, banks, sides and shoreline, or any part, of a river, creek, stream, spring, brook, lake, pond, reservoir, canal, ditch or other natural or artificial channel open to the atmosphere, the primary function of which is the conveyance or containment of water whether flow be continuous or not.*

Wetland delineation was completed in accordance with the Army Corps of Engineers Wetland Delineation Manual (Environmental Laboratory, 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (United States Army Corps of Engineers, 2011). Wetland delineation was conducted based on micro-topography, and observed surface hydrology, vegetation and soils by qualified wetland delineator. Wetland boundaries were documented using an SXBlue II Global Positioning System (GPS) receiver unit capable of sub-metre accuracy with a handheld SXPad field computer. Any inlet and outlet streams or other features associated with each wetland were marked during the delineation process and walked and mapped. Pink flagging tape was used to mark the boundaries of wetlands. Observations were made on wetland types, water flow path, dominant vegetation communities (and SAR/SOCI, if present), fish habitat potential and characterizations, and wetland functions.

Watercourses were documented using an SXBlue GPS unit and SX Pad handheld field computer capable of sub 1 m accuracy. Observations of fish habitat quality and fish habitat potential for each identified watercourse were documented, as well as Wood Turtle and Snapping Turtle habitat potential. Blue flagging tape was used to mark the boundaries of watercourses.

4.1.7.3 **Wetland Functional Analysis**

Due to the proximity of the identified wetlands to proposed Project infrastructure, wetland functional assessments were completed within Wetlands 1, 3, 5, 6, 7 and 10 (Figure 9, Appendix A). The analysis of wetland function was completed for each wetland using the Wetland Ecosystem Services Protocol - Atlantic Canada (WESP-AC) wetland evaluation technique. The WESP process involves the completion of three forms; a desktop review portion that examines the landscape level aerial conditions to which the wetland is situated, and two field forms. The process serves as a rapid method for assessing individual wetland functions and values.

WESP addresses 17 specific functions which wetlands may provide (Table 25). The specific wetland functions are individually allocated into grouped wetland functions and measured for "functional" and "benefit" scores. Wetland function relates to what a wetland does naturally (i.e., water storage), whereas wetland benefits are benefits of the function, whether it is ecological, social, or economic. The highest functioning wetlands are ones which have both high 'Function' and 'Benefit' scores for a given function. WESP enables a comparison to be made between individual wetlands within a Province to gain a sense of the importance each has in providing ecosystem services.

Table 25: Wetland Function Parameters

Grouped Wetland Function	Specific Wetland Functions
Hydrologic Function	Surface Water Storage
Aquatic Support	Aquatic Invertebrate Habitat
	Stream Flow Support
	Organic Nutrient Export
	Water Cooling
Water Quality	Sediment Retention & Stabilization
	Phosphorus Retention
	Nitrate Removal & Retention
	Carbon Sequestration
Aquatic Habitat	Anadromous Fish Habitat
	Resident Fish Habitat
	Waterbird Feeding Habitat
	Waterbird Nesting Habitat
	Amphibian and Turtle Habitat
Transition Habitat	Songbird, Raptor, & Mammal Habitat
	Pollinator Habitat
	Native Plant Habitat

In addition to the grouped wetland functions above, WESP also measures the following groups, however these are only evaluated by their benefit scores:

- Wetland Condition; and

- Wetland Risk.

The following individual functions are assessed to determine the benefit scores associated with these groups:

- Public Use & Recognition;
- Wetland Sensitivity;
- Wetland Ecological Condition; and
- Wetland Stressors.

For each wetland evaluated the WESP process calculates the overall score for the seven grouped wetland functions and the 17 specific wetland functions listed in Table 25 above. One score each is provided for function and benefit. Scores are ranked as 'Lower', 'Moderate', or 'Higher', allowing for analysis of the wetland as compared to baseline wetland scores in New Brunswick. A 'Higher' WESP score means that wetland has a greater capacity to support those processes as compared to other wetlands in the province. A 'Higher' WESP score in both the function and benefits category means the wetland supports the natural ecosystem functions and provides services potentially important to society. For our analysis, MEL weighted the WESP scores to quantitatively compare wetlands. The following weights were applied to scores for grouped wetland functions and specific wetland functions:

- Lower score = 1 point
- Moderate score = 2 points
- Higher score = 3 points

4.1.8 Species at Risk and Species of Conservation Interest

The following are the desktop and field survey methodologies used during the SAR and SOCI survey programs.

4.1.8.1 **Desktop Review**

As described in section 3.1.2, a priority list was generated using the ACCDC report.

4.1.8.2 **Field Surveys**

SAR and SOCI surveys were completed in conjunction with the other biophysical field surveys in June and August 2018. Where a SAR or SOCI was identified during surveys, additional effort was made in the field to understand the habitat at the sighting location and evaluate whether it was critical to the species for survival or life cycle requirements.

4.2 **Archaeological Resource Assessment**

In order to determine potential impact to archaeological resources, in August 2018 the Project layout was provided to the Archaeological Services, Department of Wellness, Culture and Sport (DWCS).

Archaeological Services compared proposed Project infrastructure to the Archeological Predictive Model to determine if a Heritage Resource Impact Assessment (HRIA) was required.

As a result of this process, Archaeological Services recommended the completion of a HRIA to further investigate specific locations within the Study Area.

Archaeological Prospectors of Fredericton completed the HRIA. The HRIA consisted of two components:

1. Background research of relevant documents found at Archaeological Services in Fredericton and published materials, including topographic and surficial geology maps & reports, aerial photographs, and the New Brunswick Register of Historic Places (Archaeological Prospectors 2018); and,
2. A field reconnaissance which involved an intensive visual inspection through pedestrian survey, within lands identified as potentially containing archaeological resources (as per the Predictive Model.

4.3 **Noise**

4.3.1 Noise Modelling

A Noise Impact Assessment (NIA) was completed by personnel trained in the use of noise modelling for wind power project installations in order to determine the predicted noise impacts that the Project and its infrastructure may have on the surrounding community. In order to do this, predicted noise levels were modelled at the 25 nearest residential buildings (located within a radius of 2.6km). The closest receptor site (site P in Figure 1, Appendix D) is 1.4km from the closest wind turbine. Receptor sites were identified based on geographic data from the New Brunswick Open Geodata Portal, reviewed with satellite imagery, and verified by on-site visits. Exact locations of receptor sites can be found in Figure 1 (Appendix D). Modelling utilized the Decibel module of WindPro (version 3.2.701), which considers a variety of factors including:

- Distance between noise emission source and receptor;
- Topography;
- Ground hardness; and
- Atmospheric absorption at varying frequencies.

The Decibel module uses the internationally recognized standard ISO 9613-2, Acoustics-Attenuation of sound during propagation outdoors. In general, the ISO 9613-2 model is a conservative approach in which the standard meteorological factors maximize sound propagation. The standard meteorological factors are:

- Relative humidity: 70%
- Ambient air temperature: 10°C
- Ambient barometric pressure: 101.32 kPa

A further conservative approach was used for the global ground attenuation. For this study a global ground attenuation factor of zero (0) was used, which implies a ground surface with perfect reflection for a worst-case scenario result. In reality the ground itself, trees and other vegetation, and the local topography all contribute to the absorption of noise impacts created by the proposed PBRWP.

The following noise guidelines were set by the NBDELG in their document *Additional Information Requirements for Wind Turbines* (2019).

Table 26. NBDELG Recommended Sound Criteria for Wind Turbines

Wind Speed (m/s)	4	5	6	7	8	9	10	11
Wind Turbine Noise Criteria (dBA)	40	40	40	43	45	45	49	51

While the NBDELG guideline does not specifically discuss the noise impact of substations, in this study, the substation was considered a noise emitting part of the infrastructure; and noise from it was used in subsequent calculations and sound modelling of the proposed PBRWP.

At the time of the NIA, the exact turbine model was unknown, therefore, several turbine models from various manufacturers were compared, and the loudest eligible turbine was selected to represent a worst-case scenario. The Enercon E-126 EP3 at a hub height of 116 m was selected for this purpose with 106.1 dB(A) + 1 dB(A) uncertainty = 107.1 dB(A). In order to assess sound levels realistically, and as a worst-case scenario, the substation was taken into account with a sound pressure level of 89 dB(A) at every wind speed.

Table 27. Sound Pressure Levels of Planned Infrastructure

Wind Speed (m/s)	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Broadband sound power level [dB(A)] Enercon E-126 EP3, 4.0 MW, 116m HH, Mode 0 without uncertainty	94.8	100.2	104.2	105.4	106.1	106.1	106.1	106.1
Broadband sound power level (dB(A)) Substation	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0

Corrections of tonal noise produced by the wind turbines were not included in the modelling. Generally modern wind turbines do not produce special pure tones and most manufacturers guarantee the absence of these types of audible noises.

4.4 Shadow Flicker Modeling

4.4.1 Shadow Flicker Modelling

Personnel trained in the use of shadow flicker modelling for wind power project installations have completed Shadow Flicker Modelling (SFM) for PBRWP. Shadow flicker can be described as the moving shadows cast by the rotating wind turbine blades as they pass between the sun and a nearby residence. The purpose of the SFM is to determine the impact that shadow flicker will have on the surrounding residences and community. The SFM methodology is based on guidelines prescribed by Health Canada (Health Canada, 2017). Shadow flicker guidelines are also provided by NBDELG in the report *Additional Information Requirements for Wind Turbines* in the EIA Sector Guidelines for Wind Turbines. The guidelines state that PBRWP must take mitigation measures to reduce the shadow flicker effect on sensitive receptors. PBRWP must show that in a worst-case scenario, and respecting astronomic maximum calculations, the shadow flicker effect on the receptors are limited to:

- 30 hours per year; and,
- 30 minutes per day

There are 25 residential buildings located within a radius of 2.6 km around the five wind turbine sites. These residences were selected as receptor sites for the purpose of this study. The closest receptor site (P) to a wind turbine (WTG 1) is at a distance of 1.4 km. The receptor sites were identified based on geographic data from the New Brunswick Open Geodata Portal, reviewed with satellite imagery, and verified with on-site visits. Exact locations (including a figure indicating receptor locations) are provided in Appendix E,

Shadow flicker was modelled at each receptor site using the *Shadow* module of WindPro (version 3.2.701). The results of the calculation represent the accumulated shadowing of all wind turbines within a line of sight to each receptor.

To calculate the astronomic maximum, the *Shadow* module of WindPro requires input data including terrain, dimensions of the wind turbines, and the geography and topography of the site. The input data is used to simulate the rotation and orbit of the earth on daily and yearly averaging periods for the specific project site with the following assumptions as a worst-case scenario:

- Every receptor / residence is modeled as a "greenhouse," with 3 m high and 3 m wide windows at each side of the building.
- The sun is always shining from sunrise to sunset without any clouds.
- The wind turbine rotor is always spinning.
- The rotor is always oriented perpendicular to the path of the sunlight and the receptor.
- There are no obstacles such as plants, trees, or buildings between the wind turbines and the receptors.

Two limiting factors should be noted for the shadow flicker effect, which are included in the *Shadow* module:

- Due to atmospheric diffusion and low radiation the angle of the sun must be three degrees above the horizon to produce a discernible shadow flicker.
- The beams of sunlight must be blocked with at least 20% of the wind turbine blades to have a noticeable effect.

The exact turbine model is currently unknown. Therefore, several turbine models of various manufacturers were compared and the turbine with the largest dimensions was selected to present a worst-case scenario. The Enercon E-126 turbine at a hub height of 132 m was selected for this purpose.

4.5 **Visual Impact**

4.5.1 Visual Impact Assessment

Personnel trained in completing visual modelling for wind power project installations have completed a Visual Impact Analysis (VIA) for PBRWP. The purpose of the VIA is to determine the visual impact the Project will have on the landscape and to provide stakeholders with a concept of what to expect upon completion of Project construction.

The most effective method of displaying the visual impact of the Project is using a simulated visualization of PBRWP after construction. This is done by taking photos directed toward the site from several locations in the surrounding area and using specialized software to overlay the wind turbines into the photo. The visualizations were modelled using the *Photomontage* module of WindPro (version 3.2.701).

Five (5) photo locations were chosen to illustrate the visual impact around the planned PBRWP. PBRWP is surrounded by mixedwood forest with 7 – 15 m tree height that restricts the view of the proposed project from many locations. It was necessary to search for suitable photo locations with an open line of sight to allow visibility of the wind turbines. For each photo site, GPS coordinates were recorded, as well as coordinates of control points within the photo to confirm the field of view. Camera height, focal length, and orientation (pan, tilt, & azimuth angles) were also recorded in order to ensure correct calibration with the *Photomontage* software.

The photographs were taken on the 20th of November 2018 with a Canon EOS Rebel X (10 MP). For each photograph the camera was mounted on a tripod at 1.5 m in height. The weather on this day can be described as overcast with snow showers.
The exact turbine model is currently unknown. Therefore, several turbine models from various manufacturers were compared and the turbine with the largest dimensions was selected to present a worst-case scenario. Enercon E126 turbine (126 m rotor diameter) at a hub height of 132 m was selected for this purpose. The rendering of this turbine type considered the weather and light conditions the day the photos were taken.

Minor editing was completed on the photos to increase the brightness and clarity of the visualizations.
In addition to the photo visualizations, *ArcGIS* was used to generate a map illustrating the Zone of Visual Impact (ZVI), which depicts areas in the region from which PBRWP will be visible. For this calculation, the terrain elevations and the turbine height are considered. This information is provided on Figure 1 (Appendix F). Given the relatively flat terrain, the map indicates visibility from a large area, excluding from below the bluff near the coastline to the North, and from areas with more relief to the South and South-East of the Project. It is important to note that for this exercise a ‘worst-case’ scenario approach was used. In the parameters of the *ArcGIS* software it was assumed that no trees or other vegetation or structures exist that could impede the view of PBRWP. In reality, the area surrounding PBRWP and the local communities is heavily forested, which will lead to drastically reduced visibility of the wind turbines.

4.6 Electromagnetic Interference

4.6.1 Electromagnetic Interference Study

An Electromagnetic Interference Study (EMI) was conducted by personnel trained in the use of EMI modelling for wind power project installations to determine if the proposed PBRWP may interfere with any existing radio, telecommunication or radar systems. More information (methodology and results) can be found in Appendix H.

5 DESCRIPTION OF THE EXISTING BIOPHYSICAL ENVIRONMENT

The Study Area is situated in a rural setting with approximately 25 residences within a 2.6km radius buffer from the proposed WTG locations; the closest residence to a proposed WTG (WTG1) is located 1.4km away (Figure 10, Appendix A).

5.1 Ecological Land Classification

PBRWP is located within the Caraquet Ecodistrict (6-2) in the Eastern Lowlands Ecoregion (NBERD, 2007). The Caraquet Ecodistrict covers the Acadian Peninsular coastline from Nepisiguit River to Miramichi River. This Ecodistrict has a cool, dry climate, with strong summer winds. The area has relatively fertile soils derived from marine or glaciomarine sediments, that range from fine to coarse in texture.

The Study Area lies within Ecosites 1, 2 and 3 (NBERD, 2007). Ecosites 1 and 2 are predominantly covered by red or white spruce, followed by intolerant hardwood and softwood species. Ecosite 3 is predominantly covered by black spruce, followed by red or white spruce (NBERD, 2007).

5.2 Land Use

5.2.1 Historical Land Use

The initial European settlement in the area of Pokeshaw was in approximately 1800 when Scottish immigrants established trading posts at the mouth of the Pokeshaw River. By 1815 Irish settlers principally from the Bandon, Ireland area established fishing, lumbering and farming based homesteads. This traditional use of the land continued well into the 20th century. During this period sawmills, canning plants, grist mills, schools, a post office and a railway stop had been established. Since the 1960's the industries have all closed and the railway has removed related infrastructure and both the schools and post office have also been closed.

5.2.2 Current Land Use

The Study Area is largely comprised of natural forest land; however, areas of agriculture and previous logged areas also exist. Information presented in Table 28 (below) displays the land cover and area (in hectares) of each cover type within the Study Area. This information was derived from the forest and non-forest GIS databases (NBERD, 2015).

Table 28. Calculations of Current Land Cover

Land Cover	Area (hectares)	% of Study Area
Wetland Habitat	53	20%
Agricultural	44.3	17%
Cleared (clearcut or field)	19	7%
Soil/Gravel Pit	1	0.4%
Hardwood Forest	100	39%
Softwood Forest	17	7%
Mixedwood Forest	19	7%
Road/Trail	5.5	2%
TOTAL STUDY AREA	258.8	100%

According to the NBERD GIS databases, land use within the Study Area is dominated by forested land, with some timber-harvesting activities present. The database indicates that the total area of forested habitat accounts for 53% of the Study Area land base. However, a review of 2018 aerial imagery suggests that ~74.5ha of land within the Project Area now appears to have been clear cut which reduces the total forested land area identified by the databases considerably.

5.2.3 Significant Land Use

A desktop review was completed for lands surrounding the Study Area utilizing available data accessed via the GeoNB database (GeoNB, 2019). The purpose of the review was to identify any significant lands surrounding the Study Area that could interact with PBRWP. Figure 4 (Appendix A) and the information provided below identifies the locations of significant lands identified during this process:

- Aboriginal Lands - None exist within Study Area. Nearest is the Pokemouche Indian Reserve No. 13, approximately 22 km southeast of the Study Area;
- Crown Lands Conservation Areas - Deer Wintering Areas: None existing within the Study Area or within 10 km of it;
- Wildlife Refuge - None within the Study Area. Acadian Village Wildlife Management Area is located 8.5 km to the east of the Study Area;
- Canadian Heritage Rivers - None within the Study Area. The mouth of the Restigouche River is approximately 120 km northwest of the Study Area;
- Crown Lands Conservation Areas: Watercourse and Wetland Buffers - No crown land watercourse and wetland buffers are present within, or directly adjacent to the Study Area;
- New Brunswick Hydrographic Network: Watercourses – A mapped watercourse, Riviere du Nord, is present in the eastern extent of the Study Area. See Figure 9 (Appendix A);
- New Brunswick Hydrographic Network: Wetlands – No mapped wetlands (including Provincially Significant Wetlands (PSW) are present within the Study Area. The nearest PSW is located

approximately 3km north of the Study Area. An additional PSW is located approximately 8.5 km east of the Study Area (Figure 9, Appendix A);

- New Brunswick Hydrographic Network: Waterbodies - None present within the Study Area;
- Federal Parks and Protected Areas - None within Study Area. Nearest is Kouchibouguac National Park, approximately 100 km southeast of the Study Area;
- Protected Natural Areas - None exist within or adjacent to the Study Area. Nearest is Pokeshaw Natural Area, approximately 2.5 km north of the Study Area, and Goose Lake, approximately 7.6 km south of the Study Area;
- Protected Watersheds - None exist within the Study Area, or within 10 km of the Study Area;
- Environmentally Significant Areas - None within the Study Area. Pokeshaw Island and Cliffs Environmentally Significant Area is located 2.5 km north of the Study Area;
- Provincial Parks - None exist within the Study Area. Pokeshaw Provincial Park is located 2.5 km north of the Study Area;
- National Migratory Bird Sanctuaries - None within Study Area. Nearest is the Inkerman Migratory Bird Sanctuary located approximately 33 km southeast of the Study Area;
- Canadian Important Bird Areas (IBA) - None within the Study Area. The nearest IBA is Pokeshaw Rock (IBA NB005), which is approximately 1.5 km north of the Study Area (the formation itself is approximately 2.6km northeast of the Study Area). Additional information provided in Section 3.1.1);
- Bats - Critical Bat habitat (hibernacula) is identified within a 10 km x 10 km square near Mont-Joli, QC, approximately 216 km northwest of the Study Area. A review of the ACCDC report indicates that no known bat hibernacula are present within 5 km of the Study Area. A review of the New Brunswick Mine Openings Database identifies a single open adit (which may provide potential bat hibernacula) in Gloucester County, at Tetagouche Falls, approximately 45 km northwest of the Study Area; and
- Ramsar (Wetlands of International Importance) - None existing within the Study Area. Nearest is the Tabusintac Lagoon and River Estuary, approximately 60 km southeast of the Study Area.

5.3 Atmospheric Environment

5.3.1 Weather and Climate

Weather and climate have the potential to interact with wind power projects, especially in relation to the operation of turbines and potential health and safety concerns during periods of cold weather and ice accumulation, and during high wind situations.

Historical weather information was obtained from Environment Canada's Weather Station located at Bathurst, approximately 35 km southeast of the Study Area. General conditions recorded between 1971-2000 are presented in Table 29 below.

Table 29: Historical Weather Data, Bathurst, NB (1971-2000)

Weather Parameter	Annual Average Temperature (°C)	Extreme Maximum Temperature (°C)	Extreme Minimum Temperature (°C)	Annual Average Rainfall (mm)	Annual Average Snowfall (cm)	Extreme Daily Rainfall (mm)	Extreme Snow Depth (cm)
Period	1971-2000	July 4, 1983	Jan 12, 1976	1971-2000	1971-2000	May 13 1977	Dec 28, 1978
Value	4.5	36.5	-36.1	744.4	314.2	69.6	213

Average Precipitation Values (1971-2000)													
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual Average**
Average Precipitation Values (mm)	23.5	10.2	30	57.3	78.5	83.5	99	101.6	71.7	89	65	35.3	744.4
Extreme Daily Precipitation	33.6	32	34	39.9	69.6	54.6	56.1	88.6	89.7	66.5	39.8	47.6	N/A

In addition to this data, weather data has been collected at PBRWP from the on-site MET Tower since December 2016. During this period the following temperatures have been collected:

- Average Temperature: 5.0 °C
- Minimum Temperature: -21.4 °C
- Maximum Temperature: 31.0 °C

Drizzle and fog impair visibility, and cause birds to fly at lower altitudes and follow topographical cues. The combination of such weather with lighting may attract migrating birds, and so increase the collision rate. Furthermore, seabirds that fly at night have been found to become disoriented during periods of fog, which is especially true for fledglings; this disorientation makes them prone to being attracted to artificial lighting (i.e. street lights) (Powlesland, 2009). Fog data is not present at meteorological stations in close proximity to the Study Area, however, weather conditions recorded during on-site avian surveys completed throughout 2018 were reviewed to determine the frequency of fog conditions during the survey period. On completion of the review it was evident that out of 43 survey days, fog was only present once, on May 1, 2018.

Extreme weather of any kind has the potential to impact the Project. Mitigation, planning and the design of the Project can help reduce negative impacts and risks posed to the Project by weather.

5.3.1.1 <u>Climate Change</u>

Consideration of climate change and subsequent weather conditions is worth exploring. Changes in precipitation could affect surface water drainage management and infrastructure design (i.e. culvert and water detention structures), and precipitation frequency and extent, and its potential effect on turbine efficiency has also been studied (Walker and Wade, 1988). Temperature can affect turbine efficiency through the accumulation of ice on the blades, shutdowns caused by extreme cold temperatures, and limited access to the site (Kilpatrick, 2017).

As previously discussed, frequency and extent of fog can affect migratory bird flight path characteristics and potentially increase collision with wind turbine blades. The one day where fog was observed during avian surveys indicates that the Study Area is not particularly susceptible to these conditions. However, the future of fog and its prevalence as a result of climate change is relatively unknown.

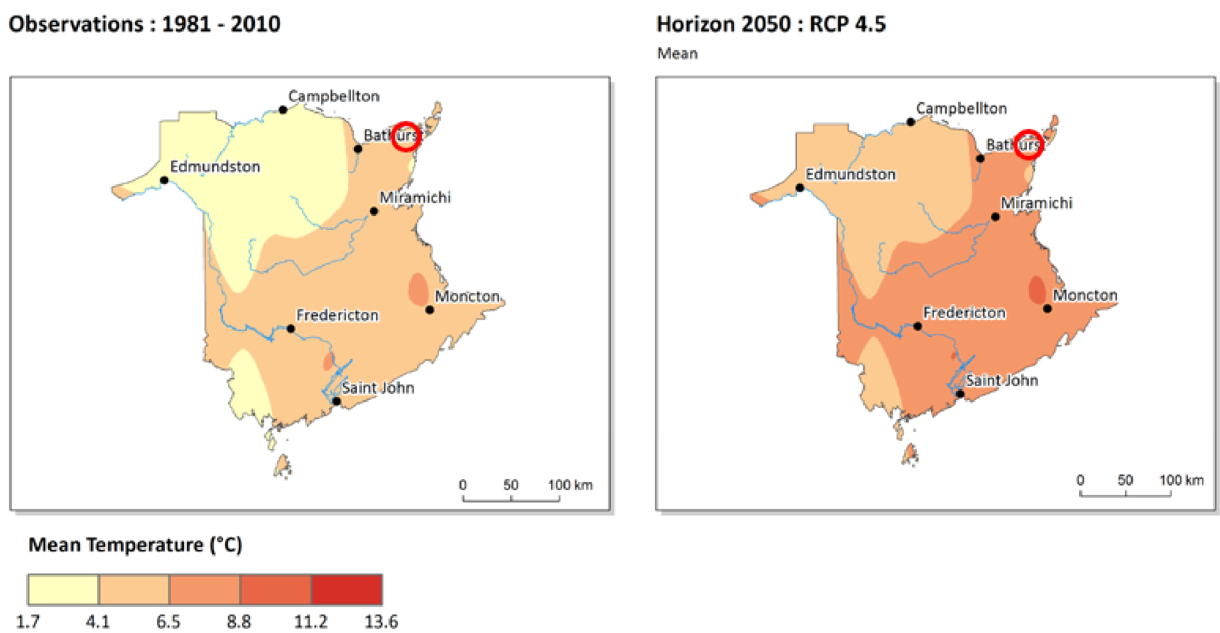

Figure 2: Mean Annual Temperatures (1981 - 2010) compared to Projected Temperatures (2015) under RCP 4.5 (Roy and Huard, 2016)

Utilizing New Brunswick's Future Climate Projections (NBFCP), potential changes in temperature and precipitation can be estimated for the region where the Project is proposed (Roy and Huard, 2016). The NBFCP utilizes historical weather data between 1980-2010 and has projected climate projections for future periods of 2020, 2050 and 2080 utilizing global climate models. A variety of emission scenarios were modelled, resulting in various future estimates. For the purposes of the information provided below, a moderate scenario was utilized, named RCP4.5, which represents the lesser anticipated effect as a result of climate change, and average conditions between 1981-2010 were compared to projected conditions in 2050.

Figure 2 (above) indicates a comparison between the Mean Annual temperatures (1981-2010) to projected temperatures at 2050 as per the NBFCP methods. The approximate location of the Study Area is circled. Additional projected temperature data in comparison to the mean values recorded between 1981-2010 at Bathurst are also presented in Table 30. The project temperature data modelled by the NBFCP indicates that New Brunswick will experience a substantial increase in mean temperature over all seasons including at the location of the Study Area. As depicted in Figure 3 (above) and Table 30, the projected temperature increase by 2050 is 2.3°C, and temperatures > 25°C will occur on 22.16 days more in 2050 than they did during the 1981-2010 period. Conversely, colder days are projected to decrease by 2050. For example, annual number of days with maximum temperatures < 0°C will occur 21.54 less days in 2050 than they did during the 1981-2010 period.

Table 30: Projected Temperature Changes in Bathurst

Climate Parameter	1981-2010	2050	Projected Difference
Mean Annual Temperature (°C)	4.83	7.16	2.33 °C
Mean Annual Number of Days with Max Temperature >25°C	45.75	67.91	22.16 more days
Mean Annual Number of Days with Max Temperature >30°C	9.47	23.02	13.55 more days
Mean Annual Number of Days with Max Temperature >35°C	0.41	2.6	2.19 more days
Annual Number of Days with Maximum Temperature < 0°C	81.69	60.15	21.54 less days
Annual Number of Days with Maximum Temperature < -10°C	16	8.51	7.49 less days
Annual Number of Days with Maximum Temperature < -20°C	0.69	0.15	0.54 less days

Figure 4 indicates a comparison between the Mean Annual Precipitation (1981-2010) to projected temperatures at 2050. The approximate location of the Project Area is circled.

Generally, the NBFCP predicts that precipitation will increase throughout the year, but the model is especially strong in these predictions for winter and spring (Roy and Huard, 2016).

Figure 4 indicates that at the Project Area location the mean annual precipitation of 1099.95mm recorded between 1981-2010 is projected to increase to 1174.11mm by 2050 (an increase of 74.16mm).

5.3.2 Air Quality

Effects to air quality as a result of the PBRWP are likely to be experienced during construction of PBRWP (i.e. dust and exhaust from equipment and machinery use).

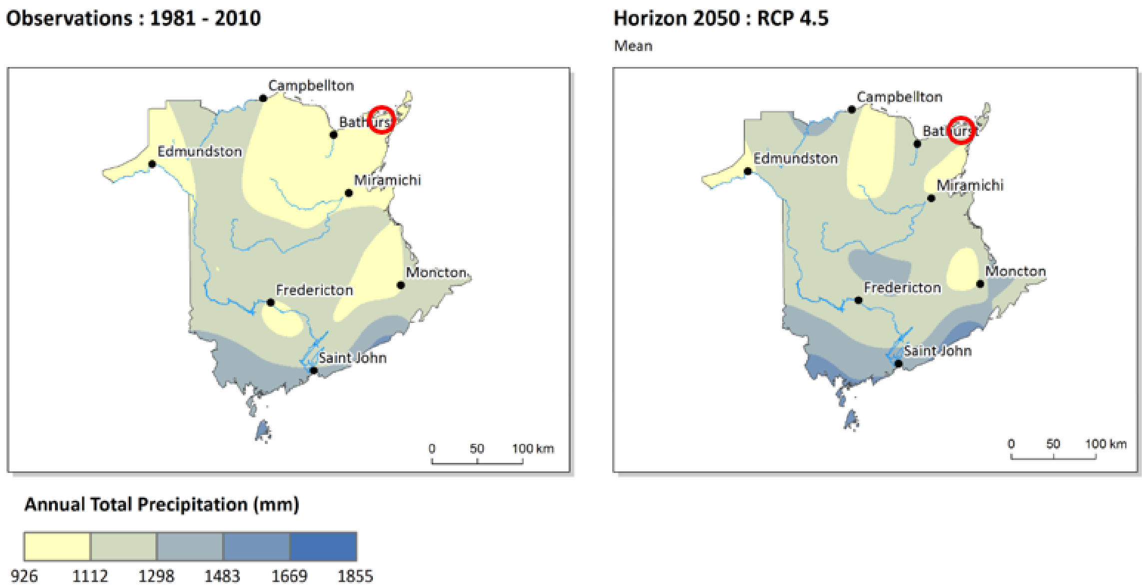

Figure 3: Mean Annual Precipitation (1981-2010) compared to Projected Temperature under RCP 4.5 (Roy and Huard, 2016)

Air quality parameters are measured at the Government of New Brunswick Monitoring Station in Bathurst (~35km southeast of the Study Area). Data collected includes Ozone (O_3), particulate matter (PM2.5), and nitrogen dioxide (NO_2). Values as of June 13, 2019 are provided in Table 31.

Table 31: Air Quality Conditions at Bathurst, NB (June 13, 2019)

Parameter	Value	CCME Limits/Period	New Brunswick Air Zone Management Level
Nitrogen Dioxide (ppb)	1.0	60 (24hr)	N/A
Fine Particulate Matter ($\mu g/m^3$)	15.0	28.0 (24hr)	0-10 (daily)
Ozone (ppb)	35.0	63 (8hr)	0-50 (annually)

These values are used to calculate a score in the Air Quality Health Index (AQHI) (ECCC, 2016). The AQHI is a scale from 1-10+, representing the following health risk categories: Low (1-3), Moderate (4-6), High (7-10), and Very High (10+). At the Bathurst monitoring station, the AQHI is considered low, when assessed in June 2019 (ECCC, 2016).

The Canadian Council of Ministers of Environment (CCME) approved Canadian Ambient Air Quality Standards for particulate matter and ground level ozone. In addition, CCME created an Air Zone Management Framework which guides air quality management actions. CCME limits for Fine Particular Matter and Ozone, as well as the threshold values for both in order to maintain the Green Management Level (i.e. keep clean areas clean) is also indicated in Table 32.

5.4 **Geophysical**

5.4.1 Physiography and Topography

The Study Area is located within the New Brunswick Lowlands physiographic region. This region borders the Northumberland Strait in a gently sloping plain. Organic soils are prevalent throughout the central and northern shores of the region (Colpitts *et al.,* 1995). The topography within the Study Area is generally flat, with a slightly higher elevation in the southwest corner (elevation = 41m above sea level) sloping gently towards a lower elevation in the northeast corner (elevation = 20m above sea level).

5.4.2 Surficial Geology

The surficial geology of the Study Area consists of sand, silt, gravel and clay at depths between 0.5 and 3m thick (Rampton, 1984). Soils within the Study Area are derived from two different parent materials: red mudstone and grey lithic feldspathic sandstones (NBERD, 1995). The primary lithology of the red mudstone consists of minor grey-red lithic-feldspathic sandstones, quartzose sandstones and/or polymictic conglomerates. The primary lithology of the sandstone consists of minor quartzose sandstones, polymictic conglomerates, quartz pebble conglomerates and/or red mudstones. The forest soil derived from the mudstone is Stony Brook, which has low amounts of coarse fragments, silt-loam to loam soil at the surface, and is a compact till deposit. The forest soil derived from the sandstone is Riverbank, which has low to high amounts of coarse fragments, sandy loam to sand soil at the surface, and was deposited by glaciofluvial or marine deposition (NBERD, 1995).

Stony Brook soils are dominated by imperfect drainage, this coupled with flat topography results in a large percentage of soil within this group with issues of over-saturation. Riverbank soils, on the other hand, are dominated by rapidly draining soils (Rees, Fahmy, Wang & Wells, 2005). According to the forest soils geodatabase, soils within the Study Area are predominantly moderately well drained with significant well or imperfectly drained areas (NBERD, 2015).

5.4.3 Bedrock Geology

The Study Area overlies bedrock formations from the Pictou Group (NBERD, 2008). Geological mapping of the region indicates the bedrock as late carboniferous sedimentary rock. The Study Area is underlain by non-calcareous grey-green sandstone, interbedded with reddish, fine-textured, sandstone siltstone, and conglomerate (Colpitts *et al.,* 1995).

5.4.3.1 **Acid Rock Drainage (ARD)**

Exposing and physically disturbing sulphide-bearing rocks can cause ARD to develop and can negatively impact the environment, human health and infrastructure. Acidic runoff, with pH levels as low as 3, can be harmful for aquatic habitats and can cause fish kills. ARD can contaminate drinking water supplies with increased concentrations of toxic and carcinogenic heavy metals having impacts to fish and fish habitat (NBDOT, 2010). Furthermore, lithological bedrock units containing black shales/slates may have higher levels of ARD mineralization (NBDOT, 2010).

A preliminary Geotechnical Investigation was completed by Gemtec Consulting Engineers and Scientists Limited at a location close to the proposed substation in May 2018. Based on the results of the study a sandstone bedrock was identified approximately 3m below grade. This is consistent with the geological mapping discussed in Section 5.3.3. Based on geological map results and those identified during the geotechnical study, ARD is unlikely. Furthermore, on site construction of access roads and turbine pads are not expected to disturb bedrock.

5.4.4 Seismicity

While significant earthquakes have occurred in eastern Canada, it is much rarer as compared to other parts of the country due to a lack of plate boundaries (NRCAN, 2016b). In 1925 and 1929 a magnitude 7 earthquake hit within the Charelvoix seismic zone in eastern Quebec and on the Grand Banks south of Newfoundland. The most recent earthquake with a significant magnitude to strike near the Study Area was in 1982 in Miramichi, when a 5.7 magnitude earthquake was detected. This earthquake caused minimal damage to the environment, and no damage to buildings up to 100km away from the epicenter (NRCAN, 2016a). The Study Area falls within the North Appalachian seismic zone, an area encompassing most of New Brunswick, Nova Scotia, and parts of Maine. Conductivity testing is planned to be carried out as part of the geotechnical investigation prior to construction.

5.4.5 Hydrogeology and Groundwater

Water supplies for individual homes near the Study Area are provided by drilled potable wells.

There are no municipal potable water wellfields within the Study Area, the closest one being over 14km away in the Town of Caraquet (NBDELG, 2019c). A query of the NBDELG Online Well Log System (OWLS) showed there are no private well log and groundwater chemistry data within 2 km of the Study Area. However, it is assumed the closest residential well is located at residential Receptor P (approximately 1,419 m from WTG1). Details associated with individual wells within a 2.5 km radius of the Study Area were identified through OWLS (NBDELG, 2019c). This database provides information on water wells in the province, including information on well locations, geology and well construction, well depth and yield. A total of 12 well logs (all drilled) were available for review.

Table 32 outlines well characteristic summaries for the 12 wells located within 2.5 km of the Study Area center. General conclusions relating to the groundwater resource in the Study Area were derived from this information. Locations of the drilled wells are provided on Figure 11 (Appendix A).

Table 32. Well Characteristics within 1 km of the Study Area

Statistic	Overall Well Depth (m)	Casing Above Ground (cm)	Depth to Bedrock (m)	Casing Diameter	Estimated Safe Yield (LPM)	Final Water Level (m)
Minimum	6.1	0	0.91	15.24	18	0
Maximum	49.38	45.72	3.66	15.24	182	19.81
Average	22.1625	28.575	2.18	15.24	56.583	7.7475
Median	19.66	30.48	2.14	15.24	46	6.25
Number of wells	12	12	12	12	12	12

There were no wells observed within the Study Area during field studies. According to the information available in the OWLS Database, the closest mapped drilled groundwater well used for potable purposes is located 780m northwest of the Study Area; however, the accuracy for this well within the database is unknown. Furthermore, there are no protected water supply areas within 50 km of the Study Area.

5.5 Terrestrial Environment

This section describes the Study Area habitat, avian use, wildlife, and vegetation communities.

5.5.1 Habitat

The following sections outline the results for the habitat desktop review and field surveys.

5.5.1.1 Desktop Results

The Study Area is within the Eastern Lowlands Ecoregion and the Caraquet ecodistrict. The Eastern Lowlands Ecoregion covers a broad area with rolling terrain which spans from Bathurst down to Sackville. The bedrock consists of Carboniferous sedimentary rocks which range from fine reddish siltstones and grey quartz rich sandstones to coarse conglomerates (NBERD, 2007). The low relief within this Ecoregion results in poor soil drainage. Generally, this Ecoregion is composed of boreal signature species such as Black Spruce (*Picea mariana*), Jack Pine (*Pinus banksiana*), Trembling Aspen (*Populus tremuloides*) which is attributed to the poorly drained and slightly acidic soils (NBERD, 2007).

The Caraquet ecodistrict is a crescent of land which is approximately 10 km wide that borders the Acadian Peninsula coastline (NBERD, 2007). This ecodistrict consists primarily of Pennsylvanian non-calcareous red and gray sandstone which is interbedded with conglomerate and mudstone. Due to the lithological variety in the conglomerates found in the soils within the ecodistrict, soils are generally fertile and support species such as Red Maple (*Acer rubrum*), Sugar Maple (*Acer saccharum*) and Birch (*Betula spp.*) which commonly dominate tolerant and intolerant hardwood stands in this district.

According to the ERD database, the Study Area consists primarily of intolerant hardwoods, mixedwood, tolerant hardwoods and softwood forest types. Other land use types exist within the Study Area which consist of cultivated lands and a small gravel pit to the south western extent of the Study Area. All proposed wind turbine locations are within mixedwood (both mature and regenerating) consisting of Red Maple, Birch and Balsam Fir and tolerant hardwood stands consisting of Red Maple and Birch as the primary tree species. The proposed substation and access road are within a conifer stand which comprises of Balsam Fir as the primary species. See Figure 8 (Appendix A) for mapped habitat types.

5.5.1.2 **Field Results**

During the field surveys it was confirmed that the Study Area consists of cultivated lands, a small gravel pit, cutblocks, access roads and undisturbed forested landscapes. Within portions of the Study Area where intact canopies exist, the community types consist of mixedwood (MW), tolerant hardwoods (TH), Spruce-hemlock (SH) and intolerant hardwoods (IH). Twenty-two HAP were assessed during the surveys.

The most prevalent community types observed during the surveys were the MW (n=32%) and SH (n=27%) with the community types TH (n=23%) and IH (n=18%) being less frequent. See Figure 4 (below) and Table 33 (below) for the relative habitat type and habitat descriptions identified within the Study Area.

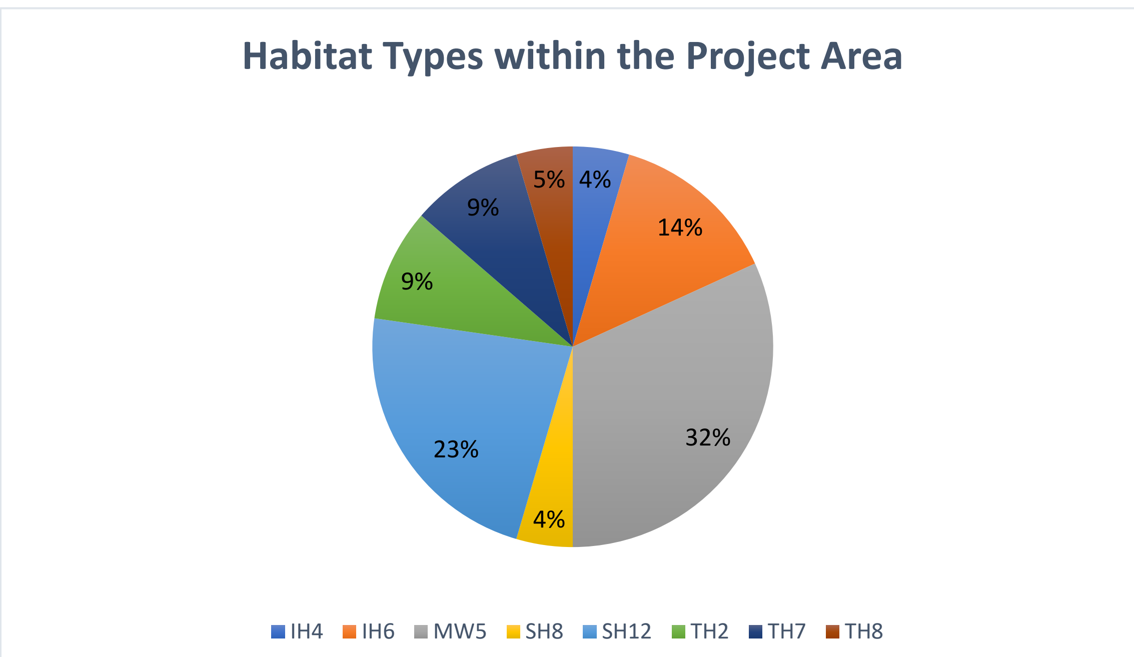

Figure 4. Relative Abundance of Habitat Types within the Study Area.

Table 33. Community and Habitat Types Observed during the Habitat Assessments

Habitat Assessment Point (HAP)	Community Type	Habitat Type	Disturbance	Stand Age Class	Habitat Description
HAP1	MW	MW5 – White Birch – Balsam Fir/Star Flower	None	Mature	An early successional mixedwood habitat type dominated by White Birch, Balsam Fir and Red Maple. Herbaceous layer was sparse and comprised of Wild Lily-of-the-valley (*Maianthemum canadense*) and Wild Sarsaparilla (*Aralia nudicaulis*). A prominent leaf litter exists.
HAP2	IH	IH6 – White Birch – Red Maple/ Sarsaparilla - Bracken	None	Mature	An early successional habitat type dominated by White Birch, Sugar Maple and Red Maple. Herbaceous layer is sparse and consists of Wild Sarsaparilla, Dwarf Raspberry (*Rubus pubescens*) and Star Flower. A prominent leaf litter exists.
HAP3	MW	MW5 - White Birch – Balsam Fir/Star Flower	None	Mature	An early successional mixedwood habitat type dominated by White Birch, Balsam Fir and Red Maple. Herbaceous layer was sparse and comprised of Stiff Clubmoss (*Lycopodium annotinum*) and Wild Sarsaparilla. A prominent leaf litter exists.
HAP4	SH	SH12 – Eastern White Cedar – Eastern Hemlock/ Beaked Hazel/ Cinnamon Fern	On edge of cutblock	Mature	A mid to later successional habitat type dominated by White Cedar (*Thuja occidentalis*) and Speckled Alder (A*lnus incana*). Herbaceous layer is sparse and comprised of scattered patches of Peat moss (*Sphagnum spp.*), and Three-seeded Sedge (*Carex trisperma*). A prominent leaf litter exists.

Habitat Assessment Point (HAP)	Community Type	Habitat Type	Disturbance	Stand Age Class	Habitat Description
HAP5	SH	SH12– Eastern White Cedar – Eastern Hemlock/ Beaked Hazel/ Cinnamon Fern	None	Mature	A mid to later successional habitat type dominated by White Cedar (*Thuja occidentalis*), Red Maple and Cinnamon fern (*Osmunda cinnamomeum*). Herbaceous layer is sparse and primarily comprises of Bunchberry (*Cornus canadensis*). A prominent leaf litter exists.
HAP6	SH	SH12– Eastern White Cedar – Eastern Hemlock/ Beaked Hazel/ Cinnamon Fern	None	Mature	A mid to later successional habitat type dominated by White Cedar (*Thuja occidentalis*) and Balsam Fir. Herbaceous layer is dense and dominated by Cinnamon Fern with a sparse leaf litter.
HAP7	SH	SH12– Eastern White Cedar – Eastern Hemlock/ Beaked Hazel/ Cinnamon Fern	None	Mature	A mid to later successional habitat type dominated by White Cedar, Red Maple and White Birch. Herbaceous layer is sparse and comprises of Bunch Berry, Wild Sarsaparilla and *Rhytidiadelphus sp.*
HAP8	IH	IH6 – White Birch – Red Maple/ Sarsaparilla - Bracken	None	Mature	An early successional habitat type dominated by White Birch, Balsam Fir, Red Maple and White Cedar. Herbaceous layer is sparse and consists of Wild Sarsaparilla, Striped Maple (*Acer pensylvanicum*) and Star Flower. A prominent leaf litter exists.
HAP9	SH	SH12– Eastern White Cedar – Eastern Hemlock/ Beaked Hazel/ Cinnamon Fern	None	Mature	A mid to later successional habitat type dominated by White Cedar, Red Maple and White Birch. Herbaceous layer is sparse and comprises of Bunch Berry and Wild Sarsaparilla.
HAP10	TH	TH2 – Sugar Maple/New York Fern – Northern Beech Fern	None	Mature	A late successional habitat type dominated by Sugar Maple, White Birch and Chokecherry (*Prunus virginiana*). Herbaceous layer dominated by Dwarf Raspberry with a prominent leaf litter.

Habitat Assessment Point (HAP)	Community Type	Habitat Type	Disturbance	Stand Age Class	Habitat Description
HAP11	TH	TH2 – Sugar Maple/New York Fern – Northern Beech Fern	None	Mature	A late successional habitat type dominated by Sugar Maple, White Birch and Chokecherry (*Prunus virginiana*). Herbaceous layer dominated by Dwarf Raspberry with a prominent leaf litter.
HAP12	TH	TH8 – Red Maple – Yellow Birch/Striped Maple	None	Mature	A mid to late successional habitat type dominated by regenerative hardwood species primarily composing of Yellow Birch, Red Maple, Sugar Maple and Striped Maple. Herbaceous layer consisted of Wood Aster and Red Raspberry (*Rubus idaeus*).
HAP13	MW	MW5 - White Birch – Balsam Fir/Star Flower	None	Mature	An early successional mixedwood habitat type dominated by White Birch, Balsam Fir and Red Maple. Herbaceous layer was sparse and comprised of Wild Lily-of-the-valley and Wild Sarsaparilla. A prominent leaf litter exists.
HAP14	TH	TH7 – Yellow Birch – White Birch/Evergreen Wood Fern	None	Mature	A mid-successional habitat type dominated by Sugar Maple, Yellow Birch and White Birch. Herbaceous layer is sparse with scatted Birch saplings and Wild Sarsaparilla with a prominent leaf litter.
HAP15	IH	IH6 – White Birch – Red Maple/ Sarsaparilla - Bracken	None	Mature	An early successional habitat type dominated by White Birch, Sugar Maple and Red Maple. Herbaceous layer is sparse and consists of Wild Sarsaparilla, Dwarf Raspberry and Star Flower. A prominent leaf litter exists.
HAP16	MW	MW5 - White Birch – Balsam Fir/Star Flower	None	Mature	An early successional mixedwood habitat type dominated by White Birch, Balsam Fir and Red Maple. Herbaceous layer was sparse and comprised of Wild Lily-of-the-valley and Wild Sarsaparilla. A prominent leaf litter exists.

Habitat Assessment Point (HAP)	Community Type	Habitat Type	Disturbance	Stand Age Class	Habitat Description
HAP17	SH	SH8 – Balsam Fir/Wood Fern/ Schreber's Moss	None	Mature	An early to mid-successional vegetation type dominated by Balsam Fir. Herbaceous layer is sparse and leaf litter is prominent.
HAP18	MW	MW5 - White Birch – Balsam Fir/Star Flower	None	Mature	An early successional mixedwood habitat type dominated by White Birch, Balsam Fir and Red Maple. Herbaceous layer was sparse and comprised of Wild Lily-of-the-valley and Wild Sarsaparilla. A prominent leaf litter exists.
HAP19	MW	MW5 - White Birch – Balsam Fir/Star Flower	None	Mature	An early successional mixedwood habitat type dominated by White Birch, Balsam Fir and Red Maple. Herbaceous layer was sparse and comprised of Wild Lily-of-the-valley and Wild Sarsaparilla. A prominent leaf litter exists.
HAP20	IH	IH4 – Trembling Aspen/Wild Raisin/ Bunchberry	None	Mature	An early successional habitat type dominated by Trembling Aspen, Red Maple and Yellow Birch. Herbaceous layer sparse and monodominant, comprising of Starflower (*Trientalis borealis*).
HAP21	TH	TH8 – Red Maple – Yellow Birch/Striped Maple	Previously disturbed	Mature	A mid to late successional habitat type dominated by regenerative hardwood species primarily composing of Yellow Birch, Red Maple, Sugar Maple and Striped Maple. Herbaceous layer consisted of Wood Aster and Red Raspberry.
HAP22	MW	MW5 - White Birch – Balsam Fir/Star Flower	None	Mature	An early successional mixedwood habitat type dominated by White Birch, Balsam Fir and Red Maple. Herbaceous layer was sparse and comprised of Wild Lily-of-the-valley (*Maianthemum canadense*) and Wild Sarsaparilla (*Aralia nudicaulis*). A prominent leaf litter exists.

5.5.1.2.1 Mixedwood Communities

The mixedwood community comprises of 32% (n=7) of the HAPs surveyed with the White Birch-Balsam Fir/Star Flower (MW5) being the only habitat type present within the Study Area. This habitat type is scattered throughout northern, eastern and southern portions of the Study Area. This habitat type is an early successional habitat type often comprising of White Birch and Balsam Fir being the dominant treed species. The herbaceous layers varied slightly between each HAP, however, typically herbaceous layers were sparse and often comprised of Wild Lily-of-the-valley and Wild Sarsaparilla with a prominent leaf litter layer. Generally, the HAPs had well drained soils and vegetation indicative to medium soil fertility.

5.5.1.2.2 Spruce-hemlock Communities

The Spruce-hemlock community comprises of 27% (n=6) of the HAPs surveyed within the Study Area. These communities are situated primarily in eastern portions of the Study Area between WTG3 and WTG4, and in southern portions of the Study Area. This community is mid to late successional community often consisting of shade tolerant softwood species (i.e. Red Spruce [*Picea rubens*], Eastern Hemlock [*Tsuga canadensis*], Balsam Fir and White Cedar) and shade intermediate softwoods (White Pine and White Spruce). Soil nutrient regime varies and can be poor to slightly rich with well drained to poorly drained soils. Within this community type, 2 habitat types exist within the Study Area - Eastern White Cedar – Eastern Hemlock/ Beaked Hazel/ Cinnamon Fern (SH12) and Balsam Fir/Wood Fern/Schreber's Moss (SH8). The SH12 (23%, n=5) habitat type observed within the Study Area were dominated by White Cedar, with a sparse herbaceous layer and poorly drained soils with calcareous soils as indicated by the presence of White Cedar. The SH12 habitat is restricted to the eastern extent of the Study Area and reflective of richer soils in this area. The SH8 (4%, n=1) is an early to mid-successional habitat type dominated by Balsam Fir with a sparse vegetation layer. This habitat type has well drained soils which were acidic and poor as indicated by the dominance of Balsam Fir.

5.5.1.2.3 Tolerant Hardwood Communities

The tolerant hardwood community comprise of 23% (n=5) of the HAPs surveyed within the Study Area. This community is primarily situated in the southern, eastern and central portions of the Study Area between WTG1, WTG2 and WTG4. This community is defined by forests often with a close canopy and dominated by shade tolerant hardwood tree species. Within this community type, 3 mid to late successional habitat types were observed and are: Sugar Maple/New York Fern – Northern Beech Fern (TH2), Yellow Birch – White Birch/Evergreen Wood Fern (TH7) and Red Maple – Yellow Birch/Striped Maple (TH8). In general, these habitat types consist of well drained, rich soils, with a prominent leaf litter and a sparse herbaceous layer often consisting of Wild Sarsaparilla and Dwarf Raspberry.

5.5.1.2.4 Intolerant Hardwood Communities

The intolerant community comprises of 18% (n=4) of the HAPs surveyed within the Study Area. This community is primarily situated in the northern, eastern and southern portions of the Study Area, typically occurring between WTG1 to WTG2 and WTG3 to WTG5. This community is defined by forests with closed canopies dominated by shade intolerant to intermediate hardwoods (i.e. Red Maple, White Birch, Grey Birch [*Betula populifolia*], Trembling Aspen, Large-tooth Aspen [*Populus grandidentata*], Red Oak

[*Quercus rubra*] and White Ash [*Fraxinus americana*]). The herbaceous layer can be quite variable depending on the nutrient regime however, common species found were Wild Sarsaparilla, Starflower and ericaceous species (on poorer nutrient sites). Two habitat types which are within this community type were observed with the Study Area and are: White Birch – Red Maple/ Sarsaparilla – Bracken (IH6) and Trembling Aspen/Wild Raisin/ Bunchberry (IH4). The IH6 (14%, n=3) habitat types observed within the Study Area are an early successional habitat dominated by shade tolerant species such as White Birch and Red Maple with some shade tolerant species scattered (i.e. Balsam Fir and White Cedar). In the HAPs surveyed, the herbaceous layer is sparse and consists of Wild Sarsaparilla, Starflower and Striped Maple saplings. Soils were well drained and consisted of a vascular plant species (e.g. Striped Maple) which were indicative of moderately rich soils. The IH4 consisted of 4% (n=1) of the HAPs surveyed which is an early successional habitat dominated by Trembling Aspen, Red Maple and Yellow Birch. The herbaceous layer was sparse and dominated of Starflower with well drained soils.

5.5.1.3 <u>**Turbine Specific Habitat**</u>

The habitat at each of the proposed WTG locations are described in Table 34.

Table 34. Habitat at Proposed Turbine Locations

Wind Turbine	Community Type	Habitat Description
WTG1	IH	An early successional habitat type dominated by White Birch, Balsam Fir, Red Maple and White Cedar. Herbaceous layer is sparse and consists of Wild Sarsaparilla, Striped Maple (*Acer pensylvanicum*) and Star Flower. A prominent leaf litter exists. Limited shrub layer, with seldom Balsam Fir saplings.
WTG2	IH	An early successional habitat type dominated by White Birch, Balsam Fir, Red Maple and White Cedar. Herbaceous layer is sparse and consists of Wild Sarsaparilla, Canada Mayflower and Star Flower. A prominent leaf litter exists. Limited shrub layer, with seldom Balsam Fir saplings.
WTG3	IH	An early successional habitat type dominated by White Birch, Balsam Fir, Red Maple and White Cedar. Herbaceous layer is sparse and consists of Wild Sarsaparilla, Striped Maple (*Acer pensylvanicum*), Star Flower and some ferns. A prominent leaf litter exists. Limited shrub layer. The habitat was bounded to the Northwest by clear-cut.
WTG4	IH - regenerating	Regenerating mixedwood forest made up of young Maple, Balsam Fir, White Birch. Other common species observed included raspberry, blackberry, Tall Meadow Rue and Ash seedlings.
WTG5	IH	An early successional habitat type dominated by White Birch, Red Maple, White Cedar, and minor Balsam Fir. Herbaceous layer is sparse and consists of Wild Sarsaparilla, Striped Maple (*Acer pensylvanicum*), Star Flower and Canada Mayflower. A prominent leaf litter exists. Limited shrub layer.

5.5.1.4 **Habitat Conclusions**

The habitat field study confirmed that in general, the Study Area consists of disturbances areas such as cut blocks, access roads/trails, cultivated fields and forested landscapes. Where forested lands are present, often mature canopies exist which indicates soil nutrient regimes ranging from poor to rich and moisture regimes from well drained to poorly drained. Areas with richer soils within the Study Area support vascular plant species such as Sugar Maple, Striped Maple and White Cedar. The herbaceous layer in upland habitat is generally sparse and often consisting of one or two vascular plant species (e.g. Wild Sarsaparilla, Starflower etc.) and soils are well drained. Areas that are nutrient poor are often dominated by conifer species such as Balsam Fir and Red Spruce with ericaceous species are present. Lastly, the topography surrounding all five proposed wind turbine locations is gentle, with little to no slope.

5.5.2 Vascular Plants

The following section outlines the results of the desktop review and the field survey studies for vascular plants.

5.5.2.1 **Desktop Review Results**

Two rare vascular plant species, Seabeach Dock *(Rumex pallidus)* and Canada Burnet *(Sanguisorba canadensis)* have been documented within 5 km of the Study Area in the ACCDC report. No rare vascular plant species were documented within the Study Area.

5.5.2.2 **Field Survey Results**

In total, 200 vascular plant species were observed within the Study Area comprising 162 native and 38 exotic species. No vascular plants Priority Species were observed within the Study Area. A list of all vascular plants species is provided in Appendix H.

In the southern boundary of the Study Area, forested communities were primarily made up of rich tolerant hardwoods which consisted of mineral treed swamps comprised of rich soils and indicated by species such as Kidney-Leaved Buttercup (*Ranunculus abortivus)* and Bristly Black Currant (*Ribes lacustre).*

In contrast, in the north east of the Study Area, the vascular plant community structure was dominated by Black Spruce, Balsam Fir and ericaceous shrubs which are indicative of nutrient poor and acidic soils. Wetland 7, which is a large wetland complex, consists of variable topography (i.e. pit and mounds) which provides variable microhabitats and nutrient regimes favourable for the SAR Southern Twayblade (*Listera australis*). Although this area was extensively searched, no Southern Twayblade was observed.

In areas of disturbances such as cut blocks, access roads and edges of cultivated lands, the vascular plant community structure primarily consists on herbaceous perennials and annuals often associated with disturbances. The majority of the exotic species observed in the Study Area are concentrated in these disturbed habitat types and often include species such as Red Clover (*Trifolium pretense*), Rabbit's-foot

Clover (*Trifolium arvense*), Canada Bluegrass (*Poa compressa*) and White-sweet Clover (*Melilotus albus*).

5.5.3 Lichens

5.5.3.1 **Field Survey Results**

During the field Surveys, 19 lichen species were observed. One species was determined to be a Priority Species: Mealy-rimmed Shingle Lichen (*Pannaria conoplea,* S3S4). See Table 35 (below) for lichen species observed within the Study Area.

Although the Study Area, in part, comprises mature hardwood and softwood canopies, the epiphytic lichen community diversity is low. The lichen community consisted primarily of common and quite ubiquitous lichen species such as *Parmelia squarrosa* and the cyanolichen diversity was low. The relatively barren tree trunks throughout the Study Area implies that canopies within the Study Area are subject to dry conditions, despite being in close proximity to the coast and with the appropriate host tree species and maturity being present.

In areas with mature treed swamps, the stand type and moisture regime are appropriate for species associated with mature stands such as *Pannaria conoplea*.

The location of the Priority Species lichen observed (*Pannaria conoplea*) is provided on Figure 12 (Appendix A) and discussed further in Section 5.7.2.

Table 35: Lichen Species Observed Within The Study Area.

Scientific Name	Common Name	SRank
Pannaria conoplea	Mealy-rimmed Shingle Lichen	S3S4
Bryoria fuscescens	Pale-footed Horsehair Lichen	S4S5
Buellia sp.	A Button Lichen	--
Cladonia cristatella	British Soldiers Lichen	S5
Cladonia ochrochlora	Smooth-footed Powderhorn Lichen	S5
Collema subflaccidum	Tree Tarpaper Lichen	S5
Dibaes baeomyces	Pink Earth Lichen	--*
Evernia mesomorpha	Boreal Oakmoss Lichen	S5
Hypogymnia physodes	Monk's Hood Lichen	S5
Leptogium cyanescens	Blue Jellyskin Lichen	S5
Lobaria pulmonaria	Lungwort Lichen	S5
Loxospora ochrophaea	Eastern Ragged-rim Lichen	--*
Parmelia squarrosa	Bottlebrush Shield Lichen	S5
pertusaria amara	Bitter Wart Lichen	--*
Phaeophyscia pusilloides	Pompom-tipped Shadow Lichen	S4
Phaeophyscia rubropulchra	Orange-cored Shadow Lichen	S5
Platismatia glauca	Varied Rag Lichen	S5
Punctelia rudecta	Rough Speckleback Lichen	S5
Ramalina dilacerata	Punctured Ramalina Lichen	S4S5
Ramalina roesleri	Frayed Ramalina Lichen	S4S5
Tuckermannopsis orbata	Variable Wrinkle Lichen	S4
Usnea longissima	Methuselah's Beard Lichen	S4

Scientific Name	Common Name	SRank
Vulpicida pinastri	Powdered Sunshine Lichen	S5

Note: Scientific names used are in accordance to the latest ACCDC species list retrieved in February 2019. Scientific names may no longer be in use, however, for consistency in this report, species names in the ACCDC species list are used.
* Species ranking in the province has yet to be determined by the ACCDC

5.5.4 Wildlife Surveys

Wildlife species, including herpetofaunal and mammal species, were assessed within the Study Area through incidental observations by MEL biologists and birder Roland Chiasson during all surveys completed throughout 2018 and 2019. As discerned as part of developing the Priority Species short list (Section 3.1.2), no SAR or SOCI wildlife species (other than avian) have been observed historically within 5 km of the Study Area. The following have been observed historically within 100km of the Study Area as per the ACCDC.

Table 36. SAR and SOCI species within 100km as listed by ACCDC

Scientific Name	Common Name	COSEWIC	SARA	NBSARA	ACCDC	Distance
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	Threatened	S2S3	29.9 ± 1.0
Lynx canadensis	Canadian Lynx	Not At Risk		Endangered	S3	38.3 ± 1.0
Puma concolor pop. 1	Cougar - Eastern pop.	Data Deficient		Endangered	SU	26.8 ± 1.0
Synaptomys cooperi	Southern Bog Lemming				S3S4	90.8 ± 0.0

No SAR or SOCI wildlife species were identified during any surveys completed within the Study Area. A description of potential SAR or SOCI species that could utilize the Study Area is provided in Section 5.7.

Table 37 lists those species that were confirmed within the Study Area either visually or by sign (scat, footprints, etc.).

Table 37. Wildlife Observations

Scientific Name	Common Name	ACCDC Prov. Rank
Ursus americanus	American Black Bear	S5
Martes americana	American Marten	S4
Thamnophis sirtalis	Common Gartersnake	S5
Alces americanus	Moose	S5
Erethizon dorsatum	North American Porcupine	S5
Vulpes vulpes	Red Fox	S5
Tamiasciursus hudsonicus	Red Squirrel	S5
	Unknown Frog sp.	
Odocoileus virginianus	White Tailed Deer	S5
Marmota monax	Woodchuck	S5

Other species, not encountered during field studies that could utilize the habitat within the Study Area include:

Table 38. Potential Terrestrial Wildlife

Scientific Name	Common Name	ACCDC Prov. Rank
Mustela vison	American Mink	S5
Castor canadensis	Beaver	S5
Lynx rufus	Bobcat	S4
Sorex cinereus	Common Masked Shrew	S5
Procyon lotor	Common Raccoon	S5
Peromyscus maniculatus	Deer mouse	S5
Tamias striatus	Eastern Chipmunk	S5
Canis latrans	Eastern Coyote	S5
Martes pennanti	Fisher	S5
Mustela frenata	Long Tailed Weasel	S5
Zapus hudsonius	Meadow Jumping Mouse	S5
Microtus pennsylvanicus	Meadow Vole	S5
Ondatra zibethicus	Muskrat	S5
Sorex hoyi	Pygmy Shrew	S5
Lutra canadensis	River Otter	S5
Lepus americanus	Snowshoe Hare	S5
Mephitis mephitis	Striped Skunk	S5
Sorex palustris	Water Shrew	S5

5.5.5 Avian

The following sections outline the results from the desktop review and the avian field surveys completed.

5.5.5.1 **Desktop Results**

The reader is referred to Section 3.1.1 for background on bird use of the regional area and Section 3.1.2 for a description of Priority Bird Species that have been identified in and surrounding the Study Area in the past.

All proposed wind turbine locations are within intolerant hardwood stands consisting of Red Maple, Birch and Balsam Fir as the primary tree species. Section 5.5.1 provides a detailed overview of habitat present.

The Study Area provides nesting, foraging and roosting habitats for a diversity of species, particularly passerines or other land birds. Due to a lack of water bodies within the Study Area, no habitat for waterbirds and waterfowl is present.

As discussed in Section 3.1.1, the habitat present within the Study Area is not consistent with the Pokeshaw Rock IBA which supports a colony of Double-crested Cormorants and other seabirds noted.

Furthermore, the Project will not disrupt large contiguous wetland or forest habitat that may be of importance to birds.

5.5.5.2 Avian Survey Results

Baseline surveys for birds were completed from April 2018 to June 2019, by Roland Chiasson, a birder who has completed numerous bird studies in New Brunswick (see resume attached in Appendix O). A total of 9,271 minutes (154 hours and 30 mins) of surveys were completed over four seasons. These surveys resulted in the observation of 22,590 individual birds, representing 116 species within or in proximity to the Study Area. When incidental observations were removed (those observed outside of dedicated surveys), 22,242 individuals representing 115 species remain. Neither incidental nor point count survey species count include birds that were not able to be identified at the species level (i.e. unknown warbler or finch species), however, these individuals were included in the total number of birds observed (both incidental and point count surveys).

Across all survey seasons a total of eighteen (18) Priority Species were observed either during dedicated survey periods or incidentally. Of the 18-Priority Species seven species are SAR and 11 are SOCI according to ranks designated by the ACCDC. These Priority Species are discussed in Section 5.6.5.

The most abundant group observed during surveys were waterbirds, due to the large number of Double-crested Cormorants observed at the Pokeshaw Rock. **However, the majority (99%) these observations were identified outside of the Study Area, predominantly at the Pokeshaw Rock IBA**. The seasonal specific survey results are discussed below. All avian survey locations can be seen in Figures 7a and 7b (Appendix A).

5.5.5.2.1 Spring Migration

The following sections describe the avian results from spring migration point count surveys and watch count surveys. A complete dataset of bird survey observations is provided in Appendix I.

Point Count Surveys

During spring migration, a total of 1,436 individuals representing 80 species were observed. With incidental observations removed (those outside of dedicated surveys), 1,377 individuals, representing 78 species (not including one unidentified woodpecker species), and one unidentified gull species, were observed during the dedicated survey period (see Table 39 below).

Table 39. Spring Migration: Species and Abundance of Birds Observed at Point Count Locations

Species Code	Common Name	Scientific Name	Obs.	Point Counts	Bird Group
ALFL	Alder Flycatcher	*Empidonax alnorum*	7	PC1, PC2, PC3, PC11, PC12, PC18	6
AMBI	American Bittern	*Botaurus lentiginosus*	1	PC12	1
AMCR	American Crow	*Corvus brachyrhynchos*	24	PC1, PC2, PC3, PC4, PC5, PC6, PC11, PC13, PC14	6
AMGO	American Goldfinch	*Carduelis tristis*	77	PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC13, PC14, PC15, PC16, PC18	6
AMKE	American Kestrel	*Falco sparverius*	1	PC4	4

Species Code	Common Name	Scientific Name	Obs.	Point Counts	Bird Group
AMPI	American Pipit	*Anthus rubescens*	30	PC11	6
AMRE	American Redstart	*Setophaga ruticilla*	18	PC1, PC2, PC4, PC5, PC6, PC7, PC9, PC12, PC16, PC17, PC18, PC19	6
AMRO	American Robin	*Turdus migratorius*	82	PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC14, PC15, PC16, PC17, PC18	6
BDOW	Barred Owl	*Strix varia*	1	PC5	5
BBWA	Bay-breasted Warbler	*Dendroica castanea*	5	PC2,PC4,PC9,PC12	6
BEKI	Belted Kingfisher	*Megaceryle alcyon*	1	PC3	7
BAWW	Black-and-White Warbler	*Mniotilta varia*	28	PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC12, PC17	6
BLBW	Blackburnian Warbler	*Dendroica fusca*	2	PC4,PC17	6
BCCH	Black-capped Chickadee	*Poecile atricapilla*	45	PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC13, PC16, PC17, PC19	6
BTBW	Black-throated Blue Warbler	*Dendroica caerulescens*	12	PC2, PC3, PC4, PC5, PC7, PC9, PC10	6
BTNW	Black-throated Green Warbler	*Dendroica virens*	14	PC1, PC3, PC5, PC7, PC8, PC9, PC10, PC15, PC16, PC19	6
BLJA	Blue Jay	*Cyanocitta cristata*	16	PC1, PC3, PC4, PC6, PC7, PC8, PC11, PC13, PC15	6
BHVI	Blue-headed Vireo	*Vireo solitarius*	38	PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC12, PC13, PC14, PC15, PC19,	6
BOBO	Bobolink	*Dolichonyx oryzivorus*	1	PC1	6
BWHA	Broad-winged Hawk	*Buteo platypterus*	3	PC1,PC4,POP15-T5	4
BRCR	Brown Creeper	*Certhia americana*	4	PC3,PC10	6
CAGO	Canada Goose	*Branta canadensis*	2	PC6,PC7	1
CSWA	Chestnut-sided Warbler	*Dendroica pensylvanica*	18	PC1, PC2, PC3, PC5, PC7, PC9, PC11, PC12, PC17, PC18	6
CHSP	Chipping Sparrow	*Spizella passerina*	9	PC2,PC3,PC4,PC7,PC10	6
COGR	Common Grackle	*Quiscalus quiscula*	16	PC3, PC4, PC8, PC11, PC12, PC14, PC18	6
COLO	Common Loon	*Gavia immer*	2	PC6	3
CORA	Common Raven	*Corvus corax*	6	PC4, PC5, PC6, PC13, PC14, PC16	6
COYE	Common Yellowthroat	*Geothlypis trichas*	22	PC1, PC5, PC7, PC8, PC9, PC10, PC11, PC12, PC14, PC15, PC18	6
DEJU	Dark-eyed Junco	*Junco hyemalis*	2	PC4,PC5	6
DCCO	Double-crested Cormorant	*Phalacrocorax auritus*	16	PC1,PC6,PC9,PC11,PC12	3
DOWO	Downy Woodpecker	*Picoides pubescens*	11	PC5,PC6,PC9,PC10,PC11	7

Species Code	Common Name	Scientific Name	Obs.	Point Counts	Bird Group
EAWP	Eastern-wood Phoebe	*Contopus virens*	1	PC10	6
FOSP	Fox Sparrow	*Passerella iliaca*	1	PC2,PC5,PC6	6
GCKI	Golden-crowned Kinglet	*Regulus satrapa*	3	PC2,PC6,PC13	6
GRAJ	Gray Jay	*Perisoreus canadensis*	1	PC11	6
GHOW	Great Horned Owl	*Bubo virginianus*	1	PC10	5
GWTE	Green-winged Teal	*Anas crecca*	4	PC12,PC14	1
HAWO	Hairy Woodpecker	*Picoides villosus*	12	PC1, PC5, PC7, PC9, PC12, PC13	7
HETH	Hermit Thrush	*Catharus guttatus*	26	PC1, PC2, PC3, PC4, PC6, PC7, PC8, PC9, PC10, PC15, PC17, PC19	6
KILL	Killdeer	*Charadrius vociferus*	5	PC7,PC9,PC11,PC14	6
LEFL	Least Flycatcher	*Empidonax minimus*	58	PC1, PC2, PC4, PC5, PC7, PC9, PC10, PC11, PC12, PC17, PC19	6
LISP	Lincoln's Sparrow	*Melospiza lincolnii*	5	PC1,PC11,PC13,PC14	6
MAWA	Magnolia Warbler	*Dendroica magnolia*	23	PC1, PC2, PC4, PC5, PC7, PC8, PC10, PC11, PC15, PC16, PC17, PC18	6
MALL	Mallard	*Anas platyrhynchos*	9	PC2,PC7,PC12,PC14	1
NAWA	Nashville Warbler	*Vermivora ruficapilla*	6	PC1,PC6,PC8,PC9	6
NOFL	Northern Flicker	*Colaptes auratus*	26	PC1, PC2, PC3, PC5, PC6, PC7, PC8, PC10, PC11, PC12, PC13, PC14, PC15, PC18	7
NOPA	Northern Parula	*Parula americana*	25	PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC12, PC15, PC18	6
NOWA	Northern Waterthrush	*Seiurus noveboracensis*	26	PC1, PC3, PC4, PC5, PC6, PC8, PC9, PC10, PC11, PC12, PC13, PC17, PC18, PC19	6
OSFL	Olive-sided Flycatcher	*Contopus cooperi*	2	PC10,PC12	6
OSPR	Osprey	*Pandion haliaetus*	11	PC10,PC14	4
OVEN	Ovenbird	*Seiurus aurocapilla*	79	PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC15, PC16, PC17, PC18, PC19	6
PAWA	Palm Warbler	*Dendroica palmarum*	3	PC11,PC14	6
PIWO	Pileated Woodpecker	*Dryocopus pileatus*	3	PC2,PC9,PC19	7
PISI	Pine Siskin	*Carduelis pinus*	5	PC3,PC4,PC12,PC14	6

Species Code	Common Name	Scientific Name	Obs.	Point Counts	Bird Group
PUFI	Purple Finch	*Carpodacus purpureus*	25	PC1, PC2, PC3, PC4, PC5, PC6, PC8, PC9, PC10, PC13, PC15, PC15, PC16, PC17	6
RBNU	Red-breasted Nuthatch	*Sitta canadensis*	32	PC1, PC3, PC4, PC5, PC7, PC8, PC9, PC10, PC11, PC12, PC13, PC15	6
REVI	Red-eyed Vireo	*Vireo olivaceus*	14	PC1, PC2, PC5, PC6, PC9, PC15, PC16, PC17, PC19	6
RWBL	Red-winged Blackbird	*Agelaius phoeniceus*	1	PC11	6
RBGR	Rose-breasted Grosbeak	*Pheucticus ludovicianus*	11	PC5, PC6, PC8, PC10, PC12, PC15, PC16, PC18, PC19	6
RCKI	Ruby-crowned Kinglet	*Regulus calendula*	46	PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC11, PC12, PC15, PC16	6
RTHU	Ruby-throated Hummingbird	*Archilochus colubris*	1	PC12	6
RUBL	Rusty Blackbird	*Euphagus carolinus*	1	PC6	6
RUGR	Ruffed Grouse	*Bonasa umbellus*	1	PC18	6
SACR	Sandhill Crane	*Grus canadensis*	1	PC11	3
SAVS	Savannah Sparrow	*Passerculus sandwichensi s*	11	PC1,PC2,PC5,PC11	6
SOSA	Solitary Sandpiper	*Tringa solitaria*	1	PC6	2
SOSP	Song Sparrow	*Melospiza melodia*	29	PC1, PC2, PC3, PC5, PC10, PC11 ,PC12, PC14	6
SPSA	Spotted Sandpiper	*Actitis macularius*	1	PC4	2
SWTH	Swainson's Thrush	*Catharus ustulatus*	8	PC3, PC5, PC7, PC10, PC15, PC19	6
SWSP	Swamp Sparrow	*Melospiza georgiana*	9	PC12,PC13,PC18	6
VEER	Veery	*Catharus fuscescens*	15	PC1, PC3, PC4, PC5, PC6, PC9, PC12, PC16, PC17, PC18	6
WTSP	White-throated Sparrow	*Zonotrichia albicollis*	198	PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC13, PC14, PC15, PC16, PC18, PC19	6
WWCR	White-Winged Crossbill	*Loxia leucoptera*	4	PC1,PC6	6
WISN	Wilson's Snipe	*Gallinago delicata*	16	PC3, PC4, PC5, PC8, PC10, PC11, PC12, PC16, PC17, PC18	7
WISP	Wilson's Storm Petrel	*Oceanites oceanicus*	1	PC9	6
WIWR	Winter Wren	*Troglodytes troglodytes*	26	PC1,PC2,PC3	6
WOOD - PECKER SP.	Unknown Woodpecker spp	*#N/A*	3	PC4,PC7	7
YBSA	Yellow-bellied Sapsucker	*Sphyrapicus varius*	29	PC2, PC3, PC4, PC5, PC7, PC8, PC9, PC10, PC11, PC13, PC17, PC19	7

Species Code	Common Name	Scientific Name	Obs.	Point Counts	Bird Group
YRWA	Yellow-rumped Warbler	*Dendroica coronata*	44	PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC8, PC9, PC10, PC11, PC12, PC13, PC14	6
	Total Species: 78	***Total Number:***	**1,377**		

Notes: Incidental observations during the spring migration surveys are not included (those observed outside of point count locations). Bird group is coded as: 1 = Waterfowl; 2 = Shorebirds; 3 = Other waterbirds; 4 = Diurnal raptors; 5 = Nocturnal raptors; 6 = Passerines and 7 = Other landbirds. See section 4.1.2 for further details.

The three most commonly observed species during spring migration points were the White-throated Sparrow (n=198), American Robin (n=82), and American Goldfinch (n=77). The largest groups observed were a flock of 30 American Pipits observed on May 24, 2018, and a flock of 30 American Crows on May 31, 2018. The American Pipits were observed at PC11 flying 40-70m above ground level, bearing east. The American Crows were observed on the ground in an agricultural field to the west of PC15. The most abundant bird group observed was passerines.

Passage Migration/Diurnal Watch Counts

During spring migration watch count surveys, a total of 7,589 individuals representing 67 species were observed. When incidental observations were removed (those observed outside of designated watch count times), 7,585 individuals representing 67 species were observed and included in the summary below. Neither incidental nor watch count survey species counts included birds that were unclassifiable to species level (i.e. unknown warbler or finch species), however, these individuals were included in the total number of birds observed (both incidental and watch count surveys).

Table 40. Spring Migration Species and Abundance of Birds Observed at Watch Count Locations

Species Code	Common Name	Scientific Name	Observations	Watch Counts	Bird Group
ABDU	American Black Duck	*Anas rubripes*	4	WC1	1
AMGO	American Goldfinch	*Carduelis tristis*	12	WC3	6
AMKE	American Kestrel	*Falco sparverius*	1	WC3	4
AMRO	American Robin	*Turdus migratorius*	4	WC2,WC3	6
BAEA	Bald Eagle	*Haliaeetus leucocephalus*	1	WC1	4
BBWA	Bay-breasted Warbler	*Dendroica castanea*	1	WC2	6
BEKI	Belted Kingfisher	*Megaceryle alcyon*	7	WC1	7
BAWW	Black-and-White Warbler	*Mniotilta varia*	2	WC3	6
BLGU	Black Guillemot	*Cepphus grylle*	170	WC1	1

Species Code	Common Name	Scientific Name	Observations	Watch Counts	Bird Group
BLSC	Black Scoter	*Melanitta nigra*	590	WC1	1
BCCH	Black-capped Chickadee	*Poecile atricapilla*	6	WC2,WC3	6
BTBW	Black-throated Blue Warbler	*Dendroica caerulescens*	3	WC3	6
BTNW	Black-throated Green Warbler	*Dendroica virens*	8	WC2,WC3	6
BLJA	Blue Jay	*Cyanocitta cristata*	4	WC2,WC3	6
BHVI	Blue-headed Vireo	*Vireo solitarius*	9	WC2,WC3	6
BWHA	Broad-winged Hawk	*Buteo platypterus*	2	WC3	4
CHSP	Chipping Sparrow	*Spizella passerina*	43	WC1	6
COEI	Common Eider	*Somateria mollissima*	4	WC1	1
COGO	Common Goldeneye	*Bucephala clangula*	7	WC1	1
COGR	Common Grackle	*Quiscalus quiscula*	6	WC1,WC2	6
COLO	Common Loon	*Gavia immer*	1	WC2	3
CORA	Common Raven	*Corvus corax*	3	WC2,WC3	6
COYE	Common Yellowthroat	*Geothlypis trichas*	4	WC2,WC3	6
DCCO	Double-crested Cormorant	*Phalacrocorax auritus*	5850	WC1	3
EAPH	Eastern Phoebe	*Sayornis phoebe*	4	WC1,WC3	6
EUST	European Starling	*Sturnus vulgaris*	30	WC1	6
GBBG	Great Black-backed Gull	*Larus marinus*	146	WC1	3
GLGU	Glaucous Gull	*Larus hyperboreus*	16	WC1	3
GRYE	Greater Yellowlegs	*Tringa melanoleuca*	1	WC1	2
GULL SP.	Gull spp	*#N/A*	50	WC1	3
HAWO	Hairy Woodpecker	*Picoides villosus*	5	WC3	7
HETH	Hermit Thrush	*Catharus guttatus*	6	WC3	6
HERG	Herring Gull	*Larus argentatus*	145	WC1	3
ICGU	Iceland Gull	*Larus glaucoides*	39	WC1, WC3	3
KILL	Killdeer	*Charadrius vociferus*	1	WC3	6

Species Code	Common Name	Scientific Name	Observations	Watch Counts	Bird Group
LEFL	Least Flycatcher	*Empidonax minimus*	9	WC2,WC3	6
LEYE	Lesser Yellowlegs	*Tringa flavipes*	1	WC3	6
LTDU	Long-tailed Duck	*Clangula hyemalis*	4	WC1	1
MAWA	Magnolia Warbler	*Dendroica magnolia*	6	WC2,WC3	6
MALL	Mallard	*Anas platyrhynchos*	5	WC3	1
NOFL	Northern Flicker	*Colaptes auratus*	4	WC1,WC3	7
NOGA	Northern Gannet	*Morus bassanus*	15	WC1	3
NOHA	Northern Harrier	*Circus cyaneus*	1	WC3	4
NOPA	Northern Parula	*Parula americana*	5	WC2,WC3	6
NOWA	Northern Waterthrush	*Seiurus noveboracensis*	5	WC2,WC3	6
OVEN	Ovenbird	*Seiurus aurocapilla*	13	WC2,WC3	6
PISI	Pine Siskin	*Carduelis pinus*	1	WC3	6
PUFI	Purple Finch	*Carpodacus purpureus*	6	WC2,WC3	6
RAZO	Razorbill	*Alca torda*	83	WC1	3
RBNU	Red-breasted Nuthatch	*Sitta canadensis*	4	WC3	6
RWBL	Red-winged Blackbird	*Agelaius phoeniceus*	25	WC1	6
RBGU	Ring-billed Gull	*Larus delawarensis*	15	WC1	3
RCKI	Ruby-crowned Kinglet	*Regulus calendula*	2	WC2,WC3	6
ROPI	Rock Pigeon	*Columba livia*	2	WC1	6
SOSA	Solitary Sandpiper	*Tringa solitaria*	1	WC3	2
SOSP	Song Sparrow	*Melospiza melodia*	4	WC1	6
SPSA	Spotted Sandpiper	*Actitis macularius*	2	WC1	2
SUSC	Surf Scoter	*Melanitta perspicillata*	113	WC1	1
SWTH	Swainson's Thrush	*Catharus ustulatus*	1	WC3	6
TRES	Tree Swallow	*Tachycineta bicolor*	2	WC3	6
VEER	Veery	*Catharus fuscescens*	2	WC3	6

Species Code	Common Name	Scientific Name	Observations	Watch Counts	Bird Group
WCSP	White-crowned Sparrow	*Zonotrichia leucophrys*	1	WC1	6
WTSP	White-throated Sparrow	*Zonotrichia albicollis*	46	WC1,WC2,WC3	6
WISN	Wilson's Snipe	*Gallinago delicata*	4	WC2,WC3	7
WIWR	Winter Wren	*Troglodytes troglodytes*	7	WC2,WC3	6
YBSA	Yellow-bellied Sapsucker	*Sphyrapicus varius*	5	WC2,WC3	7
YRWA	Yellow-rumped Warbler	*Dendroica coronata*	6	WC1,WC2,WC3	6
	67 Species	**Total Number:**	**7585**		

Notes: Incidental observations during the spring migration surveys are not included (those observed outside of point count locations). Bird group is coded as: 1 = Waterfowl; 2 = Shorebirds; 3 = Other waterbirds; 4 = Diurnal raptors; 5 = Nocturnal raptors; 6 = Passerines and 7 = Other landbirds. See section 4.1.2 for further details.

The three most commonly observed species during spring migration watch count surveys were Double-crested Cormorant (n=5,850), Black Scoter (n=590), and Black Guillemot (n=170). **However, it should be recognized that 99% of these observations were predominantly observed outside of the Study Area during WC surveys.** The most commonly observed species observed during spring migration which was within/above the Study Area was the White-throated Sparrow (n=243).

Watch count observations were generally groups of birds, many of which were less than 60 individuals. Two of the most observed species (Double-crested Cormorants and Black Scoters) were observed in flocks greater than 100 individuals. The largest of which was a flock of approximately 400 Double-crested Cormorants observed gathering nest materials from Pokeshaw River (located approximately 700 m from the western extent of the Study Area). None of these large flocks were observed landing within the Study Area nor were they observed flying over the Study Area. Instead, the flocks were largely observed on Pokeshaw Rock, rafting along the coastline, or flying along the coastline to and from Pokeshaw Rock.

5.5.5.2.2 Breeding Season

Avian SAR and SOCI observations are described in Section 5.7.5.

The following sections describe the avian results from breeding point count surveys, watch count surveys, and transect surveys.

Point Count Surveys

During breeding bird surveys, a total of 796 individuals representing 63 species were observed. When incidental observations were removed (those observed outside of dedicated surveys), 730 individuals representing 59 species remain. Neither incidental nor point count survey species counts include birds that were unidentifiable at the species level (i.e. unknown warbler or finch species), however, these individuals were included in the total number of birds observed (both incidental and point count surveys).

The incidental species not observed during dedicated surveys included: American Kestrel, Broad-winged Hawk, a Merlin, and Spotted Sandpiper. The incidental Spotted Sandpiper (ACCDC S3S4B, S5M) was observed on July 2, 2019 at PC15, outside of the dedicated survey time. An Eastern-wood Pewee (SARA & COSEWIC & NBSARA Special Concern, ACCDC S4B, S4M) were observed on June 10, 2018 near PC7, along Ridge Road. None of the other incidentally observed species are SAR/SOCI.

The field observed breeding status of the bird species observed during breeding bird surveys are noted in Table 41 below. The surveyor recorded any notes on bird behavior observed, including distraction display, carrying food, and carrying nesting material.

The following are the breeding status (MBBA 2018) observed during the breeding bird surveys:

- Observed - species observed in its breeding season;
- Possible - species observed during breeding season in suitable nesting habitat or singing males or breeding calls heard, in suitable nesting habitat during breeding season;
- Probable - agitated behavior observed or the occurrence of an adult bird, at the same place, on consecutive survey days during breeding season; and,
- Confirmed - adult carrying food or distraction display.

Table 41. Breeding Season Species and Abundance of Birds Observed at Point Count Locations.

Species Code	Common Name	Scientific Name	Obs.	Points Obs.	Bird Group	Breeding Status
ALFL	Alder Flycatcher	*Empidonax alnorum*	20	PC1, PC2, PC5, PC11, PC12, PC14, PC15, PC18, PC20, PC22, PC25, PC26	6	Probable
AMCR	American Crow	*Corvus brachyrhynchos*	74	PC3, PC11, PC14, PC17, PC26	6	Probable
AMGO	American Goldfinch	*Carduelis tristis*	34	PC1, PC3, PC5, PC6, PC7, PC9, PC11, PC15, PC16, PC17, PC18, PC22, PC23, PC24, PC25	6	Probable
AMRE	American Redstart	*Setophaga ruticilla*	31	PC1, PC2, PC3, PC4, PC6, PC9, PC10, PC12, PC17, PC19, PC20, PC21, PC22, PC23, PC25, PC26	6	Probable
AMRO	American Robin	*Turdus migratorius*	28	PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC11, PC12, PC14, PC15, PC16, PC17, PC18, PC19, PC21, PC24, PC25, PC26	6	Probable
BAWW	Black-and-white Warbler	*Mniotilta varia*	17	PC1, PC3, PC4, PC7, PC11, PC14, PC15, PC17, PC20, PC21, PC23, PC24, PC25, PC26	6	Probable
BCCH	Black-capped Chickadee	*Poecile atricapilla*	5	PC3, PC7, PC15, PC18, PC19	6	Probable
BTBW	Black-throated Blue Warbler	*Dendroica caerulescens*	2	PC9, PC19	6	Probable
BTNW	Black-throated Green Warbler	*Dendroica virens*	3	PC12, PC19, PC26	6	Probable
BLJA	Blue Jay	*Cyanocitta cristata*	3	PC5, PC15, PC19	6	Probable
BHVI	Blue-headed Vireo	*Vireo solitarius*	16	PC1, PC3, PC5, PC7, PC10, PC11, PC14, PC15, PC19, PC22, PC24, PC25	6	Probable
CEDW	Cedar Waxwing	*Bombycilla cedrorum*	19	PC6, PC12, PC15, PC18, PC21	6	Observed
CSWA	Chestnut-sided Warbler	*Dendroica pensylvanica*	21	PC1, PC2, PC7, PC11, PC14, PC15, PC17, PC18, PC22, PC25, PC26	6	Probable
COGR	Common Grackle	*Quiscalus quiscula*	2	PC11, PC15	6	Probable
COLO	Common Loon	*Gavia immer*	1	PC24	3	Observed
CORA	Common Raven	*Corvus corax*	2	PC11	6	Observed
COYE	Common Yellowthroat	*Geothlypis trichas*	26	PC1, PC4, PC5, PC7, PC10, PC11, PC14, PC15, PC18, PC20, PC22, PC24, PC26	6	Probable
DEJU	Dark-eyed Junco	*Junco hyemalis*	3	PC4, PC11, PC25	6	Observed
DOWO	Downy Woodpecker	*Picoides pubescens*	6	PC5, PC11, PC15, PC22, PC24	7	Confirmed
EAWP	Eastern Wood-Pewee	*Contopus virens*	2	PC3, PC21	6	Observed
HAWO	Hairy Woodpecker	*Picoides villosus*	2	PC2, PC9	7	Possible

Species Code	Common Name	Scientific Name	Obs.	Points Obs.	Bird Group	Breeding Status
HETH	Hermit Thrush	*Catharus guttatus*	18	PC3, PC4, PC5, PC7, PC9, PC11, PC15, PC17, PC21, PC23, PC24, PC26	6	Probable
HERG	Herring Gull	*Larus argentatus*	1	PC3	2	Observed
LEFL	Least Flycatcher	*Empidonax minimus*	30	PC1, PC2, PC3, PC5, PC7, PC10, PC12, PC17, PC19, PC21, PC22, PC25	6	Probable
LISP	Lincoln's Sparrow	*Melospiza lincolnii*	3	PC14, PC17	6	Observed
MAWA	Magnolia Warbler	*Dendroica magnolia*	18	PC1, PC3, PC6, PC15, PC16, PC18, PC20, PC22, PC23, PC25	6	Probable
MODO	Mourning Dove	*Zenaida macroura*	2	PC1, PC10	7	Possible
NAWA	Nashville Warbler	*Vermivora ruficapilla*	4	PC14, PC18, PC25	6	Possible
NOFL	Northern Flicker	*Colaptes auratus*	3	PC1, PC2, PC18	7	Probable
NOPA	Northern Parula	*Parula americana*	13	PC1, PC3, PC4, PC5, PC12, PC15, PC17, PC22, PC26	6	Probable
NOWA	Northern Waterthrush	*Seiurus noveboracensis*	8	PC9, PC11, PC12, PC17, PC22, PC25	6	Observed
OSPR	Osprey	*Pandion haliaetus*	3	PC10, PC11, PC14	4	Probable
OVEN	Ovenbird	*Seiurus aurocapilla*	40	PC1, PC3, PC4, PC5, PC6, PC9, PC10, PC12, PC15, PC16, PC17, PC19, PC20, PC21, PC23, PC24, PC25, PC26	6	Probable
PIWO	Pileated Woodpecker	*Dryocopus pileatus*	1	PC26	7	Observed
PUFI	Purple Finch	*Carpodacus purpureus*	6	PC3, PC10, PC11, PC15, PC19	6	Probable
RBGR	Rose-breasted Grosbeak	*Pheucticus ludovicianus*	1	PC14		
RBNU	Red-breasted Nuthatch	*Sitta canadensis*	5	PC1, PC7, PC15, PC19	6	Probable
REVI	Red-eyed Vireo	*Vireo olivaceus*	55	PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC10, PC11, PC12, PC15, PC17, PC18, PC19, PC20, PC21, PC22, PC23, PC24, PC25, PC26	6	Probable
RCKI	Ruby-crowned Kinglet	*Regulus calendula*	7	PC3, PC11, PC14, PC15, PC20, PC25	6	Observed
RUGR	Ruffed Grouse	*Bonasa umbellus*	4	PC7, PC16, PC17, PC18	7	Confirmed
RTHU	Ruby-throated Hummingbird	*Archilochus colubris*	1	PC15	6	Observed
SACR	Sandhill Crane	*Grus canadensis*	2	PC6	3	Observed
SAVS	Savannah Sparrow	*Passerculus sandwichensis*	5	PC1, PC2, PC5	6	Probable
SOSP	Song Sparrow	*Melospiza melodia*	15	PC2, PC5, PC11, PC12, PC14, PC15, PC22, PC24,	6	Probable

Species Code	Common Name	Scientific Name	Obs.	Points Obs.	Bird Group	Breeding Status
SWTH	Swainson's Thrush	*Catharus ustulatus*	21	PC3, PC4, PC5, PC7, PC9, PC10, PC11, PC15, PC19, PC21, PC22, PC23, PC24, PC25	6	Probable
SWSP	Swamp Sparrow	*Melospiza georgiana*	2	PC12	6	Probable
TRES	Tree Swallow	*Tachycineta bicolor*	1	PC11	6	Observed
n/a	Unknown Woodpecker sp.		4	PC5, PC6, PC21, PC24	7	Observed
VEER	Veery	*Catharus fuscescens*	19	PC4, PC6, PC11, PC12, PC15, PC16, PC18, PC19, PC22, PC23, PC26	6	Probable
WISN	Wilson's Snipe	*Gallinago delicata*	3	PC16, PC17, PC18	2	Probable
WIWA	Wilson's Warbler	*Wilsonia pusilla*	1	PC18	6	Possible
WIWR	Winter Wren	*Troglodytes troglodytes*	4	PC9, PC10, PC11	6	Probable
WTSP	White-throated Sparrow	*Zonotrichia albicollis*	102	PC1, PC2, PC3, PC4, PC5, PC6, PC7, PC9, PC10, PC11, PC12, PC14, PC15, PC16, PC18, PC19, PC20, PC21, PC22, PC24, PC25, PC26	6	Probable
YBSA	Yellow-bellied Sapsucker	*Sphyrapicus varius*	11	PC1, PC4, PC7, PC10, PC11, PC17, PC21, PC26	7	Probable
	Total: 59 Species	**Total Number:**	**730**			

Notes: Incidental observations during the spring migration surveys are not included (those observed outside of point count locations). Bird group is coded as: 1 = Waterfowl; 2 = Shorebirds; 3 = Other waterbirds; 4 = Diurnal raptors; 5 = Nocturnal raptors; 6 = Passerines and 7 = Other landbirds. See section 4.1.2 for further details.

The three most commonly observed species during breeding bird point count surveys were the White-throated Sparrow (n=102), American Crow (n=74), and Red-eyed Vireo (n=55). Two species were noted as confirmed breeders, one of which was a Downy Woodpecker that was observed agitated and young were heard. The other was a Ruffed Grouse that was observed feigning a wing injury. The remaining probable breeders (n=33) were observed at the same location on two subsequent breeding season surveys. Those identified as possible breeders (n=4) were observed singing during breeding season in suitable nesting habitat. Those identified as observed (n=19) were observed during their breeding dates (MBBA, 2019). It is not possible to confirm that all species identified were actually nesting within the boundaries of the Study Area. For instance, for a bird that was observed carrying food (confirmed breeding evidence), it is possible that the bird was nesting on an adjacent parcel of land.

All the species identified are native species in this area of New Brunswick and the province in general and observed within the typical and common habitat associated with the Study Area and surrounding landscape. The majority of observations comprised one, two or three individuals. No large flocks of birds were observed during breeding bird surveys. One flock of 30 American Crows was seen in a field near PC17. The most abundant species group observed on site during the breeding bird period was passerines (n=687), followed by other landbirds (n=33).

Passage Migration/Diurnal Watch Counts

During breeding bird watch count surveys conducted during the breeding bird season, a total of 4,577 individuals representing 24 species were observed. No incidental observations were made.

Table 42. Breeding Bird Species and Abundance of Birds Observed at Watch Count Locations

Species Code	Common Name	Scientific Name	Observations	Watch Counts	Bird Group	Breeding Status
ALFL	Alder Flycatcher	Empidonax alnorum	2	WC4	6	Probable
AMCR	American Crow	Corvus brachyrhynchos	30	WC4	6	Probable
BANS	Bank Swallow	Riparia riparia	5	WC1	6	Probable
BAWW	Black-and-white Warbler	Mniotilta varia	1	WC4	6	Probable
BLJA	Blue Jay	Cyanocitta cristata	1	WC4	6	Probable
CSWA	Chestnut-sided Warbler	Dendroica pensylvanica	1	WC4	6	Probable
COLO	Common Loon	Gavia immer	1	WC1	3	Observed
CORA	Common Raven	Corvus corax	1	WC4	6	Observed
COYE	Common Yellowthroat	Geothlypis trichas	2	WC4	6	Probable
DCCO	Double-crested Cormorant	Phalacrocorax auritus	4512	WC1, WC1A, Peat	2	Probable
MAWA	Magnolia Warbler	Dendroica magnolia	1	WC4	6	Probable
NOFL	Northern Flicker	Colaptes auratus	1	WC4	7	Probable
NOPA	Northern Parula	Parula americana	1	WC4	6	Probable

Species Code	Common Name	Scientific Name	Observations	Watch Counts	Bird Group	Breeding Status
NOWA	Northern Waterthrush	Seiurus noveboracensis	1	WC4	6	Observed
OSPR	Osprey	Pandion haliaetus	2	WC1	4	Probable
PUFI	Purple Finch	Carpodacus purpureus	1	WC4	6	Probable
REVI	Red-eyed Vireo	Vireo olivaceus	2	WC4	6	Probable
RCKI	Ruby-crowned Kinglet	Regulus calendula	1	WC4	6	Observed
SOSP	Song Sparrow	Melospiza melodia	2	WC4	6	Probable
SWSP	Swamp Sparrow	Melospiza georgiana	1	WC4	6	Probable
VEER	Veery	Catharus fuscescens	1	WC4	6	Probable
WIWR	Winter Wren	Troglodytes troglodytes	1	WC4	6	Probable
WTSP	White-throated Sparrow	Zonotrichia albicollis	5	WC4	6	Probable
YBSA	Yellow-bellied Sapsucker	Sphyrapicus varius	1	WC4	7	Probable
	Total: 24 Species	**Total Number:**	**4577**			

Notes: Incidental observations during the spring migration surveys are not included (those observed outside of point count locations). Bird group is coded as: 1 = Waterfowl; 2 = Shorebirds; 3 = Other waterbirds; 4 = Diurnal raptors; 5 = Nocturnal raptors; 6 = Passerines and 7 = Other landbirds. See section 4.1.2 for further details.

By far the most abundant species observed was the Double-crested Cormorant (n=4512). **The majority (83%) of these observations were made outside of the Study Area (i.e. at Pokeshaw Rock or reservoir).** This waterbird was observed mostly in groups of 10 or less. The largest flock observed were two flocks of 50 individual Double-crested Cormorants observed on July 9 and July 17, 2018 that were observed outside of the Study Area at WC5b, where the birds were in or near the reservoir proximal to WC5b. Additional information related to diurnal and migratory flight paths of the Double-crested Cormorant is provided in Section 5.5.5.2.8.

<u>Transect Surveys</u>

During breeding bird transects a total of 24 individuals representing 14 species were observed. No incidental observations were made.

Table 43. Breeding Bird Species and Abundance of Birds Observed at Transects

Species Code	Common Name	Scientific Name	#	Transects	Bird Group	Breeding Status
AMRO	American Robin	*Turdus migratorius*	2	T19	6	Probable
BAWW	Black-and-white Warbler	*Mniotilta varia*	1	T4	6	Probable
BTNW	Black-throated Green Warbler	*Dendroica virens*	2	T19	6	Probable
GWTE	Green-winged Teal	*Anas crecca*	1	T19	1	Observed
HETH	Hermit Thrush	*Catharus guttatus*	1	T1-2	6	Probable
LEFL	Least Flycatcher	*Empidonax minimus*	3	T4, T19, T1-2	6	Probable

Species Code	Common Name	Scientific Name	#	Transects	Bird Group	Breeding Status
MAWA	Magnolia Warbler	*Dendroica magnolia*	2	T4, T19	6	Probable
NAWA	Nashville Warbler	*Vermivora ruficapilla*	1	T19	6	Possible
NOPA	Northern Parula	*Parula americana*	2	T4, T5	6	Probable
OVEN	Ovenbird	*Seiurus aurocapilla*	4	T4, T5, T1-2	6	Probable
REVI	Red-eyed Vireo	*Vireo olivaceus*	1	T19	6	Probable
SWTH	Swainson's Thrush	*Catharus ustulatus*	1	T19	6	Probable
TUVU	Turkey Vulture	*Cathartes aura*	1	T19	4	Observed
VEER	Veery	*Catharus fuscescens*	2	T19	6	Probable
	Total: 14 Species	**Total Number:**	**24**			

Notes: Incidental observations during the spring migration surveys are not included (those observed outside of point count locations). Bird group is coded as: 1 = Waterfowl; 2 = Shorebirds; 3 = Other waterbirds; 4 = Diurnal raptors; 5 = Nocturnal raptors; 6 = Passerines and 7 = Other landbirds. See section 4.1.2 for further details.

The two most commonly observed species during breeding bird transects (within the Study Area) were the Ovenbird (n=4) and the Least Flycatcher (n=3). Most birds were observed by themselves or in pairs, singing or foraging for food.

5.5.5.2.3 Common Nighthawk Surveys

No Common Nighthawk were observed during specialized surveys at the five point count locations, nor during other avian or biophysical surveys (see Figure 7b, Appendix A for survey locations).

5.5.5.2.4 Raptor Survey

Several raptor species were observed during seasonal surveys along with nests observed during dedicated raptor surveys. The most prevalently observed raptor was the Bald Eagle, which was observed 34 times in fall migration. The second most observed raptor was the Osprey (n=17), followed by the American Kestrel (n=8). Two SAR raptor species were observed: the Bald Eagle (NBSARA Endangered) and the Peregrine Falcon (NBSARA Endangered, ACCDC S1B, S3M). One SOCI was observed: the Turkey Vulture (ACCDC S3B, S3M). Additional information regarding SAR and SOCI observations are provided in Section 5.6.

Several raptor nests were observed including a potential American Kestrel nest, a Broad-winged Hawk nest, and an Osprey nest (Table 43, below).

Table 44. Raptor Survey Identified Nests

Nest Type	Location	Distance to closest Infrastructure	Infrastructure
American Kestrel nest cavity in tree	N47° 46.123' W65° 13.814'	250m	WTG1
Broad-winged Hawk nest	N47° 46.132' W65° 14.284'	771m	WTG1
Osprey nest	N47° 46.839' W65° 12.995'	475m	WTG3

5.5.5.2.5 Fall Migration

Avian SAR and SOCI observations are described in Section 5.7.5.

The following sections describe the avian results from fall migration point count surveys, watch count surveys, and transect surveys.

Point Count Surveys

During fall migration, a total of 930 individuals representing 41 species were observed. When incidental observations were removed (those observed outside of dedicated surveys), 862 individuals representing 41 species remain. Neither incidental nor point count survey species count include birds that were unidentifiable to species level (i.e. unknown warbler or finch species), however, these individuals were included in the total number of birds observed (both incidental and point count surveys). The six incidental species observed include: American Goldfinch, Canada Goose, Common Yellowthroat, Purple Finch, Red-eyed Vireo, and Solitary Sandpiper. None of these incidental species are considered SAR or SOCI.

Table 45. Fall Migration Species and Abundance of Birds Observed at Point Count Locations

Species Code	Common Name	Scientific Name	Obs.	Point Counts	Group
ALFL	Alder Flycatcher	*Empidonax alnorum*	1	PC18	6
AMCR	American Crow	*Corvus brachyrhynchos*	58	PC15, PC17,PC18,PC3,PC4	6
AMGO	American Goldfinch	*Carduelis tristis*	71	PC1,PC2,PC3,PC4,PC5,PC7,PC8,PC9,PC10, PC11,PC12, PC15,PC16,PC17,PC18	6
AMKE	American Kestrel	*Falco sparverius*	1	PC14b	4
AMRO	American Robin	*Turdus migratorius*	10	PC4,PC5,PC6PC11,PC12,PC16,PC18	6
AMWO	American Woodcock	*Scolopax minor*	1	PC4,PC16	2
BCCH	Black-capped Chickadee	*Poecile atricapilla*	60	PC1,PC3,PC4,PC5,PC6,PC7,PC8,PC9, PC11,PC12, PC15,PC16,PC17,PC18	6
BEKI	Belted Kingfisher	*Megaceryle alcyon*	1	PC15	3
BHVI	Blue-headed Vireo	*Vireo solitarius*	4	PC4,PC5,PC9,PC18	6
BLJA	Blue Jay	*Cyanocitta cristata*	24	PC3,PC5,PC9,PC11,PC12,PC15, PC16,PC17,PC18	6
BTNW	Black-throated Green Warbler	*Dendroica virens*	4	PC9,PC15,PC18	6
BWHA	Broad-winged Hawk	*Buteo platypterus*	1	PC14b	4
CAGO	Canada Goose	*Branta canadensis*	401	PC5,PC7,PC11,PC15,PC16,PC18	1
CEDW	Cedar Waxwing	*Bombycilla cedrorum*	11	PC6,PC12,PC14,PC15,PC18,PC19	6

Species Code	Common Name	Scientific Name	Obs.	Point Counts	Group
CORA	Common Raven	*Corvus corax*	10	PC3,PC4,PC8,PC12,PC14,PC14b,PC15	6
COYE	Common Yellowthroat	*Geothlypis trichas*	13	PC3,PC7,PC8,PC9,PC12,PC15,PC18	6
DEJU	Dark-eyed Junco	*Junco hyemalis*	36	PC1,PC3,PC4,PC6,PC11,PC12, PC14b,PC15,PC17	6
EVGR	Evening Grosbeak	*Coccothraustes vespertinus*	5	PC3	6
GCKI	Golden-crowned Kinglet	*Regulus satrapa*	8	PC4,PC5,PC7,PC8	6
HAWO	Hairy Woodpecker	*Picoides villosus*	3	PC15,PC16,PC17	7
MAWA	Magnolia Warbler	*Dendroica magnolia*	1	PC18	6
MODO	Mourning Dove	*Zenaida macroura*	1	PC3	7
NOFL	Northern Flicker	*Colaptes auratus*	3	PC12,PC14b,PC15	7
OSPR	Osprey	*Pandion haliaetus*	4	PC10,PC14	4
OVEN	Ovenbird	*Seiurus aurocapilla*	1	PC5	6
PAWA	Palm Warbler	*Dendroica palmarum*	2	PC11,PC14b	6
PHVI	Philadelphia Vireo	*Vireo philadelphicus*	1	PC9	6
PISI	Pine Siskin	*Carduelis pinus*	1	PC3	6
PUFI	Purple Finch	*Carpodacus purpureus*	18	PC3,PC4,PC5,PC6,PC8,PC9PC11,PC12, PC15,PC16,PC17,PC18	6
RBNU	Red-breasted Nuthatch	*Sitta canadensis*	7	PC4, PC5, PC9,PC10,PC15,PC16	6
RCKI	Ruby-crowned Kinglet	*Regulus calendula*	3	PC1,PC3,PC18	6
REVI	Red-eyed Vireo	*Vireo olivaceus*	6	PC3,PC7,PC8,PC11,PC15	6
RTHU	Ruby-throated Hummingbird	*Archilochus colubris*	1	PC18	6
SOSA	Solitary Sandpiper	*Tringa solitaria*	1	PC3,PC15	2
SOSP	Song Sparrow	*Melospiza melodia*	3	PC5,PC12,PC15	6
SWSP	Swamp Sparrow	*Melospiza georgiana*	3	PC8,PC12	6
WCSP	White-crowned Sparrow	*Zonotrichia leucophrys*	2	PC12	6
WIWA	Wilson's Warbler	*Wilsonia pusilla*	1	PC12	6
WTSP	White-throated Sparrow	*Zonotrichia albicollis*	59	PC1,PC3,PC5,PC6,PC7,PC8,PC9,PC10, PC11, PC12,PC14b,PC15,PC17,PC18	6

Species Code	Common Name	Scientific Name	Obs.	Point Counts	Group
YRWA	Yellow-rumped Warbler	*Dendroica coronata*	14	YRWA	6
	Unknown Finch species	*n/a*	1	PC9	6
	Unknown Sparrow species	*n/a*	1	PC18	6
-	Unknown Warbler species	*n/a*	5	PC4,PC8	6
	41 Species	**Total Number:**	**862**		

Notes: Incidental observations during the spring migration surveys are not included (those observed outside of point count locations). Bird group is coded as: 1 = Waterfowl; 2 = Shorebirds; 3 = Other waterbirds; 4 = Diurnal raptors; 5 = Nocturnal raptors; 6 = Passerines and 7 = Other landbirds. See section 4.1.2 for further details.

The three most commonly observed species during fall migration point counts were the Canada Goose (n=401), followed by American Goldfinch (n=71) and Black-capped Chickadee (n=60). Most observations documented groups of up to ten individuals, however, five large flocks of Canadian Geese (n=60, incidental observation; n=22, n=100, n=20, n=250) were observed on September 14, 19, 27, and twice on October 10, 2018. Three of these flocks were observed flying over the Study Area at heights between 70 and 120 m. The flock of 60 geese were observed landed in a field near PC4. The flock of 100 was observed flying north outside of the Study Area. Three smaller flocks of American Goldfinch (n=30), American Crow (n=50) and Dark-eyed Junco (n=15) were also observed. Due to the large number of Canada Geese, the most abundant group observed on site at point count locations during the fall migration period were waterfowl (n=481), followed by passerines (n=446).

Passage Migration/Diurnal Watch Counts

During fall migration watch count surveys, a total of 6,831 individuals representing 46 species were observed. No incidental observations were made.

Table 46. Fall Migration Species and Abundance of Birds Observed at Watch Count Locations

Species Code	Common Name	Scientific Name	Observations	Watch Counts	Group
ABDU	American Black Duck	*Anas rubripes*	16	WC5b	1
AMCR	American Crow	*Corvus brachyrhynchos*	25	WC3	6
AMGO	American Goldfinch	*Carduelis tristis*	13	WC3,WC4	6
MAKE	American Kestrel	*Falco sparverius*	4	WC3	4
AMPI	American Pipit	*Anthus rubescens*	8	WC4	6
AMRO	American Robin	*Turdus migratorius*	18	WC3,WC4	6
AMWO	American Woodcock	*Scolopax minor*	1	WC3	2
BAEA	Bald Eagle	*Haliaeetus leucocephalus*	34	WC1,WC4	4
BAWW	Black-and-white Warbler	*Mniotilta varia*	1	WC3	#N/A
BCCH	Black-capped Chickadee	*Poecile atricapilla*	7	WC3,WC4	6
BDOW	Barred Owl	*Strix varia*	1	WC3	5
BEKI	Belted Kingfisher	*Megaceryle alcyon*	1	WC1	3

Species Code	Common Name	Scientific Name	Observations	Watch Counts	Group
BLJA	Blue Jay	*Cyanocitta cristata*	7	WC3,WC4	6
BWHA	Broad-winged Hawk	*Buteo platypterus*	1	WC3	4
CAGO	Canada Goose	*Branta canadensis*	2514	WC3,WC4,WC5b	1
CEDW	Cedar Waxwing	*Bombycilla cedrorum*	1	WC3	6
COGO	Common Goldeneye	*Bucephala clangula*	6	WC5b	1
COGR	Common Grackle	*Quiscalus quiscula*	3	WC3	6
CORA	Common Raven	*Corvus corax*	2	WC3	6
COYE	Common Yellowthroat	*Geothlypis trichas*	3	WC3,WC4	6
DCCO	Double-crested Cormorant	*Phalacrocorax auritus*	3551	WC1,WC5b	2
DEJU	Dark-eyed Junco	*Junco hyemalis*	13	WC3,WC4	6
DOWO	Downy Woodpecker	*Picoides pubescens*	6	WC3,WC4	7
EAWP	Eastern Wood-Pewee	*Contopus virens*	1	WC3	6
EUST	European Starling	*Sturnus vulgaris*	30	WC1	6
GBHE	Great Blue Heron	*Ardea herodias*	2	WC1	3
HAWO	Hairy Woodpecker	*Picoides villosus*	8	WC3,WC4	7
HOME	Hooded Merganser	*Lophodytes cucullatus*	16	WC5b	2
LEYE	Lesser Yellowlegs	*Tringa flavipes*	2	WC3	2
MALL	Mallard	*Anas platyrhynchos*	139	WC5b	1
NOFL	Northern Flicker	*Colaptes auratus*	2	WC3,WC4	7
NOGA	Northern Gannet	*Morus bassanus*	20	WC1	3
NOHA	Northern Harrier	*Circus cyaneus*	1	WC3	4
PAWA	Palm Warbler	*Dendroica palmarum*	3	WC3	6
PEFA	Peregrine Falcon	*Falco peregrinus pop. 1*	1	WC5b	4
PISI	Pine Siskin	*Carduelis pinus*	5	WC3,WC4	6
PUFI	Purple Finch	*Carpodacus purpureus*	4	WC3,WC4	6
RCKI	Ruby-crowned Kinglet	*Regulus calendula*	1	WC4	6
REVI	Red-eyed Vireo	*Vireo olivaceus*	3	WC3	6
SOSP	Song Sparrow	*Melospiza melodia*	5	WC3,WC4	6
SPSA	Spotted Sandpiper	*Actitis macularius*	1	WC5b	2
SWTH	Swainson's Thrush	*Catharus ustulatus*	4	WC3,WC4	6
WCSP	White-crowned Sparrow	*Zonotrichia leucophrys*	4	WC4	6
WIWR	Winter Wren	*Troglodytes troglodytes*	2	WC3	6
WTSP	White-throated Sparrow	*Zonotrichia albicollis*	29	WC3,WC4	6
YRWA	Yellow-rumped Warbler	*Dendroica coronata*	12	WC3,WC4	6
	Unknown Scoter species	*n/a*	300	WC1	#N/A
	46 Species	**Total Number:**	**6831**		

Notes: Incidental observations during the spring migration surveys are not included (those observed outside of point count locations). Bird group is coded as: 1 = Waterfowl; 2 = Shorebirds; 3 = Other waterbirds; 4 = Diurnal raptors; 5 = Nocturnal raptors; 6 = Passerines and 7 = Other landbirds. See section 4.1.2 for further details.

The three most commonly observed species during fall migration watch count surveys were Double-crested Cormorant (n=3551), Canada Goose (n=2514), and an unknown scoter species (n=300). **The majority (72%) of these observations were made outside of the Study Area (i.e. at Pokeshaw Rock).** Watch count observations were generally groups of birds, largely these groups were less than 100 individuals.

The three most commonly observed species listed above were observed in flocks greater than 100 individuals. The largest of which was a flock of approximately 450 Double-crested Cormorants observed at

Pokeshaw Rock. Large flocks were observed throughout August, September and October. The most abundant group observed from watch count locations during the fall migration period were shorebirds, followed by waterfowl.

Transect Surveys

During fall migration transects, a total of 246 individuals representing 39 species were observed. When incidental observations were removed (those observed outside of dedicated surveys), 202 individuals representing 36 species remain. Neither incidental nor transect survey species counts include birds that were unidentifiable at the species level (i.e. unknown warbler species), however, these individuals were included in the total number of birds observed (both incidental and transect surveys). The five incidental species observed include: American Crow, American Kestrel, Bald Eagle, Mourning Dove, and White-throated Sparrow. Of these incidental species, only one is considered SAR or SOCI: The Bald Eagle is listed as Endangered by NBSARA.

Table 47. Fall Migration Species and Abundance of Birds Observed During Transect Surveys

Species Code	Common Name	Scientific Name	Obs.	Transect	Group
ALFL	Alder Flycatcher	*Empidonax alnorum*	2	T11-12,T18-6	6
AMCR	American Crow	*Corvus brachyrhynchos*	5	T5-17,T6-18	6
AMGO	American Goldfinch	*Carduelis tristis*	6	T3-bat3,T5-17,T9-8,Tpc8 north	6
AMRO	American Robin	*Turdus migratorius*	14	T3-bat3,T4-5,T5-17,T6-18,T7-9,T18-16,T19-7	6
AMWO	American Woodcock	*Scolopax minor*	1	T18-16	2
BAWW	Black-and-white Warbler	*Mniotilta varia*	1	T11-10	6
BCCH	Black-capped Chickadee	*Poecile atricapilla*	23	T5-17,T6-18,T7-9,T9-8,T11-10,T18-16	6
BHVI	Blue-headed Vireo	*Vireo solitarius*	6	T3-Bat3,TPC8 north, T11-10	6
BLJA	Blue Jay	*Cyanocitta cristata*	3	T3-Bat3,TPC8 north, T7-9	6
BTNW	Black-throated Green Warbler	*Dendroica virens*	1	T18-16	6
CAGO	Canada Goose	*Branta canadensis*	1	T18-16	1
CEDW	Cedar Waxwing	*Bombycilla cedrorum*	5	T11-10,T18-16	6
CORA	Common Raven	*Corvus corax*	3	T5-17,T11-10,T15-4	6
COYE	Common Yellowthroat	*Geothlypis trichas*	6	T3-Bat3,T4-5,T5-17,TPC8 north,T9-8	6
DEJU	Dark-eyed Junco	*Junco hyemalis*	13	T3-Bat3,T9-8,T11-10,T18-7,T18-16	6
DOWO	Downy Woodpecker	*Picoides pubescens*	2	T9-8,T11-10	7
GCKI	Golden-crowned Kinglet	*Regulus satrapa*	6	T3-Bat3	6

Species Code	Common Name	Scientific Name	Obs.	Transect	Group
GRYE	Greater Yellowlegs	*Tringa melanoleuca*	2	T3-Bat3	2
HOME	Hooded Merganser	*Lophodytes cucullatus*	1	T15-4	2
LEYE	Lesser Yellowlegs	*Tringa flavipes*	4	T3-Bat3,T15-4	2
MAWA	Magnolia Warbler	*Dendroica magnolia*	6	T18-16	6
NAWA	Nashville Warbler	*Vermivora ruficapilla*	2	T11-12	6
NOFL	Northern Flicker	*Colaptes auratus*	4	T7-9,T18-16	7
PAWA	Palm Warbler	*Dendroica palmarum*	1	T3-Bat3	6
PUFI	Purple Finch	*Carpodacus purpureus*	3	T5-17,T9-8,T11-12	6
RBNU	Red-breasted Nuthatch	*Sitta canadensis*	1	Tpc8 north	6
RCKI	Ruby-crowned Kinglet	*Regulus calendula*	1	T18-16	6
REVI	Red-eyed Vireo	*Vireo olivaceus*	2	T3-Bat3,Tpc8 north	6
RTHA	Red-tailed Hawk	*Buteo jamaicensis*	1	T5-17	4
RUGR	Ruffed Grouse	*Bonasa umbellus*	1	T18-16	7
SOSA	Solitary Sandpiper	*Tringa solitaria*	11	T3-Bat3,T15-4	2
SOSP	Song Sparrow	*Melospiza melodia*	21	T3-Bat3,T9-8,T5-17,T7-11,T11-12	6
WTSP	White-throated Sparrow	*Zonotrichia albicollis*	32	T2-1,T3-Bat3,T3-15,T5-17,T9-8,T11-10,T15-4,T18-16	6
WWCR	White-winged Crossbill	*Loxia leucoptera*	2	Tpc8 north	6
YBSA	Yellow-bellied Sapsucker	*Sphyrapicus varius*	3	T5-17	7
YRWA	Yellow-rumped Warbler	*Dendroica coronata*	5	T3-Bat3, T5-17,T18-16	6
	Unknown Warbler species		1	T11-10	6
	36 Species	**Total Number:**	**202**		

Notes: Incidental observations during the spring migration surveys are not included (those observed outside of point count locations). Bird group is coded as: 1 = Waterfowl; 2 = Shorebirds; 3 = Other waterbirds; 4 = Diurnal raptors; 5 = Nocturnal raptors; 6 = Passerines and 7 = Other landbirds. See section 4.1.2 for further details.

The three most commonly observed species during fall migration transects were the White-throated Sparrow (n=32), Black-capped Chickadee (n=23), and Song Sparrow (n=21). Most observations were of individuals or small groups (30 or less). No large flocks were observed during this survey type. The most abundant group observed on site during transect completion were passerines, followed by shorebirds.

5.5.5.2.6 Winter Surveys

Very few birds were observed during Winter Surveys. Black-capped Chickadee (n=6), Golden-crowned Kinglet (n=1), Hairy Woodpecker (n=2), and Ruffed Grouse (n=2) were observed during transect surveys. None of these species are SAR/SOCI.

5.5.5.2.7 Summary of Findings

Table 48 provides a summary of bird observations across all seasons.

Table 48: Species Groups Across Seasonal Bird Surveys

Species Group	Winter	Spring	Breeding	Fall
1		642	1	3157
2		707	5	347
3		5894	4516	3575
4		24	10	52
5		2	2	1
6	7	1629	859	862
7	4	107	34	41
Unidentifiable		108	4	0
Sum	11	**9113**	**5431**	**8035**

5.5.5.2.8 Flight Path Review

The avian study within, and adjacent to the Study Area collected extensive data to abundance of birds utilizing on-site habitat as well as to characterize the migratory and diurnal (i.e. daily) flight path trends of birds in the surrounding area. This section provides a description of flight paths observed by the birder during the migratory season and characterizes the diurnal activities within and surrounding the Study Area.

Migratory Flight Paths – Pokeshaw Rock
Migration to and from Pokeshaw Rock takes place during spring and fall. This was evidenced by the large flocks of Double-crested Cormorants observed at the rock from spring to fall, and their gradual decline in numbers towards the end of September. In the last two weeks of September, this species was observed leaving the rock in small groups, heading predominately east beyond the northern boundary of the Study Area. During this season, the birds left in smaller groups, not by one large mass movement. In 2018 the arrival timing and direction of Cormorants to the rock in spring is unknown, as, on the first day of observation (April 30, 2018), the Double-crested Cormorants were already there. Anecdotal evidence from a nearby property owner states that the cormorants arrived in large numbers on April 18, 2019 coming from a seaward direction (i.e. flying from the ocean towards land). This same resident states in past years he has observed flocks of birds arriving along the coast from the direction of Gaspé. Mass movements of other species were not observed at any time.

Shorebirds, including Double-crested Cormorants, generally migrate at night by following coastlines, ridges, and valleys to aid in nocturnal migration (Lincoln, 1935; Richardson, 2000). Therefore, it is likely that this species largely followed the coast to the east of Pokeshaw Rock when arriving and leaving for migration, therefore, flying north of the Study Area and not in the air space above it. This fits with the relatively few Double-crested Cormorants observed flying over the Study Area in either spring (n=16 individuals) or fall (n=0 individuals). Furthermore, anecdotal evidence from birders in the area suggests that Miscou Island, approximately 55 km northeast from the Study Area and at the very tip of the Acadian Peninsula, is a crucial migratory corridor for waterbirds (NCC, 2018). Migrating Double-crested Cormorants may follow the Acadian Peninsula north, flying around the tip of Miscou Island, before bearing west into Caraquet Bay. From there it is a direct flight west to Pokeshaw Rock, flying north of the Study Area boundary and not crossing through its air space.

Migratory Flight Paths – Landbirds
No evidence of concentrated migratory pathways was identified during the avian study. As discussed in prior sections, the largest flocks observed during migratory periods were 30 American Crows, and 30 American Pipits in May 2018. Three flocks of Canada Geese and smaller flocks of American Goldfinch, American Crow and Dark-eyed Junco were observed in Fall 2018.

The one-year radar and acoustical study will support these observations, including potential nocturnal migration that could be occurring.

Diurnal Flight Paths
Diurnal flight observations consisted of birds making local flights for the purpose of foraging, nesting, mating, and other purposes. Unless the take-off and landing were observed, it was not possible to differentiate between a migration and a diurnal flight, other than the continued presence of birds in the area. Given the lack of obvious migration (i.e. large flocks moving through the area without stopping), it may be assumed that a majority of the birds observed in flight were doing so for diurnal activities.

A majority of birds observed in flight were doing so outside of the Study Area. As can be seen on Figure 13 (Appendix A), approximate flight paths of birds observed during Watch Count surveys are presented. The flight paths presented are indicative of larger flocks (i.e >30 birds). The flight paths are predominantly situated to the west (~0.5-1km) from the Study Area boundary, and to the north of the Study Area (~0.5km and abutting the Study Area boundary). Of the birds observed flying over the Study Area, even fewer were seen doing so within the RSA (discussed further in Section 5.5.5.2.10). Several large flocks, made up of Canada Geese in groups that ranged from 130 to 350 individuals, were observed flying on a north-south trajectory. About half of these large flocks were observed flying over the Study Area, to the west of WC3 and WC4 (Figure 13, Appendix A). Approximately 730 individuals were estimated to be flying to the reservoir on the neighbouring peat/cranberry facility on October 9 and 10, 2018. The remainder of observed birds in flight were in groups of 60 or less. No Double-crested Cormorants were observed flying over the Study Area during fall surveys.

The majority of birds flying over the Study Area during all seasons were observed flying on a North-South trajectory (i.e. the Canada Geese discussed above). The majority of birds were observed flying over the surrounding areas, outside of the Study Area, in an east-west trajectory. It is not possible, however, to determine whether this indicates any migratory flyway based on the relatively small sample size. Again, it is unclear whether these were migratory or diurnal flights. Flight paths are shown in Figure 13, Appendix A.

During the spring, the majority of flying birds were moving in a north, east, or western direction. During fall surveys, the majority of flying birds were moving in a north, east, or northeast direction.

5.5.5.2.9 Flock Size

Flock size of birds flying over the Study Area varied by season: relatively small flocks were observed in spring and breeding as compared to fall. During spring, two flocks of 30 individuals (American Pipit and American Crow) were observed flying over the Study Area. Comparatively, flocks ranging from 30 to 350 were observed in the fall flying over the Study Area. Flock sizes larger than 100 are summarized below.

Table 49. Large Flock Activity

Date	Survey Location	Species	#	Activity
September 14, 2018	WC3	Canada Goose	130	Flying south and calling
September 27, 2018	PC18	Canada Goose	100	Flying north and calling
October 9, 2018	WC3	Canada Goose	130	Flying north towards reservoir
October 9, 2018	PC18	Canada Goose	350	Flying north towards reservoir
October 10, 2018	PC7	Canada Goose	250	Flying northeast towards reservoir

Of the large flocks observed flying in the surrounding landscape, the majority of these groups were observed flying along the coast or to and from the peat/cranberry reservoir and Pokeshaw Rock. During the spring, two flocks of 100 individuals (Black Scoters and Double-crested Cormorants) were seen flying along the coast headed northeast of WC1. During this season one other flock of 100 birds was observed around Pokeshaw Rock, flushed off the rock by the presence of an eagle. During fall, flocks larger than 100 individuals and observed outside of the Study Area were observed on 5 different events. These sightings are summarized below.

Table 50. Large Flock Activity Outside of the Study Area

Date	Survey Location	Species	#	Activity
September 19, 2018	WC1	Double-crested Cormorant	300	Flying away from colony, headed east along coast
September 19, 2018	WC1	Unknown Scoter sp.	300	n/a
October 10, 2018	WC4	Canada Goose	200	Flying north and south around reservoir
October 10, 2018	PC7	Canada Goose	250	Flying northeast towards reservoir
October 10, 2018	WC5b	Canada Goose	150	Landed in fields near reservoir, then flew to reservoir

In summary, most birds observed in flight were doing so outside of the Study Area, likely during diurnal activities for the purpose of foraging, nesting, mating and other requirements. These birds were largely seen flying east-west, and were noticed utilizing habitats in the surrounding landscape, such as the neighbouring peat/cranberry reservoir and the Pokeshaw River.

5.5.5.2.10 Bird Mortality Estimating

The RSA is the circular area occupied by a turbine rotor. The maximum and minimum rotor heights define where the RSA sits in space, and, when compared to bird flight height, can potentially provide insight into the possibility of collision between flying birds and moving turbines.

For the purposes if the bird mortality estimating the turbine specific outlined in Table 51 were used. With a maximum rotor height of 208 m and a minimum rotor height of 73 m, its RSA is 16,742 m^2. Therefore, for purposes of mortality estimating, birds observed flying between 62 and 208 m above ground level – or within the RSA - may be at risk of collision.

Table 51. Proposed Turbine Specifications

Turbine Aspect	Length (m)
Hub Height	135
Blade Length	73
Rotor Diameter	146
Total Height	208

Flight Behaviour Observations

Flight behaviour was observed for 12,047 individuals during spring migration, breeding bird, and fall migration. For this analysis, avian observations during spring and breeding season were combined because it is often difficult to discern between late spring migrators and early breeders. During spring and breeding season, approximately 2.5% of individuals were observed flying over the Study Area. Of these, 36% were observed flying within the RSA (n=68 individual birds), this includes two SOCI and two SAR. Two Killdeers (S3B, S3M) observed flying at 90 m, two Pine Siskins (S3) observed flying at 69 and 70 m above ground level, one Bobolink (NBSARA, COSEWIC, SARA Threatened; S3B, S3M; 60 m), and one Rusty Blackbird (NBSARA, COSEWIC, SARA Species of Special Concern; S3B, S3M; 50 m). The SOCI species were observed at PC7, PC12, PC14, and WC3 all of which are over 200 m from the nearest proposed wind turbine. The Bobolink was observed in flight over PC1, which is over 1 km from proposed turbine location WTG1. The Rusty Blackbird was observed in flight over PC6 which is approximately 370 m northwest from WTG2 and 420 m west of WTG3.

A greater abundance and proportion of individuals were observed flying over the Study Area in the fall: 28.6% of all observed birds in flight. Of these, 91% of individuals were observed flying within the RSA (n=1,211 individual birds; 26.2%), this includes two SAR and one SOCI species: one Bald Eagle (NBSARA Endangered, S4) observed flying at 80 m, one Evening Grosbeak (COSEWIC and SARA Special Concern, S3B, S3S4N, SUM; 60m), and two Pine Siskins observed flying at 90 and 100 m above ground level. The Bald Eagle was observed flying over WC4, which is approximately 350m northwest of WTG2. The Evening Grosbeak was observed flying over PC3, approximately 600 m southwest of WTG1. The two Pine Siskins were observed at WC3, which is 210 m west of WTG1.

Table 52 below provides a summary of individual flyovers compared with total seasonal bird observations.

Table 52. Summary of Observed Birds.

Season	Total Observed		Flying Over Study Area		Flying Over Study Area, within RSA	
	# Individuals	# Species	# Individuals	# Species	# Individuals	# Species
Spring & Breeding	7,442	47	186 (2.5% of total observed)	39	68 (0.9% of total observed)	15
Fall	4,605	24	(1319 28.6% of total observed)	21	1211 (26.2% of total observed)	14

Flight height characteristics are outlined for species group and by individual species for flying birds observed in the spring in Table 52 and Table 53 below respectively.

A total of 7,442 individuals were observed flying during spring and breeding bird surveys, representing 47 species. Flight heights documented in the Spring and Breeding Seasons were between 1 m and 200 m above the ground.

Table 53. Flight height characteristics by species group during spring and breeding bird surveys.

Species Group	Number of Individuals	Flight Height for Species Group Observed (m above ground)			Individuals in Relation to Rotor Swept Arc (%)		
		Lowest	Highest	Average*	Under (<63 m)	Within (63 – 200 m)	Above (>200 m)
Waterfowl	139	1	100	8.4	99%	1%	-
Shorebirds	5	10	100	56.7	40%	60%	-
Other Waterbirds	7106	2.0	200.0	40.7	78%	22%	-
Diurnal Raptors	12	10	90	60.8	58%	42%	-
Passerines	165	20	90	64.5	50%	45%	-
Landbirds	15	5	80	44.6	87%	7%	-
Total	**7442**						

**Weighted average is used*

Table 54. Flight height characteristics by species during spring and breeding bird surveys.

Species	Number of Individuals	Flight Height for Species Group Observed (m above ground)			Individuals in relation to Rotor Swept Arc (%)		
		Lowest	Highest	Average*	Under (<63 m)	Within (63–200 m)	Above (>200 m)
American Bittern	1	50	50	50	100%	-	-
American Crow	41	60	90	81.95	27%	73%	-
American Goldfinch	12	50	90	69.67	58%	42%	-
American Kestrel	3	20	60	40	100%	-	-
American Pipit	30	55	55	55	100%		

Species	Number of Individuals	Flight Height for Species Group Observed (m above ground)			Individuals in relation to Rotor Swept Arc (%)		
		Lowest	Highest	Average*	Under (<63 m)	Within (63–200 m)	Above (>200 m)
American Woodcock	1	15	15	15	100%		
Bald Eagle	1	90	90	90		100%	
Belted Kingfisher	3	5	60	38.33	100%		
Black Guillemot	20	5	5	5	100%		
Blue Jay	7	50	60	57.14	100%		
Black Scoter	100	5	5	5	100%		
Bobolink	1	60	60	60	100%		
Broad-winged Hawk	3	40	90	63.33	67%	33%	
Canada Goose	1	100	100	100		100%	
Cedar Waxwing	5	40	40	40	100%		
Common Grackle	11	50	60	57.27	100%	-	-
Common Loon	5	90	100	95		100%	
Common Raven	6	50	90	65	67%	33%	
Double-crested Cormorant	7025	2	100	41.18	78%	19%	
Eastern Phoebe	2	40	60	50	100%		
Great Black-backed Gull	10	5	5	5	100%		
Hairy Woodpecker	2	60	60	60	100%		
Herring Gull	1	50	50	50	100%		
Iceland Gull	2	40	80	60	50%	50%	
Killdeer	2	90	90	90		100%	
Mallard	7	50	60	57.86	100%		
Merlin	1	80	80	80		100%	
Northern Flicker	3	40	60	46.667	100%		
Northern Gannet	15	5	90	33.33	100%		
Northern Harrier	1	10	10	10	100%		
Osprey	5	60	70	62.5	60%	40%	
Pine Siskin	3	60	70	66.33	33%	67%	
Pileated Woodpecker	2	60	60	60	100%		
Razorbill	10	5	5	5	100%		
Ring-billed Gull	10	5	5	5	100%		
Ruby-throated Hummingbird	1	39	39	39	100%		
Rusty Blackbird	1	50	50	50	100%		
Red-winged Blackbird	26	40	60	59.23	100%		
Savannah Sparrow	1	60	60	60	100%		
Snow Bunting	2	60	60	60	100%		
Solitary Sandpiper	2	60	100	80	100%		
Surf Scoter	10	1	1	1	100%		
Tree Swallow	4	50	90	70	25%	75%	

Species	Number of Individuals	Flight Height for Species Group Observed (m above ground)			Individuals in relation to Rotor Swept Arc (%)		
		Lowest	Highest	Average*	Under (<63 m)	Within (63–200 m)	Above (>200 m)
Wilson's Snipe	4	10	80	33.33	50%	25%	
White-winged Crossbill	4	60	80	70	50%	50%	
Yellow-bellied Sapsucker	1	30	30	30	100%		
Yellow-rumped Warbler	4	20	60	40	100%		
Unknown Gull sp.	30	200	200	200			100%
Total	**7442**						

**Weighted average used*

Tables Table 54 and Table 55 provide summaries of flight heights recorded during fall surveys, by bird groups, and by species, respectively. A total of 4,605 individuals were documented in flight in the fall, representing 24 species. One flock of birds were unable to be identified to the species level, therefore they were included in the count of individuals, but not in the species count. Flight heights documented during the fall were between 5 and 150 m above the ground.

Table 55. Flight height characteristics by species group during fall surveys

Species Group	Number of Individuals	Flight Height for Species Group Observed (m above ground)			Individuals in relation to Rotor Swept Arc (%)		
		Lowest	Highest	Average*	Under (<63 m)	Within (63 - 200 m)	Above (>200 m)
Waterfowl	1791	45	150	87.4	2%	98%	-
Shorebirds	2	60	60	60	100%		-
Other Waterbirds	2657	5	100	47.98	86%	14%	-
Diurnal Raptors	17	5	90	61.47	53%	35%	-
Passerines	137	10	120	49.19	77%	23%	-
Landbirds	1	80	80	80		100%	-
Total	**4605**						

**Weighted average used*

Table 56. Flight height characteristics by species during fall surveys

Species	Number of Individuals	Flight Height for Species Group Observed (m above ground)			Individuals in relation to Rotor Swept Arc (%)		
		Lowest	Highest	Average*	Under (<63 m)	Within (63-200 m)	Above (>200 m)
American Crow	70	10	120	36.13	77%	23%	-
American Goldfinch	34	50	60	59.71	100%	-	-

Species	Number of Individuals	Flight Height for Species Group Observed (m above ground)			Individuals in relation to Rotor Swept Arc (%)		
		Lowest	Highest	Average*	Under (<63 m)	Within (63-200 m)	Above (>200 m)
American Kestrel	4	80	80	80	-	100%	-
American Robin	5	40	80	56	60%	40%	-
Bald Eagle	9	47.5	80	51.11	89%	11%	-
Belted Kingfisher	1	60	60	60	100%	-	-
Blue Jay	3	90	90	90	-	100%	-
Broad-winged Hawk	1	80	80	80	-	100%	-
Canada Goose	1791	45	150	107.44	2%	98%	-
Cedar Waxwing	1	50	50	50	100%	-	-
Commong Grackle	1	90	90	90		100%	-
Common Raven	5	50	90	66	40%	60%	-
Double-crested Cormorant	2356	5	100	53.44	85%	15%	-
Downy Woodpecker	1	80	80	80	-	100%	-
Evening Grosbeak	5	60	60	60	100%	-	-
Lesser Yellowlegs	2	60	60	60	100%	-	-
Northern Harrier	1	5	5	5	100%	-	-
Palm Warbler	1	40	40	40	100%	-	-
Peregrine Falcon	1	90	90	90	-	100%	-
Pine Siskin	3	90	100	93.33	-	100%	-
Purple Finch	3	30	80	56.66	-	67%	33%
Red-tailed Hawk	1	90	90	90	-	100%	-
Wilson's Warbler	1	40	40	40	100%	-	-
Yellow-rumped Warbler	5	40	80	66	-	-	-
Unknown Scoter sp.	300	5	5	5	100%	-	-
Total	**4605**						

**Weighted average used*

5.5.5.2.11 <u>Avoidance Rates</u>

As stated in 4.1.2.8, most birds display avoidance behaviours to avoid turbines and other structures when possible (Everaert, 2014; Larsen & Guillemette, 2007). Therefore, an avoidance rate by species group was applied to the mortality calculations. The recommended default avoidance rate for species not listed specifically in the guidance document is 98% and has been used in the avoidance rate calculations (Scottish Natural Heritage, 2010). The following tables provide a summary of assumptions that factor into the calculation of turbine collision estimates; these values are based on the given turbine specifications, the amount of time spent surveying birds during Breeding, Spring and Fall, and the results of those surveys. Table 57 outlines the number of survey locations, the survey and Study Area, and the average number of birds observed per survey area. Table 57 also provides an estimated population size from which the mortality calculations are based.

Table 57. Mortality estimate assumptions

<table>
<tr><th>Characteristic</th><th colspan="2">Calculation Inputs</th></tr>
<tr><td>Rotor Diameter</td><td colspan="2">130 m</td></tr>
<tr><td>Hub Height</td><td colspan="2">132 m</td></tr>
<tr><td>Maximum Rotor Height</td><td colspan="2">200 m</td></tr>
<tr><td>Minimum Rotor Height</td><td colspan="2">69 m</td></tr>
<tr><td>Rotor Swept Arc (πR^2)</td><td colspan="2">12,469m^2</td></tr>
<tr><td>Number of survey locations (a)</td><td colspan="2">31 (26 point count locations, 5 watch count locations)</td></tr>
<tr><td>Survey location observation areas (b)</td><td colspan="2">420,835m^2 (calculated by taking the average observer distance of point counts and watch counts = 366m)</td></tr>
<tr><td>Number of Turbines</td><td colspan="2">5</td></tr>
<tr><td>Width of the Study Area</td><td colspan="2">3,750 m</td></tr>
<tr><td>Survey Time Total</td><td colspan="2">145 minutes</td></tr>
<tr><td rowspan="2">Total number of birds identified in survey time</td><td colspan="2">Spring & Breeding = 7442</td></tr>
<tr><td colspan="2">Fall = 4605</td></tr>
<tr><td>Population of birds that are in the turbine vicinity that could interact with a turbine at a given time (e)</td><td>Spring & Breeding
Waterfowl (including Other Waterbirds) = 7245
Shorebirds = 5
Passerines (including Landbirds) =180
Raptors = 12</td><td>Fall
Waterfowl (including Other Waterbirds) = 4448
Shorebirds = 2
Passerines (including Landbirds) = 138
Raptors = 17</td></tr>
<tr><td>Spring & Breeding - % of each group within RSA</td><td colspan="2">Waterfowl = 0.2%
Shorebirds = 20%
Passerines = 26%
Raptors = 33.3%</td></tr>
<tr><td>Fall - % of each group within RSA</td><td colspan="2">Waterfowl = 26%
Shorebirds = 0%
Passerines = 23%
Raptors = 41%</td></tr>
<tr><td>Weighted Average within RSA</td><td colspan="2">Waterfowl = 10%
Shorebirds = 14.3%
Passerines = 24.7%
Raptors = 37.8%</td></tr>
<tr><td>Risk Window (W)</td><td colspan="2">3750m x 200m = 750,000m^2</td></tr>
<tr><td>Flights per hour of birds that are in the turbine vicinity that could interact with a turbine at a given time (bch)</td><td colspan="2">Waterfowl = 13.57 flights/hour
Shorebirds = 0.01 flights/hour
Passerines = 0.37 flights/hour
Raptors = 0.03 flights/hour</td></tr>
</table>

Characteristic	Calculation Inputs
Total hours estimate for Spring & Breeding (Sh)	April 30 – July 17 = 79 days x 12hrs flight time / day
Total hours estimate for Fall (Fh)	Aug 20 – October 10 = 52 days x 12 hrs flight time / day
Number of bird flights in risk window (**n**) = bch*(Sh+Fh)	Waterfowl = 21,333 Shorebirds = 13 Passerines = 580 Raptors = 53
Area presented by wind project rotors (A) = # of turbines x RSA	62,345 m^2
Total rotor area as a proportion of the risk window = A/W	0.08
Probability of Collision (from Scottish Natural Heritage Model)	Waterfowl = 0.079 Shorebirds = 0.072 Passerines = 0.061 Raptors = 0.123

Collison Mortality Estimates

Using the calculations above, the predicted estimate of avian mortality as the result of proposed Project construction (by bird group) is provided in Table 58.

Table 58. Predicted Estimate of Avian Mortality

Species group	Total Collision Estimates for One Turbine per year
Waterfowl	0.210
Shorebirds	0.0000001
Passerines	0.009
Raptors	0.002
Total	**0.221**
Total for PBRWP (5 turbines)	**1.105**

These values were calculated using the flight heights of all birds, not just those observed flying within the Study Area. Given the slightly lower percentage of birds observed flying within the Study Area (see Table 58 above), mortality rates may actually be lower than estimated.

According to Bird Studies Canada (2017), the average mortality rates for non-raptors in Atlantic Canada is 1.81 ± 0.47 birds per turbine per year. No estimate of average mortality is available for raptors in Atlantic Canada, as the wind power projects summarized in the database did not document any raptor mortalities. Furthermore, a study done in 2013 found that after completing carcass searches at 43 wind farms across Canada, the average number of birds killed per turbine per year was 8.2 ± 1.4 (Zimmerling *et al.,* 2013).

The total predicted mortality estimate presented in Table 58 for **all 5 turbines** at PBRWP (1.105 birds per year) is below the Atlantic Canadian and national average. As such, the predicted risk of the Project to birds is considered low.

5.5.5.3 **Summary of Bird Surveys**

A total of 9,271 minutes (154 hours and 30 mins) of surveys were completed over four seasons. These surveys resulted in the observation of 22,590 individual birds, representing 116 species of which (14%) were observed within or over the Study Area and the remaining 76% were observed outside the Study Area. When incidental observations were removed (those observed outside of dedicated surveys), 22,242 individuals representing 115 species remain. A higher number of birds were observed during the spring migration period, compared to during the fall migration and breeding periods. The highest bird counts were observed during watch count surveys in all three seasons. These high numbers are due to large flocks of Double-crested Cormorants, Canada Geese, and Black Scoters that were seen on the coast. Large concentrations of Double-crested Cormorants were observed on the Pokeshaw Rock IBA. Birds of this species were observed flying to, and leaving this colony following coastal and overland routes, however, they were not observed in significant numbers flying directly above the Study Area (16 individuals in spring and no individuals in fall were observed flying over the Study Area which represents <0.1% of these species observed.

Double-crested Cormorants were the most abundant bird observed during all surveys. They were seen in the greatest numbers during seasonal watch counts: 5,850 were observed in the spring watch counts; 4,512 in breeding season watch counts; and 3,551 in fall watch counts. Their presence in this area is tied to the Pokeshaw Rock IBA. Large flocks of approximately 300-450 individuals were observed during spring and fall. A majority of these flocks were observed at the colony with the remaining flocks observed to be embarking on diurnal movements along the coast, or in one case observed to be gathering nesting material from lands adjacent to the Pokeshaw River (see Section 5.4.6.2.7 for a detailed description of flight paths).

Despite the large number of Double-crested Cormorants observed at the IBA, very few were observed over the Study Area; instead, they were largely seen flying in an east-west pattern north of the proposed turbines, or along a north-south trajectory, west of the turbines (see Figure 13, Appendix A). Additionally, despite the observation of individuals collecting nesting materials, no fledging or first-year juveniles were observed. Observation through a spotting scope confirmed the presence of older juveniles however.

Although no mass migratory movements were witnessed, many diurnal flights were observed. A portion of these flights occurred over the Study Area. In spring 2% of flights occurred over the Study Area, but only 0.8% of flights occurred over the Study Area and within the RSA. In fall, 28% of flights occurred over the Study Area, and 26% occurred both over the Study Area and within the RSA. The larger percentage in fall was due to several flocks of Canadian Geese that were either flying to or from the peat/cranberry reservoir to the north of the Study Area. These were not migratory flights, as the geese were observed remaining in the area. Geese were not observed landing within the Study Area boundaries, instead they foraged in neighbouring agricultural fields.

Waterfowl, including Canadian Geese and Double-crested Cormorants, had the highest estimated collision rates out of any of the bird groups used in the mortality estimation calculations (0.346 collisions estimates/turbine/year). However, it is important to note that these calculations were made using all observed flights during the survey seasons, not just those observed over the Study Area. Therefore, the number of birds flying through the risk window is actually much lower and, consequently, collision risk would also be lower. The results of this predictive tool indicate that 0.364 birds may collide with one turbine per year at PBRWP, and 1.105 birds may collide with turbines across the entire PBRWP (5 turbines). These numbers are well below the average mortality rates in Atlantic Canada (1.81 ± 0.47 birds per turbine per year for non-raptor species) and nationally (8.2 ± 1.4 birds per turbine per year) as determined in a study performed for 43 wind projects in Canada.

5.5.6 Bat Use

5.5.6.1 **Desktop Results**

The Study Area does not contain any forested ridgelines that may be used as bat migratory routes, nor have any bat hibernacula been identified within 5 km of the proposed turbine locations (ACCDC, 2017). No large bodies of water are located within 500 m of the Study Area, with the Bay de Chaleur and Pokeshaw River located 2.5km north and 1.5 km west of the Study Area respectively. The headwaters of the Riviere du Nord initiate adjacent to the southern Study Area boundary. However, as a 1st order stream (i.e. a headwater stream), it is unexpected to be large enough to significantly concentrate foraging or migratory movements. The ACCDC Report had no historical recordings of bat observations within 100km (ACCDC, 2017). The closest critical bat habitat is approximately 160 km north on the Gaspé Peninsula of Quebec (Environment Canada, 2015). The New Brunswick Museum Databases listed a historical siting of the Hoary Bat (Lasiurus cinereus) within Gloucester county, however, this siting was from August 1975 and was considered too long ago to pursue for more information.

5.5.6.2 **Hibernacula**

There was no evidence of rocky outcrops, abandoned mines, or other natural features within the Study Area that could potentially serve as bat hibernacula.

5.5.6.3 **Bat Monitoring Results**

Data was analysed from all four bat monitors, across five locations over the monitoring periods as discussed in Section 4.1.5, the results of which are provided in Table 57. Summaries of bat counts per detector night; average bat counts per detector night and total presence for each species across the four monitoring locations is provided. A bat count is any number of bat passes from the same species within a 1-minute time block (Miller, 2001). A detector-night is the activity recorded by 1 detector from 30 minute prior to sunset to 30 minutes after sunrise and was used to standardize measures of activity.

Where distinction between two species was not possible, the two undistinguishable species groups are grouped together as indicated in Section 4.1.6 (i.e. Eastern red bat / Tricolored bat – (LABO/PESU) refers to either of these species).

Table 59: Summary of Bat Passes Per Detector Night

Species/Species Group	Migratory (Y/N)	Bat Detector					Total all sites
		BM 1	BM 2	BM 3	BM 4a	BM 4b	
High Frequency	N/A	3	58	29	164	9	**263**
Little brown bat – (MYLU)	Y	13	153	48	46	77	**337**
Northern long-eared myotis (MYSE)	N	0	0	0	1	0	**1**
Little brown bat/Northern long-eared myotis – (Myotis)	N	1	26	1	16	0	**44**
Eastern red bat – (LABO)	Y	32	169	81	316	20	**618**
Tricolored bat – (PESU)	N	9	57	39	51	10	**166**
Eastern red bat / Tricolored bat – (LABO/PESU)	N/A	0	0	0	80	0	**80**
Low Frequency	N/A	4	0	1	8	0	**13**
Hoary bat - (LACI)	Y	92	176	181	420	0	**869**
Big brown bat - (EPFU)	Y	9	2	2	2	0	**15**
Silver-haired bat - LANO	Y	2	1	3	2	0	**8**
Silver-haired bat/Big brown bat - (EPFU/LANO)	Y	21	24	12	28	0	**85**
Total counts all species		**186**	**666**	**397**	**1134**	**116**	**2499**
Detector Nights		123	126	126	78	47	**500**
Average counts per detector night		1.51	5.29	3.15	14.54	2.47	**5.00**

During the 2018 sampling period (Table 59) there were a total of 2,499 bat passes recorded by four detectors (across five locations). Activity at the detectors sites was variable, ranging from 116 total passes at BM4b (albeit only over 47 nights from end of August – mid October), to 1134 total passes at BM4a. The highest bat activity was at the BM4a, with 14.54 passes per night. The average passes per detector night for all detectors over the entire season was 5 counts/night.

The most common species recorded during all detector surveys was the Hoary bat (*Lasiurus cinereus*) at 34.77%, followed by Eastern red bat (*Lasiurus borealis*) at 24.73%, Little brown bat (*Myotis lucifugus*) at 13.49% and high frequency bats at 10.52%. The remaining species/species groups identified comprised less than 10% each.

5.5.6.4 <u>**Seasonal and Nightly Activity**</u>

During the 2018 monitoring season (June 11th to October 15th), bat activity was first recorded on June 12th with a small peak occurring at the end of June. As is shown on Figure 6 (below), activity levels increased throughout July and again peaked between end of July and mid August, prior to decreasing sharply through September. No activity was recorded across the Study Area between October 4th and 15th, 2018.

Across the results generally, activity was relatively consistent throughout the night, beginning near dusk (7pm) and increasing sharply through the first few hours after sunset, with highest levels of activity occurring at 10pm. A smaller peak in activity was observed at 1am, after which activity tapered off and ceased just before sunrise (6am) (Figure 5, below).

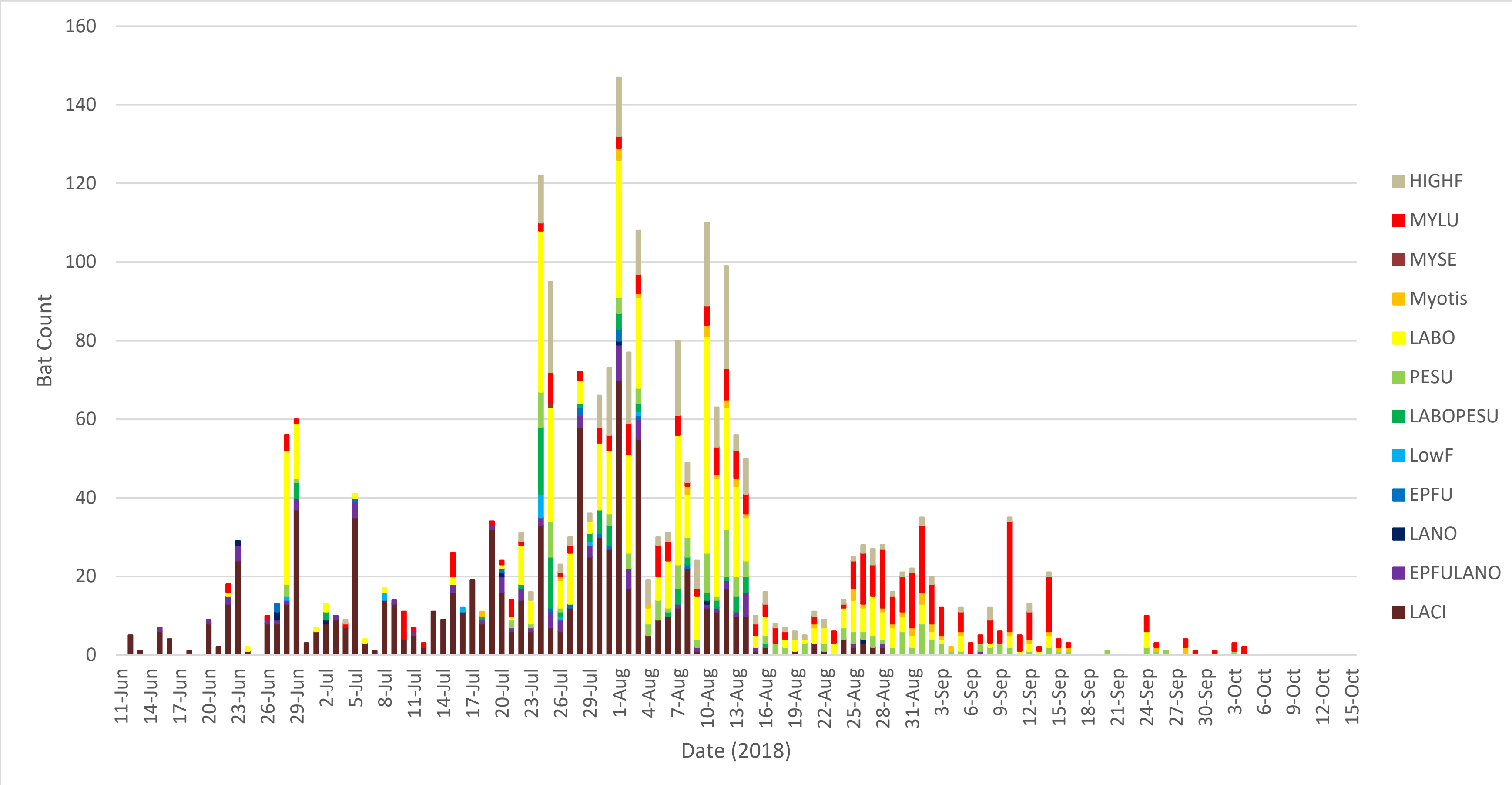

Figure 5: Nightly Bat Counts Across All Monitoring Stations

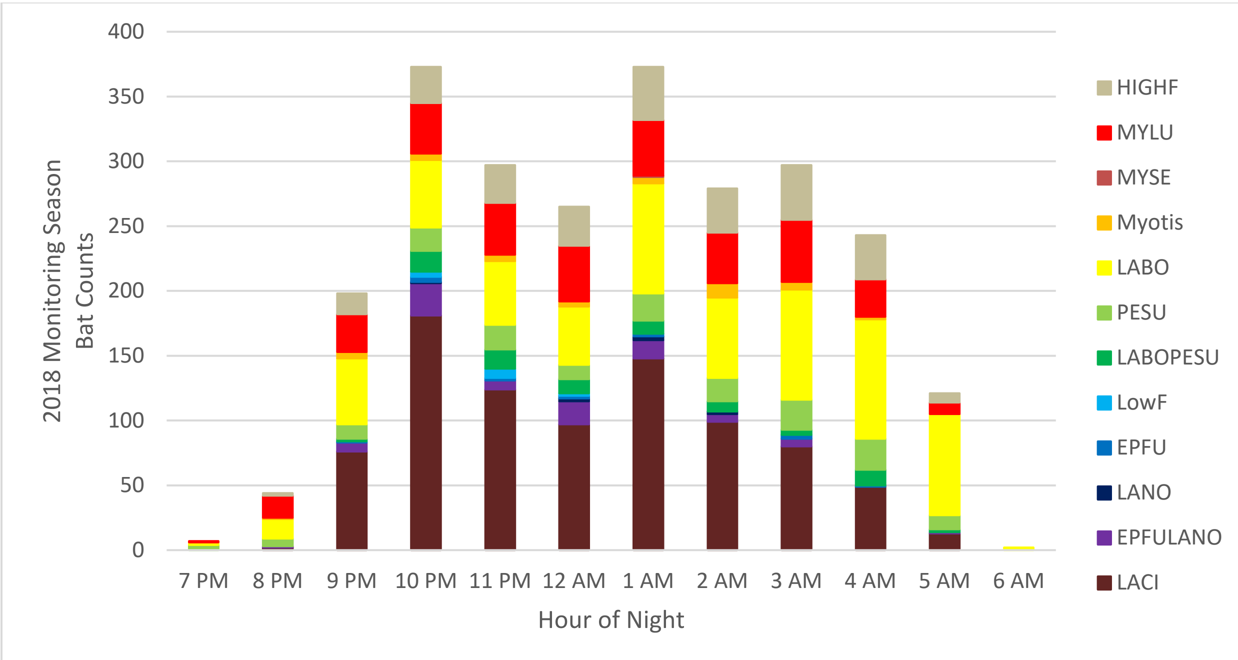

Figure 6: 2018 Nightly Timing of Bat Counts

5.5.6.5 Discussion

There are seven species of bats that occur in New Brunswick as listed in Table 57 (above), three of which are considered listed as Endangered by COSEWIC, SARA and the NBSARA (Little brown myotis, Northern long eared myotis and the Tri-coloured bat). These species are also defined as S1 species by ACCDC (see Section 3.1.2 for designations). The remaining four species are defined by ACCDC as follows:

- Big brown bat (EPFU) – S3
- Eastern red bat (LABO) – S2?M
- Hoary bat (LACI) – S2?M
- Silver Haired bat (LANO) – S1?M

These four of the seven species are considered migratory, whereas the three Endangered species mentioned above are resident bats.

On an individual basis, the Hoary bat (a migratory species) appears to be the most commonly recorded species across the monitoring period. The Little Brown Bat accounted for the highest non-migratory species group recorded. It is evident from the results however, that migratory species are by far the dominant bats present across the locations studied.

There is a lack of readily available data in New Brunswick to which the data collected for this Study can be compared to. Therefore, the Alberta model has been adopted for the purposes of analysing potential impacts to bats as a result of PBRWP. Studies have shown that on average, greater than 80% of bat fatalities currently recorded at wind energy developments in North America, involve migratory species (Arnett *et al.*, 2008). Bat fatalities, primarily migratory species, occur through direct collision with blades or indirectly from rapid decompression (barotrauma) near turbines (Baerwald *et al.,* 2008). In Alberta, during fall migration (July 15 to September 30), bat fatalities consist mainly of Hoary and Silver-haired bats (Government of Alberta, 2013). Alberta adopts a Precautionary Principle whereby the following bat passes per night for migratory species is considered when determining project risk:

- Less than 1 migratory-bat passes per detector night = potentially acceptable risk
- 1-2 migratory bat passes per detector night = potentially moderate risk
- Greater than 2 bat passes per detector night = potentially high risk of bat fatalities
  Source: Government of Alberta, 2013

Based on this model, the migratory species identified during the survey period at PBRWP have been listed in Table 60, and their respective average passes per detector night have been calculated.

Table 60: Overall Migratory Bat Passes Per Detector Night

Migratory Species	Detector					Total Passes	Average passes per detector night
	BM1	BM2	BM3	BM4a	BM4b		
Low Frequency	4	0	1	8	0	13	**0.026**
Hoary bat - (LACI)	92	176	181	420	0	869	**1.738**
Big brown bat - (EPFU)	9	2	2	2	0	15	**0.03**
Silver-haired bat - LANO	2	1	3	2	0	8	**0.016**
Eastern red bat - LABO	32	169	81	316	20	618	**1.236**
Silver-haired bat/Big brown bat - (EPFU/LANO)	21	24	12	28	0	85	**0.17**
Total Per Detector	**160**	**372**	**280**	**776**	**20**		
Total Migratory Passes (all detectors)						**1608**	
Average passes per detector night						**3.216**	

The average passes per detector night for all migratory species has been determined to be 3.216 which falls within the *potentially high risk category* as outlined by Alberta government. However, closer analysis below describes a more accurate picture of bat migration through the Study Area. Table 61 shows migratory bat passes per detector night per bat detector.

Table 61: Bat Passes Per Detector Night Per Bat Detector

Bat Species Group	Total passes per species	Detector Nights	Average passes per detector night	Total passes per species	Detector Nights	Average passes per detector night	Total passes per species	Detector Nights	Average passes per detector night
	BM1			**BM2**			**BM3**		
Low Frequency	4	123	0.03	0	126	0.00	1	126	0.01
Hoary bat - (LACI)	92		0.75	176		1.40	181		1.44
Big brown bat - (EPFU)	9		0.07	2		0.02	2		0.02
Silver-haired bat - LANO	2		0.02	1		0.01	3		0.02
Eastern red bat - LABO	32		0.26	169		1.34	81		0.64
Silver-haired bat/Big brown bat - (EPFU/LANO)	21		0.17	24		0.19	12		0.10
Average Migratory Bat Passes Per Night	**1.3**			**2.95**			**2.22**		

Bat Species Group	Total passes per species	Detector Nights	Average passes per detector night	Total passes per species	Detector Nights	Average passes per detector night
	BM4a			**BM4b**		
Low Frequency	8	78	0.10	0	47	0.00
Hoary bat - (LACI)	420		5.38	0		0.00
Big brown bat - (EPFU)	2		0.03	0		0.00
Silver-haired bat - LANO	2		0.03	0		0.00
Eastern red bat - LABO	316		4.05	20		0.43
Silver-haired bat/Big brown bat - (EPFU/LANO)	28		0.36	0		0.00
Average Migratory Bat Passes Per Night	**9.95**			**0.43**		

It is evident from the results presented in Table 61 that BM2, BM3 and BM4a present 2.95, 2.22 and 9.95 average passes per detector night for all migratory species respectively, which falls within the *potentially* *high risk category* as outlined by Alberta government. Also, as is evident in Table 61, BM1 presents 1.3 average passes per detector night for all migratory species, which falls within the *potentially moderate risk category*. The remaining detector (BM4b) presents less than 1 average pass per detector night for all migratory species which falls within the *potentially acceptable risk category* as outlined by Alberta government. The overall site average passes per detector night for all migratory species is 3.37. However, due to a change in proposed turbine location, BM4a is presently located over 1.5km from the closest turbine (WTG1). Additionally, BM4a represents a habitat type that is atypical of remaining bat monitors and proposed turbine locations (i.e. edge of active agricultural field, which would provide unique foraging potential for migratory bat species). As such, for the purposes of this analysis removing the results of BM4a from the dataset is warranted for comparative purposes. When site bat data is reviewed without the records at BM4a the overall site average of average passes of migratory species declines to 1.73 which falls within the *potentially moderate risk category*.

It should be noted that the information provided in Tables 60 and 61 provides the reader a comprehensive account of bat passes across the five monitoring stations during the periods studied. The following important items should be considered:

1) Bat passes referred to is a sequence of 2 or more echolocation calls recorded as a bat flies within range of a bat detector (Thomas and West, 1989), in comparison to relative bat abundance. Relative bat abundance is an estimate of the number of individuals in a population (i.e. number caught or detected per unit time [frequency]). Absolute abundance is expressed as a number present per area (i.e., density). Absolute abundance can not be reliably assessed for bats. Relative abundance can be compared between localities or over time, but reliable comparisons of relative abundance can not be made between different species of bat (MELPRIB, 1998).
2) Average migratory bat passes per detector night provided in Table 58 and have been determined based on the individual bat passes at each monitor, across the total detector days for all monitoring stations. As discussed in Section 4.1.5.2, due to its relocation, BM4b was only monitored for 47 days (August 29-October 15, 2018), in comparison to BM1 (123 days), BM2 (126 days), BM3 (126 days) and BM4a (78 days). According to results collected across BM1, BM2, BM3 and BM4a, it appears that highest bat activity occurs during the period end of July and mid August and as such, the time period monitored at BM4b does not account for this period.
3) The average passes of migratory species per detector night threshold described in these results is precautionary and site specific to southern Alberta (Government of Alberta, 2013). Additionally, further literature review indicates that pre-construction acoustical monitoring has only a weak correlation to future mortality (Hein *et. al.*, 2013) and is strongly affected by region, habitat and species native to the area.

5.5.6.5.1 Turbine Specific Habitat

Habitat conditions for eight of the bat species are presented in Table 62 and a reference to habitat suitability for them at each of the proposed turbine locations is presented.

Table 62: Potential Bat Habitat at Proposed WTG's

Bat Species	Habitat Preferences[1]	WTG 1		WTG2		WTG3		WTG4		WTG5	
		Roosting	Foraging	Roosting	Foraging	Roosting	Foraging	Roosting	Foraging	Roosting	Foraging
Tri-coloured	Roosts in tree foliage and clumps of lichen, caves and crevices, and rarely in barns and other buildings; typically forages over still water and rivers, but will also forage along forest edges and gaps in the forest	Potential	Potential	Potential	No	Potential	Potential	Potential	Potential	Potential	No
Northern Myotis	Roosts under bark and in crevices, houses, and barns, often within 1 km of optimal foraging areas	Potential	Potential	Potential	Potential	Potential	Potential	Potential	Potential	Potential	Potential
Long-eared Myotis	Prefers coniferous forests, typically at elevations of 2,000 to 2,500 m; roosts in tree cavities and bark crevices; forages near water and within tree canopies	Potential	Potential	Potential	Potential	Potential	Potential	Potential	Potential	Potential	Potential
Little Brown Myotis	Forages over water, farmland, meadows, cliff faces; roosts in rock crevices, hollow trees, houses, and barns	Potential	No	Potential	No	Potential	No	Potential	No	Potential	No
Big Brown Bat	Found in a variety of habitats including forests, meadows, agricultural lands and urban areas; roosts in tree cavities, under loose bark, in rock crevices, and in buildings or	Potential	Potential	Potential	Potential	Potential	Potential	Potential	Potential	Potential	Potential

Bat Species	Habitat Preferences[1]	WTG 1		WTG2		WTG3		WTG4		WTG5	
		Roosting	Foraging	Roosting	Foraging	Roosting	Foraging	Roosting	Foraging	Roosting	Foraging
	other structures. More active in winter and can tolerate a wider range of temperatures (including temperatures at 0 °C) than many other bat species										
Silver-haired Bat	Prefers temperate hardwood forests nearby ponds or streams; forages predominantly in disturbed areas, including small clearings and roadways; roosts in tree cavities or under loose bark	Potential	Potential	Potential	No	Potential	Potential	Potential	Potential	Potential	No
Hoary Bat	Roosts in trees along forest edges or clearings, at 3 to 5 m above ground; forages above trees, along streams, and along lake shores	Potential	Potential	No	Potential	Potential	Potential	Potential	Potential	No	Potential
Eastern Red Bat	Mixed hardwood forests; forages in clearings, from ground level to tree canopy; roosts in sites that provide cover from the sides and above, but have an open flight path below	Potential	Potential	Potential	No	Potential	Potential	Potential	Potential	Potential	No

[1] *As provided by CANWEA, 201*

5.6 Aquatic Environment

The Study Area is within the Acadian Peninsula Composite (primary watershed) and the Baie de Caraquet Composite (secondary watershed) and approximately 38 km north west of protected Ruisseau Carter's Brook watershed (Figure 4, Appendix A).

The Study Area is on a north east facing slope. Surface water generally flows east towards the Rivière du Nord which ultimately drains into Caraquet Bay.

The desktop review of aquatic ecosystems indicated that no areas of mapped wetland habitat exist within the Study Area as determined by the NBHN. The Draft Wetlands Reference Map (NBDELG, 2019b) indicated scattered areas of potential forested and intermediate wetlands. The majority of these predicted wetlands are located along the eastern Study Area boundary adjacent to Rivière du Nord and in the northern third of the Study Area (circled in Figure 7, below).

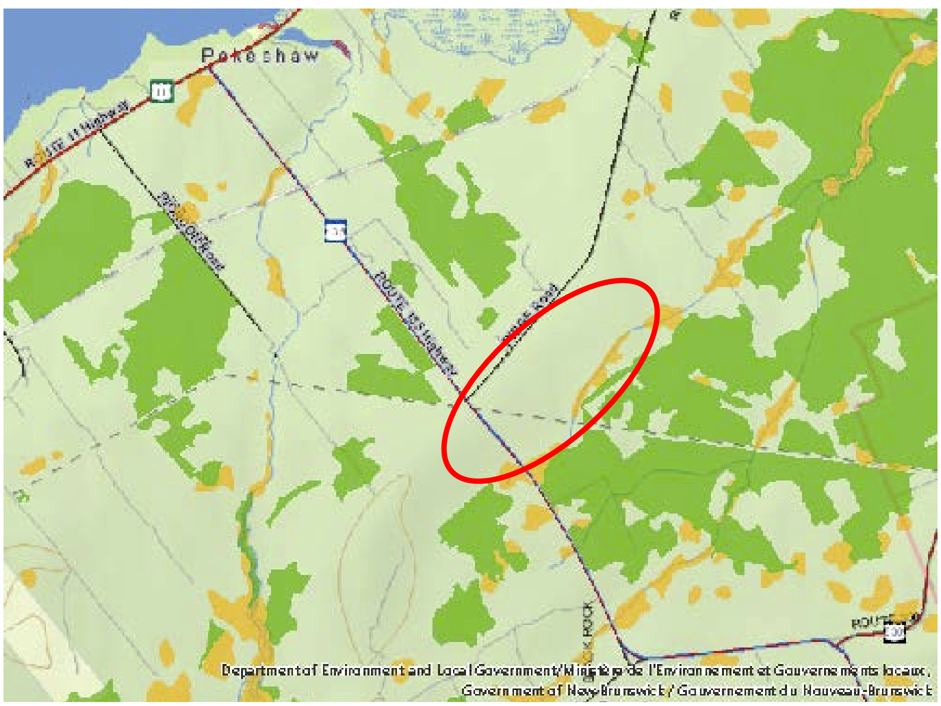

Figure 7: Draft Wetland Locations (NBDELG, 2019b)

One mapped watercourse (Rivière du Nord) drains from southwest to northeast beyond and adjacent to the eastern Study Area boundary (Figure 9 in Appendix A). The closest proposed turbine (WTG4) to Rivière du Nord is approximately 94 m (located in the eastern extent of the Study Area).

5.6.1 Wetlands

Wetlands play an important role in providing habitat to many species including those that are designated SAR and/or SOCI. Wetlands also provide important ecological services.

A review of the NBDELG Regulated Wetland database (GeoNB, 2019) identified no areas of mapped wetland habitat within the Study Area. However, there are a number of regulated wetlands identified within a kilometer of the Project; these include wetlands classified as freshwater marshes, shrub wetlands, and bogs. Riviere du Nord is associated with riparian shrub wetlands.

Field studies completed in August 2018 confirmed the presence of ten wetlands within the broader Pokeshaw Study Area. These features were evaluated in situ and are described in Table 63, and mapped in Figure 9, Appendix A. See Appendix K for a wetland photolog.

Table 63: Wetland Characterization Table

Wetland	Wetland Type	Wetland Size (ha)	Water Flow Path	Landform	Landscape Position	Hydrological Conditions	Dominant Vegetation
1	Mixedwood Treed Swamp	0.28 (Zone delineated; WL continues outside the Study Area)	Throughflow via WC	Basin	Lotic – Floodplain	Wetland saturated within 20cm	**Herbs**: *Osmunda cinnamomea, Doellingeria umbellata, Cornus canadensis, Glyceria sp., Ranunculus abortivus, Onoclea sensibilis* **Shrubs**: *Acer pensylvanica, Abies balsamea, Ribes glandulosum* **Trees**: *Acer rubrum, Betula alleghaniensis, Thuja occidentalis, Acer saccharum*
2	Hardwood Treed Swamp	0.04	Isolated	Basin	Terrene	Wetland saturated within 20cm	**Herbs**: *Onoclea sensibilis* **Shrubs**: *Alnus incana* **Trees**: *Betula alleghaniensis, Picea glauca*
3	Mixedwood Treed Swamp	3.65	Isolated	Basin	Terrene	Standing water (10% of WL), wetland saturated within 20cm, groundwater within 30cm	**Herbs**: *Carex trisperma, Oxalis montana, Osmunda cinnamomea, Acer rubrum, Aralia nudicaulis* **Shrubs**: *Thuja occidentalis* **Trees**: *Betula alleghaniensis, Thuja occidentalis, Betula papyrifera, Abies balsamea*
4	Hardwood Treed Swamp	2.96 (Zone delineated; WL continues	Throughflow via WC (WC outside the PA)	Basin	Lotic – Floodplain	Wetland saturated within 20cm.	**Herbs**: *Osmunda cinnamomea, Impatiens carpensis, Glyceria sp.* **Shrubs**: *Alnus incana* **Trees**: *Acer saccharum, Betula alleghaniensis*

Wetland	Wetland Type	Wetland Size (ha)	Water Flow Path	Landform	Landscape Position	Hydrological Conditions	Dominant Vegetation
		outside the Study Area)					
5	Hardwood Treed Shrub Swamp	0.17	Isolated	Basin	Terrene	Standing water (5% of WL), wetland saturated within 20cm, groundwater within 30cm	**Herbs**: *Onoclea sensibilis, Cornus canadensis* **Shrubs**: *Acer saccharum, Acer rubrum, Abies balsamea, Thuja occidentalis* **Trees**: *Betula alleghaniensis, Acer saccharum, Picea mariana, Acer rubrum*
6	Mixedwood Treed Swamp	3.49	Isolated	Basin	Terrene	Standing water (10% of WL), GW within 30cm, Saturated within 20cm	**Herbs**: *Onoclea sensibilis, Glyceria canadensis, Typha latifolia, Aralia nudicaulis, Osmunda cinnamonea, Maianthemum canadense* **Shrubs**: *Abies balsamea, Thuja occidentalis, Acer rubrum* **Trees**: *Thuja occidentalis, Acer rubrum, Betula papyrifera, Acer saccharum*
7	Softwood Treed Swamp/Marsh	31.90 (Zone delineated, WL continues outside the Study Area)	Isolated Outflow via watercourse outside the Study Area	Flat Basin	Terrene	Standing water (10% of WL), wetland saturated within 20cm, groundwater within 30cm	**Herbs**: *Osmunda cinnamonea, Maianthemum canadense, Maianthemum trifolium, Eriophorum virginicum, Carex stricta* **Shrubs**: *Ilex mucronate, Kalmia angustifolia Abies balsamea, Picea mariana* **Trees**: *Thuja occidentalis, Picea mariana, Larix laricina*

Wetland	Wetland Type	Wetland Size (ha)	Water Flow Path	Landform	Landscape Position	Hydrological Conditions	Dominant Vegetation
8	Softwood Treed Swamp	0.30 (Zone delineated, WL continues outside the Study Area)	Isolated	Basin	Terrene	Standing water (5% of WL), wetland saturated within 20cm, groundwater within 30cm.	**Herbs**: *Osmunda claytoniana, Onoclea sensibilis, Impatiens canadensis* **Shrubs**: *Picea mariana* **Trees**: *Thuja occidentalis*
9	Hardwood Treed Shrub Swamp	6.89 (Zone delineated, WL continues outside the Study Area)	Isolated	Basin	Terrene	Standing water (25% of WL), wetland saturated within 20cm, groundwater within 30cm.	**Herbs**: *Typha latifolia, Glyceria canadensis, Impatiens carpensis* **Shrubs**: *Alnus incana, Acer rubrum, Abies balsamea* **Trees**: *Acer rubrum, Betula papyrifera*
10	Mixedwood Treed Swamp	3.16 (Zone delineated, WL continues outside the Study Area)	Throughflow via WC (WC outside the PA)	Flat Basin	Lotic – Floodplain	Wetland saturated within 20cm	**Herbs**: *Athyrium filix-femina, Rubus pubescens, Glyceria melicaria, oclemena nemoralis* **Shrubs**: *Alnus incana, Acer rubrum, Acer pensylvanica, Abies balsamea* **Trees**: *Acer rubrum, Acer saccharum, Thuja occidentalis, Betula alleghaniensis*

Construction of access roads is proposed to alter a portion of one wetland (WL7) and extend in close proximity (~4.5 m) to additional wetlands (WL3 and WL6). The closest proposed turbine to wetland habitat is associated with WTG4 which is 53 m from WL10. Discussion of setbacks from infrastructure and wetland habitat is provided in Section 3.4, and further discussed and evaluated separately in Section 14.

Table 64 provides the proximity of proposed infrastructure to wetlands across the Study Area.

Table 64: Wetland Proximity to Infrastructure

Wetland ID	Approximate Distance to Closest Infrastructure	Infrastructure Type
WL1	237 m	WTG2
WL2	277 m	WTG1
WL3	4.5 m	Access Road
WL4	431 m	Substation
WL5	160 m	Access Road
WL6	4.5 m	Access Road
WL7	Altered	Access Road
WL8	360 m	Access Road
WL9	289 m	Access Road
WL10	53 m	WTG4

5.6.1.1 **Wetland Functional Analysis**

Due to the proximity of the identified wetlands to proposed Project infrastructure, wetland functional assessments were completed within Wetlands 1, 3, 5, 6, 7 and 10.

As outlined in Section 4.1.8.3, the WESP process calculates the overall scores for the seven wetland functional groups including a functional and benefit rating for five of the groups (Hydrologic, Water Purification, Aquatic Support, Aquatic Habitat and Terrestrial Habitat) and the benefit rating for the Wetland Condition and Wetland Risk groups. The WESP calculator utilized the responses from desktop, field and stressor questions (included in the WESP calculator) to determine whether the functions and benefits for each group are Low, Moderate or High in comparison to baseline wetland scores in New Brunswick. In order to complete an effective quantitative comparison of WESP results for wetlands within the Study Area, scores were weighted numerically as follows:

LOW: 1 point
MODERATE: 2 points
HIGH: 3 Points

Table 1 (Appendix J), provides the overall numerically weighted scores for the evaluation of the six wetlands completed across the Study Area. It should be noted that function scores are not provided for the Wetland Condition and Wetland Risk Functional groups, as the WESP calculator only considers these as benefits. Of the six wetlands evaluated, the average accumulated functional score per wetland was 2.2 (Moderate). Based on the same analysis, the average accumulated benefit score per wetland was 1.7 (Moderate). WESP guidance states that the most valuable wetlands are those that possess high functions and benefits. Benefits relate to the perceived worth of the wetland function to societal needs (Adamus *et al.*, 2016). Of the six wetlands evaluated, none of the wetlands evaluated scored in the HIGH accumulated range for both functions and benefits (see Table 1, Appendix J).

Additional analysis was completed on the individual wetland functional groups being provided by the wetlands present within the Study Area. The following sections provide results of this analysis on a per wetland functional group basis.

5.6.1.2 **WESP Grouped Wetland Function Results**

Hydrologic Group

The hydrological wetland service group evaluates the effectiveness of a wetland to store or delay the downslope movement of surface water. Wetlands that have the highest functions within this group include those that do not have surface water outlets, and instead are isolated from flowing surface water. The model does not account for wetland size, and in turn, does not account for larger wetlands having the ability to store more water than smaller wetlands.

All the wetlands scored High in function largely because the portion of wetlands within the Study Area either exist as isolated wetlands across the landscape which allow them to store and delay water movement or are associated with a stream but not contiguous with its surface water flow. However, it should be noted that some of the wetlands are small, which reduces the storage capacity in comparison to other wetlands (although this isn’t considered by WESP).

All wetlands scored Low in benefit, largely because of their low position in the watershed, the general flat topography of the area, and the small risk of flooding in the region. Since the environmental risks are limited, the benefits provided by the hydrological wetland service are not compensating for any social needs.

Water Purification Group

This wetland functional group is compiled from four different functions: Sediment Retention and Stabilization; Phosphorus Retention; Nitrate Removal; and Carbon Sequestration. The main function of this group is to evaluate each wetland’s potential to intercept, retain, and filter sediments, particulates, and organic matter. Similar to the hydrologic group, the wetlands that have the highest functions in this regard include those that do not have a surface water outlet, and instead are isolated from flowing surface water.

All wetlands scored High in function for the Water Purification Group, demonstrating they are effective at intercepting, retaining, and filtering suspended sediments, particulates, and organic matter due to their lack of outlet and low topographic gradient. As well, because of their important vegetation cover, the majority of wetlands (all, except WL3) scored High in carbon sequestration function, since the vegetation (tree, shrubs, herbs, moss…) acts as a carbon sink (see Table 2, Appendix J).

All wetlands scored Low in benefit, largely because of their isolation to urban areas and roads, which limits the social benefits of water purification.

Aquatic Support Group
The aquatic support group comprises four individual functions: Stream Flow Support; Aquatic Invertebrate Habitat; Organic nutrient export; and Water cooling. The main function of this group is to determine the wetland's ability to support ecological stream functions that promote habitat health. Therefore, wetlands lying adjacent to or containing flowing water score higher than those that do not (i.e. isolated wetlands). In addition, headwater wetlands are crucial for supporting stream flow during the dry season by contributing to water flow via groundwater input and storage capacity.

All wetlands scored in the Low-Moderate range for function and benefits because of their restricted association with other flowing surface water systems and limited presence of ponded water. Wetlands 1, 7 and 10 are associated with the Riviere du Nord outside of the Study Area, which explains their Moderate score for Functions. As well, Wetland 7 was the only wetland with a shallow organic soil (all other had loamy soil), which contributed to the Organic nutrient export function (see Table 2, Appendix J). Wetland 3 was the only wetland were small areas of ponded water were observed, hence its Moderate score for benefits.

Aquatic Habitat Group
The aquatic habitat group comprises of five different functions: Anadromous Fish Habitat; Resident Fish Habitat; Amphibian and Turtle Habitat; Waterbird Feeding Habitat; and Waterbird Nesting Habitat. Wetlands that have the highest functions within this group include those that are adjacent to or contain flowing water.

Most of the wetlands scored Low for function and benefits due to their lack of surface water features and fish habitat. None of the wetlands comprised of fish habitat. Only Wetland 3 scored Moderate for function and High for benefit due to its presence of ponded water and provision of other aquatic habitats support such as amphibian, turtle and waterfowl habitat.

Terrestrial Habitat Group
The terrestrial habitat group comprises of three different functions: Songbird, Raptor, and Mammal Habitat; Native Plant Habitat; and Pollinator Habitat. The main function of the collective group is to evaluate the wetland's ability to support healthy habitat for birds, mammals, and native plants.

For all wetlands within the Study Area, scores fall within the Moderate or High categories for function and benefit. In general, wetlands within the Study Area provide ideal habitat, which includes downed wood, prevalent ground cover, varied microtopography, tree and shrub cover in and around the wetlands, and naturally vegetated buffer zones. The wetlands have a variety of woody heights and diverse forms, which allows for nesting habitat, perches, and feeding grounds. In addition, the wetlands provide a diverse range of herbaceous vegetation. As such, wetlands within the Study Area generally provide habitat for songbirds, mammals, pollinators and potentially rare plants. *Pannaria conoplea* (S3S4) was observed in Wetland 3, hence its High score on both function and benefit. Wetlands 1 and 6 also had high scores for both function and benefit, because of rich potential habitat for pollinators.

Wetland Condition
Wetland Condition refers to the integrity or health of a wetland as defined by its vegetative composition and richness of native species. Scores are derived from the similarity between the wetland being evaluated and reference wetlands of the same type and landscape setting (Adamus, 1996).

Most wetlands scored High or Moderate for Wetland Condition which indicates that currently, the wetlands indicate healthy vegetative communities. For the wetlands that scored High, this is due to the extensive ground irregularities (ground irregularities provide microhabitats for plant species allowing plant species with different habitat requirements to establish themselves within a wetland; Wetlands 3 and 6), and the absence of extensive bare ground (Wetland 7). None of the wetlands were recorded to have invasive vascular plant species.

Wetland Risk
Wetland Risk takes sensitivity and stressors into account by averaging the two. Sensitivity is the lack of intrinsic resistance and resilience of the wetland to human or naturally caused stress (Niemi *et al.*, 1990).

The model uses five metrics to measure sensitivity: abiotic resistance, biotic resistance, site fertility, availability of colonizers, and growth rate. Stress relates to the degree to which the wetland is or has recently been altered by humans in a way that degrades its ecological condition. The model applies four stress groups: hydrologic stress, water quality stress, fragmentation stress, and general disturbance stress.

Wetlands that are highly resilient may have lower risk scores despite their exposure to multiple stressors. Additionally, wetlands exposed to fewer threats, but with low resilience may have high risk scores. Wetland resilience is tied to multiple factors, such as size, proximity to natural land cover, and presence of invasive species.

Most wetlands analyzed had Moderate risk scores. Wetland 7 presented High wetland risk scores because of logging activities and compaction disturbance in the wetland. It should be noted that all wetlands scored High for the sensitivity aspect. This is largely due to the fact that these wetlands are treed swamps, making them more vulnerable; drought consequences are greater in swamps where tree canopy cover is slower to recover after disturbance. Despite this, stressors were Low for all wetlands, except for Wetlands 7.

5.6.2 Fish and Fish Habitat

The Project is located within the Chaleur Recreational Fishery Area (NBERD, 2019b). Recreational fish species that may be present in waterbodies and watercourses in this Fishery Area may include Atlantic Salmon (*Salmo salar*), Arctic Char (*Salvelinus alpinus*), Brook Trout (*Salvelinus fontinalis*), Brown Trout (*Salmo trutta*), and Rainbow Trout (*Oncorhynchus mykiss*). Non-sport fish species that may be present in this Fishery Area include Burbot (*Lota lota*), American eel (*Anguilla rostrata*), Gaspereau (*Alosa pseudoharengus*), Rainbow smelt (*Osmerus mordax*), Shad (*Alosa spp.*), Striped bass (*Morone saxatilis*), Whitefish (*Coregonus clupeaformis*), White perch (*Morone americana*), and Yellow perch (*Perca flavescens*).

The ACCDC report states that one Atlantic salmon (SOCI; S2S3) was observed 12 km from the Study Area, one Striped bass (SARA; NBSARA Endangered; COSEWIC Special Concern; S3) was observed) 30.9 ±10 km from the Study Area. No other SAR or SOCI fish species have been historically observed and recorded within 50 km of the Study Area.

Field surveys confirmed the presence of one watercourse within the Study Area (Riviere Du Nord). The following section provides details about the characteristics within this watercourse.

5.6.2.1 Watercourse Characteristics

Watercourse 1 (Rivière du Nord):
Characteristics of Rivière du Nord were obtained by MEL biologists in August 2018 and June 2019 as part of the EIA baseline surveys. The closest WTG to Rivière due Nord is WTG4, located approximately 94m northwest of the watercourse. Representative photos of the watercourse are provided in Appendix K. Watercourse 1 (Rivière du Nord) is a mapped watercourse and exists as a 1st order stream with bank full widths ranging from 1.5 m – 2.0 m wide with substrate consisting of primarily sand with gravel, cobble and small boulders. At the time of the surveys, water depths ranged from 5 cm – 20 cm with slow moving to stagnant water. There was one raised culvert observed, resulting in a barrier for fish passage during the time of the survey. However, during high flow, fish passage is likely possible. As the stream drains northeast (beyond the Study Area boundary), Rivière du Nord becomes a much larger system (a 3rd order stream) and flows into the Caraquet Bay.

Wetland field surveys confirmed that although WC1 drains through adjacent riparian wetland, there are no contiguous surface water connections between the stream and on-site wetland habitat. As such, interaction between proposed Project infrastructure and potential fish habitat is not expected.

Table 65 (below) describes the physical characteristic of WC1 where it extends through the Study Area.

Table 65. Physical Characteristics of Rivière du Nord within the Study Area

Reference UTMs (Assessment Area)		Section Length (m)	Velocity	Gradient	Wetted Width (cm)
upstream	downstream				
333902mE 5293624mN	334288mE 5293919mN	~600 m	Slow to stagnant during dry season; moderate flow during spring	5%	80 - 100
Bankfull Width (cm)	**Depth Range (cm)**	**Bank Height (cm)**	**Substrate (%)**	**Habitat Type (%)**	**Habitat Type***
150 - 200	5 - 20	20	Sa=75, Co=10, Gr=10, Sb=5	Flat=60, Pool=20, Run=20	Type IV

SB=Small Boulder, Ru=Rubble, Co=Cobble, Pe=Pebble, Gr=Gravel, Sa=Sand, Si/Mud=Silt/Mu

*Reference Sooley, Luiker, & Barnes, 1998

5.6.2.2 **Fish Habitat**

The portion of Rivière du Nord closest to the Study Area may provide limited habitat for some fish species as described below.

American Eel are anadromous fish which occupy both fresh water and marine environments depending on their lifecycle. In freshwater streams, they are often in areas with muddy and rocky with aquatic vegetation for cover. Based on the substrate present (i.e. sand and gravel) within the Study Area, American Eel potential is low.

Striped Bass generally are anadromous fish where they spawn in fresh water and later migrate to the coastal waters at maturity (Scott and Crossman, 1973). In New Brunswick, however, Striped Bass are primarily restricted to freshwater systems such as the Richibucto River and Miramichi River. Fish eggs are semibuoyant and it is crucial eggs are laid in waterways with a strong enough current to keep the eggs suspended in the water column and oxygenated. During the time of visit, the Rivière du Nord was very shallow and slow moving/stagnant in some areas, thus did not proving suitable habitat for Striped Bass at that time.

Rivière du Nord was evaluated for habitat characterizations within the Study Area based on parameters identified in the *Standard Methods Guide for Freshwater Fish and Fish Habitat Surveys in Newfoundland and Labrador* (NL Guide) (Sooley, Luiker, & Barnes, 1998). As described in the guide, water quality and quantity tolerances of the Atlantic Salmon were used as an index of the relative health of the river for fish populations. Following this guidance document, the Atlantic Salmon were used as the indicator species for several reasons;

- Salmon inhabit areas targeted for the assessments (riffles and pool habitat);
- Salmon are sensitive to acidification;
- Salmon are a predatory species at the top of the food chain; and
- Data exists that defines preferred habitat conditions for this species.

During the assessments, the section of Rivière du Nord closest to the Study Area was determined to have a Type IV salmon habitat which provides the following features:

- poor juvenile salmonid rearing habitat with little to no spawning capability,
- provides shelter and feeding habitat for larger, older salmonid (especially Brook Trout),
- water flows usually are sluggish and varies in depth,
- substrate is soft sediment or sand, occasionally large boulders or bedrock and,
- general habitat types consist of flats, pools and glides.

5.7 **Species at Risk and Species of Conservation Interest**

A SAR is a species that is legally protected under the federal *Species at Risk Act* (SARA) or the provincial *New Brunswick Species at Risk Act* (NBSARA), or listed by the Committee on the Status of

Endangered Wildlife in Canada (COSEWIC), while a SOCI is a species that is classified as S1 to S3 by the ACCDC.

A review of ACCDC confirms the presence of several Priority Species in proximity to the Study Area (Figure 12, Appendix A). The ACCDC identified the following records of SAR, SOCI and Special Areas within 5km of the Study Area including:

- 7 records of 2 vascular flora,
- no records of nonvascular flora,
- 139 records of 31 vertebrate,
- 5 records of 2 invertebrates,
- 1 managed area,
- 2 biologically significant sites, and
- no location sensitive species.

Of these identified records, six SAR, of which one was observed during field surveys, were identified within 5km of Study Area:

- Barn Swallow (NBSARA Threatened, SARA Threatened, COSEWIC Threatened) – This species, along with its potential breeding habitat was not observed during the EA bird field study.
- Bank Swallow (COSEWIC Threatened) – This species was observed during field surveys. It is unlikely that Bank Swallows are nesting within the Study Area, however, they may be using the open field habitats for feeding.
- Bobolink (NBSARA Threatened, SARA Threatened, COSEWIC Threatened) – This species, along with its potential breeding habitat was identified during the EA bird field study.
- Canada Warbler (NBSARA Threatened, SARA Threatened, COSEWIC Threatened) –This species was not observed, but its potential breeding habitat was identified during the EA bird field study.
- Eastern Meadowlark (NBSARA Threatened, SARA Threatened, COSEWIC Threatened) – This species was not observed, but its potential breeding habitat was identified during the EA bird field study.
- Wood Thrush (NBSARA Threatened, SARA Threatened, COSEWIC Threatened) – This species was not observed, but its potential breeding habitat was identified during the EA bird field study.

The managed area identified by ACCDC within 5 km of the Study Area is the Pokeshaw Provincial Park. The two biologically significant sites include Pokeshaw Island and Cliffs ESA and Pokeshaw Rock IBA.

A summary of federally and provincially protected species identified within 20 km of the Study Area is provided in Appendix B. For avifaunal Priority Species, breeding status as documented in the Maritime Breeding Bird Atlas square summary (square 20LT39) is also included in Appendix B. If the species was observed during atlas surveys, with no breeding evidence noted, this is indicated in Appendix B as well.

5.7.1 Vascular Plants

During the vascular plant surveys in June and August 2018, one priority vascular plant species (Menzies' Rattlesnake-plaintain [*Goodyera oblongifolia*, S2]) was observed in the western extent of the Study Area.

According to the ACCDC report, two Priority Species were historically observed: Seabeach Dock (*Rumex pallidus;* S2S3) and Canada Burnet (*Sanguisorba canadensis*; S3) were documented within 5 km of the Study Area. No previously documented rare vascular plants were documented within the Study Area. See below for the description of Menzies' Rattlesnake-plaintain (*Goodyera oblongifolia*).

Menzies' Rattlesnake-plaintain (*Goodyera oblongifolia*)
Goodyera oblongifolia is a member of the Orchidaceae family with distinct oblong leaves, often with a faint white to pale midrib often growing in mezic coniferous or mixedwood forests (Hinds H. R., 2000). This species is one of the four species within this genus found in North America and can be distinguished from the other species primarily by the lack of the prominent branched white venation observed on the basal leaves in the other three species (Hinds H. R., 2000). In New Brunswick, this species is listed by ACCDC as Imperiled (S2). During the surveys, this species was initially observed in its vegetative state in June and then revisited in August 2018, when in flower, to confirm the species. Six healthy individuals were observed in the south west of the Study Area in upland, mixedwood forest with a sparse herbaceous layer blanketed by the leaf litter.

5.7.2 Lichens

During the vascular plant surveys in June and August 2018, one priority lichen species was observed incidentally, Mealy-rimmed Shingle Lichen (*Pannaria conoplea*). According to the ACCDC report, no SAR/SOCI lichens were recorded historically in the area. See below for the description of *Pannaria conoplea.*

Pannaria conoplea
Pannaria conoplea is a greyish-blue foliose to squamulose cyanolichen often found growing on hardwoods within swamps or in close proximity to lakes and/or streams (Nash, Ryan, Grise, & Bungartz, 2002). This species can superficially resemble similar rare *Fuscopannaria* species and can be distinguished from *Pannaria* by the lack of the grey-blue colour and the lack of Pannarin, a lichen metabolite, which can be detected by the use of the chemical Para-phenylenediamine (Pd) (Nash, Ryan, Grise, & Bungartz, 2002). *Pannaria conoplea* is listed as Vulnerable-Apparently Secure (S3S4) in New Brunswick. Within the Study Area, one location of *P. conoplea* was observed in a mixed-wood swamp on a mature White Cedar. Four thalli were observed.

5.7.3 Mammals

Mammalian species were inventoried within the Study Area through incidental observations by MEL biologists during surveys in 2018 and 2019. The area was assessed for potential SAR and SOCI mammal species and their habitats. A review of the ACCDC report resulted in the following historical observations of mammals within a 100 km radius: Woodland Caribou (Atlantic-Gaspé population), Harbour Porpoise (Northwest Atlantic population), Atlantic Walrus, Long-finned Pilot Whale, Canadian Lynx, Cougar (Eastern population), Maritime Shrew, and Southern Bog Lemming. A number of these species are not applicable to the Study Area due to their provincial extirpation or habitat (i.e. marine). Below are habitat descriptions for the species most likely to utilize habitat within the Study Area.

Canadian Lynx – the Canadian Lynx (*Lynx canadensis*) is listed as Endangered (NBSARA) and S3 (ACCDC). This medium-size cat chooses habitat containing dense vegetation and shrub forests, where its prey – snowshoe hare – is plentiful. Within New Brunswick, Canadian Lynx may be more prevalent in the north, although the province is close to the southern limit of the animal's distribution (NBERD, 2019a).

Cougar (Eastern population) – the Cougar (Eastern pop.; *Puma concolor*) is listed as Endangered (NBSARA). Cougars have not had a confirmed siting in New Brunswick since 1938 (CBC, 2018). Their preferred habitat includes dense hardwood forests in undisturbed tracts of land (Nature Canada, 2018)

Maritime Shrew – the Maritime Shrew (*Sorex maritimensis*) can be found in wetlands in heavily forested areas; this species is thought to be able to adapt to disturbances and anthropogenic effects (Mcalpine, Vanderwolf, & Huynh, 2012).

Southern Bog Lemming – this species (*Synaptomys cooperii*) is listed as S3S4 (ACCDC). It can be found in grassy openings in forests, among mossy boulder fields in spruce forests, and in bogs, clear-cuts, and pastureland (Ford and Laerm, 2007).

Although not historically observed in the ACCDC report, suitable habitat is present within the Study Area for the following mammals.

Northern Bog Lemming – The Northern Bog Lemming is ranked S1 by ACCDC in New Brunswick. This mammal usually lives in moist, wet meadows or bogs especially where they occur with spruce-fir forests (Maine Department of Inland Fisheries & Wildlife, 2003).

Rock Vole – The ACCDC ranks the Rock Vole as S2? in New Brunswick. Habitat for Rock Voles include rocks or talus slopes, they occur in mossy areas near flowing water in coniferous forest, spruce clear-cuts (mainly recent cuts), grassy balds near forest and sterile-looking rocky road fills (Lansing, 2005).

No opportunistic observations of SAR/SOCI mammals were observed during any other biophysical surveys throughout the entirety of the Study Area. Some habitat preferences for all of these species are present within the Study Area, however there were no observations of these species during field surveys.

5.7.4 Herpetofauna

Herpetofauna species were inventoried within the Study Area through incidental observations by MEL biologists during surveys in 2018 and 2019, specifically during wetland and watercourse evaluations. The area was assessed for potential Wood Turtles, Snapping Turtles, and their respective habitats. Neither of these species were identified as being historically observed within 5 km of the Study Area. Wood Turtle and Snapping Turtle are described below.

Wood Turtle

Wood Turtles are listed Threatened under SARA, COSEWIC and NBSARA. The species live along permanent streams but may roam, during summer, overland and can be found in a variety of terrestrial habitat. Wood Turtle nest on sand or gravel-sand beaches and banks. This species prefers clear rivers, streams or creeks with moderate current and sandy or gravelly substrate. They overwinter in numerous microhabitat types, which include burrowing in mud, under overhanging bank or in the bottoms of stream pools (Environment Canada, 2016d).

Snapping Turtle

Snapping Turtles are listed as Special Concern under the NBSARA, SARA and COSEWIC. Snapping Turtles use a variety of habitats, however, the preferred habitat is slow-moving water with a soft mud bottom and dense aquatic vegetation. They overwinter in aquatic environments which will not freeze to the bottom (Environment Canada, 2016a).

No opportunistic observations of Wood Turtles, Snapping Turtles or any other SAR or SOCI herpetofauna were observed during any biophysical surveys throughout the entirety of the Study Area.

Riviere du Nord runs parallel to the southern Study Area border and was assessed for aquatic wildlife habitat. It was found to consist of deeper pocket waters, slow-moving sections, overhanging vegetation, and vegetated banks, all of which could provide habitat for both Wood and Snapping Turtles. The distance of the watercourse from proposed turbine locations ranges from approximately 90 to 1,000 m. Wood Turtles have been known to travel overland, at a distance of 300-350 m away from watercourses (COSEWIC, 2007b). Therefore, should it utilize Riviere du Nord, there is potential for this species to use habitat within the Study Area

5.7.5 Avian

A review of the ACCDC report resulted in 144 observations of 31 avian species observed within 5 km of the Study Area. None of these observations were located within the Study Area. Of these species, those that have the potential to be present within the Study Area are listed in the Priority Species list provided in Appendix B.

For some birds, the season in which it is observed determines its rarity. The time of year in which the species was observed in conjunction with its breeding bird status qualifiers are used to determine whether a species is a Priority Species. For instance, Pine Grosbeak has an SRank of S2B, S4S5N, S4S5M in New Brunswick. If observed during breeding season, this species would be considered a Priority Species. Outside of breeding season, this species would not be considered a Priority Species.

Eighteen (18) avian Priority Species, comprised of seven SAR and eleven SOCI (see Table 66) were identified within or surrounding the Study Area during the field surveys or incidentally. The following birds were observed within the Study Area: Bald Eagle (n=2), Bobolink (n=1), Eastern Wood-Pewee (n=5), Evening Grosbeak (n=5), Killdeer (n=6), Olive-sided Flycatcher (n=2), Pine Siskin (n=12), Rusty Blackbird (n=1), Sandhill Crane (n=3), Spotted Sandpiper (n=1), Turkey Vulture (n=1), and Wilson's Snipe (n=3).

Table 66. SAR and SOCI Birds observed during dedicated survey periods

Common Name	Scientific Name	SARA	COSEWIC	NB SARA	ACCDC S-Rank	# Obs.	Observation Location
Bald Eagle	*Haliaeetus leucocephalus*			E	S4	36	WC1, WC4, incidentally near T8
Bank Swallow	*Riparia riparia*		T		S2S3B, S2S3M	5	WC1
Black Guillemot	*Cepphus grille*				S3	170	WC1
Black Scoter	*Melanitta nigra*				S3M, S1S2N	590	WC1
Bobolink	*Dolichonyx oryzivorus*	T	T	T	S3, S3M	1	PC1
Eastern Wood-Peewee	*Contopus virens*	SC	SC	SC	S4B, S4M	5	PC3, PC7, PC10, PC21, WC3,
Evening Grosbeak	*Coccothraustes vespertinus*	SC			S3B, S3S4N, SUM	5	PC3
Glaucous Gull	*Larus hyperboreus*				S2N, S2M	16	WC1
Killdeer	*Charadrius vociferus*				S3B, S3M	6	PC7, PC9, PC11, PC14, WC3
Olive-sided Flycatcher	*Contupus cooperi*			T	S3B, S3M	2	PC10, PC12
Peregrine Falcon	*Falco peregrinus*			E	S1B, S3M	1	WC5b
Pine Siskin	*Spinus pinus*				S3	12	PC3, WC3, WC4
Razorbill	*Alca torda*				S2B, S3N, S3M	83	WC1
Rusty Blackbird	*Euphagus carolinus*	SC	SC	SC	S3B, S3M	1	PC6
Sandhill Crane	*Grus canadensis*				S1B, S1M	3	PC11, PC6
Spotted Sandpiper	*Actitis macularius*				S3S4B, S5M	1	PC15
Turkey Vulture	*Cathartes aura*				S3B, S3M	1	T19
Wilson's Snipe	*Gallinago delicata*				S3S4B, S5M	3	PC16, PC17, PC18

The potential for these species to be impacted by this Project is evaluated below. Potential effects of the Project on these species, as well as proposed mitigation measures, are discussed in more detail in Section 16.2.1.

Bald Eagle – 36 Bald Eagles were observed during spring and fall migration surveys. One was observed along Transect 8 (T8) (in the Study Area), one was observed at Watch Count 4 (WC4) (in the Study

Area), with the remainder observed at Watch Count 1 (WC1) (outside of the Study Area). The majority of eagles (n=25) were observed on September 7 roosting near WC1. Bald Eagles build their nests in tall trees, near water, with good vantages. They will generally return to their nest year after year (National Eagle Center, 2018). Bald Eagles use tall, mature coniferous or deciduous trees as perches to overlook open expanses (Cornell University, 2017). Eagles were not observed in or near the Study Area during breeding season, nor were any nests observed; ideal Bald Eagle nesting habitat, described above, were not observed during field surveys. It may be that Bald Eagles use the local region, but more so outside of the Study Area, for foraging, roosting and movement, for which, habitat was observed.

<u>Bank Swallow</u> – Five Bank Swallows were observed at Watch Count 1(WC1) during breeding season. This species primarily nests in artificial structures such as barns, houses, bridges and other buildings; it uses open habitats for foraging (COSEWIC, 2013). As there are no structures in the Study Area, it is unlikely that Bank Swallows are nesting there, however, they may be using the open field habitats for feeding.

<u>Black Guillemot</u> – 170 Black Guillemot were observed at WC1 during spring migration surveys. This species was seen primarily rafting near Pokeshaw Rock. Black Guillemot have been observed at the colony between April and July of previous years, it is likely they use the rock as a breeding location (Bird Studies Canada, 2019e; Audubon, 2019). There is no available habitat for this species within the Study Area.

<u>Black Scoter</u> – 590 individual Black Scoter were observed during spring migration surveys at WC1. This species was observed in flocks ranging from 10 to 300, they were observed flying along the coastline and rafting by the shore. The seasonal bar chart presented by Bird Studies Canada for the Pokeshaw Rock IBA showed Black Scoter present during the first half of May, which is consistent with 2018 observations that spanned from April 30 to May 26. This bar chart is automatically updated when observations are submitted to eBird. Black Scoters breed in low-lying wet tundra and treeless terrain (Audubon, 2019). It is unlikely that this species is breeding in the vicinity of the Study Area.

<u>Bobolink</u> – One Bobolink was observed at Point Count 1 (PC1) on May 19, during spring migration surveys. It was observed flying across the paved road east of the observer. Bobolink nests on the ground, usually on wet soil at the base of large nonwoody plants in pastures, fields, and other grassy areas (Cornell University, 2017). Bobolink habitat is present within the Study Area in the form of small areas of agricultural land. Although proposed turbines are not positioned in this habitat, potential effects as a result of PBRWP is discussed further in Section 16.2.5.

<u>Canada Warbler</u> – This species was not observed during any surveys; however, its breeding habitat is present within the Study Area. Breeding habitat for the Canada Warbler consists of a variety of habitat, but commonly comprises of moist forests with a dense deciduous shrub layer. Nests are built on or near the ground on raised hummocks, within root masses, rotting tree stumps, clumps of grass and rock cavities (Environment Canada, 2016a). Potential low-quality breeding habitat is present within Wetland 9 due to the presence of a viable shrub layer in this swamp. However, this location is not in close proximity to proposed turbines, therefore potential impacts to this species is not expected.

<u>Eastern Wood-Pewee</u> – Five Eastern Wood-Pewee were observed throughout the Study Area. One was observed during spring migration surveys at PC10; two were observed during breeding surveys at PC3 and PC7 (incidental); one was observed during fall migration surveys at WC3; and one was observed during breeding surveys at PC21. Breeding habitat for the Eastern Wood-Pewee includes mature and intermediate-age deciduous and mixed forests, with an open understory. They are often associated with edge habitats and forest clearings (COSEWIC, 2012a). Potential suitable nesting habitat is found at various locations within the Study Area. A discussion of potential impacts as a result of the Project to Eastern Wood-Pewee is provided in Section 16.2.2.

<u>Evening Grosbeak</u> – Five Evening Grosbeaks were observed during fall migration surveys at PC3. Breeding habitat for this species consists of open, mature mixed wood forest, where fir species or White Spruce are dominant (COSEWIC, 2016a). The Evening Grosbeak often builds nests high in trees; nests are typically 10-15 cm in diameter (Cornell University, 2017). Breeding habitat is present within the Study Area.

<u>Glaucous Gull</u> – 16 Glaucous Gulls were observed during spring migration surveys at WC1. These observations were concentrated around the shoreline, near Pokeshaw Rock. This species breeds in colonies or pairs on cliff tops, flat rocky ground, and rocky outcrops (Audubon, 2019). Habitat is not present for this species within the Study Area.

<u>Killdeer</u> – Six Killdeer were observed during spring migration surveys throughout the Study Area. One individual was observed each at PC7, PC9, and PC11; two individuals were observed at PC14; and one was observed at WC3. Killdeer nest on the ground in open habitats, with little to no vegetation or gravelled areas. They prefer open habitats, including sandbars, mudflats, and open fields (Cornell University, 2017). Their preferred habitat is present within the Study Area in the form of open agricultural fields. Although proposed turbines are not positioned in this habitat, potential effects as a result of PBRWP is discussed further in Section 16.2.1.

<u>Olive-sided Flycatcher</u> – Two Olive-sided Flycatchers were observed during spring migration surveys; one each was observed at PC10 and PC12. This species forages in open areas containing tall trees or snags for perching on. Breeding habitats also require open to semi-open areas and the presence of tall snags or live trees for nests and signing (Environment Canada, 2016c). The point counts at which this species was observed both contain open areas and other appropriate habitat is present throughout the Study Area. Potential effects to the Olive-sided Flycatcher as a result of PBRWP is discussed further in Section 16.2.2.

<u>Peregrine Falcon</u> – One Peregrine Falcon was observed during fall migration surveys at WC5b. Although it was observed outside of the Study Area, it was seen flying towards WC4, which is within the Study Area. The Peregrine Falcon usually nests on cliff ledges or crevices near good foraging areas (COSEWIC, 2007a). While nesting habitat is not present for this species within the Study Area, it may use the open fields for foraging. Although proposed turbines are not positioned in nesting or foraging habitat, potential effects as a result of PBRWP is discussed further in Section 16.2.2.

Pine Siskin – Twelve Pine Siskin were observed in spring and fall migration surveys. Individuals birds were observed on multiple dates at PC3, PC4, PC14, WC3, and WC4. Preferred habitat for the Pine Siskin consists of coniferous or mixed wood forest with open canopies. They nest within conifer trees (Cornell University, 2017). Potential breeding habitat is scattered throughout the Study Area.

Razorbill – Eighty-three Razorbills were observed during spring migration surveys at WC1. This species was observed in flocks ranging from 4 individuals to 20; they were seen rafting around Pokeshaw Rock and on coastal cliffs. Razorbills have been observed at Pokeshaw Rock in the past between the end of April and July (Birds Studies Canada, 2019). This waterbird nests on sea cliffs (Audubon, 2019). Habitat is not present for this species in the Study Area.

Rusty Blackbird – A single Rusty Blackbird was observed at PC6 on May 6, during spring migration surveys. PC6 is located along Ridge Road and not within ideal habitat for this species. Rusty Blackbirds prefer coniferous-dominated forests adjacent to wetlands containing surface water, such as those with slow-moving streams, marshes, and beaver ponds (COSEWIC, 2018). These habitats do not exist within the Study Area.

Sandhill Crane – Three Sandhill Cranes were observed within the Study Area in 2018. One was observed at PC11 during spring migration surveys, the other two were observed at PC6 during breeding season. This species nests near marshes or bogs in open grasslands or forests. During migration, the Sandhill Crane can be found around open agricultural fields, prairie and river valleys (Audubon, 2019). Wetland 7 is classified as a softwood treed swamp/marsh and may contain suitable breeding habitat. Additionally, they may use the open agricultural fields within the Study Area, however, no proposed turbine locations are set to be constructed within either of these types of habitats.

Turkey Vulture – One Turkey Vulture was observed during breeding season along Transect 19 within the Study Area. Turkey Vulture breeding habitat consists of sheltered, hollowed logs, or crevices in cliffs, rocks, or caves (Audubon, 2019). No Turkey Vulture nests were observed during any surveys; nor were suitable habitats present at proposed turbine locations.

Wilson’s Snipe – Three Wilson’s Snipes were observed during breeding season at PC16, PC17, and PC18. Two of these individuals were observed in courtship flights. This species nests on the ground in tall grass, by building shallow depressions lined with plants and vegetation (Audubon, 2019). The Study Area provides potential breeding habitat for the Wilson’s Snipe in agricultural fields. Suitable habitat is not present at proposed turbine locations for this species.

5.7.6 Bats

No bat species were listed in the ACCDC report as being observed within the Study Area or within 5 km of it. The New Brunswick Museum Databases listed a historical siting of the Hoary Bat (*Lasiurus cinereus)* within Gloucester county, however, this siting was from August 1975 and was considered too long ago to pursue for more information. The Little Brown Myotis, Big Brown Bat, and Northern Long-eared Myotis were recorded at Bat Detectors within the Study Area. Their habitats are described below.

Little Brown Myotis – The Little Brown Myotis is ranked Endangered by COSEWIC, SARA, and NBSARA. It is ranked S1 by ACCDC in New Brunswick. This species requires hibernacula for overwintering. Summering habitat requires roosting areas, which may consist of treed and forested areas. This species forages wherever prey is readily available, this may be areas of closed canopy, riparian areas, and relatively open areas (Environment Canada, 2015).

Big Brown Bat – The Big Brown Bat is ranked S3 by ACCDC in New Brunswick. This species' habitat requirements are largely the same as the Little Brown Myotis.

Northern Long-eared Myotis – The Northern Long-eared Myotis is ranked Endangered by COSEWIC, SARA, and NBSARA. It is ranked S1 by ACCDC in New Brunswick. This species' habitat requirements are largely the same as the Little Brown Myotis.

No hibernacula or roosting habitat for bat species were identified in the Study Area, however, foraging habitat and the potential for roosting habitat is present throughout. See Table 60 for a comparison of bat habitat to the habitat present at the proposed wind turbine locations.

5.7.7 Invertebrates

Based on data provided by the ACCDC, the 100 km buffer around the Study Area contains 37 records of 37 invertebrate species. During field studies within the Study Area, no invertebrate SOCI or SAR were identified.

According to the ACCDC report, two SOCI invertebrates were identified within 5km from the Study Area: Aphrodite Fritillary (*Speyeria aphrodite*; ACCDC S3) and Northern Blue (*Plebejus idas;* ACCDC S3).

Aphrodite Fritillary – Aphrodite Fritillary's typical habitat is woody areas, open deciduous woods or coniferous woods and occasionally meadows (National Audubon Society, 1981). No Aphrodite Fritillarys were observed within the Study Area, although potential habitat is scattered throughout the Study Area.

Northern Blue – The typical habitat of Northern Blue is open sandy or rocky areas in spruce forests, along roads or near rocky outcrops (Michigan Natural Features Inventory, 2019). Potential habitat for this invertebrate is scattered throughout the Study Area, although no Northern Blue individuals were observed.

5.7.8 Fish

Based on data provided by the ACCDC, the 100 km buffer around the Study Area contains 341 records of three fish species. According to the ACCDC report, one SAR was identified, the American Eel was identified approximately 56 km from the Study Area. The remaining two fish species were the Atlantic Salmon (ACCDC S2S3; observed 12 km away) and Striped Bass (ACCDC S3; observed 31 km away). No priority fish species were identified by ACCDC to be within 5km of the Study Area.

American Eel – American eel can be found in fresh water, estuaries and coastal marine waters (DFO, 2016a). They are listed as Threatened by COSEWIC and NBSARA. Habitat for this species is present in Riviere du Nord. No American Eel were observed during field surveys.

Atlantic Salmon – Atlantic Salmon spawn in freshwater, generally in the same river where they were born. Juveniles spend one to eight years in fresh water before migrating to saltwater in the North Atlantic. After staying within the saltwater for one to four years, adult salmon will return to freshwater to spawn (COSEWIC, 2016b). Salmon rivers or streams are generally clear and cool, with gravel, cobble and boulder riverbeds (DFO, 2016b). Rivière du Nord provides limited potential passage, foraging, and rearing habitats. No Atlantic Salmon were observed during field surveys.

Striped Bass – This anadromous species spends part of its life in the ocean and returns to freshwater to spawn. Young Striped Bass remain in freshwater streams as they grow (U.S. Fish and Wildlife Services, 2019). Rivière du Nord provides limited potential passage, foraging, and rearing habitats. No Striped Bass were observed during field surveys.

No fish species of conversation interest (SOCI) or species at risk (SAR) were identified within the Study Area.

6 DESCRIPTION OF THE EXISTING SOCIO-ECONOMIC CONDITIONS

The Project is located 20 km west-southwest of Caraquet in Pokeshaw, Gloucester County, New Brunswick. Background on the area and population of the county and nearby centres are summarized below.

6.1 Population and Demographics

Pokeshaw is located in Gloucester County, New Brunswick, which is divided into ten parishes; the Project is located in the New Bandon Parish.

Gloucester County is the 4th most populous county in New Brunswick, and had a total census population of 78,444 in the 2016 census, which is 9.8% of the provincial population. From 2011 to 2016, the county population declined by 1.9% while the population for the province decreased by 0.5% (Statistics Canada, 2016). Statistics on the population and demographics of Gloucester County and New Brunswick are presented in Table 67 below.

Other population centres near the Study Area are Grand-Anse (population = 899), Saint-Léolin (population = 647), and Anse-Bleue (population=327).

Table 67: Population and Demographics for Gloucester County and New Brunswick.

	Gloucester County	New Brunswick
Population in 2016	78,444	747,101
Population in 2011	79,943	751,171
2011-2016 Population Change (%)	-1.9	-0.5
Total private dwellings (2016)	38,789	359,721
Median total income for households (2015)	$52,793	$59,347
Unemployment rate (2016)	15.3	11.2
Population density per square km (2016)	16.5	10.5
Land area (square km) (2016)	4,743.67	71,388.81
Median Age of the Population (2016)	51.1	45.7

The population of Gloucester County has a median age of 51.1 years, nearly 5.5 years older than that of the province as a whole, which has a median age of 45.7. The population by age cohort in Gloucester County is presented in Figure 8 (below).

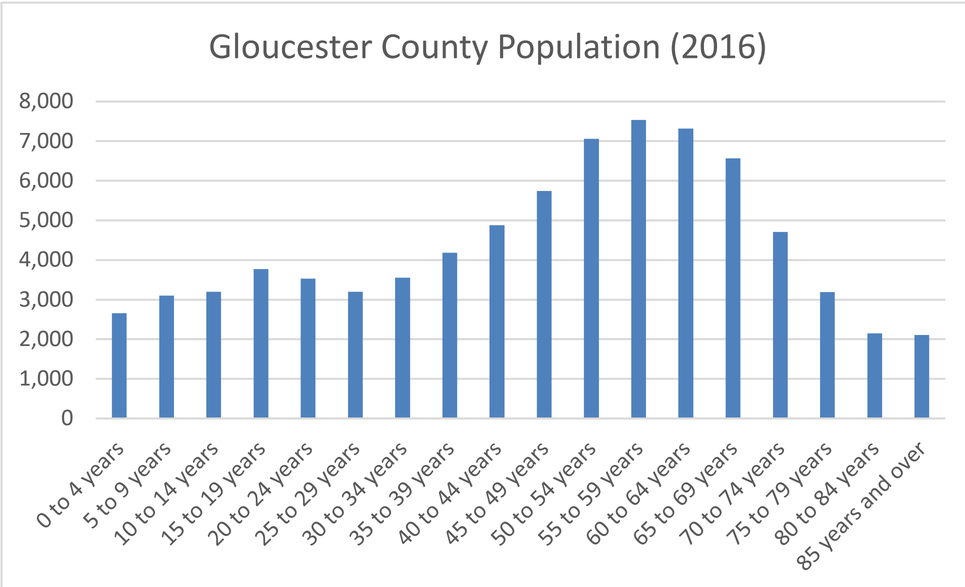

Figure 8. Population by Age Cohort, Gloucester County

Source: Statistics Canada 2016 Census of Population Community Profiles

Employment income accounted for 62.2% of income, while 24.9% came from Government Transfers.

6.2 Economy

Historically, Gloucester County has relied on resource-based industries to drive the economy; these included agriculture, fisheries, seafood processing, and forestry. Today the economy relies heavily on health care and social assistance, retail trade and manufacturing which make up 15%, 13%, and 14% respectively. The labour force by industry is outlined in Table 68, below.

Table 68. Labour Force by Industry, Gloucester County

Industry	Total	Percentage
Agriculture, forestry, fishing and hunting	2,795	8%
Mining, quarrying, and oil and gas extraction	940	3%
Utilities	230	1%
Construction	3,330	9%
Manufacturing	4,630	13%
Wholesale trade	705	2%
Retail trade	4,750	13%
Transportation and warehousing	1,045	3%
Information and cultural industries	355	1%
Finance and insurance	1,105	3%
Real estate and rental and leasing	205	1%
Professional, scientific and technical services	990	3%
Management of companies and enterprises	15	0%

Industry	Total	Percentage
Administrative and support, waste management and remediation services	870	2%
Educational services	2,350	6%
Health care and social assistance	5,390	15%
Arts, entertainment and recreation	420	1%
Accommodation and food services	2,250	6%
Other services (except public administration)	1,810	5%
Public administration	2,105	6%

Source: Statistics Canada 2016 National Household Survey

About 53% of the experienced labour force in Gloucester County is male. The participation rate (*i.e.,* the percentage of working age population in the labour force) in 2016 for the county was 54.9%, lower than the provincial average of 61.5%. The unemployment rate for Gloucester County in 2016 was 15.3%, higher than the provincial average of 11.2%.

Economic activity within 5km of the Project includes farming, fishing, residential services, tourism accommodations, among others. Historical land use within the Project Area and vicinity is dominated by agricultural activity and timber harvesting.

6.3 Tourism and Recreation

Tourism in New Brunswick is an important industry; however, its growth has been slow. Despite this, tourism visitor spending is still approximately $1.3B, making it the third largest export service sector in the province (NBTHC, 2018). The Acadian Peninsula, which Pokeshaw is part of, is a centre for culture and tourism due to its coastal nature (New Brunswick Multicultural Council, 2018).

There is a wide variety of recreational activities within Gloucester County, including fishing, hunting, hiking, camping, ATVing, boating, and many others. The Project Area is located within Zone 3 of the New Brunswick Federation of Snow Mobile Clubs. No marked ATV trails were observed within the Project Area.

The closest Provincial Park is Pokeshaw Provincial Park, located 2.5 km north of the Project Area. Hiking trails are located on the far eastern side of the Acadian Peninsula, near the Lameque Island or in the region around Bathurst.

6.4 Property Values

The concern that property values will be adversely affected by the Project is a concern raised at other wind power projects throughout North America. In 2009, the most comprehensive study known (at that time) was commissioned by the U.S. Department of Energy to determine if this impact does in fact exist. (Hoen et al., 2009). The study collected data on almost 7,500 sales of single-family homes situated within 10 miles of 24 existing wind facilities in nine different U.S. states (Hoen et al., 2009). In addition, the study reviewed a number of data sources and published material. Although the reviewed information addressed concerns about the possible impact of wind energy facilities on the property values of nearby homes, Hoen et al. found that "the available literature that has sought to quantify the impacts of wind projects on residential property values has a number of shortcomings". The list of shortcomings identified in that study (Hoen et al., 2009) are as follows:

1. Studies relied on surveys of homeowners or real estate professionals, rather than trying to quantify real price impacts based on market data;
2. Studies relied on simple statistical techniques that have limitations and that can be dramatically influenced by small numbers of sales transactions or survey respondents;
3. Studies used small datasets that are concentrated in only one wind project study area, making it difficult to reliably identify impacts that might apply in a variety of areas;
4. Many studies had no reported measurements of the statistical significance of their results;
5. Many studies have concentrated on an investigation of the existence of Area Stigma, and have ignored Scenic Vista and/or Nuisance Stigma;
6. Only a few studies included field visits to homes to determine wind turbine visibility and collect other important information about the home (e.g., the quality of the scenic vista); and,
7. Only two studies have been published in peer-reviewed academic journals.

Ultimately, the Hoen et al. study indicated that "none of the models uncovers conclusive evidence of the existence of any widespread property value impacts that might be present in communities surrounding wind energy facilities. Specifically, neither the view of the wind facilities nor the distance of the home to those facilities is found to have any consistent, measurable, and statistically significant effect on home sales prices. Although the analysis cannot dismiss the possibility that individual homes or small numbers of homes have been or could be negatively impacted, it finds that if these impacts do exist, they are either too small and/or too infrequent to result in any widespread, statistically observable impact." (Hoen et al., 2009)

Critiques have been developed in response to the Hoen report, notably by Wayne Gulden at Wind Farm Realities (2010) and Albert Wilson in 2010. These both outline concerns with methodology in the Hoen report including the conclusion that the analytical methods can not be shown to be reliable or accurate (Gulden 2010 and Wilson 2010). Another study completed by Gardner Appraisal Group Inc. in Texas, USA (Gardner 2009) states that "market data and common sense tell us property values are negatively impacted by the presence of wind turbines." (Gardner 2009). This study was completed for a conference in February 2009.

As a follow up to the Hoen et al. study, completed in 2009, a more recent study published in August 2013 was conducted to address these apparent gaps in data. This study, completed by Berkeley National Laboratory, involved the collection of data from 51,276 homes across 27 counties and nine states in the USA relating to 67 different wind facilities (Hoen et al, 2013). All homes included in the study were within a 10-mile radius of a wind power project and 1,198 homes were within a one-mile (1.6 km) radius of a wind power project.

The study results revealed no statistical evidence that residential property values near turbines were affected in the post-construction or post-announcement/pre-construction periods. Therefore, the authors conclude that if effects do exist, either the impacts are sporadic and impact only a small subset of homes or are relatively small and are present within the margin of error in the models (Hoen et al. 2013).

Further review of available literature did not find significant additional studies to aid in determining effect of wind projects on surrounding property values.

7 DESCRIPTION OF THE EXISTING ARCHAEOLOGICAL RESOURCES

Two phases of the archaeological resource impact assessment were completed for PBRWP. The first, was a historical assessment of the potential for archaeological resources to be present within the Study Area. The second, was the field reconnaissance program within the Study Area. The results summarized below are taken directly from the assessment completed by Archaeological Prospectors of Fredericton (Appendix L).

7.1 Background Research

New Brunswick Archeological Services indicated that there were two areas of potential archaeological resources within the Study Area as calculated by a Predictive Model (Figure 2, Archaeological Assessment Report, Appendix L). The Predictive Model indicated one location in lands comprising the proposed substation, and a second location along the shoreline of Rivière du Nord. Archaeological Prospectors of Fredericton initiated the HRIA including a review of background resources prior to the completion of a field survey at the locations discussed above.

A historic background study was conducted including a review of historical aerial photographs, topographical and surface geology maps, and the New Brunswick Register of Historic Places.
The review concluded that the substation location is ~150m beyond the marine high-water line at the end of the last glaciation, whereas the second location (adjacent to Rivière du Nord) is 1.7km outside of this zone.

7.2 Field Survey

The pedestrian field reconnaissance was conducted in September 2018 within the assessment areas identified by the Predictive Model as indicated on Figure 1 (Appendix L). The assessment was completed by Jason Jeandron of Archaeological Prospectors.

During the field reconnaissance, no evidence of significant artifacts or features were identified. The riparian lands adjacent to Rivière du Nord fails to act as a trigger for additional archaeological fieldwork. Land adjacent to Highway 135 (substation location) was observed to have been forested in the past but no obvious indications of farming, habitation or other activities of interest were observed.

8 MI'KMAQ TRADITIONAL KNOWLEDGE AND MI'KMAQ CURRENT USE

The closest First Nation to the Project is Pabineau First Nation, a Mi'kmaq community located approximately 9 km south of Bathurst, 43 km southwest of the Project. Archaeological field surveys conducted on September 27, 2018 found no evidence of historic or precontact land use by First Nations. Other nearby First Nations communities include Esgenoopetitj First Nation, which is 64 km south of the Project and Eel River Bar First Nation, which is 92 km west of the Project.

A New Brunswick Mi'gmaq Indigenous Knowledge Study will be carried out for the Project by Mi'gmawe'l Tplu'taqnn Inc to further explore Indigenous use of the Project Site.

8.1 Mi'kmaq Engagement

PBRWP has and will continue to engage Pabineau First Nation (the closest community to the Project Area) throughout its development, construction, and operation to ensure that all questions and concerns are addressed in an appropriate manner.

PBRWP has provided project details to the following First Nation's communities and offered these communities the opportunity to consult with PBRWP regarding any questions or concerns they may have regarding the Project:

- Amlamgog First Nation (Fort Folly);
- Metepenagiag Mi'kmaq First Nation (Red Bank);
- Elsipogtog First Nation (Big Cove);
- L'nui Menikuk First Nation (Indian Island);
- Oinpegitjoig L'Noeigati First Nation (Pabineau);
- Ugpi'ganjig First Nation (Eel River Bar);
- Natoaganeg First Nation (Eel Ground);
- Esgenoôpetitj First Nation (Burnt Church); and
- Tjipõgtõtjg First Nation (Bouctouche)

PBRWP will engage Mi'gmawe'l Tplu'taqnn (MTI) to carry out an Indigenous Knowledge Study for the Project and will ensure that all questions and concerns identified by the Study are addressed in an appropriate fashion. Furthermore, PBRWP has had several discussions with the NB Aboriginal Affairs Secretariat regarding the Project. Additional detail will be provided in the Public and First Nations Engagement Summary Report provided under a separate cover.

9 NOISE

9.1 Noise Modelling

Noise levels were calculated at 25 of the nearest residential buildings (receptors) surrounding the proposed WTGs. Under the worst-case scenario, the highest sound level predicted through the modelling exercise was 36.7 dBA, which is below the maximum allowable limit of 40 dBA. Under normal (i.e. not worst-case) circumstances and conditions, noise levels are expected to be further below the maximum allowable limit. Table 69 below shows that all calculated sound levels at the receptor sites comply with New Brunswick noise regulation at the nine wind speeds modelled.

Table 69. Sound Levels Modeled at Receptor Sites in dBA

Receptor Sites	dB(A) @ 4 m/s	dB(A) @ 5 m/s	dB(A) @ 6 m/s	dB(A) @ 7 m/s	dB(A) @ 8 m/s	dB(A) @ 9 m/s	dB(A) @ 10 m/s	dB(A) @ 11 m/s	dB(A) @ 12 m/s	Compliance with NBDELG Requirements
A	26.4	31.4	35.1	36.2	**36.7**	**36.7**	**36.7**	**36.7**	**36.7**	YES
B	23.6	28.8	32.5	33.6	34.1	34.1	34.1	34.1	34.1	YES
C	22.9	28.1	31.8	32.9	33.4	33.4	33.4	33.4	33.4	YES
D	21.7	27	30.8	31.9	32.4	32.4	32.4	32.4	32.4	YES
E	23.2	28.6	32.3	33.4	33.9	33.9	33.9	33.9	33.9	YES
F	23.8	29.2	33	34.1	34.6	34.6	34.6	34.6	34.6	YES
G	23.5	28.9	32.7	33.8	34.3	34.3	34.3	34.3	34.3	YES
H	22.4	27.8	31.6	32.7	33.2	33.2	33.2	33.2	33.2	YES
I	22.5	27.9	31.7	32.8	33.3	33.3	33.3	33.3	33.3	YES
J	22.3	27.6	31.4	32.5	33	33	33	33	33	YES
K	22.4	27.8	31.6	32.7	33.2	33.2	33.2	33.2	33.2	YES
L	21.6	27	30.8	31.9	32.4	32.4	32.4	32.4	32.4	YES
M	21.1	26.5	30.3	31.4	31.9	31.9	31.9	31.9	31.9	YES
N	21.5	26.8	30.6	31.7	32.2	32.2	32.2	32.2	32.2	YES
O	21.2	26.5	30.3	31.4	31.9	31.9	31.9	31.9	31.9	YES
P	26.4	31.4	35.1	36.2	**36.7**	**36.7**	**36.7**	**36.7**	**36.7**	YES
Q	23.3	28.6	32.3	33.4	33.9	33.9	33.9	33.9	33.9	YES
R	23.6	28.8	32.5	33.6	34.1	34.1	34.1	34.1	34.1	YES
S	22.8	27.9	31.6	32.7	33.2	33.2	33.2	33.2	33.2	YES
T	23	28.3	32.1	33.2	33.7	33.7	33.7	33.7	33.7	YES
U	23.5	28.9	32.7	33.8	34.3	34.3	34.3	34.3	34.3	YES
V	23.4	28.7	32.5	33.6	34.1	34.1	34.1	34.1	34.1	YES
W	23.4	28.6	32.4	33.5	34	34	34	34	34	YES
X	22.8	28	31.8	32.9	33.4	33.4	33.4	33.4	33.4	YES
Y	22.7	28	31.7	32.8	33.3	33.3	33.3	33.3	33.3	YES

Detailed results of the modeling exercise carried out with WindPro can be found in Appendix D. As can be seen on the Decibel Maps provided in Appendix D and Table 69 above, at a worst-case scenario, the highest noise values 36.7 dB(A) is located at receptors A and P. Both receptors are located on Highway 135, south of the Study Area.

10 SHADOW FLICKER

10.1 Shadow Flicker Modelling

Shadow flicker effects at all receptor sites are in compliance with the New Brunswick shadow flicker requirements. The highest shadow flicker effect for maximum hours per year (h/year) predicted under this worst-case scenario calculation is 11:32 h/year and below the maximum level of 30 h/year at residential buildings. The highest shadow flicker effect for maximum minutes per day (min/day) predicted under this worst-case scenario calculation is 16 min/day and below the maximum level of 30 min/day at residential buildings. Table 70 provides the results of the shadow flicker modelling at each receptor.

Table 70. Results of shadow flicker exposure times at local residences

Receptor Sites	Worst case (h/year)	Max minutes (min/day)	Compliance with NBDELG Requirements
A	0:00	0:00	YES
B	**11:32**	0:15	YES
C	10:25	0:13	YES
D	5:09	0:10	YES
E	7:07	0:13	YES
F	0:00	0:00	YES
G	0:00	0:00	YES
H	3:17	0:15	YES
I	7:18	0:16	YES
J	9:03	**0:16**	YES
K	0:00	0:00	YES
L	0:00	0:00	YES
M	0:00	0:00	YES
N	0:00	0:00	YES
O	0:00	0:00	YES
P	0:00	0:00	YES
Q	0:00	0:00	YES
R	0:00	0:00	YES
S	0:00	0:00	YES
T	3:57	0:11	YES
U	6:39	0:11	YES
V	2:22	0:10	YES
W	0:00	0:00	YES
X	0:00	0:00	YES
Y	0:00	0:00	YES

In consideration that worst-case parameters were implemented in this SFM, it can be assured that the shadow flicker requirements will not be exceeded if another turbine model with a smaller rotor diameter and lower hub height is chosen. Full results of the modeling exercise carried out with WindPro can be found in Appendix E.

11 VISUAL IMPACT

11.1 **Visual Impact Assessment**

The results of the VIA show that the turbines can be viewed from various vantage points on the landscape surrounding the Project Area. The photo visualizations and ZVI map are provided in Appendix F.

As per indicated on Figure 1 (Appendix F), at least one turbine will be visible from the communities of Haut-Caraquet to the east, Paquetville to the south and Springfield Settlement to the west.

12 ELECTROMAGNETIC INTERFERENCE

12.1 Electromagnetic Interference Study

PBRWP initiated the EMI Study including consultation with mandatory contacts as specified by the Radio Advisory Board of Canada (RABC). The results of the EMI show that the turbines do not pose any serious interference with existing radio, telecommunication or radar systems in the area. The complete report including results of consultation to date are available in Appendix G.

13 PUBLIC ENGAGEMENT SUMMARY

PBRWP has engaged with numerous stakeholders throughout the development of the Project, as is required under the NB EIA process. The purpose of these engagements is to identify and inform any parties who may be directly or indirectly affected by the Project. Stakeholders have been contacted and given the opportunity to provide feedback on the Project and express any concerns they may hold. PBRWP recognizes that stakeholder engagement is a continuous process and is committed to maintaining a high degree of support for the Project through meaningful consultation practices.

To date a wide variety of community members have been contacted, including First Nations groups, community groups & leisure clubs (including snowmobile and ATV clubs), and politicians.

A separate Public and First Nations Engagement Summary Report is in the process of being compiled and will document the outreach to date. A summary of the PBRWP's outreach efforts to date is provided below.

13.1 Public Information Open House

Public engagement was completed for the Project via a Public Information Session held in June 2019. 39 people attended the open house and comments were received and responded to. In addition, a Project information package was shared with community stakeholders including local First Nations and community groups.

Prior to the Public Information Session, 1037 flyers were distributed via Canada Post to residents in the communities surrounding the Project Area, including: Pokeshaw, Black Rock, Grand-Anse, & Saint-Leolin. The flyers advertised the date and location of the Public Information Session, as well as contact information for PBRWP. Notices of the open house were also published in two local newspapers: Acadie Nouvelle, and the Telegraph Journal. Additional information regarding the Public Information Session, including the sign in sheet and a summary of concerns raised at the meeting will be included in the Public and First Nations Engagement Summary Report provided under a separate cover.

13.2 Community Partner

The Pokeshaw Black Rock Recreation Council Inc. (PBRRC) is the community partner in the Pokeshaw Black Rock Wind Limited Partnership. The PBRRC is a NB non-profit organization made up of local community members. The majority interests of this partnership will be owned by PBRRC and they will receive substantial benefits from the Project and remain an active partner throughout the life of the Project. The benefits received by the PBRRC throughout the life of the project will be used at their sole discretion to fund projects that will benefit the communities surrounding the Project Area.

14 REGULATORY ENGAGEMENT

PBRWP has been active in engaging with DELG, throughout the EIA process. This has involved face to face meetings, phone calls, emails and the provision of update reports. In their role of Project Managing the EIA process, DELG have connected the Project Team to members of the Technical Review Committee (TRC) EIA reviewing team, to facilitate an open exchange of information, and a forum by which feedback and recommendations can be exchanged.

To date PBRWP have received feedback from the following regulatory agencies:

- DELG – General EIA Project management and recommendations;
- Health Canada – Shadow Flicker and Noise Modelling;
- ERD – Biophysical field surveys, and Project design;
- ECCC's Meteorological Services of Canada – radar considerations;
- ECC Canadian Wildlife Service – Avian Study Design;
- NB Department of Public Safety – Project design and setbacks;
- Department of Agriculture, Aquaculture and Fisheries – Land use and access to agricultural lands;
- NB Archaeological Services Branch –Archaeological screening within the Study Area; and,
- DTI – Safety of the public utilizing adjacent public roads.
- Transport Canada – An Aeronautical Assessment for Obstacle Evaluation has been approved from Transport Canada (See Appendix M); and
- Nav Canada – Letter of no concern regarding radar interference with turbines (See Appendix M).

15 PUBLIC SAFETY

15.1 Ice Throw

Under certain meteorological conditions, ice can form on the blades, tower, or any surface of the WTG. Ice formation on the blades can lead to vibrations and imbalances in the wind turbine, often resulting in the need to temporarily shut down the WTG. As the ice melts or is shaken loose by vibrations, it is possible for chunks of ice to fall from the structure or be thrown by the rotating blades. Ice throw causes a potential hazard to anyone in the vicinity of PBRWP. The maximum ice throw distance is calculated using the following formula:

$$d_t = 1.5 \times (D + H)$$

Where: d_t = Maximum throwing distance (m)
D = Rotor diameter (m)
H = Hub height (m)

The above formula is in accordance with the Canadian Wind Energy Association (CanWEA 2017) *Best Practices for Wind Farm Icing and Cold Climate Health and Safety*.

Assuming a 'worst case' scenario with the highest hub height and rotor diameter being considered, the maximum throw distance for this project is d_t = 393 m. A number of factors such as wind speed, rotational speed, size of the ice chunk, and position of the ice on the structure affect how far it may be thrown. It is widely accepted that the formula above generates a conservative ice throw distance and in practice this distance may be much smaller.

A number of technologies are available to mitigate the risks associated with ice throw. Permanent warning signs can be installed to warn those in the vicinity of PBRWP of the risk of ice throw. Warning lights can also be installed that are activated to flash when icing conditions are detected by PBRWP monitoring systems. Blade heating technologies will be installed in order to prevent significant buildup of ice to begin with, thus reducing the risks associated with larger ice chunks. Control systems can also be implemented to temporarily shut down the WTG when an ice thrown condition is detected.

A study was commissioned by PBRWP in order to better understand the risks associated with ice throw for this Project. It was found that the setbacks implemented in the design of PBRWP layout are sufficient in relation to the risks associated with ice throw. The complete study is found in Appendix N.

15.2 **High Winds**

Wind turbines are designed to harness the kinetic energy of the wind in a wide range of wind speeds, including gusts and sustained high winds. WTG control systems are designed to protect the WTG in high wind conditions. The WTG will pitch the blades to catch less in higher winds and will continuously yaw into the wind in order to efficiently manage the wind loads.

WTG's have a 'cut in speed' (wind speed at which the WTG is able to start producing energy) of approximately 3 m/s or 11 km/h, and a 'cut out speed' (wind speed at which the WTG shuts down or limits energy production for safety reasons) of approximately 28 m/s or 100 km/h. Modern turbines are equipped with storm control technology that allows the WTG blades to 'feather' or 'spill' wind in higher wind speeds, reducing the load on the blades and WTG as a whole, while still producing energy.

Control and condition monitoring systems shut down the wind turbines during high and extreme wind conditions and move the blades in vane position, to reduce risk of turbine failure and risk to nearby pedestrians or drivers.

15.3 **Public Access**

Throughout the construction process there will be a great deal of activity on Ridge Road and the access roads to be built as part of the Project. It is likely that as the condition of the public road improves, an increased number of visitors will access the project area via Ridge Road. Visitors will not be permitted to access the active construction zones unless they are equipped with the appropriate personal protective equipment (PPE) and have been authorized to do so by the site manager. Appropriate site orientation and safety training may be necessary.

While upgrades are being made to Ridge Road, there may be periods where access is temporarily blocked by excavation or construction equipment. PBRWP will notify landowners in the event that a prolonged blockage is expected and will work with landowners and users of the adjacent lands in order to minimize the effect such work may impose. Access to Ridge Road from the Northeast will not be impacted.

Overnight and on weekends there will be full time security on site. Use of the Ridge Road by the public will not be restricted, but security personnel will monitor the entire Project Area to ensure public safety, and to prevent damage and theft of tools and equipment.

Following the construction of the Project, gates may be installed on the private access roads at the discretion of the landowners. The WTG towers will remain locked and only authorized personnel will be granted entry. A fence will be constructed surrounding the substation where public access will not be allowed. The substation may be monitored by CCTV.

15.4 **Fire Hazard**

It is very rare for WTGs to catch fire, but such a danger does exist. Numerous fire prevention systems are in place to prevent such an occurrence. A robust lightning protection system is implemented in order to efficiently ground lightning strikes anywhere on the WTG. In direct drive turbines there is no gearbox or gearbox lubricants, eliminating the risk of fire from overheating mechanical parts. There are many sensors throughout the WTG continuously monitoring temperatures and will send alerts or shut down the turbine if temperature limits are exceeded. Fire extinguishers are located throughout the tower and nacelle. Exact fire prevention and fire safety measures will depend on the final turbine model selected.

PBRWP will engage local fire departments to discuss fire safety related to the Project and address any concerns presented by the fire department.

16 DISCUSSION OF IMPACTS

16.1 Valued Ecosystem Component Selection

The scope, methodology and baseline environmental conditions for the Project have been described in detail in Sections 3 through 10 in this registration document. This Project followed the EIA process as identified and defined in *A Guide to Environmental Impact Assessment in New Brunswick* and *Additional Information Requirements for Wind Turbines* (NBDELG, 2018; NBDELG, 2019). The existing environment has been described and baseline environmental work has been completed to evaluate each VEC based on the site-specific conditions relating to PBRWP.

Evaluation, based on the environmental baseline work completed for each VEC over the course of a four-season survey period, and the expertise of the various members of the EA Project Team, has been completed to determine which VEC's could have potential residual effects once planned mitigation has been implemented. Mitigation options are provided in Table 72 (and the following residual effects Sections) and additional detail will be provided in a future Environmental Protection Plan.

The thresholds for determination of significance of adverse residual environmental effects for each VEC are defined in Table 71. Potential effect and mitigation for each VEC is provided in Table 72 and VECs with potential Project interactions and potential residual effects are indicated. All VEC's that comprise potential residual effect have been carried forward (in Section 16.2) for further discussion.

Table 71. VECs Threshold for Determination of Significance

Valued Environmental Components (VECs)	Threshold for Determination of Significance
Land Use	A proven negative effect to current land use (i.e. the complete cessation of forestry and/or agriculture).
Physiography and Topography	A proven negative effect to the physiography (i.e. physical geography) and topography that is likely to cause permanent, harmful alteration.
Hydrogeology and Groundwater	A proven negative effect to surrounding water supplies (i.e. water drawdown at adjacent drilled/dug wells).
Habitat, Vascular Plants and Lichens	An effect that is likely to cause a permanent alteration to any flora species distribution, abundance or habitat, where similar habitat is not currently available at the local/regional level.
Fauna (Herpetofauna and Mammals)	An effect that is likely to cause a permanent alteration to any fauna species distribution or abundance, or alteration of core habitat.
Birds (Avifauna)	An effect that is likely to cause a permanent alteration to any bird species distribution or abundance, or alteration of core habitat.
Bats	An effect that is likely to cause a permanent alteration to any bat species distribution or abundance, or alteration of core habitat.
Wetlands	An effect to wetlands that is likely to cause an adverse change in watershed health (water quality or quantity.

Valued Environmental Components (VECs)	Threshold for Determination of Significance
Fish and Fish Habitat	An effect that is likely to cause serious harm to fish, as defined by the Government of Canada (1985, Section 2(1)): *"serious harm to fish is the death of fish or any permanent alteration to, or destruction of, fish habitat," with fish habitat defined as "spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes."*
SAR and SOCI	An effect that is likely to cause a permanent alteration to a Priority Species' distribution or abundance, or alteration of critical habitat. Sedentary species such as flora and lichens do not have the opportunity to move to avoid direct or indirect impact. For these taxa, the loss of a population of SAR, is considered significant.
Air Quality	An exceedance of the CCME approved Canadian Ambient Air Quality Standards for particulate matter and ground level ozone.
Socioeconomic Conditions	An effect by the Project likely to cause long term decreases in economic activity, human health, recreational use, land use, and tourism.
Archaeological and Heritage Resources	Any disturbance to or destruction of any archaeological or heritage resource of importance.
Mi'kmaq traditional Knowledge and Mi'kmaq current use	Any disturbance to or destruction of any First Nations archaeological or heritage resource of importance.
Noise	An exceedance of the maximum allowable noise (40 dBA) at any residential receptor as per Health Canada guidelines.
Shadow Flicker	An exceedance of the maximum allowable shadow flicker of 30 hours per year and 30 minutes per any one day.
Visual Impact	Visual presence of turbines likely to cause a human health effect.
Electromagnetic Interference	A negative effect to existing radio, telecommunications and radar systems that cannot be effectively mitigated.
Public Safety	An effect by the Project likely to cause long term decreases in public safety in the surrounding area, which includes adjacent roads and PIDs within the Project Area.

Table 72. Valued Ecosystem Component (VEC) Evaluation

Valued Ecosystem Components (VECs)	Description of Potential Impacts and Rationale	Mitigation	Predicted Residual Effects?
Current Land Use	Property Values: No proven effects on land values from wind power projects (Section 6.4)	None required.	N/A
	Loss of land use (i.e. forestry) on those areas directly impacted by infrastructure. Impacts to existing land use (human and natural) occurring within and adjacent to the Project Area.	• The Project has abided by all existing municipal, local, and regional by-laws and regulatory requirements. • A majority of the Project utilizes the existing Ridge Road for access to the WTG access routes. • Sections of the Project Area are previously disturbed by forestry and agricultural activities, therefore, there is minimal pristine areas that will be newly disturbed. • Current land-use (i.e. forestry and agriculture) will continue on PID's occupied by WTG's. • Loss of use by landowners is compensated by the Project.	None. Mitigation measures will result in no predicted residual effects.
	Contamination from spills and waste materials (i.e. fuels and hydraulic fluids).	• Develop and follow a hazardous material and spill contingency plan. • Follow the *New Brunswick Clean Environment Act* and the *Transportation of Dangerous Goods Act.* • Have spill kits and properly trained staff on site. • Minimize the potential for spills or leaks during all work on-site by regularly inspecting and maintaining equipment. • Provide spill containment infrastructure on-site for fuel and oil storage. • No fueling and servicing of equipment within 50m of watercourses and wetlands. • Proper waste management protocols will be adhered to.	

Valued Ecosystem Components (VECs)	Description of Potential Impacts and Rationale	Mitigation	Predicted Residual Effects?
Topography and Soils	Topography (land elevations) will be slightly altered at turbine pad and access road locations. Potential impacts to surface water run-off characteristics could occur (Section 5.4.1). However, topography at proposed turbine locations is very gently sloped and will not require extensive changes to accommodate turbine construction.		
	Construction on cleared lands may increase potential for soil erosion. Changes to soil quality through disturbance during construction. Disturbance of surficial soils leading to increased potential for sediment and erosion/sedimentation in waterbodies and wetlands.	• Upper soil material removed during construction will be saved and used during reclamation in order to restore the local seed bank. • Stripped upper soil material will be stored separately from excavated or graded subsoils to avoid admixing, loss and changes to soil quality. • Soil material will be replaced when weather is optimal (i.e. minimal precipitation). • Areas of soil that do become compacted may be aerated to aid in reclamation of soil quality. • When possible, construction during adverse weather will be avoided to mitigate rutting, admixing, and soil compaction.	None. Mitigation measures will result in no predicted residual effects.
Hydrogeology and Groundwater	Damage from blasting activities to potable groundwater wells is not expected due to distance to closest wells (1,419 m from WTG1km) and no requirement to blast (Section 5.4.5).	None required.	N/A
Lichens	No Priority Species Lichens were identified within proposed Project infrastructure locations (Section 5.5.3).	None required.	N/A

Valued Ecosystem Components (VECs)	Description of Potential Impacts and Rationale	Mitigation	Predicted Residual Effects?
Vascular Plants	No Priority Species Vascular Plants were identified within proposed Project infrastructure locations.	None required.	N/A
	Loss of vegetation due to clearing activities.	• A majority of the Project utilizes the existing Ridge Road for access to the WTG access routes, therefore limiting construction of new roads and associated disturbances.	None. Mitigation measures will result in no predicted residual effects
	Contamination from spills and wastes from materials such as fuels and hydraulic fluids.	• Develop and follow a hazardous material and spill contingency plan. • Have spill kits and properly trained staff on site. • Follow the *New Brunswick Clean Environment Act* and the *Transportation of Dangerous Goods Act.* • Provide spill containment infrastructure on-site for fuel and oil storage. • Development of Project EPP that will specify additional best management practices related to contamination prevention.	
	Dust from construction activities smothering plants.	• Dust control methods such as road watering will be used during construction as needed.	
	Introduction of invasive species.	• Best management practices will be outlined in the project EPP to avoid the introduction of invasive species (i.e. development of a vegetation management plan as part of the Project EPP including prevention methods, methods of vegetation control and monitoring).	

Valued Ecosystem Components (VECs)	Description of Potential Impacts and Rationale	Mitigation	Predicted Residual Effects?
Habitat	Habitat fragmentation, alteration, and loss (Section 5.5.1). Sections of the Project Area are previously disturbed by forestry and agricultural activities, therefore, there is minimal pristine areas that will be newly disturbed. Pre-construction environmental surveys have classified habitat types throughout the Project Area, none of which are unique regionally Therefore effects will be limited as a result of PBRWP.	• Siting and construction are planned to avoid all environmentally sensitive areas. • A majority of the Project utilizes the existing Ridge Road for access to the WTG access routes, therefore limiting construction of new roads and associated disturbances.	None. Mitigation measures will result in no predicted residual effects
Fauna (Herpetofauna and Mammals)	Potential mortality of fauna species due to clearing and construction activities.	• Where applicable, minimization of construction will occur outside of critical wildlife time windows. • Implementation of breeding bird nest surveys during nesting season.	None. Mitigation measures will result in no predicted residual effects
	Potential wildlife-vehicle collisions.	• Adhere to speed limits to avoid wildlife collisions.	
	Sensory disturbance to fauna from construction and/or operation (including light, noise, vibrations).	• Lighting during construction and on WTGs will meet the minimum light levels required by Transport Canada, while being minimized for wildlife. • Lighting during construction will point downwards to minimize light disturbance. • Construction activities will be confined to Project footprint only.	
	Wildlife/human interaction	• Proper waste management protocols will be adhered to. • Littering and intentional feeding of wildlife will be prohibited. • Integration of wildlife management plan into Project EPP including procedures for wildlife encounters, sightings and reporting.	

Valued Ecosystem Components (VECs)	Description of Potential Impacts and Rationale	Mitigation	Predicted Residual Effects?
Birds (Avifauna)	Fragmentation, alteration and/or loss of avifauna habitat. Potential turbine or infrastructure collisions. Destruction of migratory bird nests. Alteration of bird migratory pathways as a result of the Project. Sensory disturbances (lighting, sound) may impact avifauna.	• Due to the potential residual effects on avifauna despite mitigation efforts, this VEC has been considered for further assessment.	Yes. See Section 16.2.1
Bats	Fragmentation, alteration and/or loss of bat habitat. Mortality resulting from barotrauma. Potential turbine or infrastructure collisions. Sensory disturbances (lighting, sound) may impact bats.	• Due to the potential residual effects on bats despite mitigation efforts, this VEC has been considered for further assessment.	Yes. See Section 16.2.2
Wetlands	<u>Direct Wetland Impacts</u> The Project footprint has avoided wetlands to the extent possible including setbacks and the design of access roads at existing woods road locations, to minimize the need to disturb new areas. Direct impact to single wetland by access road development and potential effects to surface water flow in the wetland (Section 5.6.1).	• A WAWA permit will be applied for if the proposed access route through WL7 is accepted in its current design. • Wetland compensation will be implemented for the lost wetland area. • Access routes through wetlands will follow all guidelines in the Watercourse and Wetland Alteration Technical Guidelines and all conditions associated with the WAWA Permit. • Culverts will be installed to maintain drainage and surface water connection within any impacted wetlands. • Where necessary, culverts will be installed to maintain drainage and surface water connection within any impacted wetlands.	None. Mitigation measures will result in no predicted residual effects.

Valued Ecosystem Components (VECs)	Description of Potential Impacts and Rationale	Mitigation	Predicted Residual Effects?
Wetlands	<u>Indirect Wetland Impacts</u> Environmental baseline surveys has identified all wetlands in the Project Area, and Project design has largely avoided and setback from these wetlands. Setbacks from infrastructure and wetland are provided in Section 5.6.1.		None. Mitigation measures will result in no predicted residual effects
	Contamination from spills and wastes from materials such as fuels and hydraulic fluids during construction, maintenance or decommissioning.	• Develop and follow a hazardous material and spill contingency plan. • Have spill kits and properly trained staff on site. • Follow the *New Brunswick Clean Environment Act* and the *Transportation of Dangerous Goods Act.* • Provide spill containment infrastructure on-site for fuel and oil storage. Development of Project EPP that will specify additional best management practices related to contamination prevention.	
	Potential indirect impacts from sediment and erosion or change in water quality/quantity entering downgradient wetlands from construction.	• Wetland disturbances will be minimized whenever possible through the use of berms, barriers, and by conducting drainage away from wetlands. • Erosion and sediment control structures will be installed where necessary. Implementation of sediment and erosion control plan as part of Project EPP.	
Fish and Fish Habitat	Environmental baseline surveys has identified all watercourses in the Project Area, and Project design has largely avoided and setback from these watercourses. A single watercourse (Rivière du Nord) drains through the eastern extent of the Project Area; it is not expected to be directly impacted by the Project and the closest infrastructure (WTG4) is setback ~ 94 m from it. Setbacks from infrastructure and wetland are provided in Section 5.6.1.		None. Mitigation measures will result in no predicted residual effects

Valued Ecosystem Components (VECs)	Description of Potential Impacts and Rationale	Mitigation	Predicted Residual Effects?
	Increased sedimentation in Rivière du Nord (WC1) during construction.	• Erosion and sediment control structures will be installed where necessary. • Implementation of sediment and erosion control plan as part of Project EPP. • Water will not be discharged directly towards WC1; rather water will be redirected from construction areas through the use of berms, barriers, and via ditches.	
	Contamination from spills and wastes from materials such as fuels and hydraulic fluids during construction, maintenance or decommissioning.	• Develop and follow a hazardous material and spill contingency plan. • Have spill kits and properly trained staff on site. • Follow the *New Brunswick Clean Environment Act* and the *Transportation of Dangerous Goods Act.* • Provide spill containment infrastructure on-site for fuel and oil storage. • Development of Project EPP that will specify additional best management practices related to contamination prevention. • Minimize the potential for spills or leaks during all work on-site by regularly inspecting and maintaining equipment. • Provide spill containment infrastructure on-site for fuel and oil storage. • No fueling and servicing of equipment within 50 m of watercourses and wetlands. • Proper waste management protocols will be adhered to.	
SAR and SOCI	Potential direct and indirect effects to SAR and SOCI species identified during field studies. Direct effects may include mortality due to vehicle/turbine collisions and/or sensory disturbance. Potential indirect effect to habitat used by SAR and SOCI species through habitat fragmentation, alteration, and loss.	• Due to the potential residual effects on SAR/SOCI despite mitigation efforts, this VEC has been considered for further assessment.	Yes. See Section 16.2.3

Valued Ecosystem Components (VECs)	Description of Potential Impacts and Rationale	Mitigation	Predicted Residual Effects?
Socio-economic Conditions	The Project is not expected to cause negative effect to the local community of residents for the following reasons: • The Project will support the local economy and local jobs within Gloucester County. • CWF will employ, whenever possible, local contractors to complete Project tasks. • Available literature did not find significant evidence in determining the effect of wind projects on surrounding property values. • The Project lands are privately owned and do not support public recreation areas.		N/A
	Possible negative effects could include:		None. Mitigation measures will result in no predicted residual effects
	Road closures and delays during construction and safety of the community during the construction period.	• PBRWP has committed to implementing signage within the truck routes to increase driver awareness to perform safe driving practices during turbine construction. • PBRWP will advise the community of potential road closures prior to it occurring during construction. • Appropriate signage and personnel will be used to direct local traffic during construction. • Project activities will follow all applicable local and provincial traffic regulations.	
	Construction related traffic and nuisance.	• Construction will occur during daylight hours. • Construction and maintenance will be conducted in a respectful manner; • Neighboring properties will be notified regarding temporary and intermittent changes in noise and of intended work schedule. • Proper waste management protocols will be followed.	

Valued Ecosystem Components (VECs)	Description of Potential Impacts and Rationale	Mitigation	Predicted Residual Effects?
Archaeological and Heritage Resources	The ARIA found no evidence of significant extant structures or artifacts (Section 7).	• Should the development area differ from the area assessed in the ARIA, PBRWP will consult with a permitted archaeologist to ensure potential effects will not occur.	None. Mitigation measures will result in no predicted residual effects
Mi'kmaq traditional Knowledge and Mi'kmaq current use	Potential interaction with First Nations archaeological and heritage resources.	• The archaeological resource impact assessment did not identify any First Nations resources. • PBRWP has committed to the implementation of an Indigenous Knowledge Study (IKS) for the Project.	None. Mitigation measures will result in no predicted residual effects at this time (Pending outcome of IKS)
Noise	Construction related noise: there are very few residences close to the construction areas, so construction noise is not expected to be an effect. However, the following mitigation is also provided:	• Neighboring properties will be notified regarding temporary and intermittent changes in noise and of intended work schedule • Construction will occur during daylight hours. • PBRWP will advise the community of planned construction and potential for noise.	None. Mitigation measures will result in no predicted residual effects
	Operation related noise.	• The predicted noise levels are below recommended sound criteria for wind turbines for all sensitive receptors within 2.6 km.	
Shadow Flicker	Nuisance shadow flicker at receptor sites.	• The predicted shadow flicker effects are below criteria for wind turbines for all sensitive receptors within 2.6 km	None. Mitigation measures will result in no predicted residual effects

Valued Ecosystem Components (VECs)	Description of Potential Impacts and Rationale	Mitigation	Predicted Residual Effects?
Visual Impact	Alteration to the visual landscape for property owners and visitors. At least one turbine will be visible from the communities of Haut-Caraquet to the east, Paquetville to the south and Springfield Settlement to the west (Section 11). Predicted view plains were provided to the public during the Public Information Session however no concerns were raised.	None. No mitigation deemed necessary.	
Electromagnetic Interference	Wind turbines can interfere with various types of electromagnetic signals emitted from radar and/or telecommunication systems. An EMI study was completed by PBRWP and consultation with relevant stakeholders has determined there are no objections regarding the Project to date. No mitigation deemed necessary (Section 12).	None. No mitigation deemed necessary.	
Public Safety	Vehicle collisions during construction. Unforeseen accidents involving blade throw, ice throw, tower collapse and fire.	• PBRWP has committed to implementing signage within the truck routes to increase driver awareness to perform safe driving practices during turbine construction. • PBRWP will advise the community of proposed construction periods. • The Project Area is located on private land, as such public access to turbines is not expected. Signage will be posted at the entrance to the site providing the public safety warnings. • Private landowners may gate access to individual turbine locations. • Engineers licensed to practice in New Brunswick will provide the final sign-off on the approved turbine model. • Engage local fire departments to discuss fire safety related to the Project	None. Mitigation measures will result in no predicted residual effects

Valued Ecosystem Components (VECs)	Description of Potential Impacts and Rationale	Mitigation	Predicted Residual Effects?
Air Quality	Negative effects to Air quality are possible during the construction period of the Project.	• Ensure water trucks are used to minimize air borne dust. • Implement other dust control measures outlined in the Project EPP (i.e. equipment filters, dust suppression, cover stockpiles).	None. Mitigation measures will result in no predicted residual effects

Where mitigation can be used to avoid the effects of interaction between the Project and the VECs, the result is no significant adverse affect. Further analysis is done on those VECs where, as indicated in Table 73, there may be a residual impact. The following three VECs have been carried forward to the detailed effects assessment:

- Birds (Avifauna);
- Bats; and
- SAR and SOCI

16.2 Effects Assessment

Effects assessment involves the following steps:

1. Identification of potential Project interactions on selected VEC;
2. Identification of potential effects;
3. Description of recommended mitigation;
4. Identification of expected residual effects (post mitigation);
5. Evaluation of significance of residual effects; and,
6. Description of recommended follow up and monitoring.

Project interactions and potential effects for each identified VEC are discussed and evaluated in the following sections to determine specific mitigation requirements, expected significance of residual effects, and any monitoring and follow up requirements. Following the hierarchy laid out in *A Guide to Environmental Impact Assessment in New Brunswick,* mitigation has been designed to prioritize in the following way:

- Impact avoidance;
- Impact reduction; and,
- Impact compensation.

16.2.1 Birds (Avifauna)

Table 73 provides a summary of the potential environmental effects resulting from the Project-VEC interactions with birds. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, and Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). Interaction and potential effects have been divided into direct mortality of birds, alteration to habitat and sensory disturbance. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 73. Project- VEC Interactions by Project Phase on Birds (Avifauna)

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect		
	Direct Mortality	Habitat Alteration	Sensory Disturbance
Construction			
Site preparation/clearing	X	X	X
Access road construction	X	X	X
Blasting (only if necessary)		X	X
Turbine pad levelling and grading	X	X	X
Waste management			X
Operation and Maintenance			
Project presence	X		X
Infrastructure maintenance			X
Winter maintenance			X
Vegetation management	X	X	
Decommissioning			
Turbine dismantling and removal			X
Turbine pad and road reclamation		X	X
Accidents, Malfunctions and Unplanned Events			
Erosion and sediment control failure	X	X	
Fuel spill from machinery/trucks	X	X	
Fire	X	X	X

The effects of wind turbines on birds has been studied in great detail over the past decades (Kern and Kerlinger, 2003; Drewitt and Langston, 2006; Smallwood, 2013). The impact that turbines may have on birds depends largely on topography, turbine design, and the bird communities in the vicinity. While birds may be affected during construction, they are most likely to interact with the Project during its operation. This section will describe the potential Project interactions (including estimated mortality) and environmental effects associated with the various Project activities.

Direct mortality resulting from the collision with WTG blades is the most apparent Project interaction. Risk of collision is increased when WTG are in proximity to migratory pathways, significant nesting or foraging habitat, or along the coast. The Project is located 3.6 km away from Pokeshaw Rock sea stack, an area occupied by a seabird colony. The habitat within the Study Area differs drastically from what is present at Pokeshaw Rock, furthermore, the avian field surveys did not indicate the presence of any large flocks of seabirds utilizing the Study Area or its air space in any way. Shorebirds, including Double-crested Cormorants, generally migrate at night by following coastlines, ridges, and valleys to aid in nocturnal migration (Lincoln, 1935; Richardson, 2000). Therefore, it is likely that this species largely follows the coast to the east of Pokeshaw Rock when arriving and leaving for migration, thus, flying north of the Study Area and not in the air space above it. This aligns with the relatively few Double-crested Cormorants observed flying over the Study Area in spring and fall surveys. Furthermore, anecdotal evidence from birders in the area suggests that Miscou Island, approximately 55 km northeast from the Study Area at the very tip of the Acadian Peninsula, is a crucial migratory corridor for waterbirds (NCC, 2018). It is likely that migrating Double-crested Cormorants follow the Acadian Peninsula north, flying around the tip of Miscou Island, before bearing west into Caraquet Bay. From there it is a direct flight west to Pokeshaw Rock, flying north of the Study Area boundary, while avoiding its air space.

While collision with WTG's causing direct mortality is an often a cited effect on birds, a study completed in 2013 found that after completing carcass searches at 43 wind farms across Canada, the average number of birds killed per turbine per year was 8.2 ± 1.4 (Zimmerling *et al.,* 2013). According to Bird Studies Canada (2017), the average mortality rates for non-raptors in Atlantic Canada is 1.81 ± 0.47 birds per turbine per year. No estimate of average mortality is available for raptors in Atlantic Canada, as the wind power projects summarized in the database did not document any raptor mortalities. Neither of these figures are high enough to cause a significant, permanent alteration to abundance of a bird species. Furthermore, mortality estimates based on the number of birds observed flying within the RSA within the Study Area is estimated to be 0.364 birds per year at PBRWP, which is well below the average mortality rates in Atlantic Canada and nationally, and even lower than the average killed in the study completed by Zimmerling *et al.* (2013).

Habitat alteration may occur as a result of various Project activities. The killing of birds or the destruction of their nests, eggs, or young is an offence under the *Migratory Birds Convention Act.* Avian habitat directly within the footprint of proposed new access roads and turbine pad area construction will be eliminated. Clearing and grubbing for site preparation will remove vegetation, reducing the quantity of terrestrial habitat, and affecting the quality of already marginal habitat. The Project will result in a slight increase in edge area, which may act as a barrier for some bird species, while presenting potential benefits to others. Some bird species benefit from forest edges and have shown to return in subsequent years after an area is cleared. A study in Alberta showed that the abundance of Alder Flycatchers increased in a previously cut area (Tittler et al. 2001). Additionally, Rusty Blackbirds can also tolerate forestry activities as long has their habitat of coniferous dominant trees of varied heights near waterbodies is maintained (pers. comm. C. Staicer 2018).

Very little clearing is necessary for this Project, as the main access road already exists (Ridge Road), and the proposed turbines require relatively small areas to be cleared. If a bird species utilizing habitat within the allotted areas to be cleared is unable to relocate to alternate suitable habitat, then direct mortality is a potential effect.

Sensory disturbance may occur during construction, in particular during site preparation. Activities during the breeding season for birds has the potential to cause direct mortality, abandonment of nests, and the destruction of nest contents, all of which could include species designated as SAR or SOCI. If adjacent suitable habitat is not available, birds that have been displaced will not likely nest until habitat becomes available. This may result in a higher non-breeding population. A literature review conducted by Shannon et al. (2016) found that birds have the potential to exhibit changes in song characteristics, reproduction, abundance, stress levels, and species richness at levels greater than 45 dBA. This noise level is not expected to be reached unless blasting occurs. Avifauna may be displaced from areas adjacent to the Project as a result of construction and/or operations-related noise. This potential environmental effect would be prolonged over the lifetime of the Project.

It has been known that exterior structures such as substations, buildings and other floodlit structures can attract birds during the night and lead to mortality events. In addition, migratory birds during fall and spring are especially attracted to lighting on tall structures.

Avian habitat present within the Project Area is not unique and is extensively present within the surrounding landscape and across large tracts of undeveloped land. As discussed in Section 5.1.2, the Project Area is mostly comprised of hardwood, softwood or mixed forest types. Agricultural land-use is also present within the Project Area, though to a lesser extent than forested habitat. Construction of Project infrastructure will impact avian habitats; however current land uses (i.e. forestry and agriculture) have and continue to also alter the use of the Project Area by birds. An example of this can be seen in the cleared agricultural land to the west of Highway 135, and smaller agricultural areas that are northeast of the Project Area. On May 19, 2018 a Bobolink was observed flying across the paved road near PC1 (see Figure 7a, Appendix A). Bobolinks prefer habitats that include prairies and meadows; therefore, it is possible it was utilizing these cleared agricultural fields. However, these lands are in active agricultural use (haying) and as such, do not provide critical habitat for this species unless left to fallow. It is important to note that these current land uses will continue if the proposed PBRWP proceeds. While the complete cessation of all human activity on the landscape would likely have the most positive effect on avian habitat (i.e. fallowed fields would provide undisturbed grassland habitat, mature tree stands would provide diverse forest habitat, etc.), this is unlikely to occur even if PBRWP does not proceed. It is expected that any birds utilizing habitat that will be disturbed by Project activities will move to similar habitats within and adjacent to the Project Area. Given that avian habitat within the Project Area is not unique as compared to surrounding habitats, displaced bird species will find similar habitat in nearby areas.

Decommissioning of the turbines will result in a positive effect on the Project, involving the reclamation of land and re-establishment of vegetation and habitat for birds across the Project Area.

Erosion and sediment control measures could fail during precipitation events and release sediment, potentially affecting wetland or stream habitat specifically used by birds. Mitigation to prevent such effects are provided below and this type of effect is temporary and short-term and is highly localized to the affected area.

Fire events during any phase of the Project could destroy vegetation, and subsequently effect habitat for birds, and result in their displacement or mortality, particularly during breeding season when the young are less mobile.

16.2.1.1 **Mitigation**

PBRWP is committed to the development of an EPP which among other commitments will specify best management practices associated with birds utilizing the Project Area, mitigation methods and contingency plans associated with vegetation removal, turbine operation, progressive reclamation and re-vegetation of the Project Area. The Project EPP will include methods by which the Project can take place while minimizing interactions with avifauna, these include:

- As discussed in Section 3.1.3, in combination with other wind developers in NB, PBRWP will implement one year of radar and acoustic monitoring as soon as possible, either during the construction phase or the first year of post-construction as per communication with NBDELG;
- Conduct post-construction mortality monitoring that includes systematic and episodic surveys as per the document *Additional Information Requirements for Wind Turbines*;
- Should post-construction monitoring identify significant mortality events are occurring at PBRWP to a particular species of bird, at a particular time of the year, or during specific weather conditions, PBRWP will consult with NBELG and CWS to determine appropriate mitigation to minimize future interactions and effects;
- Discourage ground-nesting species (e.g. Common Nighthawk, Bank Swallow) by limiting large piles or patches of bare soil during the breeding season, where practicable;
- Should any ground- or burrow-nesting species initiate breeding activities within stockpiles or exposed areas, PBRWP will avoid disturbance to these areas until chicks can fly and the nesting areas are no longer being utilized;
- Implement wildlife best management plans. These will be outlined in detail in the Project EPP and include procedures for wildlife encounters, sightings and reporting;
- Grubbings and topsoil will be salvaged and stored for use in site restoration;
- Implement an erosion and sediment control plan;
- Regularly inspect and repair erosion and sediment control devices;
- Equipment will be equipped with spill kits and site personnel will be instructed on their use;
- Implement reclamation program to re-establish similar habitat to support reintroduction of birds post turbine life.
- PBRWP will implement the following lighting procedures to minimize the potential hazards to birds;
    - Install downward-facing lights on site infrastructure to reduce attraction to birds;
    - Use movement detection lighting on office structures, doors to turbines, gates, etc. which turn off when not in use, instead of permanent lighting;
    - Installation of lighting on tall structures to meet Transport Canada guidelines, and where possible, strobe lights will be utilized at minimum intensities, minimum light fixtures and minimum number of flashes per minute.

Should site activities during active nesting periods be unavoidable, additional mitigative measures such as pre-disturbance nest searches and avoidance and setbacks from active nests will be applied. Additionally, if mortality monitoring reveal that bird mortalities exceed rates typically found at other wind generating projects elsewhere in the province, further adaptive management and mitigation procedures will be developed in coordination with CWS.

16.2.1.2 Residual Effect and Significance

The predicted residual environmental effects of the Project on avifauna are assessed to be adverse, but not significant after the implementation of mitigation measures. Based on the degree of disturbance proposed to occur within the Project Area, and the best management practices and post-construction monitoring that will be implemented as part of the Project EPP, no significant residual environmental effects on avifauna are expected.

16.2.2 Bats

Table 74 provides a summary of the potential environmental effects resulting from the Project-VEC interactions with bats. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). Interaction and potential effects have been divided into direct mortality of bats, alteration to habitat and sensory disturbance. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 74. Project- VEC Interactions by Project Phase on Bats

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect		
	Direct Mortality	**Habitat Alteration**	**Sensory Disturbance**
Construction			
Site preparation/clearing	X	X	X
Access road construction	X	X	X
Blasting (only if necessary)		X	X
Turbine pad levelling and grading	X	X	X
Waste management			X
Operation and Maintenance			
Project presence	X		X
Infrastructure maintenance			X
Winter maintenance			X
Vegetation management	X	X	
Decommissioning			
Turbine dismantling and removal			X
Turbine pad and road reclamation		X	X
Accidents, Malfunctions and Unplanned Events			
Erosion and sediment control failure	X	X	
Fuel spill from machinery/trucks	X	X	

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect		
	Direct Mortality	**Habitat Alteration**	**Sensory Disturbance**
Fire	X	X	X

Project construction is not expected to significantly impact bats present in the area, although it may result in some direct mortality as bat habitat is present within the Project Area. Construction is fairly limited to building of access roads, turbine pads, and turbine erection. All construction will occur during normal working hours (i.e. daylight) therefore collisions with flying bats are unlikely. No hibernacula were identified during baseline surveys; therefore, disturbances are not expected during the construction phase.

Bat mortality is a known potential effect of wind energy projects' operational phases throughout North America. Mortality potential is strongly impacted by region, habitat, and bat species in the vicinity of WTGs (Hein *et al.,* 2013). Siting turbine locations in areas that avoid bat migratory routes is the most significant step to decrease mortalities available (DNV GL, 2018). The prominent causes of bat deaths at wind turbine sites are direct collision (i.e., direct blunt-force trauma) and barotrauma (indirect trauma). It is difficult to attribute individual fatalities exclusively to either direct or indirect trauma (Grodsky *et al.,* 2011). Barotrauma involves tissue damage to air containing body structures (i.e the lungs) caused by rapid or excessive air pressure changes. It is believed that air pressure changes in air space directly adjacent to moving turbine blades causes expansion of air in the lungs not accommodated by exhalation, therefore resulting in lung damage and internal hemorrhaging. Grodsky *et al.* used radiology to investigate causes of bat mortality and found that a majority of the bats examined (74%; 29 out of 39 individuals) had bone fractures that are likely to have occurred during direct turbine collisions (2011). Approximately half (52%; 12 out of 23 individuals) of the examined bats had mild to severe hemorrhaging in the middle or inner ears (or both) (Grodsky *et al.,* 2011).

Despite these findings by Grodsky *et al.* the true nature of bat mortality at wind turbine sites remains poorly understood; therefore, a precautionary approach should be taken. Bat activity at the Project Area was initially high, however one bat monitor station (BM4a) located in lands to the west of Highway 135 were skewing results higher. No WTG's are proposed in this area of the Study Area, of higher bat activity, which has resulted in proposed WTG's being positioned in lands to the east of Highway 135 where bat activity is lower.

Habitat suitable for bat roosting and foraging was reviewed for all proposed WTG's in Section 5.4.6.1.1. Observations at each WTG location indicates that for the most part, habitat to support these activities is present at all WTG locations. However, similar to the effects on birds, the habitat present across the Study Area (and WTG locations specifically), is also present extensively in surrounding undeveloped forested lands. As such, removal of this habitat for the construction of WTG's and access roads associated with

PBRWP is not expected to have an effect of bat populations in the region. Decommissioning of PBRWP will result in the return of potential bat habitat.

As with any construction and/or operation of a project involving the use of machinery and equipment, there is potential for accidents, malfunctions and unplanned events to occur. Erosion and sediment control measures could fail during precipitation events, releasing sediment and potentially affecting wetland or stream habitat used by wildlife including bat species. This type of effect is temporary and short-term and is highly localized to the affected area. Fire events during any Project phase could remove significant amounts of vegetation, thereby having an environmental effect on wildlife habitat, resulting in their displacement or mortality. Risk is especially high during the breeding season when young are less mobile. The Project EPP will discuss mitigation and precaution measures related to fire potential.

16.2.2.1 **Mitigation**

PBRWP is committed to the development of an EPP which among other commitments will specify best management practices associated with bats utilizing the Project Area, mitigation methods and contingency plans associated with vegetation removal, turbine operation, progressive reclamation and re-vegetation of the Project Area. The Project EPP will include methods by which the Project can take place while minimizing interactions with bats, including:

- Conduct post-construction mortality monitoring that includes systematic and episodic surveys as per the document *Additional Information Requirements for Wind Turbines*;
- Should post-construction monitoring reveal that bat mortalities exceed rates typically found at other wind generating projects elsewhere in the province, further adaptive management and mitigation procedures will be developed in coordination with CWS (i.e. reducing cut in speeds during periods of high bat activity);
- Install downward-facing lights on site infrastructure to reduce attraction to bats; and,
- Implement wildlife best management plans.

16.2.2.2 **Residual Effect and Significance**

The predicted residual environmental effects of the Project on bats are assessed to be adverse, but not significant after the implementation of mitigation measures. Based on the degree of disturbance proposed to occur within the Project Area, and the best management practices and monitoring that will be implemented as part of the Project, no significant residual environmental effects on bats are expected.

16.2.3 Species of Conservation Interest and Species at Risk

The following SAR and SOCI were identified within or surrounding the Project Area:

- One flora SOCI (Mealy-rimmed Shingle Lichen, *Pannaria conoplea,* S3S4);

- Three SAR/SOCI bat species (Little Brown Myotis, *Myotis lucifugus*, COSEWIC, SARA, NBSARA Endangered, S1; Big Brown Bat, *Eptesicus fuscus*, S3; Northern Long-eared Myotis, *Myotis septentrionalis*, COSEWIC, SARA, NBSARA Endangered, S1); and,
- Seven SAR, and 11 SOCI birds (12 of which were identified within the Study Area).

No SAR/SOCI herpetofauna species were observed, although wetland habitat and riparian areas adjacent to Riviere du Nord provide potential habitat to support overland passage habitat for Wood Turtle. No breeding habitat for turtles was identified within the Study Area. No SAR/SOCI terrestrial mammal species were observed, but potential habitat is present for various species (see Section 5.6.3). No priority invertebrates were observed. No priority fish species were observed, but potential passage habitat exists within Riviere du Nord for Brook Trout, Atlantic Salmon, and American Eel, and habitat to support these species in on-site portions of Riviere du Nord is very limited.

Table 75 provides a summary of the potential environmental effects resulting from the Project-VEC interactions on SOCI and SAR. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). Interaction and potential effects have been divided into direct mortality, alteration to habitat and sensory disturbance. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 75. Project- VEC Interactions by Project Phase on potential SAR/SOCI

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect		
	Direct Mortality	**Habitat Alteration**	**Sensory Disturbance**
Construction			
Site preparation/clearing	X	X	X
Access road construction	X	X	X
Blasting (only if necessary)		X	X
Turbine pad levelling and grading	X	X	X
Waste management			X
Operation and Maintenance			
Project presence	X		X
Infrastructure maintenance			X
Winter maintenance			X
Vegetation management	X	X	
Decommissioning			
Turbine dismantling and removal			X
Turbine pad and road reclamation		X	X
Accidents, Malfunctions and Unplanned Events			
Erosion and sediment control failure	X	X	
Fuel spill from machinery/trucks	X	X	

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect		
	Direct Mortality	**Habitat Alteration**	**Sensory Disturbance**
Fire	X	X	X

Potential effects to SAR and SOCI are similar to those discussed for Birds (Section 16.2.1) and Bats (Section 16.2.2) including:

- Direct mortality;
- Alteration or loss of habitat/habitat fragmentation; and
- Sensory disturbance resulting in area avoidance or behaviour changes.

Observations of SAR and SOCI birds were made in various locations across the Study Area, including some in close proximity to proposed WTG's (i.e. Eastern Wood-Pewee at WTG3 and Eastern Wood-Pewee, Killdeer and Pine Siskin in within 200 m of WTG1) (see Figure 12, Appendix A). No breeding evidence was noted during these observations, however as discussed in Section 5.6.5, preferred habitat for these species, and other SAR/SOCI birds across the Study Area is variable and available throughout the Study Area. Of particular note however is that no specific habitat was identified for the SAR/SOCI birds at any proposed WTG locations or access road routes which has been determined as unique to the survival of the birds identified. Habitat for all SAR/SOCI is available in surrounding undeveloped land. During the breeding season Passerines (including those discussed above), are typically feeding and foraging on insects, ground invertebrates, seeds and plants. Therefore, interaction with proposed WTG's are expected to be limited during this season due to the dominant activities occurring below the RSA. Potential collision of SAR/SOCI with WTG blades is more likely during migration due to higher flight paths; however as previously discussed, mortality estimates for PBRWP are low and no large flocks or movement of SAR/SOCI birds were identified within the Study Area during baseline bird surveys.

Other mobile SAR and SOCI species have also been identified in Section 5.6, and potential habitat for them also exists within the Project Area (i.e. bats, invertebrates and mammals). Similar to birds, there were no unique habitats identified within the Study Area for these species, and extensive alternate habitat also exists in adjacent lands; therefore, it is presumed that mobile species will be able to find alternate habitats.

The one immobile species, (Mealy-rimmed Shingle Lichen, *Pannaria conoplea,* S3S4), is located within Wetland 3, which will remain unaltered by Project infrastructure. This lichen is approximately 220 m away from the nearest turbine (WTG3). Fragmented habitats that result in a change in sun exposure and moisture regimes can have a drying effect on forest edges, which may impact lichens (Rheault *et al.,* 2003). However, the proposed turbine location is set back well away from the observed lichen and will act as a buffer zone for this SOCI species.

There is limited research available relating to the potential effect of wind projects on terrestrial mammals during the operations phase of projects. However, SAR/SOCI mammals may potentially be impacted by increased site accessibility, increased human activity, and turbine noise disturbance. The clearing of forest for access roads may allow more predators to use the area, thus harming prey species. Increased human activity in the area for monitoring and maintenance may also impact species that are particularly wary of human interaction.

Sensory disturbance from turbine noise was studied in Northern California, and it was found that vocal communications and an animal's ability to hear can be hampered by turbine noise (Rabin, Coss, and Owings, 2006). These researchers tested the ability of California ground squirrels to use alarm calls in the presence of turbine noise and found these animals to have heightened caution and elevated vigilance levels (Rabin *et al.,* 2006). Any species listed in Section 5.6.3 that uses communication for survival may be impacted by turbine noise, however, these impacts are not fully understood. A previous study found that small game species showed no difference in distribution and habitat use when comparing a site with turbines and one without (Von Menzel and Pohlmeyer, 1999). Further research is needed to fully understand the impacts of turbines on terrestrial mammals.

Decommissioning of the turbine components, turbine pads and access roads will result in a positive effect on the habitat available for SAR/SOCI, involving the reclamation of land and vegetation across the Project Area, and reduction in overall habitat fragmentation associated with the Project.

Accidents, malfunctions and unplanned events that may occur in association with the Project could have unforeseen adverse environmental effects on the SAR/SOCI in the area.

Fire events, fuel losses, or erosion/sediment control failure during any phase of the Project could remove/destroy/flood significant amounts of vegetation, thereby having an environmental effect on habitat for wildlife including SAR and SOCI and potentially result in their displacement or mortality.

16.2.3.1 **Mitigation**

Mitigation of effects to SAR/SOCI are consistent with those stated for Birds and Bats (Sections 14.2.1 and 14.2.3). However, a Project EPP will raise awareness of these specific SAR and SOCI to site personnel and provide recommendations for protective measures to be in place.

The following mitigation measures will be employed to minimize affects to SAR/SOCI:

- Construction phase to be completed as efficiently as possible and within the shortest possible timeframe;
- Limited use of herbicides on site;
- Implement wildlife best management plans;

- Provide wildlife awareness training to site personnel;
- Implement erosion and sediment control plan;
- Regularly inspect and repair erosion and sediment control devices;
- Equipment will be equipped with spill kits and site personnel will be instructed on their use;
- Implement reclamation program to re-establish habitat to support reintroduction of bats post turbine life.

Should monitoring reveal that SAR/SOCI species are being impacted, further adaptive management and mitigation procedures will be developed in coordination with NBERD and/or the appropriate regulatory agencies.

16.2.3.2 **Residual Effect and Significance**

The predicted residual environmental effects of the Project on SAR/SOCI species are assessed to be adverse, but not significant after the implementation of mitigation measures. Based on the degree of disturbance proposed to occur within the Project Area, and the best management practices and monitoring that will be implemented as part of the Project EPP, no significant residual environmental effects on SAR/SOCI species are expected.

16.3 **Cumulative Residual Effects**

Cumulative residual effects are those environmental effects that occur despite mitigation measures and in conjunction with other activities on the landscape. These effects may be physical, biological, social or cultural or a combination. Cumulative residual effects may also be affected by unforeseen events caused by climate change, making it all the more difficult and necessary to consider.

Implementation of the mitigation measures described above will limit negative environmental effects from PBRWP. Economic activity along the Acadian Peninsula and especially in the area surrounding the Project Area is likely to continue (i.e. forestry and agriculture in the area directly surrounding the turbines, with tourism, fisheries, and residential services taking place further away). The placement of the PBRWP WTGs in and around active forestry and agricultural fields may actually preserve these land-uses, which are crucial parts of local livelihoods, for the life of the project. As the surrounding area grows and development encroaches, it is all the more important to maintain natural areas that promote multiple uses such as energy generation and food production.

17 LIMITATIONS

Constraints Analysis

- On some maps, land use or land cover is defined everywhere to form a complete mosaic of polygons. On topographic maps landuse/landcover is depicted only in certain areas. The source data in some cases may need to be conditioned to allow the second type of depiction if it is a mosaic, and certain constraints will operate differently in each case, and,
- Conflicts that might exist between objects in a database are typically of a logical nature, such as topological inconsistencies or duplicate identifiers. We attempted to ensure that our database has addressed any potential inconsistencies, however inconsistencies may still occur. In map generalization, the vast majority of conflicts are physical, spatial consequences of reducing map scale. The greater the degree of scale change, the more cluttered an un-generalized map will be, and this signals the extents of potential conflicts in presentation of the data.

Limitations incurred at the time of the assessment include:

- Habitat survey methods and results are presented with the acknowledgment of three biases which have been built into the survey methods. These are as follows:
  - Bias towards upland habitat. This bias was purposefully built into the survey methods with the understanding that all wetlands within the Study Area were delineated and evaluated in detail through completion of the separate wetland study.
  - The second bias is towards forested landscapes as opposed to non-forested landscapes. In this context, clear cut lands, or those which have experienced timber harvesting of any sort, are still considered forested because the removal of timber is only a temporary disturbance. Non-forested portions of the landscape, such as roads or extensive gravel areas, often associated with historic mine workings, were not assessed during the habitat survey simply because they lack forest cover and their capability for supporting forest cover in the foreseeable future is low based on the level of disturbance present
  - The third bias in this survey is that habitat surveys were completed at discrete points and no effort was made to delineate the extent of that habitat type around those points. As such, the ability to extrapolate habitat survey results across the entire Project Area is limited. These habitat survey points are meant to describe habitat in ‘snapshots’ of specific locations and completed to provide a summary of habitats present within the Study Area and also to inform specific biophysical field surveys. The results of the habitat survey describe the diversity of habitat types present throughout the Study Area and the relative abundance thereof, rather than absolute percent cover of each habitat type throughout the Study Area. As stated above, habitat surveys were also completed at each individual WTG.

- McCallum Environmental Ltd. has relied in good faith upon the evaluation and conclusions in all third-party assessments. MEL relies upon these representations and information provided but can make no warranty as to accuracy of information provided;
- There are a potentially infinite number of methods in which human activity can influence wildlife behaviors and populations and merely demonstrating that one factor is not operative does not negate the influence of the remainder of possible factors;
- The EIA provides an inventory based on acceptable industry methodologies. A single assessment may not define the absolute status of site conditions;
- Effects of impacts separated in time and space that may affect the areas in question, have not been not been included in this assessment.

<u>General Limitations incurred include:</u>

- Classification and identification of soils, vegetation, wildlife, and general environmental characteristics (*i.e.,* vegetation concentrations, and wildlife usage) have been based upon commonly accepted practices in environmental consulting. Classification and identification of these factors are judgmental and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may not identify all factors;
- All reasonable assessment programs will involve an inherent risk that some conditions will not be detected and all reports summarizing such investigations will be based on assumptions of what characteristics may exist between the sample points.

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19 CERTIFICATION

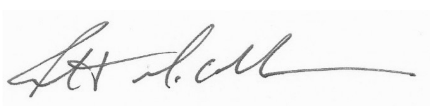
This Report has considered relevant factors and influences pertinent within the scope of the assessment and has completed and provided relevant information in accordance with the methodologies described.

The undersigned has considered relevant factors and influences pertinent within the scope of the assessment and written and combined and referenced the report accordingly.

Andy Walter
Project Manager
McCallum Environmental Ltd.

I have reviewed the information as submitted and completed this report in conformity with the Code of Ethics and the Duties of Professional Biologists and good industry practice.

Respectfully submitted,



Robert McCallum, P.Biol

President.